Essays in the Economics of Education: Graduate specialisation, training and labour market outcomes in the context of disparities in local economic performance in the UK

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Declaration

I certify that the thesis I have presented for examination for the MPhil/PhD degree of the London School of Economics and Political Science is solely my own work other than where I have clearly indicated that it is the work of others (in which case the extent of any work carried out jointly by me and any other person is clearly identified in it).

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Abstract

Spatial disparities in economic performance are amongst the most pervasive and persistent characteristics of modern economies. In the UK and across the EU, minimising regional inequalities is an objective of government policy. Yet analysis of how local differences in unemployment, earnings and industrial structure affect individual agents is not straightforward. Individual heterogeneity and sorting behaviour make separating the effects of agent attributes and regional characteristics difficult – a problem which is only compounded by the potential impact of unobserved individual heterogeneity.

This thesis seeks to disentangle the effects of agent attributes – both observed and unobserved – from the effects of local labour markets in three individual level decisions made by graduates in the UK. The chapters examine (a) how agents choose which degree subject to study at university, (b) the determinants of postgraduate participation and (c) the likelihood of a graduate finding employment after completion. In this way, this thesis examines micro-level choices which affect the aggregate supply of skilled labour in the UK.

The methodology I adopt permits conclusions to be drawn about how individual behaviour varies across observably different groups and offers insights into how local economic performance can shape the supply of skilled labour. I conclude that while agent attributes – including gender, ethnicity and prior academic attainment – are the most important determinants of an individual's academic choices, economic circumstances have a significant, if smaller role to play. The results have several public policy implications, ranging from the impact of educational inequalities to the funding arrangements for postgraduate study in the UK.

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All errors, omissions and mistakes remain my own.

Contents

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1. Introduction

Spatial disparities in economic performance are among the most pervasive and persistent characteristics of modern economies. In the UK and across the EU, minimising inter-regional inequalities is a central policy objective. Yet wide differences remain both within and between regions. In the UK in 2010, unemployment at the Local Authority level ranged between 2.9% in Surrey and 15.6% in Methyr Tydfil, while average full-time earnings varied from £10.90 per hour in Blackpool to £32.30 per hour in Kensington and Chelsea. Ranking Local Authorities by average full-time earnings reveals the persistence of these effects, as eight of the ten highest earning areas in 2002 remained in the top ten eight years later.[1]

The evolution and impact of regional economic disparities is of significant interest to policy-makers and academics alike. Yet analysis of how local differences in unemployment, earnings and industrial structure affect individual agents is not straightforward. Individual heterogeneity and sorting behaviour have made separating the effects of agent attributes and regional characteristics difficult – a problem which is compounded by the potential impact of unobserved individual heterogeneity.

This thesis seeks to disentangle the effects of agent attributes – both observed and unobserved – from the impact of local economic performance in three micro-level decisions concerning the formation and supply of skilled labour in the UK. Specifically, it examines the impact of individual and local economic characteristics on choices about (1) the type of training and (2) the level of training which individual students in higher education choose to acquire, as well as (3) the labour market outcomes which result. In

[1] Unemployment data is taken from the Labour Force Survey. Earnings data is taken from the Annual Survey of Hours and Earnings for 2010. These are nominal wage figures and consequently do not reflect differences in real incomes, which may be significantly smaller if the cost of living in high-wage areas is also higher. See Gibbons, Overman and Pelkonen (2011) for a discussion of wage disparities in Great Britain.

each of the following chapters, the methodology adopted is designed to control for several different forms of endogeneity bias. In common with a large body of literature in labour economics, special attention is paid to the role of selection effects and their potentially detrimental impact on parameter estimates.

To provide some context for the following three contributions, this introduction offers a brief overview of three foundational topics. Firstly, it reviews the literature on the relationship between human capital and individual economic outcomes. Secondly, it discusses the methods by which skilled labour and knowledge are thought to influence the concentration of economic activity. Thirdly, it summarises recent changes in higher education policy in the UK which provides important context. The final section draws together elements from each of these topics and provides a summary of the three subsequent chapters. A discussion of the limitations of the work and suggestions for future research are deferred to the concluding section of the thesis.

1.1 Scientific context: Human capital and economic outcomes

The importance of human capital for individual, local and national economic outcomes is now well established. Individuals who have larger stocks of human capital – broadly defined as their skills and experience, knowledge and ability – are thought to be more productive (Becker 1975), healthier (Silles 2009, Kenkel 1991, Grossman 1973, Perri 1984), more likely to raise high-ability children (Currie and Moretti 2003, Oreopoulos, Page and Stevens 2003, 2006, Chevalier 2004, Black, Devereux and Salvanes 2004), less likely to suffer unemployment (Nickell 1979, Ashenfelter and Ham 1979, Mincer 1991, Katz 1974) and are more highly paid (Hansen, Weisbrod and Scanlon 1970, Mincer 1974, Angrist 1995, Harmon and Walker 1995, Blundell *et al.* 2000) than individuals who are less well endowed. Specifying y_i as a variable which captures the

likelihood of one of these outcomes (better health or higher earnings for example) and h_i as an indicator of an individual i's human capital, labour economists think of y_i as an increasing function of h_i:

$$y_i = f(h_i) \quad (1)$$

To estimate the returns to education empirically, many researchers have adopted a functional form based on Mincer (1974). In these regressions, a measure of earnings (w_i) is regressed on years of education (e_i), experience (Exp_i) and its square, alongside a set of other control variables (x_i):

$$w_i = \beta_0 + \beta_1 e_i + \beta_2 Exp_i + \beta_3 Exp_i^2 + \beta_4 x_i + \varepsilon_i \quad (2)$$

In regressions such as (2), a positive and significant estimate of β_1 is interpreted as evidence that additional schooling raises average earnings. However, several conceptual problems with this approach are now well known (Card 1999, Angrist and Krueger 1999). Firstly, researchers may measure observed years of education with error, arising either where individuals mis-state their completed schooling or where the appropriate measure of education differs from that provided. Secondly, equation (2) assumes that each additional year of education has the same marginal effect on earnings and that the effect is constant across all individuals. However, several researchers have argued that the return to education may be non-linear: varying across qualification boundaries (school-leaving, undergraduate, postgraduate) and across types of individual (Card 1999).

Thirdly, unobserved individual attributes and selection effects present a series of challenges to empirical specifications such as (2). In particular, if there is a positive

correlation between the level of acquired schooling and an agent's unobserved innate ability, cross-sectional ordinary-least squares (OLS) techniques may attribute the impact of both variables to the coefficient on schooling, β_1. Formally, the coefficient on schooling is attenuated by the covariance between the observed explanatory variable and the omitted variable.

All of these conceptual problems have required economists to use inventive methods to generate unbiased estimates of the return to education. To this end, some researchers have sought to control for unobserved ability directly. Using measures such as IQ, cognitive test scores, or scores from numerical and verbal reasoning tests (Altonji and Dunn 1995, 1996a, 1996b), these researchers assume that their new measures of ability capture the relevant, formerly unobserved variable for identification.

Concern about the effectiveness of this strategy has encouraged other economists to adopt an instrumental variables approach, using information on quarter of birth (Angrist and Krueger 1991, Staiger and Stock 1997) or the proximity of educational establishments (Card 1995) as instruments for completed schooling. Still others have used regression discontinuity designs such as a change in compulsory schooling laws to instrument for acquired schooling (Harmon and Walker 1995) or historical events such as the Vietnam War (Angrist and Krueger 1992). In each case, researchers make the maintained assumption that their instrument does not affect their outcome of interest, except through its influence on obtained schooling. A third empirical approach involves identifying individuals who might plausibly have similar unobservable characteristics but who make different choices about their levels of education. Researchers using this approach often gather data on identical twins, as they share a common genetic inheritance and (often) the same family setting and upbringing (Griliches 1979, Ashenfelter and Rouse 1998, Ashenfelter and Krueger 1994, Miller *et al.* 1995).

Those researchers who have sought to relate individual economic outcomes to the spatial context in which they are based must confront one further conceptual problem which complicates empirical analysis. These researchers usually begin with a reduced form similar to that of (2), and add information about individual i's area of residence, j, to the list of explanatory variables:

$$w_{i,j} = \beta_0 + \beta_1 e_i + \beta_2 Exp_i + \beta_3 Exp_i^2 + \beta_4 x_i + \beta_5 u_j + \varepsilon_i \qquad (3)$$

In equation (3), u_j is some variable of interest defined for the region in which the agent lives. If u_j captures the unemployment rate in area j, then β_5 relates individual wages to unemployment in the individual's region of residence. A positive, significant estimate of β_5 would suggest that higher unemployment rates raise the wages of those in employment, while a negative estimate of β_5 would indicate the reverse.

The conceptual difficulty with this approach is that it assumes individuals are randomly assigned to regions. In this case, a regression such as (3) produces consistent and unbiased estimates of the impact of regional unemployment on wages. However, if agents sort into areas of residence based on unobserved characteristics which also affect their wage, then the β_5 coefficient is also likely to suffer from endogeneity bias (Gobillon, Selod and Zenou 2007, Dujardin, Selod and Thomas 2008). In this case, the OLS procedure has difficulty distinguishing between the impact of living in the region and the impact of the characteristics which encouraged the individual to sort into the region.

Controlling for the impact of selection into particular spatial areas is still relatively rare in the empirical economics literature, although a growing number of researchers are beginning to consider its potentially detrimental impact on parameter estimates. In their examination of wage inequality in Great Britain, Gibbons, Overman

and Pelkonen (2011) include controls for selection into areas of residence. They conclude that regional economic effects contribute little to earnings disparities after controlling for selection into particular regions. Dahl (2002) examines the returns to education in the United States and explicitly models the individual's location choice, arguing that skilled individuals will tend to move towards states offering high returns on their investment in human capital. He concludes that not controlling for selection into different spatial areas tends to over-state the return to education. Finally, Moretti (2011) examines real wage differences between high- and low-ability groups and the share of high-ability residents in cities in the United States. He concludes that failing to control for price differences across geographical locations tends to over-state the real wage premium associated with high-level qualifications.

1.2 Regional economic disparities and empirical approaches

While a broad range of empirical difficulties have beset attempts to identify the effects of schooling on wages, a large literature has sought to relate average skill levels in a given spatial area to aggregate economic outcomes. In urban economics and economic geography, concentrations of skilled workers are thought to bring about stronger economic performance at the local level. Areas which have larger stocks of human capital are thought to be more innovative (Faggian and McCann 2009) and better able to absorb new knowledge following a shift in the technological frontier (Faggian and McCann 2006, Acs *et al.*, 2007; Falvey *et al.*, 2007). A renewed interest in the economics of space (Krugman 1991) has led economists to revisit the early contributions of Alonso (1964), Weber (1909) and Hotelling (1929), and to develop increasingly elaborate models to explain the concentration of economic output in space,

as well as inter-regional trade flows (Fujita, Krugman and Venables 2001) which conflict with neo-classical notions of competitive economics (Starett 1978).

Alongside the direct effects of the skills of the resident population, economists have proposed a range of non-market methods by which skills and knowledge affect local economic outcomes. 'Jacobs' inter-industry (Jacobs 1969) and Marshall-Arrow-Romer (MAR) intra-industry knowledge spillovers (Döring and Schnellenbach 2006, Henderson, 2003; Jaffe *et al.*, 1993, Moreno *et al.*, 2005; LeSage *et al.*, 2007, Moretti 2004) have been used by several researchers to help explain the willingness of firms and workers to locate in cities. Still other economists argue that concentrations of human capital can become self-perpetuating, as workers resident in these concentrations learn new skills from the other individuals with whom they interact (Glaeser 1999, Glaeser and Maré 1994, Glaeser *et al.* 1992).

At the national level, models of economic growth suggest that nations which invest in the skills of their workforce have the potential to develop more quickly. Mankiw, Romer and Weil (1992) argue that investing in human capital has the potential to increase the level of income in a country, while endogenous growth theory (Lucas 1988, Romer 1990, Jones 2004) relates the rate of technological advance to the ratio of skilled to unskilled workers. In these models, larger stocks of human capital may enhance not only the level, but also the long-term steady-state growth rate of an economy.

As with empirical investigations of the impact of education at the individual level, estimates of many of these hypothesised effects are plagued by equally, if not more serious conceptual problems. Firstly, aggregating up the Mincerian wage equation to a regional level produces an equation such as (4), where W_r and X_R capture average regional wages and the averaged observed characteristics of the resident population respectively. $\bar{e}_r$ and $\bar{a}$ reflect the average years of schooling and the average level of

ability in region r respectively, while β_1 reflects the marginal contribution to regional average income of an additional average year of education.

$$W_r = \beta_0 + \beta_1 \bar{e}_r + \beta_2 X_R + \bar{a} + \varepsilon_r \quad (4)$$

As in equation (2), a positive estimate of β_1 is considered to be evidence of a positive relationship between average wages and average years of schooling. However, as is made clear by the inclusion of $\bar{a}$, equation (4) suffers from a similar form of endogeneity bias as equation (2). If the average level of innate ability and average years of schooling are correlated, estimates of β_1 are biased as before.

Secondly, when estimated using cross-sectional data, equation (4) will fail to take into account the likely reverse causation which exists between the wage growth and average years of schooling. While concentrations of highly skilled individuals may increase average incomes, higher average incomes will tend to attract skilled individuals who wish to earn a higher wage. In the short term, areas with growing wages would expect to see the inward migration of skilled labour. In the longer term, these workers may be supplemented through 'home grown' human capital, generated as school leavers respond to the greater local return to education.

This discussion makes clear that both at an aggregate and at an individual level, estimating the effects of schooling and human capital on economic outcomes is far from straightforward. While the majority of studies have found that there are significant, positive returns to education both at the individual and local levels, doubt remains about the magnitude of this effect. Empirical work in this area suffers from several different forms of potential bias arising from sorting behaviour.

1.3 Higher education policy reform in the UK

The primary focus of the three papers in this thesis is the impact of individual, academic and local economic characteristics on graduate choices about the type and level of training they obtain and the labour market outcomes which result. This section provides a brief over-view of recent changes to higher education policy in the United Kingdom, which forms the context for much of the work that follows.

Higher education in the United Kingdom has undergone rapid change over recent decades, both in terms of the aggregate size of the sector and the mechanisms by which teaching is funded. Between 2000/01 and 2010/11, the total number of undergraduates at UK institutions increased from 1.54m to 1.91m, while the total number of postgraduates increased by more than 31% from 448,695 to 588,720. Although the number of overseas students has increased significantly over this time period, the majority of the increase in numbers at undergraduate level has come from greater participation among students domiciled in the UK: the number of these students increased by 19.4% between 2000/01 and 2010/11 (HESA 2011).

According to HEFCE (2010) the growing numbers in higher education are attributable to both demographic changes and an increase in the take-up rate among school-leavers. The participation rate of young people in higher education has increased steadily between 1995/96 and 2009/10, rising from 30% to 36%, although wide differences remain in the participation rates of individuals from different economic backgrounds. HEFCE (2010) reports that participation among young people from the most disadvantaged backgrounds increased from 13% to 19% over this period, while participation among students from the wealthiest neighbourhoods increased from 50% to 57%.

Examining trends in participation over a much longer time-frame indicates that the recent period of growth is exceptional. Using data from the Labour Force Survey, Dolton and Lin (2011) find that the university entrance rate remained relatively static for males between the late 1960s and the early 1990s. For female students, participation increased gradually over this time period. Coinciding with both an economic downturn and the introduction of the General Certificate of Secondary Education (GCSE) examinations, a significant change took place at the start of the 1990s. Wyness (2010) presents data on participation rates between the early 1960s and the present day, which suggests that the participation rate grew from just 5% in 1963 to 17% in 1990, but more than doubled to 42% by 2006.[2] Both Blanden and Machin (2004) and Greenaway and Haynes (2003) report that the total number of students in higher education (UK domiciled and overseas, undergraduate and postgraduate, full-time and part time) increased from 400,000 in 1960 to more than two million in 2000.

The expansion of the higher education sector has placed growing demands on the public exchequer, which governments since the early 1990s have been increasingly unwilling to meet. Prior to 1990, undergraduate students in the UK enjoyed higher education free at the point of use. As a means of encouraging the growth of a skilled labour force, the publicly-funded Local Education Authorities paid the tuition fee associated with each individual's programme and provided a maintenance grant to help cover living costs.

[2] Wyness (2010) acknowledges a break in the participation rate series in 2001. Prior to 2001, participation was measured using the Initial Entry Rate (IER), which was defined as the number of students aged 18 to 30 entering higher education for the first time, expressed as a proportion of the total population of these age groups. The IER was discontinued in 2001 and replaced with the Higher Education Initial Entry Participation Rate (HEIPR). This measure was calculated as the number of students aged 18 to 30 who enter higher education for the first time and are still studying six months later, as a proportion of the 18 to 30 year old population. Both measures differ from the Youth Participation rates presented in HEFCE (2010), which are calculated as the percentage of students aged 18 and 19 who enter higher education for the first time.

Following the introduction of mortgage-style, interest-free student loans in 1990 which partially replaced maintenance grants, three sets of reforms have taken place which have gradually shifted the burden of financing away from the general tax-payer and onto individual students. The first of these occurred after the publication of the Dearing Report in 1997. The report made some 93 recommendations, among which was the introduction of means-tested, up-front tuition fees of £1,000 for all undergraduate courses from September 1998 onwards. These fees reflected an estimated 25% of the costs of educating an undergraduate and were seen as a means of channelling greater funding to universities from the private sector (Wyness 2010). Maintenance grants were cut and replaced with an expanded system of interest-free, income-contingent loans which students repaid as a fraction of their salaries above £10,000.

The growing number of students in higher education, concerns about access for poorer students and the rising costs of this system led to a further set of reforms embodied in the Higher Education Act 2004. The single, centrally-set, up-front undergraduate tuition fee was abolished and institutions were given the ability to vary fees up to a cap of £3,000. Payment of these fees was deferred until after graduation through a further expansion of the student loans system. Students would now repay their loans at a marginal rate of 9% once they reached an income of £15,000. A regulatory body, the Office for Fair Access, was created to ensure that universities remained accessible to students from all backgrounds and a set of tax-financed scholarships were established. Maintenance grants were re-introduced for students from poorer backgrounds and a series of access obligations were placed on universities who wanted to charge the maximum rate.

The third and most recent set of reforms represent the most radical changes to university funding of recent times. As set out by Barr (2010) in response to the Browne Review (Browne 2010), the cap on tuition fees will be lifted from £3,000 to £9,000 to

allow greater scope for competition among providers.[3] The level of public subsidy for undergraduate teaching will be significantly reduced and the system of income contingent loans will be expanded to allow for the increase in fees. The threshold at which repayment begins will also be lifted from £15,000 to £21,000, although the zero real interest rate is to be abolished. While the introduction of these reforms has been controversial, it remains too early to assess their impact. The funding of postgraduate study has remained relatively static over this time period and is reviewed in more detail in a subsequent chapter.

1.4 Contributions and context

The preceding sections provide the context and motivation for the following contributions. Drawing together empirical and theoretical research in the economics of education field with the institutional arrangements for higher education in the United Kingdom, the papers of this thesis seek to address three questions about the supply of highly skilled labour in the UK. In each case the methodology adopted is designed to correct for a range of potentially biasing effects, allowing closer identification of the extent to which individual, academic and local economic characteristics condition agent behaviour.

The first of the three contributions offers a micro-level examination of degree choice, considering how individual agents choose which academic field to study at university. While the debate about whether qualifications enhance, or simply signal,

[3] Some critics of the Higher Education Act 2004 argued that the low level of the cap on tuition fees inhibited institutions from competing for students on the basis of price. The vast majority of institutions responded to the Act by setting the price for all their courses at the capped level, eliminating the effect of competition on tuition fees. By lifting the price ceiling, the most recent set of reforms are intended to create scope for greater price differentiation and to encourage the creation of a market for higher education.

human capital remains unresolved (Spence 1973, Stiglitz 1975), empirical evidence suggests that students of different academic subjects have different labour market experiences and career paths (Dolton and Makepeace 1990, Blundell *et al*. 2000). These differences raise questions about how students choose their area of specialism. Building on prior work, a large micro-level dataset and a detailed classification of academic subjects are used to identify the impact of individual, academic and local economic characteristics on the probability of taking each subject. The primary contributions of this paper include (1) a more detailed study of degree choice than has previously been carried out, involving larger sample sizes and a more detailed classification of academic subjects, (2) a more rigorous empirical approach to selection into secondary schools, controlling for all time-invariant, unobserved characteristics of each school attended and (3) a more carefully specified examination of local economic effects, controlling for selection into different labour market areas of residence. The results suggest that individual, academic and local economic factors all play a significant role in determining students' degree specialism.

The second paper assesses the probability that an undergraduate chooses to progress to a postgraduate degree. Having considered the nature of the skills students choose to acquire in the first chapter, this paper examines the academic level to which students from different backgrounds study. Special attention is given to the role of postgraduate tuition fees in determining demand for courses beyond undergraduate level. The primary contributions of this paper include (1) introducing a large, new dataset of postgraduate tuition fees by subject and institution which was developed through extensive data collection, (2) a detailed examination of participation above undergraduate level, identifying the influence of individual, academic and local economic characteristics, (3) the development of a strategy designed to control for the endogeneity of postgraduate fees and (4) a more rigorous study of postgraduate

participation than has previously been carried out, including controls for endogenous selection into university courses and areas of residence. The results suggest that postgraduate fees, socio-economic group, academic performance and local economic conditions all play a role in determining progression probabilities.

Graduate labour market outcomes in the context of differences in local economic characteristics are examined in the final paper. Drawing on previous work, this third paper models both the probability that graduates find employment after completing their studies and the probability that they needed their degree for their first labour market position. The primary contributions of this paper include (1) a critical discussion of previous work in the field of 'over-education' with a particular focus on empirical approaches and methodologies, (2) a contextual framework which highlights the empirical challenges of future work in this field and (3) an assessment of the probability of a graduate finding (a) employment and (b) employment commensurate with their qualifications in the context of differences in individual, academic, parental and local economic characteristics. The results suggest that all four groups of variables have a significant impact on graduate labour market outcomes and provide some evidence that the well-documented advantages of being born in wealthy circumstances stretch beyond education and into the labour market.

The concluding section of this thesis draws on the results of all three papers to provide a summary of my findings. It discusses the limitations of the work presented here and offers thoughts for further work.

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2. Geography or Economics? A micro-level analysis of the determinants of degree choice in the context of regional economic disparities in the UK

It is now widely accepted that human capital has an important impact on economic outcomes at the individual, local and national levels. Individuals who have more human capital are thought to be more productive (Becker 1975), less likely to suffer unemployment (Nickell 1979, Ashenfelter and Ham 1979, Mincer 1991, Katz 1974) and are more highly paid (Hansen, Weisbrod and Scanlon 1970, Mincer 1974, Angrist 1995, Harmon and Walker 1995, Blundell *et al*. 2000) than individuals who are less well endowed. Regions with strong workforce skills are thought to absorb new knowledge more easily and innovate more readily (Faggian and McCann 2006) and economies with larger human capital stocks are thought to grow more quickly (Midelfart-Knarvik, Overman and Venables 2001, Glaeser *et al.* 1992).

Although the debate over whether qualifications enhance human capital or simply signal higher ability remains unresolved (Spence 1973, Stiglitz 1975), there is evidence that individuals with degrees in different subjects have different labour market experiences. Dolton and Makepeace (1990) and Blundell *et al.* (2000) find that graduates who undertake degrees in economics and law earn significantly more than individuals with qualifications in other subjects. Bratti, Naylor and Smith (2005), Bratti and Mancini (2003) and Fengliang *et al.* (2009) confirm these results. Dolton and Makepeace (1990) also find evidence that the subject studied strongly affects which industry a graduate enters, and Department for Education and Skills (DFES) (2004) finds evidence that career paths within a chosen industry can vary significantly between disciplines.

While these results suggest that degree specialism can influence labour market outcomes, the opposite may equally hold: that labour market outcomes can influence

training decisions and, more specifically, can influence degree specialism. While students may choose the subject which maximises the expected return on their investment in higher education, their expectations are likely to be based on the earnings and employment experience of their friends, family or community. As a result, the link between degree subject, industry of employment and subsequent career progress also presents a potential insight into how graduates perceive and respond to labour market signals. Despite the importance of this link for individuals and firms, relatively few papers have explored subject choice at university level and related the choice to local labour market conditions.

This paper seeks to address this deficiency through a micro-level study of degree choice among graduates from British universities between 2004/05 and 2008/09 and makes several contributions to the existing literature. Firstly, it uses a detailed set of 19 subjects to allow a systematic examination of individual, academic and parental influences on degree choice. Secondly, it considers degree choice in the context of local labour market conditions to assess whether local patterns of employment, wages and worklessness affect students' decisions. Thirdly, it uses a dataset composed of multiple cross-sectional surveys to identify the effect of individual, academic, parental and economic characteristics in a linear probability model with travel to work area (TTWA) and school level fixed effects, controlling for several potential sources of endogeneity. The analysis shows that individual and academic characteristics, such as gender, ethnicity and prior academic attainment, strongly affect degree choice. I also find evidence of endogenous residential and school selection and that local labour market signals encourage individuals to take up particular degrees in preference to others.

The rest of this paper is organised as follows. Section 2.1 presents a review of the existing literature. Section 2.2 sets out the empirical framework. Sections 2.3 and 2.4 present the methodology and data respectively and Section 2.5 presents the results.

Section 2.6 details my robustness checks and the limitations of my work, while Section 2.7 offers some conclusions.

2.1 Literature review

The expansion of higher education in the UK and a growing interest in spatial economics has led to a number of papers exploring the effect of local economic conditions on investment in human capital (Rice 1999, 2000, Gibbons and Vignoles 2009). However, recent contributions to the subject choice literature have ignored the effect of local labour demand conditions on students' choice of degree. This section will first survey these recent contributions before examining how economic conditions can influence the decision to invest in human capital.

2.1.1 Choice of degree subject

Although the literature on subject choice at university level is relatively small, several recent contributions have sought to estimate how individual, academic and parental characteristics shape students' decisions.

Davies and Guppy (1997) use micro-level data from the National Longitudinal Survey of Youth in the United States to examine the factors which lead students to enter relatively 'lucrative' fields.[4] Through a series of ordinary least squares and logistic regressions they estimate the expected return to a degree subject and examine how gender, ethnicity, socio-economic background and ability (measured by a series of tests of reasoning and knowledge) affect the probability of a student choosing to study in a relatively high-return field. They conclude that male students and students with higher

[4] Davies and Guppy (1997) define 'lucrative' fields in terms of the expected earnings of graduating students.

measures of ability are more likely to enter lucrative fields, as are students from the lower socio-economic groups. Davies and Guppy (1997) find no evidence of significant ethnic group effects.

Simpson (2001) focuses explicitly on trends in subject choice among students from different ethnic groups. Using the High School and Beyond national longitudinal survey in the United States, Simpson estimates a series of multinomial logistic regressions for Asian, African, European, Hispanic and Native American students who choose among five broad subject areas. Conditional on gender, family background and income, prior academic training and some measures of 'cultural capital', Simpson finds significant differences in choice of college major between ethnic groups. Asian Americans are more likely to study Health and Life Sciences than European and Hispanic Americans, and less likely to study Business or Public Service majors than African Americans. European Americans are more likely to take a Liberal Arts major than African Americans. Simpson (2001) also finds that females are significantly less likely to take a Technical major (such as Computer Science, Engineering, Mathematics or Physics) than males. Prior academic attainment, parental income and type of school attended are all found to influence subject choice in different ways for each ethnic group.

Van de Werfhorst *et al.* (2003) use a similar methodology to assess subject choice among British students. Using longitudinal micro-level data from the National Child Development Study, they estimate a multinomial logistic regression in a choice of six subjects (Medicine and Law, Engineering, Science, Economics, Social Studies and Arts) conditional on family background, ability, prior academic attainment and measures of 'economic' and 'cultural capital'. They conclude (1) that students choose subjects in which they have performed comparatively well, (2) that students who perform well in reading tests are more likely to take degrees in Social Studies or Arts

and that (3) students who are relatively good at maths are more likely to take Engineering, Science or Economics degrees. Van de Wefhorst *et al.* (2003) also find that although students from wealthy backgrounds are more likely to take degrees in Law and Medicine, there is little other evidence of large and significant differences by socio-economic class.

Montmarquette *et al.* (2002) also start by estimating a series of multinomial logistic regressions in subject choice. Using Canadian micro-data from the National Longitudinal Survey of Youth, they examine the factors which determine college major among a choice of four subject areas (Business, Liberal Arts, Science and Education). To control for differences in future earnings across degree types, Montmarquette *et al.* (2002) use reported student expectations to estimate expected income for each student. They conclude that gender and expected income are important determinants of degree choice.

While multinomial logistic regressions are an attractive method of estimating students' choices among several subjects, the method imposes the Independence of Irrelevant Alternatives assumption (IIA). This assumption requires that the probability of each outcome is a function of the characteristics of that outcome and independent of changes in the characteristics of the alternatives. If this assumption fails, then the probability of one outcome may be correlated with the probability of another, leading to inconsistent parameter estimates. In the context of the subject choice literature this is a particular concern, as students with particular skills may be more suited to a subset of academic subjects. Students with strong language skills, for example, may be more likely to take a languages degree than Mathematics, but the probabilities of them taking a degree in French, German or Italian are likely to be correlated. This problem becomes more acute as classifications which involve more disaggregated subject typologies are utilised.

Two researchers have sought to relax the IIA assumption by adopting an alternative estimation strategy. Both Montmarquette *et al.* (2002) and Bratti (2006) estimate multinomial probits in their examinations of subject choice in an attempt to model the error structure more carefully. These studies allow the probability of taking different subjects to be correlated. Bratti (2006) provides a useful measure against which to examine the results presented in this paper. Using British micro-data from the Universities Statistical Record for each cohort entering university between 1981 and 1991, Bratti (2006) estimates a multinomial probit in three subject choices: (1) 'Non-quantitative subjects' (including Social Studies, Communications, Languages, Creative Arts and Education, excluding Economics), (2) 'Quantitiative subjects' (including Sciences, Engineering, Architecture and Economics) and (3) Law and Medicine. Bratti's primary focus is on patterns of subject choice among students from different socio-economic backgrounds, conditional on age, gender, prior academic attainment and school type. He concludes that gender and prior academic attainment are important determinants of degree choice, but finds no effect of socio-economic class.

2.1.2 Local economic conditions

Despite these relatively recent and sophisticated contributions to the literature on subject choice, none of the above papers incorporate spatial and local economic effects on students' decisions. Local economic conditions are likely to affect the individual's choice through two mechanisms. Firstly, levels of wages and unemployment help to determine the opportunity cost of a course of study. If wages are high and unemployment low, then the cost of study in terms of forgone wages is relatively high. Conversely, students whose local labour markets can be characterised by low wages and high unemployment are likely to see a course of study as less costly. As a result, a

stronger local economy may actually deter investment in human capital through a steady supply of well-paid jobs (Rice 1999, 2000).

Secondly, local labour market demand may inform students about the availability of employment opportunities in the short term. Students may respond to the expansion of a particular local industry by seeking to acquire a qualification which will allow them to access employment opportunities in that industry. Conversely, students may choose not to take qualifications which lead to employment in an industry which is in decline. In both cases, recent labour market developments and the implied likelihood of finding employment in the short-term influence degree choice.

Longer-term perceptions of the relative risks and returns of different subject specialisms may also be inferred from local economic conditions. Students from areas in which the wage premium attached to a specific degree is particularly high (low) may be more (less) drawn to a particular subject. To the extent that they are observed or inferred by individual students, differential rates of worklessness between qualification groups may also affect the attractiveness of particular academic courses. In these cases, local labour market trends may help students to form expectations about the varying career paths associated with particular degree subjects.

Growing interest in spatial economic issues has steadily increased the level of sophistication with which papers have approached the estimation of these effects. Pissarides (1981) includes national unemployment rates and wage ratios in his aggregate analysis of the rate of 'staying-on at school' and concludes that national unemployment (for men) and wages (for men and women) affect the post-compulsory schooling participation decision.[5] Whitfield and Wilson (1990) also find that national unemployment plays a role in determining whether students choose to remain in

[5] Pissarides (1981) is interested in the pay-off to further education and so includes the ratio of average wages in high occupational groups (for which an FE degree is a qualifying criterion) to average wages in low occupational groups (which do not require an FE qualification).

education after age 16, while McVicar and Rice (2000) attribute some of the increase in further education participation during the 1990s to higher national unemployment rates. In each case, poorer macroeconomic conditions increase the probability of participation.

Developing this approach, subsequent papers have sought to relate economic conditions at the student's point of domicile to their education decisions, attempting to capture the 'relevant market' to which a student is responding. The wide differences in economic performance within the UK are a powerful argument in favour of this shift (Gibbons, Overman and Pelkonen 2010, Gibbons, Overman and Resende 2010). Rice (1999) finds that unemployment at the local authority level affects participation decisions – although it has greatest impact on relatively poorly qualified males. Rice (2000) confirms these results, but adds that poorly qualified males from ethnic minorities are less affected by local labour market signals than poorly qualified white males. Rice (1999) also concludes that a higher ratio between the earnings of managerial and manual occupations tends to increase participation in further education – highlighting the potential for greater expected returns to encourage investment in human capital.

2.1.3 Variation in the return to a degree

There is a wealth of evidence which suggests that on average, there is a relatively large pecuniary return to holding a higher education qualification.[6] Blundell *et al.* (2000) report that holding a degree increases the probability that an individual is in work at age 22 and find that starting salaries among these individuals are significantly higher than for those who opted not to invest in a degree. Office for National Statistics (2003) and

[6] A discussion of the empirical difficulties of estimating the returns to education – including the appropriate counterfactual and unobserved characteristics – is included in the introduction and is returned to in Section 4.1.

Dolton and Makepeace (1990) conclude similarly that in spite of the increased supply of well-qualified individuals, the return to a degree remains large and significant.

At a more detailed level these papers also suggest that the return to a qualification depends on the subject of the degree. Blundell *et al.* (2000) find evidence that graduates of economics, accounting and law earn significantly more than graduates of other subjects after controlling for individual characteristics. Dolton and Makepeace (1990) also find that starting salaries and subsequent earnings vary significantly across subjects. Their study of the cohort graduating in 1980 found that starting salaries ranged from £5,116 per year for law graduates to £8,518 for engineering students and that earnings six years after graduation ranged from £9,607 per year for sociology students to £16,460 for graduates in computer science. Bratti, Naylor and Smith (2005), Bratti and Mancini (2003) and Fengliang *et al.* (2009) all find similar evidence of significant differences in the return to degrees of different subjects, both in terms of immediate starting salaries and earnings some years later. Although there are likely to be large non-pecuniary benefits to some courses of study, such wide differences in the return to a degree raise questions about how graduates choose their subject of study.

2.2 Empirical framework

The empirical framework for this analysis draws on a simple, adapted model of investment in human capital (Rice 1999). The present discounted value of the expected net benefit, B, of an individual, i, taking a degree subject, d, at a university, U, is given by:

$$B_{i,d,U} = C_d - \left(E_d + T_d + P_d(\theta_i)\right) \quad (1)$$

Where C_d captures the present discounted value of the expected lifetime consumption path where the individual acquires the degree and E_d captures the expected lifetime consumption benefits of entering employment, less the pecuniary and other costs of working. T_d reflects the tuition costs associated with acquiring the degree while $P_d(\theta_i)$ captures the psychic costs of acquiring the degree to the individual, which depend on the individual's personal, academic and parental characteristics, θ_i. If $B_{i,d,U} < 0$, it follows that subject d is excluded as a possible subject of study. Note that participation will only take place if, for at least one subject, $B_{i,d,U} > 0$.

While tuition fees may play a role in determining the probability of participation in tertiary education (Dynarski 2003, 2005, Kane 2003, 2004, Dearden *et al.* 2011, Dolton and Lin 2011), an assessment of their impact on subject choice is beyond the scope of this paper. Tuition fees for undergraduate study in the UK were capped by the Higher Education Act 2004. In an effort to establish a market for higher education, the same Act afforded universities the right to charge reduced fees where they felt appropriate. Yet, in practice, all but one institution chose to charge the maximum amount,[7] which in this context means that the tuition costs of any two subjects are effectively identical, except where the lengths of the degree courses differ. As a consequence, I neglect differences in undergraduate tuition fees from the following analysis.

In common with other models of revealed choice, the workings of this model are largely unobserved. The two elements which are observed are (1) the participation condition: individuals will choose to attend university if at least one subject offers a strictly positive expected return, and (2) the final choice of subject. As the data used in this paper only includes students who have chosen to participate the conclusions drawn

[7] The only institution not to do so was Leeds Metropolitan University, which offered courses at a discounted rate between 2006/07 and 2008/09 (Times Higher Education 2011).

here are necessarily limited to those who choose to enter higher education. Consequently, the findings of this paper shed light on the factors determining subject choice conditional on participation, but cannot be applied to school leavers as a whole with precision.

2.3 Estimation issues and strategy

The primary empirical objective of this paper is to explore the determinants of degree choice at the individual level. Building on the framework set out above, the empirical strategy uses a micro-level discrete choice model to examine how individuals choose the academic field of their undergraduate degree. Two estimation issues complicate this approach.

2.3.1 Estimation issues

The first of these two estimation issues arises out of a process of endogenous residential selection (Dujardin, Selod and Thomas 2008). The essence of this problem can be simply stated like this: suppose we are interested in the effect of unemployment in an individual's home town on his propensity to take a science degree. To proceed we run a regression of the binary 'science degree indicator' against the local unemployment rate. A significant coefficient is interpreted as evidence in favour of some form of a relationship.

However, suppose that the individual chose to live in his town because of some unobserved characteristic – high ability, for instance – which means he prefers to live in an area with low unemployment. In this case the estimated coefficient would reflect both the influence of that unobserved characteristic – ability – and the local

unemployment rate. In these circumstances the estimated parameter captures both the effect of the local unemployment rate and the effect of the unobserved attribute.[8]

To some extent this problem is mitigated by the fact that in most cases it is the parents, not the individual students, who have chosen their residential location prior to university. Consequently, the difficulty is really a problem of endogenous residential selection one generation removed. To help control for this problem, papers examining spatial labour market mismatch have used the employment experiences of young workers living at home, whose residential location was chosen by their parents (Dujardin, Selod and Thomas 2008). However, because it is widely thought that parents pass on many of their characteristics to their children there is still a risk that parameter estimates will be influenced by residential sorting.

The second estimation issue concerns the school attended. Previous work by Simpson (2001) and Bratti (2006) suggests that school type is an important determinant of subject choice, as students from Private schools are found to have a greater propensity to do some subjects than students from State schools. At least two effects may undermine parameter estimates in this setting. Firstly, analogously to the argument set out above, suppose students select into particular school types based on an unobserved attribute – musical ability, for example – which also influences their degree choice. In this case, the parameter estimate on a given school type would capture both the effect of the school and the effect of the unobserved musical ability.[9] Secondly, variation in school resources, class-sizes, teacher quality or ethos may all have an impact on subject choice and consequently should enter the specification. Variables

[8] Formally, the estimated coefficient on local unemployment would be attenuated by the covariance between the unobserved attribute – ability – and the unemployment measure.
[9] Analogously to the earlier case, the formal problem is that the coefficient on school type is attenuated by the covariance between the observed school type and the unobserved attribute – musical ability.

which are wholly or partly unobservable – arguably including teacher quality or school ethos – present a particular problem.

Research elsewhere also suggests that there is significant variation in higher education outcomes and behaviour within school types. Smith and Naylor (2005) find that males (females) who attended an Independent school are 6.5% (5.4%) less likely to attain a 'good' degree at university, but on closer inspection they find significant variation between the highest- and lowest-performing Private schools. Relative to (average) State school students and conditional on personal, academic and parental characteristics, males (females) who attended the best Independent schools are 7% (13.3%) more likely to achieve a good degree, while those at the worst performing Independent schools are 17.8% (18.7%) less likely to achieve a good degree. More cause for concern about within school type variation is derived from recent education policy reforms which have encouraged schools to specialise in particular areas such as 'performing arts', 'science' and 'sports'. These changes may have influenced school level trends in applications to take some degree types, particularly where different State schools have specialised in different subject areas. As a consequence, a simple set of 'State' and 'Private' school dummies may not be sufficient to reliably identify the true school level effect.

2.3.2 Estimation strategy

To mitigate these problems and to explore the determinants of degree choice systematically, this paper implements two levels of investigation. In the first part a linear probability model is implemented (Angrist and Krueger 1999, Kuhn and Weinberger 2005) for each of the 19 subject areas of the form:

$$Pr(d_{i,j,s,t} = D) = A_0 + A_1 c_{i,j,t} + A_2 p_i \quad (2)$$

This specification, based on (1), states that the probability of taking a degree subject, d, is a function of the future consumption benefits of the degree, $c_{i,j,t}$, and the psychic costs of taking the degree, p_i. The subscripts i, j, s and t index individuals, labour market areas, schools and time respectively.

As these quantities are not observed directly, several variables are used as proxies. Following prior work (Rice 1999, 2000), the return to a degree is modelled as a function of local labour market conditions, including employment by industry, earnings and the local unemployment rate. Note that by including labour market conditions across the range of industrial sectors, this makes no assumptions about the career path or employment choice that individuals make after completing their studies, but allows estimation of how labour market signals from a range of different industries affect degree choice through their impact on the expected return.

The relative psychic costs of a degree are also unobserved and must be accounted for by another set of proxy variables. Individual characteristics including age, gender and ethnicity, prior academic attainment and type of school attended, as well as parental socio-economic class are included to try to model the systematic components of this variable. This specification provides a baseline set of results.

The second level of analysis involves a set of linear regressions of the form:

$$Pr(d_{i,j,s,t} = D) = A_0 + A_1 c_{i,j,t} + A_2 p_i + f_j + f_s + f_t + \varepsilon_i \quad (3)$$

Equation (3) outlines a similar strategy: to regress the indicator for each subject against individual, academic and parental characteristics as well as local economic conditions. However, this time a full set of fixed effects are introduced for each travel to work area (TTWA) of domicile, f_j, for each school attended, f_s, and for each cohort, f_t.

This amounts to using the multiple cross-section nature of the data to allow each school and each TTWA of residence before university to have a single, intercept shifting effect on the probability of taking a particular subject. In this specification the return to a degree is identified using changes in local economic characteristics rather than level effects.

Introducing these arrays of fixed effects helps to control for some of the selection effects outlined above, but involves three additional identifying assumptions. Firstly, to control for endogenous residential selection, I assume that all individuals from a given TTWA have a common, time-invariant set of unobserved characteristics which influence (1) their location decision and (2) their degree specialism. Specifying an array of domicile TTWA fixed effects allows areas of residence to have a single, intercept-shifting impact on the probability of taking a given subject. TTWAs are defined by the Office for National Statistics (ONS) using census data on commuter flows. They identify geographical areas in which the majority of individuals both reside and work and consequently more closely reflect the geography of the labour market than administrative boundaries. This paper uses the 1998 TTWA edition from the ONS, which is based on commuting data from the 1991 census and identifies 297 TTWAs across England, Wales and Scotland. This allows the analysis to move towards a more causal interpretation of the coefficients on local labour market conditions, to the extent that the unobserved characteristics of individuals from the same area are both common and time-invariant.[10]

Secondly, fixed effects for each secondary school are introduced to partially control for (1) endogenous sorting into schools and (2) differences in school resources.

[10] If the set of common unobservable characteristics associated with a particular TTWA varies over time, then the analysis carried out here remains susceptible to the impact of endogenous residential selection. Tabulations of observable characteristics for each TTWA suggest this risk is small, but this is essentially an un-testable, maintained assumption.

Analogously to the TTWA fixed effects, this allows attendance at each secondary school to have a single, intercept-shifting impact on the probability of taking a given degree subject. There are roughly 5,000 registered secondary schools in the UK, of which some 4,127 (4,459) appear in the dataset for males (females). As before, this requires the assumption that both relative school resources and school sorting have an essentially time-invariant impact on subject choice probabilities.

A third and final maintained assumption is introduced regarding the impact of unobserved ability. As detailed measures of ability are not available, this analysis includes measures of performance in school-leaving exams (A level tariff point score). For identification, either (1) this variable must capture any aspects of student ability that are relevant for degree choice or (2) those components of unobserved ability that influence degree choice must be uncorrelated with the explanatory variables in the regression. Both versions of this maintained assumption are quite strong. I return to the question of unobserved individual heterogeneity in Section 2.6.

The simple linear regression approach adopted for this paper represents a compromise between the desire to model subject choice in as detailed a manner as possible and the need for a consistent and computationally achievable method of estimation. As set out above, previous work in the field has used a multinomial specification to model students' choices among relatively few degree specialisms from relatively small samples. Bratti (2006) utilises the most coherent empirical framework of the work surveyed here, using a multinomial probit to relax the IIA assumption, yet limits his analysis to three broad subjects. However, because this paper seeks to model students' choices among a more detailed set of nineteen academic fields, to incorporate a large number of fixed effects and to utilise a relatively large dataset, the multinomial probit is computationally infeasible. To compensate for the well-known short-comings of the linear approach I adopt, the regressions were run with clustered standard errors

based on the TTWA of domicile. However, this framework requires me to assume that students compare a particular degree subject relative to the average of all other courses. This is a key limitation of the paper which I return to in Section Six.

Finally, to check the robustness of the analysis and to ensure the results did not arise from the nature of the model adopted, a series of logistic regressions were also run for each subject (excluding fixed effects), but the findings were not significantly different to those based on the ordinary least squares approach in the first part. A series of fixed effect conditional logit regressions were also run for a subset of subjects and students, which yielded similar results to the second part of the analysis presented here.

2.4 Data

The data used in this paper come from a wide range of sources, linked together using the student's reported postcode district of domicile.[11]

2.4.1 Individual level data

The student level data used in this paper are drawn from the Destination of Leavers from Higher Education (DLHE) survey provided by the Higher Education Statistics Agency (HESA 2005, 2006, 2007, 2008, 2009) which has been used and analysed extensively elsewhere (Faggian and McCann 2006, 2009, Faggian, McCann and Sheppard, 2006, 2007a, 2007b, Naylor and Smith 2004, Smith and Naylor 2005).[12] The DLHE is a survey of graduates from universities in the UK six to nine months after they leave higher education. It includes a wealth of information on their previous schooling,

[11] There are 2,971 postcode districts currently in use in the UK.
[12] Data from the Higher Education Statistics Agency is available from www.hesa.ac.uk. HESA cannot accept responsibility for any inferences or conclusions derived from the data by third parties.

their academic attainment at school and at university, as well as a range of individual characteristics such as age, gender and ethnicity. The dataset also includes geographical information at the postcode district level which details where the student lived before they went to university.

In addition to information about the individual student, the dataset also includes indicators provided by the University and Colleges Admissions Service (UCAS). These variables provide the socio-economic classification of the student's household prior to starting university.

As the primary aim of this paper is to assess how students make their choice of degree subject, the target population is restricted to full-time undergraduates completing their first-degree between 2004/05 and 2008/09, who were domiciled, educated and attended university in Great Britain. Limiting my work to students aged between 20 and 24 at graduation who held A-level or equivalent qualifications before commencing their degree studies yields a target sample of 764,680 individuals.

From this target group, I remove several other groups because of missing or unmatchable data. Firstly, students who study joint degree programmes complicate the analysis of 'subject choice'. As the DLHE dataset provides information about how much of a student's degree was devoted to a particular subject, only students who spent at least half of their time on one subject area are included. Students who split their time equally between two subjects were dropped. This ensures that the sample only includes individuals who have made a specific subject choice. Secondly, students who do not report which school they attended or who do not provide an A-Level tariff score are dropped. Finally, student's whose postcode district of domicile could not be confidently assigned to a single TTWA were also dropped.[13] This leaves a sample of 574,210

[13] Students were assigned to a domicile TTWA using their reported domicile postcode district. This method linked 60% of the final sample to a single domicile TTWA. Where postcode districts did not map directly into TTWAs, data on the number of 17, 18 and

individuals. An analysis of the individuals who were dropped suggested that the lower socio-economic groups are slightly over-represented, as are students with poorer than average A-level results. However, these differences are relatively slight and the age, gender and ethnic profiles of these students are broadly similar to that of the sample as a whole.

Summary statistics for included students from all five cohorts combined are reported in Table 2.1. Taken together, there are 24.7% more females in the sample than males and more than 80% of all students are white. A slightly higher proportion of males were educated at Private schools than females, and 52% of the students surveyed had parents in Professional and Managerial occupations.

Finally, the individual level data also provided information about the subject each student chose to study at university, broken down into the 162 subject codes of the Joint Academic Classification of Subjects (JACS). These were aggregated to the 20 JACS2 subjects (see Appendix 2A for more details) for reasons of practicality. Table 2.2 provides information about the number of students taking each subject. For males the most popular subjects are Mathematics, Social Studies, Biological Science and Engineering, which account for more than 40% of male students. The most popular subjects among female students are Biological Science, Social Studies, Art & Music, and Degrees Related to Medicine, which together account for 43% of female students. The greatest differences between men and women are the in the proportions taking Mathematics and Engineering (which are more popular with male students) and Biological Science and Degrees Related to Medicine (which are more popular with female students).

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19 year olds normally resident in each Output Area from the 2001 census was used to generate the likelihood of an individual coming from each possible TTWA. 0.9% of the final sample is dropped because of uncertainty about their domicile TTWA. Of those remaining, 92% can be assigned to a single TTWA with greater than 80% certainty. 86% can be assigned to a single TTWA with greater than 90% certainty. Further tests were carried out to ensure that the results are robust to different methods of attribution.

Table 2.1: Summary statistics of student characteristics

	Male		*Female*	
	Frequency	*%*	*Frequency*	*%*
Total	255,590		318,620	
Ethnicity				
White	211,350	82.7	263,765	82.8
Black	4,870	1.9	8,445	2.7
Asian	28,060	11.0	33,330	10.5
Other	7,330	2.9	9,720	3.1
Unknown	3,980	1.6	3,360	1.1
Schooling				
Private	43,960	17.2	44,385	13.9
State	210,865	82.5	273,205	85.7
Unknown	765	0.3	1,030	0.3
Parent's socio-economic class				
Higher Managerial & Professional	62,935	24.6	73,305	23.0
Lower Managerial & Professional	71,265	27.9	89,955	28.2
Intermediate	30,520	11.9	38,405	12.1
Small Employers	15,115	5.9	20,220	6.3
Lower Super. & Technical	10,520	4.1	13,750	4.3
Semi-routine	20,665	8.1	27,760	8.7
Routine, Unemployed	9,190	3.6	12,900	4.0
Unknown	35,380	13.8	42,325	13.3
Disability classification				
Some form of Disability	12,955	5.1	15,060	4.7
None Reported	242,635	94.9	303,565	95.3

Note(s): (1) 44.5% (55.4%) of the sample are male (female). Numbers are rounded to nearest 5. (2) Source: Higher Education Statistics Agency, Destination of Leavers from Higher Education Survey, 2004/05-2008/09

2.4.2 Local economic data

In addition to the DLHE, a wide range of data from different sources was included to generate information about the local economy at each individual's point of domicile. Using the postcode district of domicile as a spatial reference, data at the TTWA level was included on a range of labour market conditions. As discussed above, TTWAs are defined by the Office for National Statistics (ONS) using census data on commuter flows and more closely reflect the geography of the labour market than administrative

Table 2.2: Subject choice and gender

Subject	*Males*	*%*	*Females*	*%*	*Total*
Combined Degrees	735	0.3	1,715	0.5	2,450
Other Languages	1,065	0.4	1,700	0.5	2,765
Veterinary Science	1,390	0.5	3,460	1.1	4,845
Education	2,375	0.9	15,175	4.8	17,545
Mineral Technology	2,500	1.0	1,410	0.4	3,910
European Languages	2,765	1.1	7,515	2.4	10,275
Medicine & Dentistry	4,850	1.9	7,735	2.4	12,585
Architecture	7,645	3.0	3,345	1.1	10,990
Communications	7,900	3.1	12,125	3.8	20,020
Medicine Related	8,370	3.3	26,980	8.5	35,350
Lang., Ling. & Classics	8,755	3.4	23,600	7.4	32,355
Law	12,325	4.8	22,845	7.2	35,170
Art & Music	18,255	7.1	30,755	9.7	49,010
History	18,265	7.1	20,435	6.4	38,700
Physical Science	20,645	8.1	14,670	4.6	35,315
Engineering	21,615	8.5	3,090	1.0	24,705
Biological Science	25,015	9.8	48,420	15.2	73,440
Social Studies	26,935	10.5	31,685	9.9	58,620
Mathematics	29,935	11.7	9,880	3.1	39,815

Note(s): (1) Numbers are rounded to nearest 5. (2) Source: Higher Education Statistics Agency, Destination of Leavers from Higher Education Survey, 2004/05-2008/09

boundaries. I use the 1998 TTWA boundaries from the ONS, which are based on commuting data from the 1991 census and identify 297 TTWAs across England, Wales and Scotland.

Several different indicators of local economic performance are included in my analysis. Firstly, the extent of unemployment is measured using the number of claimants of the Job Seekers Allowance, which was drawn from the Department for Work and Pensions datasets. Secondly, average full-time hourly earnings were extracted from the Annual Survey of Hours and Earnings. Thirdly, the industrial composition of

the local workforce was measured using employment in twelve sectors from the Annual Business Inquiry (See Appendix 2A for Industries included). Finally, to control for differences in the size of the potential workforce, data on the size of the working age population was included from the ONS's Mid-Year Population Estimates. All these variables were defined at the TTWA level and entered in log form.

2.5 Results

The primary aim of this paper is to explore the determinants of degree choice at the individual level in the context of local economic conditions. To assess these empirically, two levels of investigation were carried out. First, a series of linear probability models were estimated in the probability of taking a particular subject as a function of individual, academic, parental and local economic characteristics as set out in (2) above. In these regressions, a significant coefficient on a local economic variable is interpreted as evidence of some kind of relationship between labour market signals and the probability of taking a particular subject. This estimation provides a baseline set of results.

The second level of analysis involved the estimation of a further set of linear probability models, this time including a full set of fixed effects for the student's residential location prior to university and the school which they attended, as detailed in (3). This represents a much 'harder test' for the local economic variables, as the fixed effects control for local factors which remain unchanged through time. The full results of this second part are reported in Appendix 2B. Each pair of columns in Appendix 2B represents a regression for a different subject including individual, academic, parental and local economic characteristics. Results are reported separately for men and women. Results from the first level of analysis, which does not include these sets of fixed

effects, are reported in Appendix 2C. As there are many common findings between these two sets, the discussion is focussed on the preferred set of results which include fixed effects. An analysis of the differences between the simple OLS and the OLS with fixed effects is deferred until Section 2.6.

Before proceeding to the full results, Table 2.3 underlines the importance of running the analysis for males and females separately. An initial set of pooled regressions were run for each subject, conditioning on individual, academic, parental and local economic characteristics as well as a gender dummy variable and the full set of explanatory variables interacted with the gender dummy. Column (1) reports the coefficient on the Female dummy variable from these regressions. The estimated coefficients suggest that conditional on a wide range of other variables, female students are more likely to take degrees in Biological Science (+32.6%), Engineering (+32.1%) and Language, Linguistics & Classics (+29.6%), but less likely to take degrees in Medicine & Dentistry (-27.8%), Mathematics (-23.8%) and Physical Science (-17.7%). Some of these relatively large effects correspond with the descriptive statistics presented in Table 2.2: more than three times as many males take Mathematics than females, while females outnumber males in Language, Linguistics & Classics by more than two to one. However, several results confound the simple descriptive statistics. The difference between men and women in Engineering in particular is surprising: there are more than six times as many male engineers as female engineers in my sample, yet the coefficient on the female dummy variable is large, positive and statistically significant.

Part of the cause of this effect is shown in the third column of Table 2.3, which shows the results of F-tests for the joint significance of all explanatory variables interacted with the female dummy. While the coefficient on the female dummy is insignificant at the 5% level in nine subject regressions, the results of F-tests on the exclusion of the female interaction terms are significant at the 1% level for all subjects.

Table 2.3: Gender effects

Subject	*Female*	*T-Stat*	*F-Test*
Medicine & Dentistry	**-0.278*** **	-7.76	**32.61*** **
Mathematics	**-0.238*** **	-3.18	**198.35*** **
Physical Science	**-0.177*** **	-3.71	**54.77*** **
Art & Music	**-0.160*** **	-3.08	**23.03*** **
Business Studies	-0.150*	-1.89	**22.43*** **
European Languages	**-0.133*** **	-3.93	**32.79*** **
Medicine Related	-0.079	-1.42	**100.82*** **
Social Studies	-0.065	-0.99	**58.16*** **
Veterinary Science	**-0.046** **	-2.3	**10.45*** **
Mineral Technology	-0.025	-1.47	**15.69*** **
Other Languages	-0.016	-1.44	**2.17*** **
Architecture	0.029	1.03	**79.93*** **
Communications	0.068*	1.78	**19.48*** **
History	0.073	1.55	**11.90*** **
Education	0.086	1.49	**72.56*** **
Law	**0.166*** **	4.02	**51.35*** **
Lang, Ling & Classics	**0.296*** **	6.04	**70.93*** **
Engineering	**0.321*** **	3.32	**197.66*** **
Biological Science	**0.326*** **	4.56	**75.17*** **

Note(s): (1) Results reported from a set of regressions of the probability of taking each subject against personal, academic, parental and local economic characteristics, where all the explanatory variables have also been interacted with a dummy variable taking a value one for female students, zero otherwise. Column 1 shows the estimated coefficient on this female dummy variable and Column 2 shows the t-statistic associated with that coefficient. Column 3 shows the result of a F-Test on the joint significance of the interacted terms. (2) *, ** and *** represent significance at the 10%, 5% and 1% levels respectively.

This suggests that the 'female effect' cannot be limited to a dummy variable and that the included variables have different impacts on male and female students. As a result, the following analyses were conducted separately for men and women.

2.5.1 Ethnicity and disability

Although prior work in this area has been limited, among the strongest results from Simpson's (2001) analysis suggested patterns of subject choice varied significantly among ethnic groups. The models estimated here confirm these results and add detail to the nature of these different choices.

Taken from Appendix 2B, Panel A of Figure 2.1 shows the estimated coefficient on the Asian dummy variable for men and women for nineteen subjects. The dotted lines illustrate the 95% confidence intervals (based on clustered standard errors)[14] around these coefficients and demonstrate the significance of the estimates in all but one subject (Social Studies). As the results of the baseline and fixed effects estimation were very similar, Figure 2.1 shows the results from the preferred, fixed effects analysis. Asian males are significantly more likely than white males to take Mathematics (+7.5%), Business Studies (+7.0%) and Degrees Related to Medicine (+6.7%) and less likely to take degrees in History (-6.4%), Art & Music (-6.0%) and Physical Science (-4.1%). Similar, significant differences between Asian females and White females are also evident, which broadly mirror the choices of Asian males. Asian females are more likely to take Degrees Related to Medicine (+7.1%), Law (+6.8%) and Business Studies (+6.7%), and less likely to take degrees in Art & Music (-7.1%), History (-4.5%) and Languages, Linguistics & Classics (-4.3%) than White females.

As should be clear from this discussion, conditional on family, academic and economic characteristics, being Asian appears to be associated with a particular pattern of subject choice irrespective of gender, as the same effects are evident for both men

[14] Standard errors are clustered on the TTWA of domicile to control for the spatial aspects of the error structure and to deal with heteroscedasticity in the linear probability model.

Figure 2.1: Effect of ethnicity on subject choice

Note(s): (1) Dotted lines represent 95% confidence intervals, based on standard errors clustered on domicile travel-to-work-areas

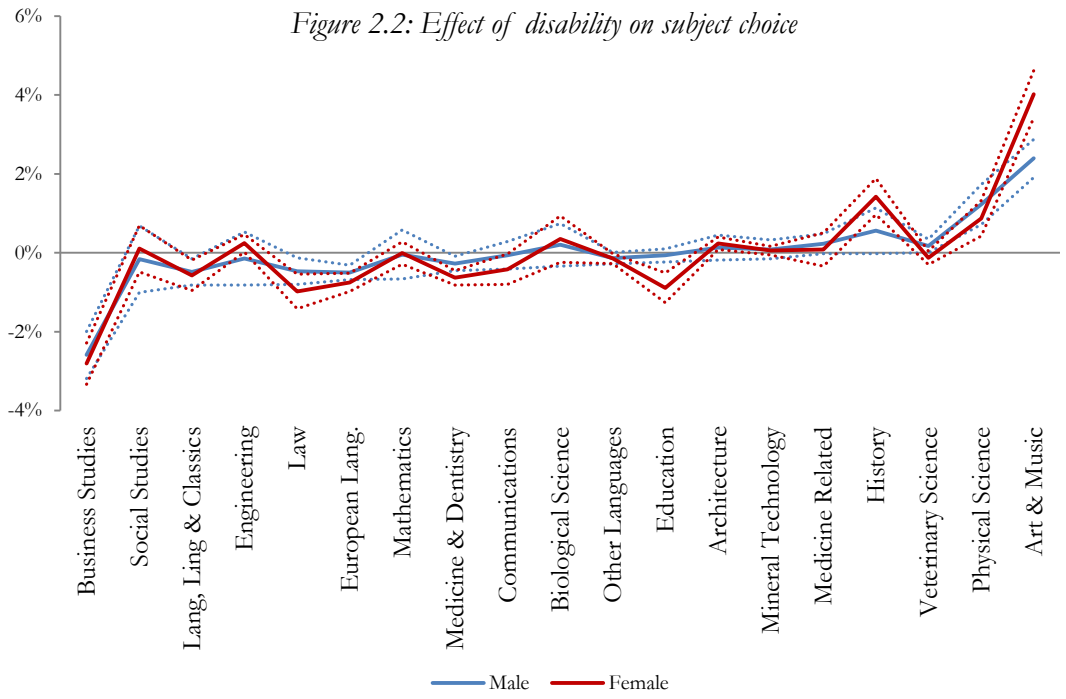
and women. Mathematics, Business Studies and Degrees Related to Medicine appear to attract Asian students more than White students, while conversely, History and Art & Music both appear less attractive to Asian students. However, in some cases the difference between Asian and White females is of a different magnitude to the difference between Asian and White males. Asian females, for instance, are more likely to do Law relative to White females, than Asian males relative to White males. As a result, the pattern of subject specialisation appears to be deeper than simple ethnic groups, with individuals of different gender and ethnic groups specialising in different ways.

The fixed effects results for Black students are similarly significant (Panel B), but suggest a different pattern of subject specialisation. Black males are more likely than white students to take Business Studies (+5.8%), Law (+5.3%) and Degrees Related to Medicine (+4.2%) and less likely to take degrees in History (-5.8%), Art & Music (-4.1%) and Physical Science (-3.8%). Black females are more likely to take Law (+9.6%), Business Studies (+5.0%) and Degrees Related to Medicine (+4.6%) and less likely to take Art & Music (-4.9%), Language, Linguistics & Classics (-4.9%) and Education (-4.5%) than White females.

However, as with Asian students, the results also suggest that there are strong intra-ethnic group differences between men and women. The difference between Black and White males and Black and White females varies particularly strongly for Law and Education. The size and significance of these results varies very little with the inclusion of the fixed effects.

Figure 2.2 shows the impact of having a disability on the probability of taking particular subjects. Once again, the OLS and OLS with fixed effects results are largely consistent. Having a disability has a relatively small effect on subject choice and appears to affect men and women in largely the same way. The only exceptions to this

Figure 2.2: Effect of disability on subject choice



Note(s): (1) Dotted lines represent 95% confidence intervals, based on standard errors clustered on domicile travel-to-work-areas

result are the coefficients for Art & Music, Law, Business Studies and Language, Linguistics and Classics. Reporting a disability, either physical or mental, is associated with a significantly higher probability of taking an Art & Music degree for both males (+2.4%) and females (+4.0%), and a significantly lower probability of taking a Business Studies degree (-2.6% and -2.8% for males and females respectively). As can be seen in Figure 2.2, the effect of disability is statistically significant for several other subjects, but relatively small in magnitude.

2.5.2 Parental background and schooling

Beyond the individual's personal characteristics, the results indicate that parental and academic characteristics also have a bearing on degree choice, although their effect varies from subject to subject. The non-fixed effects results suggest that for men (women), coming from a higher occupational background is associated with a lower probability of studying Business Studies, Communications, Art & Music or Education

(Business Studies and Education), and a higher probability of studying Medicine & Dentistry and Social Studies (Medicine & Dentistry, Veterinary Science, Architecture and History).

In the second set of results, which include domicile travel to work area fixed effects, the magnitude of these coefficients is reduced, but they remain significant in many cases. Male (female) students with Higher Managerial or Professional parents are 1.2-1.5% (1.2%-1.8%) more likely to study Medicine & Dentistry and 1.1%-1.9% (0.6%-2.1%) less likely to take a Business Studies degree than students from less wealthy occupational groups. Students from poorer backgrounds appear to be both relatively more likely to take degrees in Education, and relatively less likely to take History degrees. The findings also broadly echo Micklewright's (1989) conclusion that women's decisions appear more affected by parental background than men's, based on both the magnitude and significance of the two sets of estimated coefficients. However, the results are not consistent with the earlier findings of Bratti (2006) and Davies and Guppy (1997) who found no significant impact of socio-economic background.

To incorporate the effects of prior academic attainment on choice of subject, four dummy variables were used to describe the individual's A-level point score relative to the rest of their cohort. These were defined as achieving a point score (1) less than one standard deviation below the mean, (2) between one standard deviation below the mean and the mean, (3) between the mean and one standard deviation above the mean, and (4) more than one standard deviation above the mean. The reference category excluded from the regressions was a point score between the mean and one standard deviation above the mean and the coefficients on the remaining three variables are shown in Appendix 2B. Panel A of Figure 2.3 shows the results for males. They suggest that poor academic attainment at A-level (defined as a point score below the mean) is

Figure 2.3: Effect of prior academic attainment on subject choice

Note(s): (1) High is here defined as having a Tariff point score more than one standard deviation (s.d.)above the mean, Medium-Low is defined as being between the mean and one s.d. below the mean and Low is defined as a tariff point score less than one s.d.below the mean. (2) All coefficients significant at conventional levels except those points which are 'white-filled' and listed here. (3) For males, all coefficients significant at conventional levels except Social Studies (High), Medicine Related(High) and Other Languages (Medium-Low), Veterinary Science (High), History (High), Mathematics (Medium-Low). (4) For females, all coefficients significant at conventional levels except Medicine-Related (Medium-Low), Other Languages (Medium-Low), European Languages (High), Architecture (Medium-Low) and Engineering(Low), Mathematics (Low).

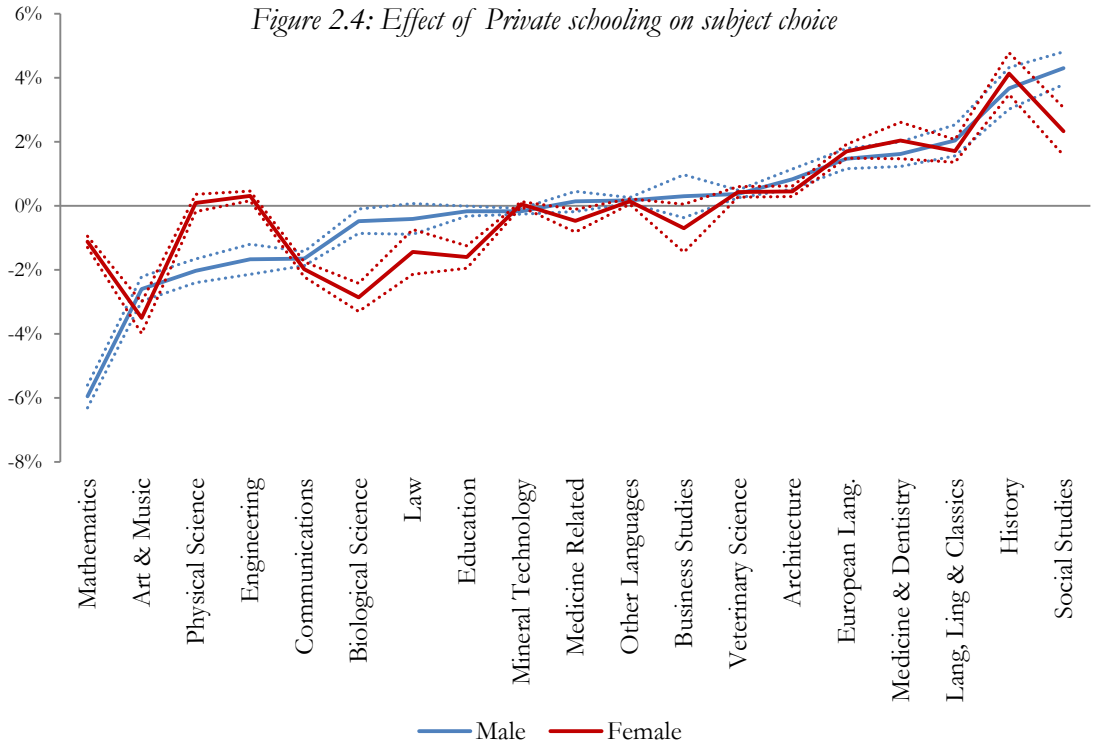
associated with a higher probability of taking a Business Studies, Biological Science or Art & Music degree. Male students who achieve a point score less than one standard deviation below the mean point score are 7.8% more likely to take a Business Studies degree and 3.2% more likely to take an Art & Music degree than males who achieved point scores between the mean and one standard deviation above the mean.

By contrast, male students who achieved among the highest point scores are more likely to study Mathematics, Medicine & Dentistry, Law and Physical Science than individuals with lower point scores. Taking the coefficient estimates together, males who performed best in their cohort are 13.4% less likely to take a Business Studies degree and 4.8% less likely to take a degree in Art & Music compared to the lowest performing students. Conversely, the results suggest that the best performing males are 4.9% more likely to take a degree in Medicine & Dentistry and 5.5% more likely to take Law than the lowest performing male students.

Panel B of Figure 2.3 shows the equivalent set of results for females, which mirrors many of the effects evident for males. Female students who performed relatively poorly at A-level are more likely to undertake degrees in Business Studies, Education and Art & Music, while those performing at the very highest levels are more likely to take Law, Medicine & Dentistry, Mathematics and Language, Linguistics & Classics. Based on these results, high performing female students are 4.6% less likely to take an Arts & Music degree, 8.2% less likely to take an Education degree and 10.1% less likely to take a Business Studies degree than the lowest performing female students. Conversely, they are 6.8% more likely to take a Law degree, 5.8% more likely to take a Language, Linguistics & Classics degree and 4.0% more likely to take a History degree.

The non-fixed effects results also suggest that school type plays a role in determining subject choice. Relative to attending a State school, Figure 2.4 shows that attending a Private school significantly affects the probability of taking 16 of 19

Figure 2.4: Effect of Private schooling on subject choice



Note(s): (1) Dotted lines represent 95% confidence intervals, based on standard errors clustered on domicile travel-to-work-areas

subjects shown for both males and females. Private schooling is associated with a higher probability of taking Social Studies, History and Languages, Linguistics & Classics for both males and females, and associated with a lower probability of taking a degree in Art & Music, Mathematics and Communications.

The strength of these school type effects in the baseline results are consistent with the findings of Simpson (2001) and Bratti (2006), but also support a more detailed investigation of how schools influence subject choice. This was carried out in the second analysis using fixed school and domicile effects. For males, fixed effects for some 4,127 schools and 297 TTWAs were estimated. For females the analysis included 4,459 schools and 297 TTWA effects. Table 2.4 details the F-statistics associated with a test of the significance of the estimated school fixed effects (columns one and four), the significance of the TTWA effects (columns two and five) and the joint significance of both the school and TTWA effects (columns three and six). For males, school and domicile TTWA characteristics appear to make a significant contribution to all but one

Table 2.4: F-tests for the significance of fixed effects

	Males			*Females*		
Subject	*School*	*Domicile*	*Total*	*School*	*Domicile*	*Total*
Medicine & Dentistry	1.63***	17.14***	3.15***	1.90***	36.56***	5.15***
Medicine Related	1.17***	1.05	1.19***	1.52***	1.10	1.60***
Biological Science	1.49***	2.55***	1.65***	1.67***	2.39***	1.81***
Veterinary Science	1.71***	3.87***	1.87***	1.67***	3.32***	1.82***
Physical Science	1.51***	1.29***	1.60***	1.39***	1.12*	1.41***
Mathematics	2.00***	2.24***	2.12***	1.43***	0.84	1.44***
Engineering	1.58***	7.73***	2.60***	1.23***	2.23***	1.35***
Mineral Technology	1.25***	1.15**	1.27***	0.94	0.07*	0.97
Architecture	1.41***	1.44***	1.46***	1.03*	1.27**	1.07***
Social Studies	1.63***	3.14***	1.86***	1.70***	2.80***	1.87***
Law	1.39***	1.65***	1.46***	1.63***	1.46***	1.70***
Business Studies	1.79***	1.14*	1.89***	1.84***	2.33***	2.22***
Communications	1.88***	1.77***	1.98***	1.74***	1.29***	1.81***
Lang, Ling & Classics	1.46***	1.77***	1.59***	1.45***	2.64***	1.71***
European Languages	1.48***	3.19***	1.65***	1.45***	8.89***	2.23***
Other Languages	1.01	1.04	1.01	1.03*	1.20**	1.08***
History	1.59***	2.99***	1.86***	2.02***	2.64***	2.22***
Art & Music	6.39***	2.97***	6.49***	9.58***	346***	9.61***
Education	1.81***	1.59***	1.87***	1.87***	1.43***	2.17***

Note(s): (1) F-test of the joint significance of school and domicile travel-to-work-areas fixed effects. (2) *, ** and *** represent significance at the 10%, 5% and 1% levels respectively

of the possible subject choices and are particularly important in determining the probabilities of taking degrees in Medicine & Dentistry, Art & Music and Engineering.

The results for females are similarly strong. The F-statistics for the joint significance of all the fixed effects suggests that school and domicile characteristics contribute significantly to all but one subject choice. As with male students, these effects appear to be particularly important in determining the probability of students choosing to take degrees in Medicine & Dentistry and Art & Music. Taken together these results suggest that students from the same school in the same areas make similar

choices about what subject to study at degree level and highlight the need to adopt a systematic approach to controlling for potential sources of endogeneity.

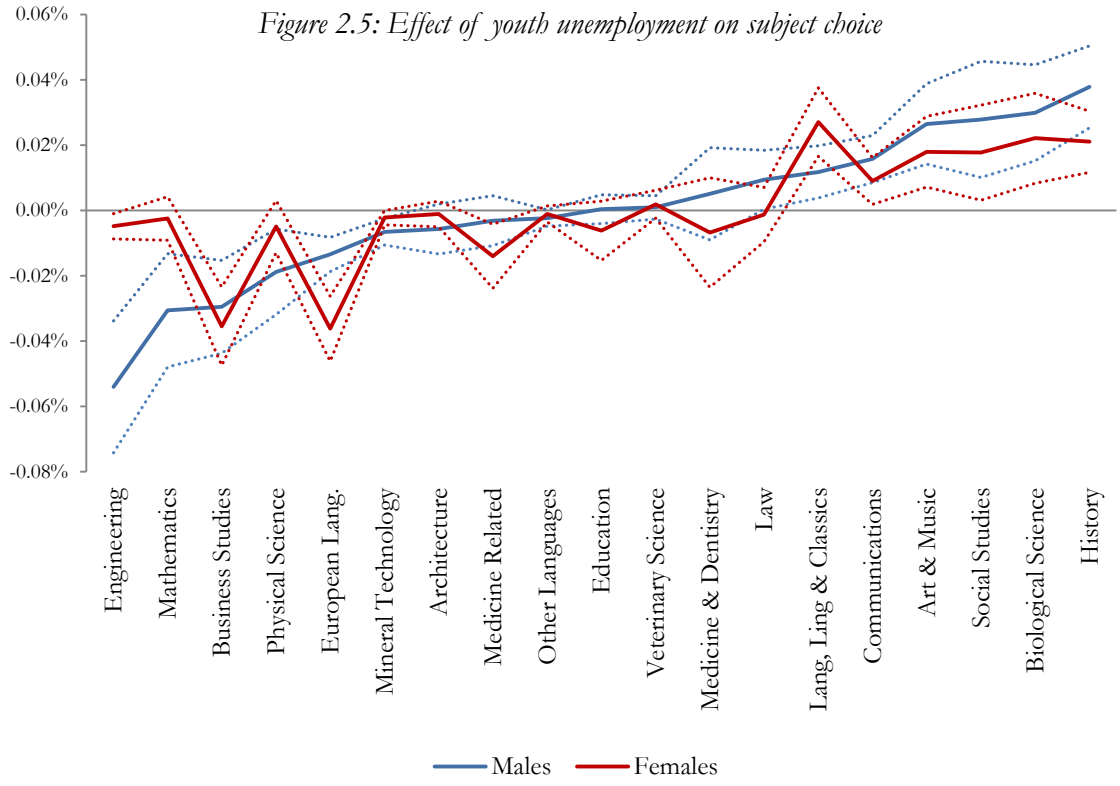
2.5.3 Local economic conditions

Alongside personal, academic and parental characteristics, a range of variables designed to capture local economic conditions were incorporated into the regressions in both stages. These variables included youth unemployment, average full-time hourly wages and employment levels in different industries at the TTWA level. As detailed in the Appendices, the results suggest that local economic conditions play a significant role in determining student degree specialism, although these effects are an order of magnitude smaller than the impact of individual and academic characteristics. Taken as a whole, youth unemployment enters significantly in 13 (10) of the detailed 19 subject regressions for males (females), and average full-time hourly wages enter significantly in 17 (18) cases.

Figure 2.5 shows the estimated coefficients on youth unemployment from the fixed effects analysis. After controlling for time-invariant characteristics of schools and residences, higher rates of youth unemployment significantly increase the probabilities of both males and females taking History, Biological Science, Social Studies and Art & Music degrees. High youth unemployment reduces the probability of female students taking Business Studies and European Languages, and reduces the probability of male students taking Engineering, Mathematics and Business Studies.

However, while these effects are significant, their impact is very small. The estimated coefficient of largest absolute size for males (females) affects the probability of taking Engineering (European Languages). For males, a five percent increase in

Figure 2.5: Effect of youth unemployment on subject choice



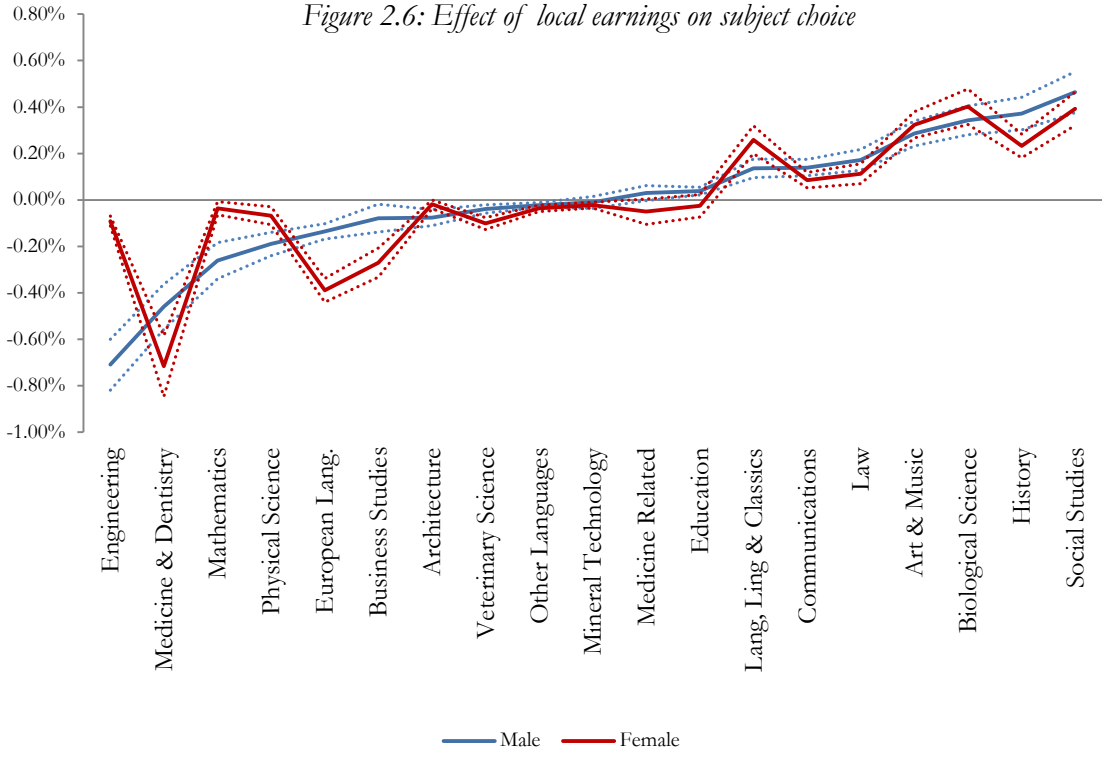
Note(s): (1) Dotted lines represent 95% confidence intervals, based on standard errors clustered on travel-to-work-areas

Youth unemployment reduces the probability of taking an Engineering degree by 0.27%. For females, a similar increase in unemployment reduces the probability of taking a European Language degree by just 0.18%.

By contrast, the estimated coefficients on average full-time hourly earnings (Figure 2.6) are significant and substantially larger than those on youth unemployment. Growing average full-time hourly earnings has a significant and positive impact on the probability of male and female students taking Social Studies, History, Biological Science and Art & Music. Among male students, earnings growth tends to reduce the likelihood of taking degrees in Engineering, Medicine & Dentistry and Mathematics. Among female students, earnings growth reduces the probability of taking Medicine & Dentistry, European Languages and Business Studies.

The largest estimated effects of earnings affect the probability of males (female) taking Engineering (Medicine & Dentistry) degrees. For males, a five percent increase

Figure 2.6: Effect of local earnings on subject choice



Note(s): (1) Dotted lines represent 95% confidence intervals, based on standard errors clustered on domicile travel-to-work-areas

in average earnings is associated with a 3.5% fall in the likelihood of taking an Engineering degree. For females, a similar increase in earnings is associated with a 3.6% fall in the probability of taking Medicine & Dentistry degree.

To estimate the impact of the industrial composition of employment on subject choice, the levels employment in eleven broad sectors were included in the regressions.[15] After controlling for time-invariant characteristics of school and domicile, the impact of growing employment in different sectors enters significantly in several subject choice regressions. For females, 76 of the 209 estimated coefficients in the main 19-subject regressions are significant at the five percent level or above. For males, 80 of the 209 estimated effects are significant. As with the youth unemployment coefficients,

[15] A breakdown of twelve industries is used, corresponding to the categories level of the SIC code classification. Financial Intermediation is excluded as the base industry, resulting in eleven estimated coefficients, for nineteen subjects, for males and females, generating 418 estimated coefficients. See Appendix 2A for the full breakdown of included industries.

many of these effects are small, but offer a direct examination of how employment changes around the student's domicile affect degree choice.

While many of the estimated effects defy explanation, several are suggestive. Employment growth in Manufacturing of five percent in their TTWA of domicile is associated with a higher probability that male students take degrees in Mathematics (+0.34%) and Engineering (+0.5%) and reduces the probability of students taking degrees in Social Studies (-0.42%), History (-0.25%) and Art & Music (-0.22%). For females, a similar increase in Manufacturing employment reduces the likelihood of taking History (-0.25%), Art & Music (-0.28%) as well as Languages, Linguistics & Classics (-0.33%). Meanwhile, growth in Business Activities encourages both male and female students to take degrees in Social Studies and Law. These results suggest that labour market signals do affect students' decisions about training.

2.6 Robustness tests and limitations

Several different methods were used to test the robustness of the results. Firstly, for an earlier version of this paper, a similar micro-level analysis was carried out using a subset of the individual level DLHE data. This earlier paper differed in several important respects. Firstly, it utilised data for only the first three years considered here: including students who completed their first-degree between 2004/05 and 2006/07, rather than between 2004/05 and 2008/09. Secondly, the earlier version of this paper used economic data at the Local Authority District (LA) level to examine the impact of local labour markets on degree specialism. There are 432 LAs in England, Wales, Scotland and Northern Ireland, of which the 408 of Great Britain were included in the analysis. Measures of youth and adult unemployment and inactivity as well as employment and earnings growth by industry were incorporated. Earnings and

employment growth by industry were calculated relative to a fixed point three years prior to the student's university commencement. Thirdly, to control for endogenous residential selection, the earlier paper incorporated fixed effects for each postcode district of domicile. Controlling at this level involved the estimation of some 2,611 (2,646) fixed effects for males (females). Fixed effects for each school were incorporated in a similar way as in this paper.

The results of this earlier paper are shown in Appendix 2D, and are consistent with many of the findings presented here. Individual and academic characteristics are found to be similarly important and the magnitude of their impact on degree specialism is largely the same. The greatest differences between the papers arise from the estimated effects of wages and employment. While both papers find evidence that local economic variables have a statistically significant impact on degree choice, the results of the earlier paper suggest that these impacts are slightly larger. These disparities I attribute to three methodological differences. Firstly, the most obvious difference lies in the use of spatial scale – both of the explanatory variables and the fixed effects – and may reflect the well documented modifiable areal unit problem (Briant, Combes and Lafourcade 2008). By using travel to work areas, this paper offers a more rigorous examination of the 'local' labour markets with which student's would be familiar. In many parts of the country, LAs are too small and disregard the geography of economic activity.

Secondly, as more data became available the results of the later analysis should be more rigorous as they depend on larger samples. This may particularly affect the local economic variables as the methodology depends on changes over time for identification: using five cohorts instead of three involves more variation and should provide more robust results. Finally, this variation may have been significantly increased by the onset of the financial crisis in the more recent data, as economic conditions became more changeable across the labour market.

In addition to this sub-analysis, a series of checks were carried out to ensure that the results were not affected by the methodological constraints of the linear probability model. Logit models were estimated and compared to the first stage OLS results without fixed effects and the variables were introduced gradually to ensure that results are not dependent on co-linearities in the explanatory variables. These results are not reported for concision, while the first stage OLS results are shown in Appendix 2C.

However, perhaps the most serious risks associated with the results of this paper lie in the largely un-testable, maintained assumptions on which I depend for identification. As outlined in Section Three, the analysis is founded on a total of four maintained assumptions: (1) that the impact of selection into a particular school can be treated as a time-invariant effect, (2) that the impact of residential selection can be treated as a time-invariant effect, (3) that students make their choice of subject by comparing a particular degree specialism with the average for all other possible courses and (4) that unobserved individual attributes such as ability, are either (a) uncorrelated with the other explanatory variables or (b) perfectly captured by student performance at A-level. Of these, the third and fourth present the greatest risk to the parameter estimates. In the former case, students may only consider an inter-dependent subset of all possible degree courses which may render the parameter estimates presented here inconsistent. In the latter case, if unobserved ability – or some aspect of ability such as mathematical or musical ability – is correlated with other explanatory variables then parameter estimates may also be biased.

2.7 Conclusions

The primary objective of this paper is to examine the determinants of degree choice in the context of differences in local economic performance in the UK. Previous research

has suggested that gender and ethnicity, prior academic attainment and parental socio-economic class all affect an individual's decision to invest in human capital and that many of these same factors also affect the subject of study.

In this analysis a more detailed breakdown of subjects has been utilised than ever before and several forms of endogeneity are controlled for through the fixed effects estimation strategy. The results suggest that there are significant differences in subject choice between men and women and between people from different ethnic groups. Prior academic attainment is also an important determinant of subject choice: strongly suggesting that students who do not perform well at the end of their school careers make different (or perhaps constrained) decisions compared to the highest performers.

This analysis also suggests that socio-economic background contributes to the probability of taking some specific subjects. The evidence presented here is that students from particular socio-economic groups are more likely to do some subjects than others, but that the magnitude of these effects is small relative to other individual characteristics. The results support the notion that there are unobserved characteristics common to individuals within particular neighbourhoods and schools which may determine both where they choose to live and what they choose to study at university.

Taken together, the results of this study present several important conclusions for higher education policy and local economic development. Firstly, they suggest that students do respond to local labour market signals when choosing which subject to study at university. In particular, growing average wages appear to be associated with a higher probability of students taking more arts subjects, including History, Social Studies and Art & Music. However, after controlling for time-invariant characteristics of residence, the magnitude of all these effects is relatively small. While local wages do appear to play a role, it is the individual characteristics of students in a local area which

make the largest and most significant contribution to student choice of subject and therefore to the supply of individuals with different skills.

Secondly, while socio-economic group has a relatively small impact, the estimated effects strongly suggest that multiple layers of advantage tend to make particular subject choices additively more likely. Conversely, multiple layers of disadvantage tend to increase the probability of other choices. Well-qualified students, white students, students who were educated at Private schools and students who live in areas with growing average earnings appear more likely to take History or Languages, Linguistics & Classics degrees than students who are poorly qualified, ethnic minority students or from less prosperous areas, who are more likely to take Business Studies degrees. This result suggests that simply ensuring that every student has the means to study at university is not enough. Access to common and high standards of secondary schooling is a key enabler through which students will have a fair chance to study the subject to which they aspire.

Thirdly, the results suggest that in spite of the impact of these multiple layers of advantage, groups which have hitherto been under-represented in particular professions are gaining the qualifications they need to break into occupations dominated by particular genders or ethnic groups. All else equal, highly qualified male students from ethnic minorities are more likely to study Engineering or Mathematics than equivalently well-qualified white students, and highly qualified female students from ethnic minorities are more likely to study Medicine or Law than white female students. Research is needed to explore the extent to which these trends reflect different preferences over academic fields, relative to the impact of different rates of higher education participation between ethnic groups.

Finally, the results also have implications for the evolution of economic inequalities across the UK. Given the importance placed on improved educational

quality and choice as a means of reducing regional inequalities, the results are distinctly mixed. On one hand, they suggest that students do respond to labour market signals from around their domicile when choosing their degree subject and as a consequence, local industry may be helping to create the next generation of employees. On the other hand the relative weakness of these effects suggests that there is a signalling failure between local employers and students. The importance of individual level characteristics and strong patterns of migration among students (Abreu, Faggian and McCann 2010) suggest that local industry in many parts of the country is failing to inspire students to study for employment. Further research is needed to examine how the skills acquired are being used, where they are being used and whether local industry can more effectively attract and inspire young people in their subject and later career choices.

2A Appendix A: Classifications

Table A.1: Classification of Industries[1]

Industry	*SIC2003 Code*
Agriculture, hunting and forestry, & Fishing	A & B
Mining and quarrying	C
Manufacturing	D
Electricity, gas and water supply	E
Construction	F
Wholesale and retail trade	G
Hotels and restaurants	H
Transport, storage and communication	I
Financial intermediation	J
Real estate, renting and business activities	K
Public administration and defence	L
Education	M

Note(s): (1) Listings available at www.ons.gov.uk

Table A.2: 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

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

2B Appendix: Table B.1: Males[1, 2, 3, 11]

		Medicine & Dent.		*Medicine Related*		*Biological Science*		*Veterinary Science*		*Physical Science*		*Mathematics*		*Engineering*	
Age[4]		**0.018*** **	(0.001)	**0.003*** **	(0.001)	**-0.015*** **	(0.002)	**0.002*** **	(0.000)	**-0.004*** **	(0.001)	**-0.011*** **	(0.001)	**0.021*** **	(0.002)
Ethnicity	Black	**0.017*** **	(0.002)	**0.042*** **	(0.003)	-0.005*	(0.003)	**-0.004*** **	(0.000)	**-0.038*** **	(0.004)	0.001	(0.003)	**0.031*** **	(0.003)
	Asian	**0.043*** **	(0.002)	**0.067*** **	(0.004)	**-0.033*** **	(0.003)	**-0.005*** **	(0.001)	**-0.041*** **	(0.003)	**0.075*** **	(0.007)	**0.010** **	(0.004)
	Other	**0.021*** **	(0.002)	**0.021*** **	(0.002)	0.003	(0.003)	**-0.003*** **	(0.001)	**-0.021*** **	(0.003)	**0.011** **	(0.005)	0.005	(0.003)
	Unknown	0.003	(0.003)	0.005	(0.003)	**-0.032*** **	(0.004)	-0.001	(0.001)	-0.007	(0.006)	0.007	(0.006)	**-0.011** **	(0.005)
Disability		**-0.003*** **	(0.001)	0.002*	(0.001)	0.002	(0.003)	0.002*	(0.001)	**0.012*** **	(0.003)	0.000	(0.003)	-0.001	(0.003)
Parental Occ.	Lower Manag. & Prof.	**-0.012*** **	(0.001)	**-0.004*** **	(0.001)	**0.005*** **	(0.002)	0.000	(0.000)	**-0.006*** **	(0.002)	**-0.006*** **	(0.002)	**-0.008*** **	(0.001)
	Intermediate	**-0.012*** **	(0.001)	**-0.004*** **	(0.001)	**0.004** **	(0.002)	0.000	(0.000)	-0.002	(0.002)	0.002	(0.002)	-0.003	(0.002)
	Small Employers	**-0.015*** **	(0.001)	-0.002	(0.002)	0.003	(0.003)	**0.018*** **	(0.003)	**-0.010*** **	(0.003)	-0.004	(0.003)	0.002	(0.003)
	Lower Super. & Tech.	**-0.012*** **	(0.001)	-0.001	(0.002)	**0.010*** **	(0.003)	0.000	(0.001)	-0.002	(0.003)	**0.013** **	(0.005)	**0.015*** **	(0.004)
	Semi-routine	**-0.015*** **	(0.001)	-0.003*	(0.002)	**0.005** **	(0.002)	0.000	(0.001)	-0.003	(0.002)	**0.012*** **	(0.003)	**0.011*** **	(0.003)
	Routine, Unemp.	**-0.012*** **	(0.001)	0.000	(0.002)	0.005	(0.003)	0.000	(0.001)	-0.001	(0.003)	0.004	(0.004)	-0.006*	(0.003)
	Unknown	**-0.012*** **	(0.001)	**-0.004*** **	(0.001)	0.004*	(0.002)	0.000	(0.000)	-0.003*	(0.002)	0.000	(0.002)	-0.003	(0.002)
School Results[5]	4th Quartile	**-0.018*** **	(0.001)	**-0.023*** **	(0.002)	**0.028*** **	(0.002)	**0.003*** **	(0.001)	**-0.026*** **	(0.002)	**0.025*** **	(0.003)	**-0.012*** **	(0.003)
	3rd Quartile	**-0.015*** **	(0.001)	**-0.008*** **	(0.001)	**0.016*** **	(0.002)	**0.002*** **	(0.001)	**-0.006*** **	(0.002)	0.000	(0.002)	**-0.012*** **	(0.002)
	Top Quartile	**0.031*** **	(0.001)	0.002*	(0.001)	**-0.024*** **	(0.002)	0.000	(0.000)	**0.021*** **	(0.002)	**0.046*** **	(0.003)	**0.010*** **	(0.002)
Economic Effects[6]	Youth Unemp.[7]	0.005	(0.007)	-0.003	(0.004)	**0.030*** **	(0.008)	0.001	(0.002)	**-0.019*** **	(0.007)	**-0.031*** **	(0.009)	**-0.054*** **	(0.01)
	Mean FT Earnings[8]	**-0.460*** **	(0.049)	0.029*	(0.017)	**0.343*** **	(0.032)	**-0.040*** **	(0.009)	**-0.190*** **	(0.026)	**-0.262*** **	(0.040)	**-0.709*** **	(0.056)
	Working Age Pop.[9]	**-0.888*** **	(0.154)	0.069	(0.052)	**0.556*** **	(0.132)	0.019	(0.024)	**-0.228*** **	(0.082)	**-0.596*** **	(0.183)	**-1.042*** **	(0.225)
Emp. by Ind.[6, 10]	Agric., Fish., Mining.	0.001	(0.003)	**-0.005** **	(0.002)	0.006	(0.004)	0.000	(0.001)	-0.003	(0.004)	**-0.014*** **	(0.005)	**-0.018*** **	(0.006)
	Manufacturing	**0.098*** **	(0.019)	0.006	(0.007)	**-0.074*** **	(0.013)	0.001	(0.004)	**0.034*** **	(0.012)	**0.067*** **	(0.016)	**0.100*** **	(0.026)
	Elect., Gas, Water	**0.000*** **	(0.000)	**0.000*** **	(0.000)	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)	**0.000*** **	(0.000)	0.000	(0.000)
	Construction	0.002	(0.007)	0.005	(0.004)	-0.001	(0.007)	0.001	(0.002)	-0.012*	(0.006)	-0.010	(0.009)	0.000	(0.010)
	Wholesale, Retail	0.001	(0.019)	-0.004	(0.010)	**-0.052** **	(0.023)	0.007	(0.006)	**0.047** **	(0.019)	0.030	(0.026)	**0.121*** **	(0.030)
	Hotels, Restaurants	**-0.022*** **	(0.008)	**-0.010** **	(0.004)	**0.016** **	(0.008)	-0.004*	(0.002)	0.006	(0.008)	**-0.021** **	(0.009)	-0.010	(0.012)
	Transport, Comms.	**0.018** **	(0.009)	-0.007*	(0.004)	-0.015*	(0.008)	-0.001	(0.002)	0.003	(0.008)	0.014	(0.009)	**0.027** **	(0.012)
	Business Activities	**-0.035*** **	(0.009)	-0.002	(0.004)	**0.019** **	(0.009)	**-0.005** **	(0.002)	-0.012*	(0.007)	**-0.022** **	(0.009)	**-0.067*** **	(0.01)
	Public Admin., Def.	0.000	(0.007)	-0.005	(0.004)	0.005	(0.008)	0.003	(0.002)	0.001	(0.006)	-0.015*	(0.008)	-0.015	(0.009)
	Education	**-0.047*** **	(0.011)	0.002	(0.006)	0.017*	(0.010)	-0.001	(0.003)	**-0.016** **	(0.008)	**-0.024** **	(0.012)	**-0.048*** **	(0.013)
	Health, Social Work	**-0.088*** **	(0.016)	0.003	(0.007)	**0.044*** **	(0.015)	-0.015	(0.009)	-0.013	(0.013)	**-0.075*** **	(0.017)	**-0.123*** **	(0.027)
Controls	School, Domicile, Year	YES:(4,127), (297), (5)		YES:(4,127), (297), (5)		YES:(4,127), (297), (5)		YES:(4,127), (297), (5)		YES:(4,127), (297), (5)		YES:(4,127), (297), (5)		YES:(4,127), (297), (5)	

Notes: (1) Dep. Var. takes a value one if student chooses a given subject, zero o/w. (2) Standard errors (in brackets) are clustered at the TTWA level. (3) Subjects defined at the single digit JACS level – See Appendix 2A for details. (4) These variables are quasi-continuous. (5) School results are split into cohort quartiles based on the UCAS tariff point score obtained. The best performing students in each cohort appear in the Top Quartile. (6) These variables are defined at the TTWA level. (7) Youth Unemp. is defined as the number of 18-24 year old males/females who are claiming the Job-Seekers Allowance. (8) Average FT Earnings are defined as the average hourly earnings of males/females in FT employment. (9) Working Age Pop. is defined as the number of people aged 16-retirement, allowing for different retirement ages of men and women. (10) Emp. by Industry variables are the number of FT employees in each sector. See Appendix 2A for industrial classification. (11) *, ** and *** indicate significance at the 10%, 5% and 1% levels respectively. All regressions include 255,591 observations.

2B Appendix: Table B.1 (Cont): Males[1, 2, 3, 11]

		Mineral Tech.		*Architecture*		*Social Studies*		*Law*		*Business Studies*		*Communications*		*Lang, Ling & Class*	
Age[4]		**0.001*** **	(0.000)	**0.002*** **	(0.001)	**-0.009*** **	(0.001)	**-0.010*** **	(0.001)	0.001	(0.001)	**-0.003*** **	(0.001)	**-0.002*** **	(0.001)
Ethnicity	Black	**-0.004** **	(0.001)	**-0.009*** **	(0.002)	**0.007** **	(0.003)	**0.053*** **	(0.005)	**0.058*** **	(0.004)	**-0.007*** **	(0.002)	**-0.023*** **	(0.002)
	Asian	**-0.003*** **	(0.001)	**-0.008*** **	(0.001)	0.001	(0.003)	**0.031*** **	(0.005)	**0.070*** **	(0.004)	**-0.023*** **	(0.002)	**-0.032*** **	(0.003)
	Other	0.000	(0.001)	**-0.006*** **	(0.002)	**0.009** **	(0.004)	**0.019*** **	(0.003)	**0.009** **	(0.005)	-0.004*	(0.002)	**-0.011*** **	(0.002)
	Unknown	0.001	(0.002)	-0.005*	(0.003)	**0.016*** **	(0.005)	**0.009*** **	(0.003)	-0.003	(0.006)	0.000	(0.003)	**0.015*** **	(0.005)
Disability		0.001	(0.001)	0.001	(0.002)	-0.002	(0.004)	**-0.005*** **	(0.002)	**-0.026*** **	(0.003)	-0.001	(0.002)	**-0.005*** **	(0.002)
Parental Occ.	Lower Manag. & Prof.	0.000	(0.001)	**-0.003*** **	(0.001)	-0.001	(0.002)	-0.002	(0.001)	**0.015*** **	(0.002)	**0.006*** **	(0.001)	**0.005*** **	(0.001)
	Intermediate	0.000	(0.001)	**-0.006*** **	(0.001)	0.002	(0.002)	-0.003*	(0.002)	**0.011*** **	(0.002)	**0.005*** **	(0.001)	0.001	(0.001)
	Small Employers	**-0.003*** **	(0.001)	**0.008*** **	(0.002)	**-0.012*** **	(0.002)	-0.001	(0.002)	**0.019*** **	(0.003)	0.003*	(0.001)	0.000	(0.002)
	Lower Super. & Tech.	0.000	(0.001)	**0.006*** **	(0.002)	**-0.014*** **	(0.003)	-0.002	(0.002)	0.007	(0.004)	0.000	(0.002)	**-0.004** **	(0.002)
	Semi-routine	0.000	(0.001)	**-0.004*** **	(0.001)	**-0.011*** **	(0.003)	**-0.007*** **	(0.002)	0.005	(0.005)	**0.007*** **	(0.002)	**0.003** **	(0.002)
	Routine, Unemp.	**-0.002** **	(0.001)	**-0.005*** **	(0.002)	-0.004	(0.003)	-0.004	(0.002)	**0.013*** **	(0.004)	0.004	(0.002)	0.003*	(0.002)
	Unknown	0.000	(0.001)	-0.001	(0.001)	**-0.009*** **	(0.003)	0.000	(0.002)	**0.009*** **	(0.002)	**0.007*** **	(0.001)	0.002	(0.002)
School Results[5]	4th Quartile	**0.011*** **	(0.001)	**0.015*** **	(0.001)	**-0.038*** **	(0.003)	**-0.034*** **	(0.002)	**0.078*** **	(0.005)	**0.014*** **	(0.001)	**-0.022*** **	(0.001)
	3rd Quartile	**0.006*** **	(0.001)	**0.011*** **	(0.001)	**-0.014*** **	(0.002)	**-0.017*** **	(0.001)	**0.038*** **	(0.003)	**0.011*** **	(0.001)	**-0.012*** **	(0.001)
	Top Quartile	**-0.003*** **	(0.000)	**-0.008*** **	(0.002)	-0.003	(0.003)	**0.021*** **	(0.003)	**-0.056*** **	(0.002)	**-0.011*** **	(0.001)	**0.006*** **	(0.002)
Economic Effects[6]	Youth Unemp.[7]	**-0.007*** **	(0.002)	-0.006	(0.004)	**0.028*** **	(0.009)	**0.009** **	(0.005)	**-0.029*** **	(0.007)	**0.016*** **	(0.004)	**0.012*** **	(0.004)
	Mean FT Earnings[8]	-0.011	(0.013)	**-0.076*** **	(0.018)	**0.465*** **	(0.045)	**0.173*** **	(0.023)	**-0.079** **	(0.031)	**0.139*** **	(0.018)	**0.136*** **	(0.020)
	Working Age Pop.[9]	0.009	(0.025)	**-0.106** **	(0.052)	**0.608*** **	(0.187)	**0.254*** **	(0.07)	**-0.205** **	(0.101)	**0.214*** **	(0.062)	**0.367*** **	(0.074)
Emp. by Ind.[6, 10]	Agric., Fish., Mining.	0.000	(0.001)	-0.001	(0.002)	**0.012** **	(0.006)	0.004	(0.002)	-0.006	(0.004)	**0.006*** **	(0.002)	0.005*	(0.003)
	Manufacturing	0.003	(0.003)	0.012*	(0.007)	**-0.083*** **	(0.024)	**-0.023** **	(0.01)	-0.014	(0.013)	**-0.026*** **	(0.008)	**-0.034*** **	(0.008)
	Elect., Gas, Water	0.000	(0.000)	0.000	(0.000)	**0.000*** **	(0.000)	0.000	(0.000)	**0.000*** **	(0.000)	0.000	(0.000)	**0.000*** **	(0.000)
	Construction	0.002	(0.002)	-0.001	(0.003)	-0.008	(0.009)	0.008	(0.005)	0.009	(0.007)	**0.007** **	(0.003)	0.001	(0.004)
	Wholesale, Retail	-0.001	(0.006)	0.014	(0.01)	**-0.054** **	(0.026)	-0.024*	(0.014)	0.033	(0.023)	-0.023*	(0.012)	**-0.024** **	(0.012)
	Hotels, Restaurants	-0.001	(0.002)	0.005	(0.004)	0.006	(0.009)	0.005	(0.006)	-0.002	(0.009)	**0.014*** **	(0.005)	-0.001	(0.005)
	Transport, Comms.	-0.004*	(0.002)	-0.001	(0.004)	-0.007	(0.009)	-0.002	(0.005)	**0.016** **	(0.007)	-0.005	(0.004)	-0.007	(0.005)
	Business Activities	**0.005** **	(0.002)	-0.002	(0.005)	**0.034*** **	(0.009)	**0.015*** **	(0.005)	-0.001	(0.008)	0.008*	(0.005)	**0.017*** **	(0.005)
	Public Admin., Def.	-0.001	(0.002)	0.001	(0.003)	0.015*	(0.008)	0.000	(0.005)	-0.001	(0.008)	-0.001	(0.004)	**0.009** **	(0.004)
	Education	**-0.007** **	(0.003)	-0.001	(0.005)	**0.051*** **	(0.011)	0.015*	(0.008)	-0.005	(0.011)	**0.012** **	(0.005)	0.007	(0.007)
	Health, Social Work	0.000	(0.004)	0.013*	(0.007)	**0.069*** **	(0.020)	**0.032*** **	(0.010)	0.003	(0.014)	**0.030*** **	(0.009)	**0.026*** **	(0.009)
Controls	School, Domicile, Year	YES:(4,127), (297), (5)		YES:(4,127), (297), (5)		YES:(4,127), (297), (5)		YES:(4,127), (297), (5)		YES:(4,127), (297), (5)		YES:(4,127), (297), (5)		YES:(4,127), (297), (5)	

Notes: (1) Dep. Var. takes a value one if student chooses a given subject, zero o/w. (2) Standard errors (in brackets) are clustered at the TTWA level. (3) Subjects defined at the single digit JACS level – See Appendix 2A for details. (4) These variables are quasi-continuous. (5) School results are split into cohort quartiles based on the UCAS tariff point score obtained. The best performing students in each cohort appear in the Top Quartile. (6) These variables are defined at the TTWA level. (7) Youth Unemp. is defined as the number of 18-24 year old males/females who are claiming the Job-Seekers Allowance. (8) Average FT Earnings are defined as the average hourly earnings of males/females in FT employment. (9) Working Age Pop. is defined as the number of people aged 16-retirement, allowing for different retirement ages of men and women. (10) Emp. by Industry variables are the number of FT employees in each sector. See Appendix 2A for industrial classification. (11) *, ** and *** indicate significance at the 10%, 5% and 1% levels respectively. All regressions include 255,591 observations.

2B Appendix: Table B.1 (Cont.): Males[1, 2, 3, 11]

		Euro. Languages		*Other Languages*		*History*		*Art & Music*		*Education*		*Combined*	
Age[4]		**0.006*** **	(0.000)	**0.002*** **	(0.000)	**-0.009*** **	(0.001)	**0.004*** **	(0.001)	0.000	(0.000)	**0.000** **	(0.000)
Ethnicity	Black	**-0.009*** **	(0.002)	**-0.003*** **	(0.001)	**-0.058*** **	(0.006)	**-0.041*** **	(0.003)	**-0.007*** **	(0.001)	0.000	(0.000)
	Asian	**-0.013*** **	(0.001)	**-0.004*** **	(0.001)	**-0.064*** **	(0.006)	**-0.060*** **	(0.002)	**-0.008*** **	(0.001)	-0.001	(0.000)
	Other	-0.005*	(0.002)	0.001	(0.001)	**-0.031*** **	(0.004)	**-0.014*** **	(0.002)	**-0.004*** **	(0.001)	-0.001	(0.000)
	Unknown	0.000	(0.002)	0.001	(0.001)	**0.020*** **	(0.008)	**-0.014*** **	(0.004)	**-0.003*** **	(0.001)	0.000	(0.001)
Disability		**-0.005*** **	(0.001)	-0.001*	(0.001)	0.006*	(0.003)	**0.024*** **	(0.002)	-0.001	(0.001)	-0.001	(0.000)
Parental Occ.	Lower Manag. & Prof.	0.001*	(0.001)	0.000	(0.000)	0.002	(0.002)	**0.006*** **	(0.001)	0.001	(0.000)	**0.001** **	(0.000)
	Intermediate	0.001	(0.001)	**-0.001** **	(0.000)	0.000	(0.002)	0.002	(0.002)	**0.003*** **	(0.001)	0.000	(0.000)
	Small Employers	-0.001	(0.001)	-0.001	(0.001)	**-0.010*** **	(0.003)	**0.006** **	(0.003)	**0.002** **	(0.001)	**-0.001*** **	(0.000)
	Lower Super. & Tech.	**-0.002** **	(0.001)	**-0.001** **	(0.001)	**-0.010*** **	(0.003)	-0.005*	(0.003)	**0.003*** **	(0.001)	-0.001	(0.000)
	Semi-routine	0.001	(0.001)	**-0.001** **	(0.000)	**-0.006*** **	(0.002)	0.004*	(0.002)	**0.003*** **	(0.001)	0.000	(0.000)
	Routine, Unemp.	0.001	(0.001)	-0.001	(0.001)	0.000	(0.003)	0.002	(0.003)	**0.004*** **	(0.001)	-0.001	(0.001)
	Unknown	0.000	(0.001)	0.000	(0.000)	**-0.004** **	(0.002)	**0.012*** **	(0.002)	0.001	(0.001)	0.000	(0.000)
School Results[5]	4th Quartile	**-0.007*** **	(0.001)	**-0.002*** **	(0.000)	**-0.037*** **	(0.003)	**0.032*** **	(0.002)	**0.013*** **	(0.001)	0.000	(0.000)
	3rd Quartile	**-0.003*** **	(0.001)	0.000	(0.000)	**-0.019*** **	(0.002)	**0.017*** **	(0.002)	**0.006*** **	(0.001)	0.001	(0.000)
	Top Quartile	**-0.003*** **	(0.001)	**-0.002*** **	(0.000)	-0.005	(0.004)	**-0.016*** **	(0.002)	**-0.004*** **	(0.001)	0.000	(0.000)
Economic Effects[6]	Youth Unemp.[7]	**-0.013*** **	(0.003)	-0.002*	(0.001)	**0.038*** **	(0.006)	**0.026*** **	(0.006)	0.000	(0.002)	-0.001	(0.001)
	Mean FT Earnings[8]	**-0.136*** **	(0.017)	**-0.022*** **	(0.005)	**0.372*** **	(0.036)	**0.286*** **	(0.027)	**0.038*** **	(0.008)	0.005	(0.004)
	Working Age Pop.[9]	**-0.226*** **	(0.061)	**-0.037** **	(0.017)	**0.636*** **	(0.130)	**0.494*** **	(0.093)	**0.076** **	(0.029)	0.025*	(0.014)
Emp. by Ind.[6, 10]	Agric., Fish., Mining.	**-0.006*** **	(0.002)	-0.001	(0.001)	**0.009** **	(0.004)	**0.010*** **	(0.003)	0.001	(0.001)	0.000	(0.000)
	Manufacturing	**0.025*** **	(0.008)	0.003	(0.002)	**-0.050*** **	(0.017)	**-0.043*** **	(0.012)	-0.003	(0.004)	0.002	(0.002)
	Elect., Gas, Water	**0.000*** **	(0.000)	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)
	Construction	0.000	(0.003)	0.000	(0.001)	0.007	(0.007)	-0.006	(0.006)	-0.003	(0.002)	0.000	(0.001)
	Wholesale, Retail	**0.029*** **	(0.008)	0.004	(0.004)	**-0.053** **	(0.021)	**-0.056*** **	(0.017)	0.007	(0.006)	-0.001	(0.003)
	Hotels, Restaurants	-0.002	(0.003)	**-0.003** **	(0.002)	0.010	(0.008)	0.013*	(0.007)	0.001	(0.002)	0.001	(0.001)
	Transport, Comms.	-0.001	(0.003)	0.003*	(0.001)	-0.015*	(0.008)	-0.010	(0.007)	-0.005*	(0.002)	-0.001	(0.001)
	Business Activities	**-0.009*** **	(0.003)	-0.002	(0.001)	**0.027*** **	(0.007)	**0.025*** **	(0.007)	0.005*	(0.002)	0.002	(0.001)
	Public Admin., Def.	-0.003	(0.003)	-0.001	(0.001)	-0.007	(0.008)	**0.015*** **	(0.006)	-0.001	(0.002)	0.001	(0.001)
	Education	-0.004	(0.004)	0.000	(0.002)	**0.020** **	(0.010)	**0.028*** **	(0.009)	0.000	(0.003)	0.001	(0.001)
	Health, Social Work	**-0.019*** **	(0.006)	**-0.004** **	(0.002)	**0.049*** **	(0.015)	**0.068*** **	(0.012)	-0.001	(0.004)	0.002	(0.002)
Controls	School, Domicile, Year	YES:(4,127), (297), (5)		YES:(4,127), (297), (5)		YES:(4,127), (297), (5)		YES:(4,127), (297), (5)		YES:(4,127), (297), (5)		YES:(4,127), (297), (5)	

Notes: (1) Dep. Var. takes a value one if student chooses a given subject, zero o/w. (2) Standard errors (in brackets) are clustered at the TTWA level. (3) Subjects defined at the single digit JACS level – See Appendix 2A for details. (4) These variables are quasi-continuous. (5) School results are split into cohort quartiles based on the UCAS tariff point score obtained. The best performing students in each cohort appear in the Top Quartile. (6) These variables are defined at the TTWA level. (7) Youth Unemp. is defined as the number of 18-24 year old males/females who are claiming the Job-Seekers Allowance. (8) Average FT Earnings are defined as the average hourly earnings of males/females in FT employment. (9) Working Age Pop. is defined as the number of people aged 16-retirement, allowing for different retirement ages of men and women. (10) Emp. by Industry variables are the number of FT employees in each sector. See Appendix 2A for industrial classification. (11) *, ** and *** indicate significance at the 10%, 5% and 1% levels respectively. All regressions include 255,591 observations.

2B Appendix: Table B.2: Females[1, 2, 3, 11]

		Medicine & Dent.		*Medicine Related*		*Biological Science*		*Veterinary Science*		*Physical Science*		*Mathematics*		*Engineering*	
Age[4]		**0.028*** **	(0.002)	**0.013*** **	(0.001)	**-0.022*** **	(0.001)	**0.005*** **	(0.001)	**-0.001** **	(0.001)	**-0.002*** **	(0.001)	**0.004*** **	(0.000)
Ethnicity	Black	**0.017*** **	(0.001)	**0.046*** **	(0.002)	**-0.018*** **	(0.003)	**-0.009*** **	(0.001)	**-0.019*** **	(0.002)	**0.005** **	(0.002)	**0.012*** **	(0.001)
	Asian	**0.037*** **	(0.002)	**0.071*** **	(0.005)	**-0.023*** **	(0.004)	**-0.011*** **	(0.001)	**-0.019*** **	(0.002)	**0.045*** **	(0.004)	**0.007*** **	(0.001)
	Other	**0.017*** **	(0.002)	**0.008*** **	(0.003)	-0.006*	(0.003)	**-0.006*** **	(0.001)	**-0.017*** **	(0.002)	0.003	(0.002)	**0.003*** **	(0.001)
	Unknown	0.001	(0.003)	-0.004	(0.004)	-0.009	(0.007)	**-0.007*** **	(0.002)	-0.002	(0.003)	0.006	(0.004)	0.003*	(0.002)
Disability		**-0.006*** **	(0.001)	0.001	(0.002)	0.003	(0.003)	-0.001	(0.001)	**0.009*** **	(0.002)	0.000	(0.001)	**0.002** **	(0.001)
Parental Occ.	Lower Manag. & Prof.	**-0.014*** **	(0.001)	**-0.006*** **	(0.001)	**-0.004** **	(0.002)	**-0.002*** **	(0.001)	**-0.004*** **	(0.001)	-0.001	(0.001)	**-0.002*** **	(0.001)
	Intermediate	**-0.012*** **	(0.001)	-0.003	(0.002)	**0.006** **	(0.003)	**-0.002*** **	(0.001)	0.000	(0.001)	0.002*	(0.001)	-0.001	(0.001)
	Small Employers	**-0.017*** **	(0.001)	-0.003	(0.003)	0.005*	(0.003)	**0.007*** **	(0.002)	**-0.003** **	(0.002)	-0.001	(0.001)	**-0.002*** **	(0.001)
	Lower Super. & Tech.	**-0.012*** **	(0.001)	**0.007** **	(0.003)	0.007*	(0.004)	0.000	(0.001)	**0.004** **	(0.002)	0.001	(0.002)	0.000	(0.001)
	Semi-routine	**-0.016*** **	(0.001)	-0.005*	(0.003)	**0.007*** **	(0.002)	-0.002*	(0.001)	0.002	(0.002)	0.004*	(0.002)	0.001	(0.001)
	Routine, Unemp.	**-0.018*** **	(0.001)	**-0.006** **	(0.003)	0.005	(0.004)	**-0.002*** **	(0.001)	-0.003	(0.002)	0.002	(0.002)	-0.001	(0.001)
	Unknown	**-0.014*** **	(0.002)	**-0.008*** **	(0.002)	0.000	(0.002)	**-0.002*** **	(0.001)	**-0.004*** **	(0.001)	0.001	(0.001)	**-0.001** **	(0.001)
School Results[5]	4th Quartile	**-0.018*** **	(0.001)	**-0.019*** **	(0.002)	**-0.026*** **	(0.003)	**0.007*** **	(0.001)	**-0.005*** **	(0.001)	0.000	(0.002)	-0.001*	(0.001)
	3rd Quartile	**-0.016*** **	(0.001)	0.003*	(0.002)	**-0.006** **	(0.003)	**0.002*** **	(0.001)	**-0.003** **	(0.001)	**-0.004*** **	(0.001)	**-0.001** **	(0.000)
	Top Quartile	**0.040*** **	(0.002)	**-0.012*** **	(0.002)	**-0.021*** **	(0.002)	**0.003*** **	(0.001)	**0.007*** **	(0.001)	**0.027*** **	(0.002)	**0.004*** **	(0.001)
Economic Effects[6]	Youth Unemp.[7]	-0.007	(0.009)	**-0.014*** **	(0.005)	**0.022*** **	(0.007)	0.002	(0.002)	-0.005	(0.004)	-0.002	(0.003)	**-0.005** **	(0.002)
	Mean FT Earnings[8]	**-0.717*** **	(0.067)	-0.051*	(0.028)	**0.402*** **	(0.039)	**-0.101*** **	(0.013)	**-0.068*** **	(0.020)	**-0.036** **	(0.014)	**-0.091*** **	(0.011)
	Working Age Pop.[9]	**-1.247*** **	(0.24)	-0.074	(0.104)	**0.773*** **	(0.135)	**-0.169*** **	(0.040)	**-0.122** **	(0.057)	-0.081*	(0.046)	**-0.137*** **	(0.040)
Emp. by Ind.[6, 10]	Agric., Fish., Mining.	-0.002	(0.005)	**-0.013*** **	(0.003)	0.008*	(0.004)	0.000	(0.001)	0.000	(0.003)	-0.002	(0.002)	**-0.003** **	(0.001)
	Manufacturing	**0.144*** **	(0.028)	0.014	(0.011)	**-0.046*** **	(0.017)	0.007	(0.004)	0.013*	(0.008)	0.007	(0.005)	**0.017*** **	(0.005)
	Elect., Gas, Water	**0.000*** **	(0.000)	0.000	(0.000)	**0.000*** **	(0.000)	0.000	(0.000)	0.000	(0.000)	**0.000*** **	(0.000)	0.000	(0.000)
	Construction	0.001	(0.011)	-0.006	(0.006)	-0.008	(0.008)	-0.002	(0.002)	0.000	(0.005)	0.003	(0.004)	-0.003	(0.002)
	Wholesale, Retail	0.000	(0.031)	0.024	(0.018)	**-0.058** **	(0.024)	0.006	(0.008)	**0.030** **	(0.012)	0.012	(0.010)	**0.014** **	(0.007)
	Hotels, Restaurants	**-0.027** **	(0.011)	0.000	(0.007)	0.008	(0.009)	**-0.005** **	(0.003)	**-0.012** **	(0.005)	0.003	(0.004)	-0.003	(0.002)
	Transport, Comms.	0.018	(0.012)	-0.001	(0.007)	-0.002	(0.008)	0.004	(0.003)	-0.004	(0.005)	0.001	(0.003)	0.002	(0.002)
	Business Activities	**-0.058*** **	(0.013)	-0.009	(0.007)	**0.026** **	(0.010)	**-0.007** **	(0.003)	-0.005	(0.006)	0.000	(0.004)	**-0.007*** **	(0.002)
	Public Admin., Def.	-0.004	(0.011)	-0.005	(0.006)	0.006	(0.009)	-0.001	(0.003)	0.002	(0.004)	-0.001	(0.004)	-0.003	(0.002)
	Education	**-0.065*** **	(0.015)	0.008	(0.010)	0.010	(0.011)	**-0.008** **	(0.003)	-0.005	(0.008)	-0.008*	(0.004)	**-0.006** **	(0.003)
	Health, Social Work	**-0.147*** **	(0.025)	-0.003	(0.013)	**0.051*** **	(0.016)	**-0.025*** **	(0.009)	-0.013	(0.009)	-0.008	(0.006)	**-0.020*** **	(0.005)
Controls	School, Domicile, Year	YES:(4,459), (297), (5)		YES:(4,459), (297), (5)		YES:(4,459), (297), (5)		YES:(4,459), (297), (5)		YES:(4,459), (297), (5)		YES:(4,459), (297), (5)		YES:(4,459), (297), (5)	

Notes: (1) Dep. Var. takes a value one if student chooses a given subject, zero o/w. (2) Standard errors (in brackets) are clustered at the TTWA level. (3) Subjects defined at the single digit JACS level – See Appendix 2A for details. (4) These variables are quasi-continuous. (5) School results are split into cohort quartiles based on the UCAS tariff point score obtained. The best performing students in each cohort appear in the Top Quartile. (6) These variables are defined at the TTWA level. (7) Youth Unemp. is defined as the number of 18-24 year old males/females who are claiming the Job-Seekers Allowance. (8) Average FT Earnings are defined as the average hourly earnings of males/females in FT employment. (9) Working Age Pop. is defined as the number of people aged 16-retirement, allowing for different retirement ages of men and women. (10) Emp. by Industry variables are the number of FT employees in each sector. See Appendix 2A for industrial classification. (11) *, ** and *** indicate significance at the 10%, 5% and 1% levels respectively. All regressions include 318,621 observations.

2B Appendix: Table B.2 (Cont): Females[1, 2, 3, 11]

		Mineral Tech.		*Architecture*		*Social Studies*		*Law*		*Business Studies*		*Communications*		*Lang, Ling & Class*	
Age[4]		**0.001*** **	(0.000)	0.000	(0.000)	**-0.007*** **	(0.001)	**-0.016*** **	(0.001)	**0.004*** **	(0.001)	**-0.007*** **	(0.001)	**-0.009*** **	(0.001)
Ethnicity	Black	0.001	(0.001)	0.002*	(0.001)	**0.024*** **	(0.004)	**0.096*** **	(0.002)	**0.050*** **	(0.003)	0.004	(0.002)	**-0.049*** **	(0.005)
	Asian	**0.002** **	(0.001)	**0.003*** **	(0.001)	-0.003	(0.003)	**0.068*** **	(0.008)	**0.067*** **	(0.004)	**-0.019*** **	(0.001)	**-0.043*** **	(0.005)
	Other	**0.002*** **	(0.001)	0.003*	(0.001)	0.004	(0.004)	**0.037*** **	(0.005)	0.005*	(0.003)	**0.006*** **	(0.002)	-0.004	(0.003)
	Unknown	0.000	(0.001)	-0.001	(0.001)	0.003	(0.006)	**0.021*** **	(0.005)	-0.001	(0.005)	**0.011*** **	(0.004)	0.009	(0.006)
Disability		0.001	(0.001)	**0.002*** **	(0.001)	0.001	(0.003)	**-0.010*** **	(0.002)	**-0.028*** **	(0.003)	**-0.004** **	(0.002)	**-0.006*** **	(0.002)
Parental Occ.	Lower Manag. & Prof.	**0.001*** **	(0.000)	**-0.002** **	(0.001)	**0.004*** **	(0.001)	**-0.003** **	(0.001)	**0.008*** **	(0.001)	**0.006*** **	(0.001)	**0.004*** **	(0.001)
	Intermediate	0.000	(0.000)	**-0.002*** **	(0.001)	0.001	(0.002)	-0.002	(0.002)	**0.006*** **	(0.001)	0.001	(0.001)	0.000	(0.002)
	Small Employers	0.001	(0.001)	0.001	(0.001)	**-0.005** **	(0.002)	0.001	(0.002)	**0.021*** **	(0.003)	0.001	(0.001)	-0.001	(0.002)
	Lower Super. & Tech.	0.000	(0.001)	-0.001	(0.001)	**-0.008*** **	(0.003)	-0.005*	(0.002)	**0.014*** **	(0.003)	0.000	(0.002)	**-0.005** **	(0.002)
	Semi-routine	0.000	(0.000)	**-0.003*** **	(0.001)	0.001	(0.002)	**-0.004** **	(0.002)	**0.009*** **	(0.002)	-0.001	(0.001)	0.000	(0.002)
	Routine, Unemp.	0.000	(0.001)	**-0.003*** **	(0.001)	0.002	(0.003)	0.003	(0.003)	**0.017*** **	(0.003)	0.000	(0.002)	0.000	(0.002)
	Unknown	0.000	(0.000)	**-0.002*** **	(0.001)	0.001	(0.002)	**0.006*** **	(0.002)	**0.013*** **	(0.002)	**0.004*** **	(0.001)	**-0.004** **	(0.002)
School Results[5]	4th Quartile	**0.003*** **	(0.000)	**-0.001*** **	(0.001)	**0.019*** **	(0.003)	**-0.039*** **	(0.003)	**0.072*** **	(0.006)	**0.017*** **	(0.001)	**-0.040*** **	(0.002)
	3rd Quartile	**0.002*** **	(0.000)	0.000	(0.001)	**0.010*** **	(0.001)	**-0.022*** **	(0.001)	**0.031*** **	(0.002)	**0.014*** **	(0.001)	**-0.024*** **	(0.002)
	Top Quartile	**-0.002*** **	(0.000)	0.001*	(0.001)	**-0.013*** **	(0.002)	**0.029*** **	(0.003)	**-0.029*** **	(0.002)	**-0.014*** **	(0.001)	**0.018*** **	(0.003)
Economic Effects[6]	Youth Unemp.[7]	-0.002*	(0.001)	-0.001	(0.002)	**0.018** **	(0.007)	-0.001	(0.004)	**-0.035*** **	(0.006)	**0.009** **	(0.004)	**0.027*** **	(0.005)
	Mean FT Earnings[8]	**-0.022*** **	(0.006)	**-0.019** **	(0.009)	**0.392*** **	(0.037)	**0.112*** **	(0.022)	**-0.270*** **	(0.032)	**0.085*** **	(0.017)	**0.259*** **	(0.031)
	Working Age Pop.[9]	0.001	(0.018)	-0.017	(0.020)	**0.540*** **	(0.145)	0.076	(0.073)	**-0.437*** **	(0.106)	**0.204*** **	(0.058)	**0.339*** **	(0.125)
Emp. by Ind.[6, 10]	Agric., Fish., Mining.	0.000	(0.001)	-0.001	(0.001)	**0.011** **	(0.005)	**0.008*** **	(0.003)	-0.006*	(0.003)	0.001	(0.002)	0.004	(0.004)
	Manufacturing	0.000	(0.002)	0.000	(0.003)	**-0.057*** **	(0.019)	**-0.042*** **	(0.009)	**0.053*** **	(0.011)	**-0.024*** **	(0.006)	**-0.066*** **	(0.014)
	Elect., Gas, Water	0.000	(0.000)	0.000	(0.000)	**0.000*** **	(0.000)	0.000*	(0.000)	0.000**	(0.000)	0.000	(0.000)	**0.000** **	(0.000)
	Construction	0.000	(0.001)	-0.001	(0.002)	0.008	(0.008)	-0.002	(0.004)	0.002	(0.007)	-0.002	(0.003)	-0.001	(0.006)
	Wholesale, Retail	0.007*	(0.004)	0.002	(0.006)	**-0.077*** **	(0.021)	-0.001	(0.014)	**0.052*** **	(0.018)	**-0.027*** **	(0.009)	-0.027	(0.019)
	Hotels, Restaurants	0.000	(0.002)	-0.001	(0.002)	**0.023*** **	(0.008)	-0.001	(0.005)	-0.007	(0.008)	0.000	(0.004)	**0.015** **	(0.007)
	Transport, Comms.	0.002	(0.001)	0.004*	(0.002)	-0.012	(0.008)	**0.011** **	(0.005)	-0.001	(0.007)	-0.003	(0.004)	-0.008	(0.007)
	Business Activities	-0.001	(0.001)	0.001	(0.003)	**0.021** **	(0.008)	**0.015*** **	(0.006)	**-0.021*** **	(0.008)	0.003	(0.004)	**0.026*** **	(0.007)
	Public Admin., Def.	0.000	(0.001)	0.000	(0.003)	0.008	(0.008)	0.005	(0.005)	0.001	(0.005)	-0.002	(0.003)	0.007	(0.007)
	Education	0.000	(0.001)	0.002	(0.002)	**0.022** **	(0.010)	**0.015** **	(0.007)	-0.001	(0.009)	0.004	(0.005)	**0.026*** **	(0.009)
	Health, Social Work	0.000	(0.002)	-0.002	(0.004)	**0.070*** **	(0.016)	0.021*	(0.011)	**-0.037*** **	(0.014)	0.022***	(0.007)	**0.063*** **	(0.013)
Controls	School, Domicile, Year	YES:(4,459), (297), (5)		YES:(4,459), (297), (5)		YES:(4,459), (297), (5)		YES:(4,459), (297), (5)		YES:(4,459), (297), (5)		YES:(4,459), (297), (5)		YES:(4,459), (297), (5)	

Notes: (1) Dep. Var. takes a value one if student chooses a given subject, zero o/w. (2) Standard errors (in brackets) are clustered at the TTWA level. (3) Subjects defined at the single digit JACS level – See Appendix 2A for details. (4) These variables are quasi-continuous. (5) School results are split into cohort quartiles based on the UCAS tariff point score obtained. The best performing students in each cohort appear in the Top Quartile. (6) These variables are defined at the TTWA level. (7) Youth Unemp. is defined as the number of 18-24 year old males/females who are claiming the Job-Seekers Allowance. (8) Average FT Earnings are defined as the average hourly earnings of males/females in FT employment. (9) Working Age Pop. is defined as the number of people aged 16-retirement, allowing for different retirement ages of men and women. (10) Emp. by Industry variables are the number of FT employees in each sector. See Appendix 2A for industrial classification. (11) *, ** and *** indicate significance at the 10%, 5% and 1% levels respectively. All regressions include 318,621 observations.

2B Appendix: Table B.2 (Cont.): Females[1, 2, 3, 11]

		Euro. Languages		*Other Languages*		*History*		*Art & Music*		*Education*		*Combined*	
Age[4]		**0.013*** **	(0.001)	**0.002*** **	(0.000)	**-0.009*** **	(0.001)	0.002	(0.001)	**0.002** **	(0.001)	0.000	(0.000)
Ethnicity	Black	**-0.016*** **	(0.002)	**-0.003*** **	(0.000)	**-0.045*** **	(0.004)	**-0.049*** **	(0.005)	**-0.045*** **	(0.001)	-0.001*	(0.001)
	Asian	**-0.022*** **	(0.001)	**-0.004*** **	(0.001)	**-0.045*** **	(0.005)	**-0.071*** **	(0.002)	**-0.035*** **	(0.002)	**-0.001*** **	(0.000)
	Other	-0.001	(0.002)	**0.004*** **	(0.001)	**-0.017*** **	(0.005)	**-0.014*** **	(0.003)	**-0.027*** **	(0.002)	0.000	(0.001)
	Unknown	0.000	(0.002)	0.002*	(0.001)	0.010*	(0.006)	**-0.020*** **	(0.004)	**-0.021*** **	(0.004)	**-0.002** **	(0.001)
Disability		**-0.007*** **	(0.001)	**-0.001** **	(0.001)	**0.014*** **	(0.002)	**0.040*** **	(0.003)	**-0.009*** **	(0.002)	-0.001	(0.001)
Parental Occ.	Lower Manag. & Prof.	**0.003*** **	(0.001)	0.000	(0.000)	-0.001	(0.001)	**0.008*** **	(0.002)	**0.005*** **	(0.001)	0.000	(0.000)
	Intermediate	0.002	(0.001)	-0.001	(0.000)	-0.003	(0.002)	-0.002	(0.002)	**0.009*** **	(0.002)	0.000	(0.000)
	Small Employers	0.000	(0.002)	-0.001	(0.001)	**-0.011*** **	(0.002)	-0.001	(0.003)	**0.012*** **	(0.002)	0.000	(0.001)
	Lower Super. & Tech.	**-0.003** **	(0.001)	**-0.002*** **	(0.000)	**-0.009*** **	(0.002)	**-0.007** **	(0.003)	**0.017*** **	(0.002)	0.001	(0.001)
	Semi-routine	0.000	(0.001)	-0.001	(0.000)	-0.003*	(0.002)	-0.002	(0.002)	**0.013*** **	(0.002)	0.000	(0.001)
	Routine, Unemp.	0.000	(0.002)	**-0.001** **	(0.001)	**-0.006** **	(0.002)	**-0.008*** **	(0.003)	**0.017*** **	(0.003)	0.000	(0.001)
	Unknown	0.002	(0.001)	-0.001	(0.000)	**-0.007*** **	(0.002)	**0.013*** **	(0.002)	**0.003** **	(0.001)	0.000	(0.000)
School Results[5]	4th Quartile	**-0.017*** **	(0.001)	**-0.002*** **	(0.000)	**-0.036*** **	(0.002)	**0.027*** **	(0.002)	**0.061*** **	(0.003)	0.000	(0.001)
	3rd Quartile	**-0.010*** **	(0.001)	0.000	(0.000)	**-0.019*** **	(0.002)	**0.014*** **	(0.002)	**0.030*** **	(0.002)	**-0.001** **	(0.000)
	Top Quartile	-0.002	(0.001)	**-0.002*** **	(0.001)	**0.004** **	(0.002)	**-0.019*** **	(0.002)	**-0.021*** **	(0.002)	0.000	(0.000)
Economic Effects[6]	Youth Unemp.[7]	**-0.036*** **	(0.005)	-0.001	(0.001)	**0.021*** **	(0.005)	**0.018*** **	(0.006)	-0.006	(0.005)	0.000	(0.001)
	Mean FT Earnings[8]	**-0.389*** **	(0.026)	**-0.036*** **	(0.007)	**0.233*** **	(0.026)	**0.323*** **	(0.029)	-0.026	(0.025)	**0.020*** **	(0.006)
	Working Age Pop.[9]	**-0.516*** **	(0.115)	**-0.090*** **	(0.021)	**0.508*** **	(0.114)	**0.401*** **	(0.085)	-0.009	(0.079)	**0.057** **	(0.024)
Emp. by Ind.[6, 10]	Agric., Fish., Mining.	**-0.013*** **	(0.004)	-0.001	(0.001)	0.004	(0.003)	0.003	(0.003)	0.004	(0.003)	-0.001	(0.001)
	Manufacturing	**0.070*** **	(0.015)	**0.011*** **	(0.003)	**-0.050*** **	(0.012)	**-0.055*** **	(0.011)	0.008	(0.008)	-0.003	(0.003)
	Elect., Gas, Water	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)	**0.000*** **	(0.000)
	Construction	0.007	(0.006)	-0.002	(0.002)	0.002	(0.006)	0.000	(0.006)	0.004	(0.005)	-0.001	(0.002)
	Wholesale, Retail	**0.055*** **	(0.016)	0.001	(0.004)	-0.011	(0.017)	**-0.035** **	(0.016)	**0.037** **	(0.015)	-0.002	(0.004)
	Hotels, Restaurants	**-0.016*** **	(0.006)	0.000	(0.002)	0.010	(0.006)	0.003	(0.008)	**0.011** **	(0.006)	-0.001	(0.002)
	Transport, Comms.	**0.014** **	(0.006)	**0.003** **	(0.001)	-0.010	(0.007)	-0.012*	(0.007)	-0.006	(0.005)	-0.001	(0.002)
	Business Activities	**-0.024*** **	(0.007)	-0.002	(0.002)	**0.014** **	(0.006)	**0.025*** **	(0.007)	0.005	(0.006)	**-0.003** **	(0.001)
	Public Admin., Def.	-0.009*	(0.005)	-0.002*	(0.001)	0.007	(0.006)	-0.002	(0.006)	-0.007	(0.005)	0.001	(0.001)
	Education	**-0.023*** **	(0.007)	**-0.004** **	(0.002)	**0.020*** **	(0.007)	**0.022** **	(0.011)	-0.010	(0.007)	0.003	(0.002)
	Health, Social Work	**-0.046*** **	(0.011)	**-0.006** **	(0.003)	**0.038*** **	(0.011)	**0.061*** **	(0.013)	**-0.025*** **	(0.009)	0.005*	(0.003)
Controls	School, Domicile, Year	YES:(4,459), (297), (5)		YES:(4,459), (297), (5)		YES:(4,459), (297), (5)		YES:(4,459), (297), (5)		YES:(4,459), (297), (5)		YES:(4,459), (297), (5)	

Notes: (1) Dep. Var. takes a value one if student chooses a given subject, zero o/w. (2) Standard errors (in brackets) are clustered at the TTWA level. (3) Subjects defined at the single digit JACS level – See Appendix 2A for details. (4) These variables are quasi-continuous. (5) School results are split into cohort quartiles based on the UCAS tariff point score obtained. The best performing students in each cohort appear in the Top Quartile. (6) These variables are defined at the TTWA level. (7) Youth Unemp. is defined as the number of 18-24 year old males/females who are claiming the Job-Seekers Allowance. (8) Average FT Earnings are defined as the average hourly earnings of males/females in FT employment. (9) Working Age Pop. is defined as the number of people aged 16-retirement, allowing for different retirement ages of men and women. (10) Emp. by Industry variables are the number of FT employees in each sector. See Appendix 2A for industrial classification. (11) *, ** and *** indicate significance at the 10%, 5% and 1% levels respectively. All regressions include 318,621 observations.

2C Appendix: Table C.1: Males[1, 2, 3, 11]

		Medicine & Dent.		*Medicine Related*		*Biological Science*		*Veterinary Science*		*Physical Science*		*Mathematics*		*Engineering*	
Age[4]		**0.030*** **	(0.001)	**0.002*** **	(0.001)	**-0.026*** **	(0.002)	**0.002*** **	(0.000)	**-0.003*** **	(0.001)	0.000	(0.001)	**0.038*** **	(0.002)
Ethnicity	Black	**0.009*** **	(0.002)	**0.039*** **	(0.002)	**-0.014*** **	(0.002)	**-0.004*** **	(0.000)	**-0.040*** **	(0.003)	**0.023*** **	(0.007)	**0.033*** **	(0.004)
	Asian	**0.041*** **	(0.002)	**0.066*** **	(0.004)	**-0.041*** **	(0.003)	**-0.005*** **	(0.001)	**-0.043*** **	(0.003)	**0.089*** **	(0.009)	0.011*	(0.006)
	Other	**0.021*** **	(0.002)	**0.021*** **	(0.002)	0.000	(0.004)	**-0.003*** **	(0.001)	**-0.022*** **	(0.003)	**0.015** **	(0.006)	0.005	(0.003)
	Unknown	0.001	(0.003)	0.004	(0.003)	**-0.032*** **	(0.004)	-0.002	(0.001)	-0.009	(0.006)	0.006	(0.007)	**-0.012** **	(0.005)
Disability		**-0.005*** **	(0.001)	0.001	(0.001)	0.000	(0.003)	0.002*	(0.001)	**0.010*** **	(0.003)	-0.002	(0.003)	-0.003	(0.003)
Parental Occ.	Lower Manag. & Prof.	**-0.014*** **	(0.001)	**-0.004*** **	(0.001)	**0.006*** **	(0.002)	0.000	(0.000)	**-0.006*** **	(0.001)	**-0.006*** **	(0.002)	**-0.010*** **	(0.002)
	Intermediate	**-0.014*** **	(0.001)	**-0.003*** **	(0.001)	**0.005** **	(0.002)	-0.001	(0.001)	-0.001	(0.002)	**0.005** **	(0.002)	**-0.005** **	(0.002)
	Small Employers	**-0.018*** **	(0.001)	-0.002	(0.002)	0.004	(0.003)	**0.018*** **	(0.003)	**-0.010*** **	(0.003)	-0.003	(0.003)	-0.001	(0.003)
	Lower Super. & Tech.	**-0.015*** **	(0.001)	-0.002	(0.002)	**0.010*** **	(0.003)	-0.001	(0.001)	-0.001	(0.003)	**0.019*** **	(0.005)	**0.013*** **	(0.003)
	Semi-routine	**-0.019*** **	(0.001)	**-0.003** **	(0.001)	**0.005** **	(0.002)	-0.001	(0.001)	-0.004*	(0.002)	**0.019*** **	(0.003)	**0.008*** **	(0.002)
	Routine, Unemp.	**-0.018*** **	(0.001)	-0.001	(0.003)	0.004	(0.003)	-0.001	(0.001)	-0.003	(0.003)	**0.015*** **	(0.004)	**-0.013*** **	(0.003)
	Unknown	**-0.018*** **	(0.001)	**-0.005*** **	(0.001)	**0.005** **	(0.002)	-0.001	(0.000)	**-0.004** **	(0.002)	0.003	(0.002)	**-0.009*** **	(0.002)
School Results[5]	4th Quartile	**-0.024*** **	(0.002)	**-0.025*** **	(0.002)	**0.026*** **	(0.002)	**0.003*** **	(0.001)	**-0.028*** **	(0.002)	**0.034*** **	(0.004)	**-0.022*** **	(0.004)
	3rd Quartile	**-0.018*** **	(0.001)	**-0.008*** **	(0.001)	**0.015*** **	(0.002)	**0.002*** **	(0.001)	**-0.006*** **	(0.002)	0.003	(0.002)	**-0.015*** **	(0.002)
	Top Quartile	**0.034*** **	(0.002)	0.002	(0.001)	**-0.023*** **	(0.002)	0.001	(0.000)	**0.019*** **	(0.002)	**0.042*** **	(0.003)	**0.014*** **	(0.002)
Economic Effects[6]	Youth Unemp.[7]	**0.016*** **	(0.002)	0.001	(0.002)	**-0.005** **	(0.002)	**0.004*** **	(0.001)	**-0.020*** **	(0.002)	**-0.059*** **	(0.002)	**-0.017*** **	(0.002)
	Mean FT Earnings[8]	-0.003	(0.006)	0.011	(0.010)	-0.008	(0.011)	-0.002	(0.002)	**-0.018** **	(0.009)	**-0.042*** **	(0.009)	-0.022*	(0.013)
	Working Age Pop.[9]	-0.004	(0.004)	0.000	(0.001)	-0.002	(0.003)	**-0.002** **	(0.001)	**-0.010*** **	(0.003)	0.001	(0.004)	-0.007	(0.005)
Emp. by Ind.[6, 10]	Agric., Fish., Mining.	**-0.091*** **	(0.019)	-0.004	(0.006)	**0.032** **	(0.014)	**-0.012*** **	(0.004)	**-0.070*** **	(0.012)	**-0.059*** **	(0.015)	**-0.124*** **	(0.029)
	Manufacturing	**-0.004** **	(0.002)	**0.004*** **	(0.001)	0.003	(0.002)	-0.001	(0.001)	**-0.005** **	(0.002)	-0.010	(0.006)	0.007	(0.005)
	Elect., Gas, Water	-0.001	(0.001)	**-0.005*** **	(0.001)	-0.001	(0.002)	0.000	(0.000)	-0.001	(0.001)	0.001	(0.002)	**0.009** **	(0.005)
	Construction	0.003	(0.002)	0.001	(0.001)	-0.002	(0.003)	-0.001	(0.001)	0.001	(0.003)	0.006	(0.004)	0.000	(0.004)
	Wholesale, Retail	**0.000*** **	(0.000)	**0.000** **	(0.000)	**0.000*** **	(0.000)	**0.000*** **	(0.000)	**0.000*** **	(0.000)	**0.000** **	(0.000)	**0.000*** **	(0.000)
	Hotels, Restaurants	**-0.007** **	(0.003)	0.004*	(0.002)	0.003	(0.004)	0.000	(0.001)	**-0.009** **	(0.004)	0.000	(0.005)	-0.004	(0.006)
	Transport, Comms.	**0.023*** **	(0.008)	-0.003	(0.003)	-0.005	(0.007)	**0.006*** **	(0.002)	**0.015** **	(0.007)	0.008	(0.010)	0.003	(0.013)
	Business Activities	0.001	(0.003)	-0.001	(0.002)	0.002	(0.004)	0.001	(0.001)	0.002	(0.004)	-0.004	(0.005)	0.008	(0.006)
	Public Admin., Def.	0.001	(0.002)	-0.001	(0.001)	**-0.007*** **	(0.002)	0.001	(0.001)	0.000	(0.002)	0.003	(0.003)	0.003	(0.004)
	Education	-0.002	(0.003)	**-0.005** **	(0.002)	-0.004	(0.005)	**-0.003*** **	(0.001)	0.002	(0.004)	0.002	(0.004)	0.008	(0.010)
	Health, Social Work	0.003	(0.002)	0.000	(0.001)	-0.002	(0.003)	0.001	(0.001)	**0.007*** **	(0.003)	0.003	(0.003)	0.007*	(0.004)
Controls	Year, School Type	YES:(5), (2)		YES:(5), (2)		YES:(5), (2)		YES:(5), (2)		YES:(5), (2)		YES:(5), (2)		YES:(5), (2)	

Notes: (1) Dep. Var. takes a value one if student chooses a given subject, zero o/w. (2) Standard errors (in brackets) are clustered at the TTWA level. (3) Subjects defined at the single digit JACS level – See Appendix 2A for details. (4) These variables are quasi-continuous. (5) School results are split into cohort quartiles based on the UCAS tariff point score obtained. The best performing students in each cohort appear in the Top Quartile. (6) These variables are defined at the TTWA level. (7) Youth Unemp. is defined as the number of 18-24 year old males/females who are claiming the Job-Seekers Allowance. (8) Average FT Earnings are defined as the average hourly earnings of males/females in FT employment. (9) Working Age Pop. is defined as the number of people aged 16-retirement, allowing for different retirement ages of men and women. (10) Emp. by Industry variables are the number of FT employees in each sector. See Appendix 2A for industrial classification. (11) *, ** and *** indicate significance at the 10%, 5% and 1% levels respectively. All regressions include 255,591 observations.

2C Appendix: Table C.1 (Cont): Males[1, 2, 3, 11]

		Mineral Tech.		*Architecture*		*Social Studies*		*Law*		*Business Studies*		*Communications*		*Lang, Ling & Class*	
Age[4]		**0.001*** **	(0.000)	**0.003*** **	(0.001)	**-0.020*** **	(0.001)	**-0.014*** **	(0.001)	-0.001	(0.001)	**-0.007*** **	(0.001)	**-0.006*** **	(0.001)
Ethnicity	Black	**-0.004*** **	(0.001)	**-0.012*** **	(0.002)	**0.006** **	(0.002)	**0.054*** **	(0.005)	**0.059*** **	(0.005)	**-0.009*** **	(0.002)	**-0.021*** **	(0.003)
	Asian	**-0.004*** **	(0.001)	**-0.010*** **	(0.001)	0.002	(0.003)	**0.036*** **	(0.005)	**0.068*** **	(0.006)	**-0.027*** **	(0.001)	**-0.030*** **	(0.003)
	Other	0.000	(0.001)	**-0.008*** **	(0.002)	**0.011** **	(0.004)	**0.020*** **	(0.002)	0.003	(0.005)	**-0.005*** **	(0.002)	**-0.008*** **	(0.002)
	Unknown	0.001	(0.002)	**-0.006** **	(0.003)	**0.018*** **	(0.005)	**0.010*** **	(0.003)	-0.004	(0.006)	0.001	(0.003)	**0.016*** **	(0.004)
Disability		0.001	(0.001)	0.002	(0.002)	-0.002	(0.004)	**-0.004** **	(0.002)	**-0.026*** **	(0.003)	0.001	(0.002)	**-0.006*** **	(0.002)
Parental Occ.	Lower Manag. & Prof.	0.000	(0.001)	**-0.003*** **	(0.001)	-0.002	(0.003)	-0.002	(0.001)	**0.015*** **	(0.002)	**0.007*** **	(0.001)	**0.005*** **	(0.001)
	Intermediate	0.000	(0.001)	**-0.007*** **	(0.001)	0.000	(0.002)	-0.003	(0.002)	**0.011*** **	(0.002)	**0.006*** **	(0.001)	0.001	(0.001)
	Small Employers	**-0.003*** **	(0.001)	**0.007*** **	(0.002)	**-0.016*** **	(0.002)	0.000	(0.002)	**0.019*** **	(0.003)	**0.004*** **	(0.001)	0.001	(0.002)
	Lower Super. & Tech.	-0.001	(0.001)	0.004*	(0.002)	**-0.019*** **	(0.003)	0.000	(0.002)	0.008*	(0.005)	0.002	(0.002)	**-0.004** **	(0.002)
	Semi-routine	-0.001	(0.001)	**-0.006*** **	(0.001)	**-0.016*** **	(0.003)	**-0.006*** **	(0.002)	0.006	(0.005)	**0.009*** **	(0.002)	**0.004** **	(0.002)
	Routine, Unemp.	**-0.003*** **	(0.001)	**-0.009*** **	(0.002)	**-0.009*** **	(0.003)	0.000	(0.002)	**0.013*** **	(0.004)	**0.007*** **	(0.002)	**0.004** **	(0.002)
	Unknown	0.000	(0.001)	**-0.003** **	(0.001)	**-0.010*** **	(0.003)	0.003*	(0.001)	**0.008*** **	(0.003)	**0.009*** **	(0.001)	**0.004** **	(0.001)
School Results[5]	4th Quartile	**0.010*** **	(0.001)	**0.013*** **	(0.001)	**-0.043*** **	(0.004)	**-0.028*** **	(0.002)	**0.073*** **	(0.006)	**0.019*** **	(0.001)	**-0.021*** **	(0.002)
	3rd Quartile	**0.005*** **	(0.001)	**0.011*** **	(0.001)	**-0.016*** **	(0.002)	**-0.015*** **	(0.001)	**0.037*** **	(0.003)	**0.012*** **	(0.001)	**-0.013*** **	(0.002)
	Top Quartile	**-0.003*** **	(0.000)	**-0.007*** **	(0.001)	-0.006*	(0.003)	**0.020*** **	(0.003)	**-0.052*** **	(0.002)	**-0.012*** **	(0.001)	**0.006*** **	(0.002)
Economic Effects[6]	Youth Unemp.[7]	**-0.002*** **	(0.000)	**0.008*** **	(0.002)	**0.043*** **	(0.003)	-0.004*	(0.002)	0.003	(0.003)	**-0.016*** **	(0.001)	**0.020*** **	(0.002)
	Mean FT Earnings[8]	-0.003	(0.004)	-0.006	(0.006)	-0.002	(0.009)	0.006	(0.007)	**-0.066*** **	(0.010)	0.004	(0.008)	0.012*	(0.006)
	Working Age Pop.[9]	**-0.004*** **	(0.001)	-0.003*	(0.001)	0.009*	(0.005)	**0.010*** **	(0.002)	-0.003	(0.004)	**0.003** **	(0.001)	**0.009*** **	(0.002)
Emp. by Ind.[6, 10]	Agric., Fish., Mining.	**-0.015*** **	(0.004)	**-0.023*** **	(0.006)	**0.125*** **	(0.022)	0.010	(0.008)	0.001	(0.019)	**0.017** **	(0.008)	**0.048*** **	(0.010)
	Manufacturing	0.000	(0.001)	**0.005*** **	(0.001)	-0.006	(0.004)	0.001	(0.002)	**0.012** **	(0.005)	-0.001	(0.002)	-0.003*	(0.002)
	Elect., Gas, Water	**-0.001** **	(0.000)	0.001	(0.001)	0.002	(0.002)	-0.001	(0.001)	0.001	(0.002)	0.000	(0.001)	0.000	(0.001)
	Construction	0.001	(0.001)	0.000	(0.002)	**-0.009*** **	(0.003)	-0.002	(0.002)	**0.009** **	(0.004)	-0.003*	(0.002)	**-0.004** **	(0.002)
	Wholesale, Retail	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)	**0.000*** **	(0.000)	**0.000** **	(0.000)	**0.000*** **	(0.000)	**0.000** **	(0.000)
	Hotels, Restaurants	0.000	(0.001)	**0.005** **	(0.002)	-0.001	(0.005)	**0.008*** **	(0.002)	0.008	(0.005)	0.003	(0.002)	-0.001	(0.003)
	Transport, Comms.	**0.004** **	(0.002)	**-0.008** **	(0.004)	-0.010	(0.009)	**-0.012** **	(0.005)	0.010	(0.010)	-0.004	(0.004)	-0.005	(0.005)
	Business Activities	0.001	(0.001)	0.004*	(0.002)	-0.007	(0.005)	-0.004*	(0.002)	0.003	(0.006)	0.001	(0.003)	-0.004*	(0.002)
	Public Admin., Def.	**-0.001** **	(0.001)	0.001	(0.001)	0.004*	(0.003)	-0.002	(0.001)	0.001	(0.004)	0.000	(0.001)	-0.001	(0.002)
	Education	0.001	(0.001)	0.001	(0.002)	0.002	(0.006)	0.000	(0.003)	0.000	(0.006)	0.001	(0.003)	0.001	(0.003)
	Health, Social Work	-0.001	(0.001)	-0.001	(0.001)	-0.001	(0.003)	-0.002	(0.002)	-0.001	(0.004)	**-0.004** **	(0.001)	-0.001	(0.002)
Controls	Year, School Type	YES:(5), (2)		YES:(5), (2)		YES:(5), (2)		YES:(5), (2)		YES:(5), (2)		YES:(5), (2)		YES:(5), (2)	

Notes: (1) Dep. Var. takes a value one if student chooses a given subject, zero o/w. (2) Standard errors (in brackets) are clustered at the TTWA level. (3) Subjects defined at the single digit JACS level – See Appendix 2A for details. (4) These variables are quasi-continuous. (5) School results are split into cohort quartiles based on the UCAS tariff point score obtained. The best performing students in each cohort appear in the Top Quartile. (6) These variables are defined at the TTWA level. (7) Youth Unemp. is defined as the number of 18-24 year old males/females who are claiming the Job-Seekers Allowance. (8) Average FT Earnings are defined as the average hourly earnings of males/females in FT employment. (9) Working Age Pop. is defined as the number of people aged 16-retirement, allowing for different retirement ages of men and women. (10) Emp. by Industry variables are the number of FT employees in each sector. See Appendix 2A for industrial classification. (11) *, ** and *** indicate significance at the 10%, 5% and 1% levels respectively. All regressions include 255,591 observations.

2C Appendix: Table C.1 (Cont.): Males[1, 2, 3, 11]

		Euro. Languages		*Other Languages*		*History*		*Art & Music*		*Education*		*Combined*	
Age[4]		**0.010*** **	(0.001)	**0.002*** **	(0.000)	**-0.018*** **	(0.001)	**0.006*** **	(0.001)	**-0.001*** **	(0.000)	0.000*	(0.000)
Ethnicity	Black	**-0.009*** **	(0.002)	**-0.004*** **	(0.001)	**-0.057*** **	(0.006)	**-0.040*** **	(0.003)	**-0.009*** **	(0.001)	-0.001	(0.000)
	Asian	**-0.013*** **	(0.001)	**-0.004*** **	(0.001)	**-0.063*** **	(0.006)	**-0.065*** **	(0.002)	**-0.009*** **	(0.001)	**-0.001** **	(0.000)
	Other	-0.004*	(0.002)	0.001	(0.001)	**-0.029*** **	(0.004)	**-0.013*** **	(0.003)	**-0.005*** **	(0.001)	**-0.001** **	(0.000)
	Unknown	0.000	(0.002)	0.001	(0.001)	**0.022*** **	(0.007)	**-0.012*** **	(0.004)	**-0.003** **	(0.001)	0.000	(0.001)
Disability		**-0.006*** **	(0.001)	**-0.002** **	(0.001)	0.006*	(0.003)	**0.033*** **	(0.003)	-0.001	(0.001)	-0.001	(0.000)
Parental Occ.	Lower Manag. & Prof.	0.001	(0.001)	0.000	(0.000)	0.002	(0.002)	**0.008*** **	(0.001)	**0.001** **	(0.000)	**0.001** **	(0.000)
	Intermediate	0.001	(0.001)	**-0.001** **	(0.000)	0.001	(0.002)	0.003	(0.002)	**0.003*** **	(0.001)	0.000	(0.000)
	Small Employers	**-0.002** **	(0.001)	-0.001	(0.001)	**-0.008*** **	(0.002)	**0.010*** **	(0.003)	**0.002** **	(0.001)	**-0.001*** **	(0.000)
	Lower Super. & Tech.	**-0.003*** **	(0.001)	**-0.001** **	(0.001)	**-0.011*** **	(0.003)	-0.002	(0.003)	**0.003*** **	(0.001)	0.000	(0.000)
	Semi-routine	0.000	(0.001)	**-0.001*** **	(0.000)	**-0.007*** **	(0.002)	**0.010*** **	(0.002)	**0.003*** **	(0.001)	0.000	(0.000)
	Routine, Unemp.	0.000	(0.001)	-0.001	(0.001)	0.002	(0.003)	**0.011*** **	(0.003)	**0.004*** **	(0.001)	-0.001	(0.001)
	Unknown	-0.001	(0.001)	0.000	(0.000)	-0.002	(0.002)	**0.019*** **	(0.002)	0.001	(0.001)	0.000	(0.000)
School Results[5]	4th Quartile	**-0.010*** **	(0.001)	**-0.003*** **	(0.000)	**-0.036*** **	(0.003)	**0.052*** **	(0.002)	**0.011*** **	(0.001)	0.000	(0.000)
	3rd Quartile	**-0.005*** **	(0.001)	0.000	(0.000)	**-0.019*** **	(0.003)	**0.022*** **	(0.002)	**0.006*** **	(0.001)	0.000	(0.000)
	Top Quartile	-0.001*	(0.001)	**-0.001*** **	(0.000)	**-0.008** **	(0.003)	**-0.021*** **	(0.002)	**-0.004*** **	(0.001)	-0.001*	(0.000)
Economic Effects[6]	Youth Unemp.[7]	**0.015*** **	(0.002)	**0.002*** **	(0.000)	**0.037*** **	(0.003)	**-0.026*** **	(0.002)	**-0.002** **	(0.001)	**0.002*** **	(0.000)
	Mean FT Earnings[8]	-0.002	(0.004)	**-0.004*** **	(0.001)	0.010	(0.011)	**0.133*** **	(0.044)	0.000	(0.004)	0.002	(0.003)
	Working Age Pop.[9]	**-0.004*** **	(0.001)	-0.001	(0.000)	0.003	(0.004)	0.001	(0.003)	0.001	(0.001)	0.000	(0.000)
Emp. by Ind.[6, 10]	Agric., Fish., Mining.	**-0.015*** **	(0.006)	-0.001	(0.002)	**0.110*** **	(0.016)	**0.070*** **	(0.016)	-0.001	(0.004)	0.002	(0.002)
	Manufacturing	**-0.002** **	(0.001)	**-0.001*** **	(0.000)	-0.002	(0.003)	0.001	(0.003)	0.002**	(0.001)	0.000	(0.000)
	Elect., Gas, Water	**-0.001** **	(0.001)	0.000	(0.000)	-0.002	(0.002)	-0.001	(0.002)	0.000	(0.001)	0.000	(0.000)
	Construction	0.001	(0.001)	0.000	(0.000)	0.003	(0.003)	-0.003	(0.003)	0.000	(0.001)	0.001	(0.001)
	Wholesale, Retail	**0.000*** **	(0.000)	0.000	(0.000)	0.000	(0.000)	**0.000*** **	(0.000)	0.000	(0.000)	**0.000** **	(0.000)
	Hotels, Restaurants	**-0.003** **	(0.001)	**-0.002*** **	(0.001)	-0.004	(0.004)	0.000	(0.005)	0.001	(0.001)	0.000	(0.001)
	Transport, Comms.	**0.017*** **	(0.003)	**0.003*** **	(0.001)	-0.014*	(0.007)	**-0.019** **	(0.007)	-0.004	(0.003)	**-0.003** **	(0.001)
	Business Activities	0.001	(0.001)	0.000	(0.001)	-0.007	(0.004)	0.002	(0.004)	0.000	(0.001)	0.000	(0.001)
	Public Admin., Def.	-0.001	(0.001)	0.000	(0.000)	0.000	(0.002)	-0.001	(0.002)	0.000	(0.001)	0.000	(0.000)
	Education	**-0.004** **	(0.002)	0.000	(0.001)	0.000	(0.005)	0.000	(0.005)	0.000	(0.001)	0.000	(0.001)
	Health, Social Work	-0.002*	(0.001)	0.000	(0.000)	-0.005*	(0.003)	-0.002	(0.003)	0.000	(0.001)	0.000	(0.000)
Controls	Year, School Type	YES:(5), (2)		YES:(5), (2)		YES:(5), (2)		YES:(5), (2)		YES:(5), (2)		YES:(5), (2)	

Notes: (1) Dep. Var. takes a value one if student chooses a given subject, zero o/w. (2) Standard errors (in brackets) are clustered at the TTWA level. (3) Subjects defined at the single digit JACS level – See Appendix 2A for details. (4) These variables are quasi-continuous. (5) School results are split into cohort quartiles based on the UCAS tariff point score obtained. The best performing students in each cohort appear in the Top Quartile. (6) These variables are defined at the TTWA level. (7) Youth Unemp. is defined as the number of 18-24 year old males/females who are claiming the Job-Seekers Allowance. (8) Average FT Earnings are defined as the average hourly earnings of males/females in FT employment. (9) Working Age Pop. is defined as the number of people aged 16-retirement, allowing for different retirement ages of men and women. (10) Emp. by Industry variables are the number of FT employees in each sector. See Appendix 2A for industrial classification. (11) *, ** and *** indicate significance at the 10%, 5% and 1% levels respectively. All regressions include 255,591 observations.

2C Appendix: Table C.2: Females[1, 2, 3, 11]

		Medicine & Dent.		*Medicine Related*		*Biological Science*		*Veterinary Science*		*Physical Science*		*Mathematics*		*Engineering*	
Age[4]		**0.045*** **	(0.001)	**0.012*** **	(0.001)	**-0.035*** **	(0.001)	**0.007*** **	(0.001)	**-0.002*** **	(0.001)	**-0.002** **	(0.001)	**0.006*** **	(0.000)
Ethnicity	Black	**0.011*** **	(0.002)	**0.041*** **	(0.002)	**-0.014*** **	(0.004)	**-0.009*** **	(0.001)	**-0.020*** **	(0.002)	**0.010*** **	(0.003)	**0.012*** **	(0.001)
	Asian	**0.038*** **	(0.003)	**0.075*** **	(0.006)	**-0.023*** **	(0.005)	**-0.010*** **	(0.001)	**-0.020*** **	(0.002)	**0.048*** **	(0.005)	**0.008*** **	(0.001)
	Other	**0.017*** **	(0.002)	**0.006** **	(0.003)	**-0.007** **	(0.003)	**-0.006*** **	(0.001)	**-0.017*** **	(0.002)	0.005*	(0.003)	**0.003*** **	(0.001)
	Unknown	0.001	(0.003)	-0.006	(0.004)	-0.009	(0.007)	**-0.007*** **	(0.002)	-0.003	(0.003)	0.007	(0.004)	0.003*	(0.002)
Disability		**-0.010*** **	(0.001)	-0.001	(0.002)	0.003	(0.003)	**-0.002** **	(0.001)	**0.007*** **	(0.002)	-0.001	(0.001)	0.002*	(0.001)
Parental Occ.	Lower Manag. & Prof.	**-0.017*** **	(0.001)	**-0.007*** **	(0.001)	-0.003*	(0.002)	**-0.002*** **	(0.001)	**-0.004*** **	(0.001)	-0.001	(0.001)	**-0.002*** **	(0.001)
	Intermediate	**-0.015*** **	(0.001)	-0.003	(0.002)	**0.006*** **	(0.002)	**-0.003*** **	(0.001)	0.000	(0.001)	**0.003*** **	(0.001)	-0.001	(0.001)
	Small Employers	**-0.023*** **	(0.001)	-0.005*	(0.003)	0.003	(0.003)	**0.007*** **	(0.002)	**-0.004*** **	(0.002)	0.000	(0.001)	**-0.003*** **	(0.001)
	Lower Super. & Tech.	**-0.016*** **	(0.001)	0.005	(0.003)	**0.008** **	(0.004)	-0.001	(0.001)	**0.004** **	(0.002)	0.002	(0.002)	-0.001	(0.001)
	Semi-routine	**-0.022*** **	(0.001)	**-0.008** **	(0.003)	**0.008*** **	(0.002)	**-0.003*** **	(0.001)	0.001	(0.002)	**0.005** **	(0.002)	0.000	(0.001)
	Routine, Unemp.	**-0.025*** **	(0.001)	**-0.011*** **	(0.003)	0.005	(0.004)	**-0.004*** **	(0.001)	-0.004*	(0.002)	0.004*	(0.002)	**-0.002** **	(0.001)
	Unknown	**-0.023*** **	(0.002)	**-0.012*** **	(0.003)	0.001	(0.002)	**-0.004*** **	(0.001)	**-0.005*** **	(0.001)	0.002*	(0.001)	**-0.002*** **	(0.001)
School Results[5]	4th Quartile	**-0.027*** **	(0.003)	**-0.027*** **	(0.002)	**-0.027*** **	(0.004)	**0.005*** **	(0.001)	**-0.008*** **	(0.001)	0.001	(0.002)	**-0.003*** **	(0.001)
	3rd Quartile	**-0.020*** **	(0.002)	0.000	(0.002)	-0.005*	(0.003)	**0.001*** **	(0.000)	**-0.004*** **	(0.001)	**-0.003*** **	(0.001)	**-0.002*** **	(0.000)
	Top Quartile	**0.042*** **	(0.002)	**-0.010*** **	(0.002)	**-0.019*** **	(0.002)	**0.003*** **	(0.001)	**0.007*** **	(0.001)	**0.025*** **	(0.002)	**0.005*** **	(0.001)
Economic Effects[6]	Youth Unemp.[7]	**0.020*** **	(0.003)	**-0.005** **	(0.002)	**-0.029*** **	(0.002)	**0.004*** **	(0.001)	0.001	(0.001)	**-0.011*** **	(0.001)	**0.003*** **	(0.001)
	Mean FT Earnings[8]	**-0.018*** **	(0.005)	0.023	(0.023)	-0.013	(0.012)	0.000	(0.003)	**-0.022*** **	(0.007)	0.000	(0.005)	-0.004*	(0.002)
	Working Age Pop.[9]	-0.009*	(0.005)	**-0.005** **	(0.002)	0.003	(0.003)	-0.002*	(0.001)	-0.002*	(0.001)	**0.004** **	(0.002)	0.000	(0.001)
Emp. by Ind.[6, 10]	Agric., Fish., Mining.	**-0.119*** **	(0.024)	**-0.035*** **	(0.012)	**0.037** **	(0.014)	**-0.022*** **	(0.004)	**-0.030*** **	(0.006)	0.001	(0.005)	**-0.014*** **	(0.004)
	Manufacturing	-0.004	(0.003)	**0.005** **	(0.003)	-0.001	(0.003)	**-0.003*** **	(0.001)	**-0.003** **	(0.001)	**-0.004** **	(0.002)	0.000	(0.001)
	Elect., Gas, Water	0.000	(0.002)	-0.001	(0.002)	-0.002	(0.002)	**0.002*** **	(0.000)	0.000	(0.001)	-0.001	(0.001)	0.001	(0.000)
	Construction	**0.008** **	(0.003)	**0.006** **	(0.003)	0.001	(0.003)	0.000	(0.001)	0.001	(0.002)	-0.002	(0.002)	0.001	(0.001)
	Wholesale, Retail	**0.000*** **	(0.000)	0.000*	(0.000)	**0.000*** **	(0.000)	**0.000*** **	(0.000)	**0.000*** **	(0.000)	**0.000** **	(0.000)	**0.000*** **	(0.000)
	Hotels, Restaurants	**-0.010** **	(0.004)	0.005	(0.004)	0.008	(0.005)	-0.002	(0.001)	-0.005**	(0.002)	-0.001	(0.002)	-0.002*	(0.001)
	Transport, Comms.	**0.035*** **	(0.010)	-0.009	(0.007)	**-0.018** **	(0.009)	**0.009*** **	(0.002)	0.010**	(0.005)	-0.001	(0.003)	0.001	(0.002)
	Business Activities	0.002	(0.004)	0.001	(0.003)	-0.004	(0.004)	0.000	(0.001)	-0.003	(0.002)	0.002	(0.002)	0.002*	(0.001)
	Public Admin., Def.	0.002	(0.002)	0.002	(0.002)	0.000	(0.003)	**0.002*** **	(0.001)	0.001	(0.001)	0.000	(0.001)	0.001	(0.001)
	Education	-0.007	(0.004)	**-0.010** **	(0.005)	0.009*	(0.005)	-0.002	(0.001)	0.000	(0.002)	0.000	(0.002)	0.000	(0.001)
	Health, Social Work	0.005*	(0.003)	-0.002	(0.002)	-0.002	(0.003)	0.000	(0.001)	**0.003** **	(0.002)	0.000	(0.001)	0.001	(0.001)
Controls	Year, School Type	YES:(5), (2)		YES:(5), (2)		YES:(5), (2)		YES:(5), (2)		YES:(5), (2)		YES:(5), (2)		YES:(5), (2)	

Notes: (1) Dep. Var. takes a value one if student chooses a given subject, zero o/w. (2) Standard errors (in brackets) are clustered at the TTWA level. (3) Subjects defined at the single digit JACS level – See Appendix 2A for details. (4) These variables are quasi-continuous. (5) School results are split into cohort quartiles based on the UCAS tariff point score obtained. The best performing students in each cohort appear in the Top Quartile. (6) These variables are defined at the TTWA level. (7) Youth Unemp. is defined as the number of 18-24 year old males/females who are claiming the Job-Seekers Allowance. (8) Average FT Earnings are defined as the average hourly earnings of males/females in FT employment. (9) Working Age Pop. is defined as the number of people aged 16-retirement, allowing for different retirement ages of men and women. (10) Emp. by Industry variables are the number of FT employees in each sector. See Appendix 2A for industrial classification. (11) *, ** and *** indicate significance at the 10%, 5% and 1% levels respectively. All regressions include 318,621 observations.

2C Appendix: Table C.2 (Cont): Females[1, 2, 3, 11]

		Mineral Tech.		*Architecture*		*Social Studies*		*Law*		*Business Studies*		*Communications*		*Lang, Ling & Class*	
Age[4]		**0.001*** **	(0.000)	**0.001*** **	(0.000)	**-0.017*** **	(0.001)	**-0.019*** **	(0.001)	**0.010*** **	(0.001)	**-0.009*** **	(0.000)	**-0.017*** **	(0.001)
Ethnicity	Black	0.000	(0.001)	0.001	(0.001)	**0.023*** **	(0.003)	**0.104*** **	(0.002)	**0.054*** **	(0.004)	**0.006** **	(0.002)	**-0.042*** **	(0.005)
	Asian	0.001	(0.001)	0.001	(0.001)	-0.001	(0.002)	**0.073*** **	(0.006)	**0.069*** **	(0.005)	**-0.022*** **	(0.002)	**-0.040*** **	(0.004)
	Other	**0.002** **	(0.001)	0.002	(0.001)	0.005	(0.004)	**0.038*** **	(0.005)	0.003	(0.004)	**0.006*** **	(0.002)	0.001	(0.002)
	Unknown	0.000	(0.001)	-0.002	(0.001)	0.006	(0.006)	**0.022*** **	(0.006)	0.001	(0.005)	**0.013*** **	(0.004)	0.008	(0.005)
Disability		0.001	(0.001)	**0.002** **	(0.001)	0.001	(0.003)	**-0.010*** **	(0.002)	**-0.031*** **	(0.003)	-0.003	(0.002)	**-0.005*** **	(0.002)
Parental Occ.	Lower Manag. & Prof.	**0.001*** **	(0.000)	**-0.002** **	(0.001)	**0.003** **	(0.001)	-0.001	(0.001)	**0.008*** **	(0.001)	**0.007*** **	(0.001)	**0.005*** **	(0.001)
	Intermediate	0.000	(0.000)	**-0.002*** **	(0.001)	0.000	(0.002)	0.000	(0.002)	**0.007*** **	(0.002)	**0.002** **	(0.001)	0.001	(0.001)
	Small Employers	0.001	(0.001)	0.001	(0.001)	**-0.007*** **	(0.002)	0.003	(0.002)	**0.021*** **	(0.003)	0.002	(0.002)	0.001	(0.002)
	Lower Super. & Tech.	0.000	(0.001)	-0.001	(0.001)	**-0.011*** **	(0.003)	-0.001	(0.002)	**0.016*** **	(0.003)	0.002	(0.002)	**-0.004** **	(0.002)
	Semi-routine	0.000	(0.000)	**-0.003*** **	(0.001)	0.000	(0.002)	0.000	(0.002)	**0.010*** **	(0.002)	0.001	(0.001)	0.002	(0.002)
	Routine, Unemp.	0.000	(0.001)	**-0.004*** **	(0.001)	0.001	(0.003)	**0.009*** **	(0.003)	**0.018*** **	(0.003)	0.002	(0.002)	0.003	(0.002)
	Unknown	0.000	(0.000)	**-0.002*** **	(0.001)	0.001	(0.002)	**0.011*** **	(0.002)	**0.012*** **	(0.003)	**0.006*** **	(0.001)	0.000	(0.002)
School Results[5]	4th Quartile	**0.003*** **	(0.000)	**-0.002*** **	(0.000)	**0.015*** **	(0.004)	**-0.031*** **	(0.002)	**0.068*** **	(0.008)	**0.020*** **	(0.002)	**-0.035*** **	(0.002)
	3rd Quartile	**0.002*** **	(0.000)	0.000	(0.001)	**0.007*** **	(0.002)	**-0.018*** **	(0.001)	**0.030*** **	(0.003)	**0.016*** **	(0.001)	**-0.022*** **	(0.002)
	Top Quartile	**-0.001*** **	(0.000)	**0.002** **	(0.001)	**-0.012*** **	(0.002)	**0.027*** **	(0.003)	**-0.022*** **	(0.002)	**-0.014*** **	(0.001)	**0.014*** **	(0.003)
Economic Effects[6]	Youth Unemp.[7]	0.001	(0.000)	**0.005*** **	(0.001)	**0.023*** **	(0.004)	**-0.014*** **	(0.004)	-0.007*	(0.004)	**-0.020*** **	(0.001)	**0.017*** **	(0.002)
	Mean FT Earnings[8]	0.005	(0.003)	0.002	(0.003)	-0.005	(0.010)	-0.009	(0.007)	**-0.053*** **	(0.009)	**-0.014*** **	(0.005)	0.003	(0.009)
	Working Age Pop.[9]	0.000	(0.001)	-0.001	(0.001)	**0.008** **	(0.004)	**0.008*** **	(0.002)	-0.001	(0.005)	-0.002	(0.002)	0.007*	(0.004)
Emp. by Ind.[6, 10]	Agric., Fish., Mining.	-0.001	(0.002)	0.000	(0.004)	**0.078*** **	(0.015)	**-0.024** **	(0.010)	-0.007	(0.023)	0.010	(0.008)	**0.052*** **	(0.017)
	Manufacturing	0.000	(0.000)	0.001	(0.001)	0.001	(0.003)	0.003	(0.002)	0.010*	(0.006)	-0.003*	(0.002)	**-0.007** **	(0.003)
	Elect., Gas, Water	0.000	(0.000)	0.001	(0.000)	**0.003** **	(0.002)	0.001	(0.002)	0.005	(0.003)	-0.001	(0.001)	-0.003	(0.002)
	Construction	**0.002*** **	(0.001)	0.001	(0.001)	-0.006*	(0.003)	-0.004	(0.003)	-0.003	(0.004)	-0.002	(0.002)	-0.004	(0.003)
	Wholesale, Retail	**0.000*** **	(0.000)	0.000	(0.000)	0.000*	(0.000)	**0.000*** **	(0.000)	0.000	(0.000)	**0.000*** **	(0.000)	0.000*	(0.000)
	Hotels, Restaurants	0.000	(0.001)	-0.002*	(0.001)	0.007	(0.005)	0.002	(0.003)	0.009	(0.006)	0.001	(0.002)	-0.008*	(0.004)
	Transport, Comms.	0.002	(0.001)	-0.002	(0.002)	**-0.032*** **	(0.009)	-0.002	(0.007)	0.004	(0.012)	-0.001	(0.004)	-0.004	(0.009)
	Business Activities	**0.003*** **	(0.001)	0.001	(0.001)	0.002	(0.004)	-0.005*	(0.003)	0.002	(0.005)	0.000	(0.003)	0.004	(0.003)
	Public Admin., Def.	-0.001*	(0.000)	-0.001	(0.000)	-0.003	(0.002)	-0.004*	(0.002)	0.002	(0.004)	0.000	(0.001)	-0.004	(0.003)
	Education	-0.001	(0.001)	0.000	(0.001)	0.003	(0.005)	0.001	(0.004)	0.001	(0.007)	**0.005** **	(0.003)	0.002	(0.006)
	Health, Social Work	-0.001	(0.001)	0.001	(0.001)	-0.002	(0.003)	0.000	(0.002)	0.006	(0.004)	-0.003	(0.002)	-0.003	(0.003)
Controls	Year, School Type	YES:(5), (2)		YES:(5), (2)		YES:(5), (2)		YES:(5), (2)		YES:(5), (2)		YES:(5), (2)		YES:(5), (2)	

Notes: (1) Dep. Var. takes a value one if student chooses a given subject, zero o/w. (2) Standard errors (in brackets) are clustered at the TTWA level. (3) Subjects defined at the single digit JACS level – See Appendix 2A for details. (4) These variables are quasi-continuous. (5) School results are split into cohort quartiles based on the UCAS tariff point score obtained. The best performing students in each cohort appear in the Top Quartile. (6) These variables are defined at the TTWA level. (7) Youth Unemp. is defined as the number of 18-24 year old males/females who are claiming the Job-Seekers Allowance. (8) Average FT Earnings are defined as the average hourly earnings of males/females in FT employment. (9) Working Age Pop. is defined as the number of people aged 16-retirement, allowing for different retirement ages of men and women. (10) Emp. by Industry variables are the number of FT employees in each sector. See Appendix 2A for industrial classification. (11) *, ** and *** indicate significance at the 10%, 5% and 1% levels respectively. All regressions include 318,621 observations.

2C Appendix: Table C.2 (Cont.): Females[1, 2, 3, 11]

		Euro. Languages		*Other Languages*		*History*		*Art & Music*		*Education*		*Combined*	
Age[4]		**0.021*** **	(0.001)	**0.003*** **	(0.000)	**-0.016*** **	(0.001)	**0.010*** **	(0.001)	0.001	(0.001)	0.000	(0.000)
Ethnicity	Black	**-0.014*** **	(0.002)	**-0.003*** **	(0.001)	**-0.042*** **	(0.006)	**-0.058*** **	(0.003)	**-0.056*** **	(0.002)	**-0.001** **	(0.001)
	Asian	**-0.020*** **	(0.001)	**-0.004*** **	(0.001)	**-0.044*** **	(0.007)	**-0.086*** **	(0.003)	**-0.043*** **	(0.003)	**-0.001** **	(0.001)
	Other	0.001	(0.002)	**0.004*** **	(0.001)	**-0.015*** **	(0.005)	**-0.015*** **	(0.005)	**-0.033*** **	(0.002)	-0.001	(0.001)
	Unknown	-0.002	(0.002)	0.002*	(0.001)	0.011*	(0.006)	**-0.022*** **	(0.005)	**-0.021*** **	(0.004)	**-0.002** **	(0.001)
Disability		**-0.009*** **	(0.001)	**-0.002** **	(0.001)	**0.016*** **	(0.002)	**0.053*** **	(0.003)	**-0.010*** **	(0.002)	0.000	(0.001)
Parental Occ.	Lower Manag. & Prof.	0.002	(0.001)	0.000	(0.000)	-0.002	(0.001)	**0.011*** **	(0.002)	**0.005*** **	(0.001)	0.000	(0.000)
	Intermediate	0.000	(0.001)	**-0.001** **	(0.000)	-0.004*	(0.002)	0.000	(0.002)	**0.010*** **	(0.002)	0.000	(0.000)
	Small Employers	-0.002	(0.002)	-0.001	(0.001)	**-0.010*** **	(0.002)	0.004	(0.003)	**0.012*** **	(0.002)	0.000	(0.000)
	Lower Super. & Tech.	**-0.005*** **	(0.001)	**-0.002*** **	(0.001)	**-0.010*** **	(0.002)	-0.002	(0.003)	**0.019*** **	(0.002)	0.001	(0.001)
	Semi-routine	**-0.003** **	(0.001)	**-0.001*** **	(0.000)	**-0.004** **	(0.002)	0.004*	(0.002)	**0.013*** **	(0.002)	0.000	(0.001)
	Routine, Unemp.	-0.003	(0.002)	**-0.002*** **	(0.001)	**-0.005** **	(0.002)	0.000	(0.003)	**0.018*** **	(0.003)	-0.001	(0.001)
	Unknown	-0.002	(0.001)	**-0.001*** **	(0.000)	**-0.006*** **	(0.002)	**0.023*** **	(0.002)	0.002	(0.001)	0.000	(0.000)
School Results[5]	4th Quartile	**-0.022*** **	(0.001)	**-0.003*** **	(0.000)	**-0.037*** **	(0.002)	**0.053*** **	(0.002)	**0.056*** **	(0.003)	0.000	(0.001)
	3rd Quartile	**-0.012*** **	(0.001)	0.000	(0.000)	**-0.019*** **	(0.002)	**0.023*** **	(0.002)	**0.028*** **	(0.002)	**-0.001** **	(0.000)
	Top Quartile	0.000	(0.001)	**-0.001** **	(0.001)	0.000	(0.002)	**-0.026*** **	(0.002)	**-0.019*** **	(0.002)	0.000	(0.000)
Economic Effects[6]	Youth Unemp.[7]	**0.017*** **	(0.001)	**0.001*** **	(0.000)	**0.041*** **	(0.003)	**-0.035*** **	(0.003)	**-0.016*** **	(0.002)	**0.002*** **	(0.001)
	Mean FT Earnings[8]	**-0.019*** **	(0.003)	**-0.005*** **	(0.001)	-0.007	(0.006)	**0.155*** **	(0.053)	**-0.018** **	(0.007)	-0.001	(0.002)
	Working Age Pop.[9]	**-0.008*** **	(0.002)	**-0.001*** **	(0.000)	0.001	(0.004)	-0.002	(0.003)	0.001	(0.003)	0.001	(0.001)
Emp. by Ind.[6, 10]	Agric., Fish., Mining.	**-0.051*** **	(0.009)	-0.001	(0.003)	**0.067*** **	(0.015)	**0.087*** **	(0.018)	**-0.034** **	(0.016)	0.005*	(0.003)
	Manufacturing	**-0.005** **	(0.002)	-0.001	(0.001)	-0.004	(0.004)	0.005	(0.003)	0.006	(0.004)	**0.001** **	(0.001)
	Elect., Gas, Water	-0.002*	(0.001)	0.000	(0.000)	-0.002	(0.002)	-0.002	(0.002)	0.000	(0.002)	0.000	(0.000)
	Construction	0.003*	(0.002)	**0.002*** **	(0.001)	-0.002	(0.003)	-0.004	(0.004)	-0.001	(0.003)	0.002	(0.001)
	Wholesale, Retail	**0.000*** **	(0.000)	0.000	(0.000)	0.000	(0.000)	**0.000*** **	(0.000)	**0.000** **	(0.000)	**0.000** **	(0.000)
	Hotels, Restaurants	**-0.009*** **	(0.003)	**-0.002*** **	(0.001)	-0.004	(0.004)	0.007	(0.005)	0.005	(0.005)	0.000	(0.001)
	Transport, Comms.	**0.025*** **	(0.006)	**0.005*** **	(0.001)	0.001	(0.006)	-0.005	(0.009)	-0.012*	(0.007)	**-0.005** **	(0.002)
	Business Activities	0.002	(0.003)	0.001	(0.001)	-0.006*	(0.003)	-0.003	(0.005)	-0.002	(0.004)	**0.002** **	(0.001)
	Public Admin., Def.	0.002	(0.001)	0.000	(0.000)	-0.001	(0.003)	0.000	(0.003)	0.001	(0.002)	0.001	(0.000)
	Education	-0.002	(0.003)	-0.001*	(0.001)	-0.001	(0.004)	0.001	(0.005)	0.002	(0.005)	-0.001	(0.001)
	Health, Social Work	0.001	(0.002)	0.000	(0.001)	0.000	(0.002)	-0.005	(0.003)	0.001	(0.003)	0.000	(0.001)
Controls	Year, School Type	YES:(5), (2)		YES:(5), (2)		YES:(5), (2)		YES:(5), (2)		YES:(5), (2)		YES:(5), (2)	

Notes: (1) Dep. Var. takes a value one if student chooses a given subject, zero o/w. (2) Standard errors (in brackets) are clustered at the TTWA level. (3) Subjects defined at the single digit JACS level – See Appendix 2A for details. (4) These variables are quasi-continuous. (5) School results are split into cohort quartiles based on the UCAS tariff point score obtained. The best performing students in each cohort appear in the Top Quartile. (6) These variables are defined at the TTWA level. (7) Youth Unemp. is defined as the number of 18-24 year old males/females who are claiming the Job-Seekers Allowance. (8) Average FT Earnings are defined as the average hourly earnings of males/females in FT employment. (9) Working Age Pop. is defined as the number of people aged 16-retirement, allowing for different retirement ages of men and women. (10) Emp. by Industry variables are the number of FT employees in each sector. See Appendix 2A for industrial classification. (11) *, ** and *** indicate significance at the 10%, 5% and 1% levels respectively. All regressions include 318,621 observations.

2D Appendix: Table D.1: Males[1, 2, 4]

		Medicine & Dent.		*Medicine Related*		*Biological Science*		*Veterinary Science*		*Physical Science*		*Mathematics*		*Engineering*	
Disability		0.000	(0.001)	0.003	(0.002)	0.000	(0.003)	**0.003*** **	(0.001)	**0.018*** **	(0.003)	0.000	(0.003)	0.006*	(0.003)
Parental Occ.	Top	0.001	(0.002)	-0.002	(0.003)	-0.005	(0.005)	-0.001	(0.001)	-0.001	(0.004)	-0.001	(0.006)	-0.001	(0.004)
	Middle	**-0.004** **	(0.002)	-0.005	(0.003)	-0.005	(0.005)	**0.006*** **	(0.001)	-0.003	(0.004)	0.007	(0.006)	**0.014*** **	(0.004)
	Unknown	0.002	(0.002)	**-0.007** **	(0.003)	-0.009*	(0.005)	-0.001	(0.001)	0.001	(0.004)	-0.005	(0.006)	0.006	(0.005)
School Results[5]	4th Quartile	0.000	(0.000)	**-0.013*** **	(0.001)	**0.013*** **	(0.003)	**0.002*** **	(0.001)	**-0.018*** **	(0.002)	**0.032*** **	(0.003)	**0.009*** **	(0.002)
	3rd Quartile	**0.011*** **	(0.001)	**0.009*** **	(0.001)	**-0.024*** **	(0.002)	**-0.002*** **	(0.001)	**0.013*** **	(0.002)	**0.006*** **	(0.002)	**0.010*** **	(0.002)
	Top Quartile	**0.040*** **	(0.002)	**0.006*** **	(0.002)	**-0.046*** **	(0.003)	**-0.002*** **	(0.001)	**0.038*** **	(0.003)	**0.065*** **	(0.003)	**0.022*** **	(0.003)
Economic Effects[3]	Unemp. Rate	0.000	(0.000)	0.001	(0.001)	-0.001	(0.001)	-0.001*	(0.000)	-0.002*	(0.001)	**0.003** **	(0.001)	-0.001	(0.001)
	Inactivity Rate	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)	0.000	(0.001)	-0.001*	(0.000)
	Youth Unemp. Rate	0.003*	(0.002)	**-0.005** **	(0.002)	**-0.010** **	(0.005)	0.001	(0.001)	0.007	(0.004)	**0.010** **	(0.005)	**0.009** **	(0.004)
Emp. Growth by Ind[3]	Agric., Hunting, For.	0.002	(0.003)	0.002	(0.004)	-0.012	(0.009)	-0.001	(0.001)	**0.020** **	(0.008)	-0.003	(0.008)	-0.001	(0.008)
	Mining & Quarrying	0.001	(0.001)	0.000	(0.001)	-0.001	(0.002)	0.000	(0.000)	**0.004*** **	(0.001)	-0.002	(0.002)	0.001	(0.002)
	Manufacturing	0.021*	(0.012)	0.018	(0.016)	-0.028	(0.029)	0.000	(0.008)	0.018	(0.029)	-0.019	(0.033)	**0.054** **	(0.026)
	Elect., Gas, Water	0.000	(0.001)	0.001	(0.001)	0.000	(0.002)	0.000	(0.001)	-0.001	(0.002)	0.002	(0.002)	0.003*	(0.002)
	Construction	0.002	(0.006)	-0.006	(0.007)	0.014	(0.015)	0.002	(0.004)	0.011	(0.015)	-0.010	(0.016)	-0.013	(0.014)
	Hotels, Restaurants	**-0.012** **	(0.006)	-0.014*	(0.008)	0.024	(0.017)	-0.005	(0.004)	-0.011	(0.015)	-0.010	(0.017)	0.025*	(0.014)
	Transport, Comms.	0.005	(0.006)	-0.008	(0.009)	-0.029	(0.018)	0.005	(0.004)	0.008	(0.015)	0.010	(0.019)	-0.001	(0.014)
	Financial Intermed.	-0.001	(0.005)	-0.003	(0.007)	-0.012	(0.017)	-0.006	(0.005)	0.006	(0.013)	0.008	(0.018)	0.023*	(0.013)
	Other Business Act.	-0.002	(0.007)	-0.001	(0.009)	-0.021	(0.019)	-0.001	(0.005)	0.008	(0.016)	-0.006	(0.02)	0.005	(0.015)
	Business Activities	-0.003	(0.005)	-0.008	(0.007)	-0.007	(0.013)	0.005	(0.003)	**0.028** **	(0.012)	0.004	(0.014)	-0.003	(0.012)
	Public Admin., Def.	-0.005	(0.007)	0.008	(0.008)	-0.033*	(0.017)	-0.006	(0.005)	-0.009	(0.017)	0.002	(0.020)	-0.010	(0.016)
	Education	-0.011	(0.008)	-0.001	(0.012)	**-0.042** **	(0.020)	-0.009	(0.006)	-0.006	(0.018)	-0.019	(0.023)	0.018	(0.018)
	Health, Social Work	**0.018** **	(0.007)	0.007	(0.010)	0.019	(0.018)	0.000	(0.004)	0.004	(0.017)	0.032	(0.021)	0.005	(0.015)
Wages Growth by Ind.[3]	Agric., Hunting, For.	**0.070*** **	(0.022)	-0.028	(0.032)	-0.059	(0.057)	-0.002	(0.013)	**0.091** **	(0.046)	**0.287*** **	(0.063)	0.042	(0.046)
	Mining & Quarrying	0.007	(0.011)	0.023	(0.015)	-0.006	(0.029)	0.008	(0.007)	-0.018	(0.027)	0.039	(0.031)	**0.110*** **	(0.025)
	Manufacturing	-0.101	(0.085)	-0.071	(0.124)	**-0.713*** **	(0.221)	0.060	(0.058)	**0.795*** **	(0.204)	**0.735*** **	(0.251)	**1.938*** **	(0.195)
	Elect., Gas, Water	**-0.040** **	(0.016)	-0.005	(0.021)	0.011	(0.040)	-0.006	(0.010)	-0.010	(0.037)	-0.054	(0.045)	-0.052	(0.033)
	Construction	**0.227*** **	(0.045)	-0.045	(0.057)	-0.146	(0.122)	0.021	(0.030)	0.082	(0.117)	**0.280** **	(0.118)	0.029	(0.097)
	Hotels, Restaurants	**0.115*** **	(0.020)	0.054*	(0.032)	**-0.153** **	(0.063)	0.022	(0.017)	0.075	(0.059)	**0.197*** **	(0.066)	**0.314*** **	(0.053)
	Transport, Comms.	**0.331*** **	(0.093)	-0.093	(0.091)	0.126	(0.178)	**0.119** **	(0.053)	**-0.351** **	(0.159)	0.144	(0.187)	**-0.661*** **	(0.154)
	Financial Intermed.	**0.114*** **	(0.037)	0.037	(0.058)	-0.123	(0.110)	-0.003	(0.025)	-0.011	(0.090)	0.010	(0.115)	**0.242*** **	(0.083)
	Other Business Act.	**0.073** **	(0.033)	0.050	(0.043)	**-0.230*** **	(0.079)	0.015	(0.019)	**0.225*** **	(0.071)	**0.538*** **	(0.089)	**0.396*** **	(0.066)
	Business Activities	**0.480*** **	(0.089)	-0.002	(0.105)	-0.152	(0.204)	0.090*	(0.053)	-0.171	(0.189)	**0.553** **	(0.240)	**0.447** **	(0.175)
	Public Admin., Def.	**-0.229*** **	(0.082)	-0.090	(0.119)	0.248	(0.210)	-0.065	(0.056)	-0.324*	(0.187)	0.200	(0.236)	**-1.003*** **	(0.196)
	Education	**-0.442*** **	(0.083)	-0.068	(0.093)	0.167	(0.164)	-0.085*	(0.047)	0.044	(0.156)	0.185	(0.196)	-0.249	(0.154)
	Health, Social Work	**-0.106*** **	(0.030)	-0.004	(0.030)	0.040	(0.059)	-0.031*	(0.018)	0.024	(0.051)	0.002	(0.062)	0.044	(0.052)

Notes: (1) Dep. Var. takes a value 1(0) if the subject is (not) taken. (2) Standard errors (in brackets) clustered by Postcode District. (3) Economic variables vary by Local Authority. All other variables as defined above. (4) *, ** and *** indicate significance at the 10%, 5% and 1% levels respectively. All regressions include 132,254 observations, as well as fixed effects for School (3,070), Domicile Postcode District (2,611), Age (5) and Ethnicity (5).

2D Appendix: Table D.1 (Cont): Males[1, 2, 4]

		Mineral Technology		*Architecture*		*Social Studies*		*Law*		*Business Studies*		*Communications*	
Disability		0.001	(0.001)	**0.007*** **	(0.002)	-0.001	(0.004)	**-0.009*** **	(0.002)	**-0.027*** **	(0.004)	**-0.005*** **	(0.002)
Parental Occ.	Top	0.002	(0.001)	0.002	(0.002)	0.002	(0.005)	0.005	(0.003)	-0.002	(0.006)	0.002	(0.003)
	Middle	0.001	(0.002)	**0.005** **	(0.003)	**-0.010** **	(0.005)	0.001	(0.004)	-0.001	(0.006)	0.002	(0.003)
	Unknown	0.000	(0.002)	0.003	(0.003)	-0.005	(0.005)	0.006	(0.004)	0.001	(0.006)	0.004	(0.003)
School Results	4th Quartile	**0.004*** **	(0.001)	**0.005*** **	(0.002)	**-0.031*** **	(0.002)	**-0.021*** **	(0.001)	**0.035*** **	(0.003)	-0.001	(0.002)
	3rd Quartile	**-0.007*** **	(0.001)	**-0.013*** **	(0.001)	**0.021*** **	(0.002)	**0.030*** **	(0.002)	**-0.053*** **	(0.002)	**-0.013*** **	(0.001)
	Top Quartile	**-0.012*** **	(0.001)	**-0.017*** **	(0.001)	**0.011*** **	(0.003)	**0.051*** **	(0.002)	**-0.113*** **	(0.003)	**-0.027*** **	(0.001)
Economic Effects[3]	Unemp. Rate	**-0.001** **	(0.000)	0.000	(0.001)	-0.001	(0.001)	0.001	(0.001)	0.000	(0.001)	0.001	(0.001)
	Inactivity Rate	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)	0.001	(0.001)	0.000	(0.000)
	Youth Unemp. Rate	0.001	(0.002)	-0.002	(0.002)	-0.003	(0.005)	0.000	(0.003)	-0.004	(0.005)	-0.002	(0.003)
Emp. Growth by Ind[3]	Agric., Hunting, For.	-0.001	(0.003)	-0.005	(0.003)	0.006	(0.007)	0.005	(0.006)	-0.020*	(0.011)	-0.006	(0.004)
	Mining & Quarrying	-0.001*	(0.001)	-0.001	(0.001)	0.000	(0.002)	-0.001	(0.002)	0.002	(0.003)	0.000	(0.001)
	Manufacturing	**-0.025** **	(0.010)	-0.002	(0.015)	0.012	(0.033)	-0.020	(0.021)	0.049	(0.034)	**-0.044** **	(0.017)
	Elect., Gas, Water	-0.001*	(0.001)	0.002*	(0.001)	-0.001	(0.002)	0.001	(0.002)	-0.003	(0.002)	**0.003** **	(0.001)
	Construction	-0.004	(0.005)	0.011	(0.008)	-0.016	(0.016)	-0.006	(0.010)	-0.006	(0.017)	0.010	(0.009)
	Hotels, Restaurants	-0.001	(0.005)	**0.030*** **	(0.009)	-0.020	(0.018)	-0.001	(0.012)	-0.028	(0.019)	0.019*	(0.010)
	Transport, Comms.	-0.003	(0.006)	-0.003	(0.009)	-0.010	(0.018)	0.021*	(0.013)	-0.010	(0.019)	0.007	(0.010)
	Financial Intermed.	0.006	(0.005)	-0.013*	(0.007)	-0.023	(0.016)	-0.001	(0.011)	0.007	(0.018)	0.001	(0.009)
	Other Business Act.	-0.001	(0.006)	-0.002	(0.009)	0.022	(0.017)	0.004	(0.012)	0.017	(0.019)	-0.004	(0.010)
	Business Activities	0.002	(0.004)	-0.010	(0.007)	0.009	(0.014)	0.011	(0.010)	-0.018	(0.016)	-0.004	(0.008)
	Public Admin., Def.	0.004	(0.005)	0.009	(0.011)	-0.008	(0.017)	0.008	(0.012)	**0.052** **	(0.020)	-0.013	(0.010)
	Education	0.007	(0.007)	-0.007	(0.011)	-0.004	(0.024)	0.026	(0.016)	-0.004	(0.024)	0.003	(0.012)
	Health, Social Work	0.003	(0.006)	-0.006	(0.011)	-0.015	(0.018)	**-0.044*** **	(0.013)	0.007	(0.020)	-0.002	(0.011)
Wages Growth by Ind[3]	Agric., Hunting, For.	0.004	(0.018)	0.047	(0.032)	-0.088	(0.059)	**-0.160*** **	(0.046)	-0.117*	(0.063)	-0.031	(0.035)
	Mining & Quarrying	-0.014	(0.009)	0.008	(0.015)	-0.034	(0.028)	0.006	(0.021)	-0.020	(0.033)	-0.023	(0.015)
	Manufacturing	0.030	(0.073)	0.155	(0.123)	**-0.796*** **	(0.238)	**-0.649*** **	(0.170)	**1.179*** **	(0.265)	**-0.671*** **	(0.130)
	Elect., Gas, Water	**0.027** **	(0.013)	-0.017	(0.022)	0.002	(0.041)	**0.065** **	(0.030)	0.074	(0.047)	0.002	(0.023)
	Construction	0.030	(0.037)	0.067	(0.064)	-0.101	(0.127)	-0.159*	(0.084)	-0.027	(0.128)	0.041	(0.067)
	Hotels, Restaurants	-0.006	(0.020)	0.027	(0.034)	**-0.203*** **	(0.065)	**-0.101** **	(0.047)	0.071	(0.071)	-0.060*	(0.036)
	Transport, Comms.	0.001	(0.054)	**0.311*** **	(0.112)	0.086	(0.182)	-0.243*	(0.127)	-0.190	(0.205)	**0.234** **	(0.107)
	Financial Intermed.	-0.006	(0.034)	**-0.135** **	(0.058)	-0.043	(0.102)	0.111	(0.084)	0.028	(0.123)	-0.035	(0.061)
	Other Business Act.	-0.029	(0.025)	-0.029	(0.043)	**-0.166** **	(0.078)	**-0.250*** **	(0.060)	-0.119	(0.093)	**-0.154*** **	(0.046)
	Business Activities	-0.090	(0.066)	0.116	(0.122)	-0.321	(0.208)	**-0.361** **	(0.153)	-0.270	(0.260)	-0.055	(0.116)
	Public Admin., Def.	0.018	(0.062)	-0.175	(0.117)	0.202	(0.212)	0.206	(0.155)	-0.303	(0.240)	0.218*	(0.120)
	Education	0.057	(0.048)	-0.090	(0.101)	-0.200	(0.163)	0.242*	(0.125)	-0.034	(0.203)	0.070	(0.094)
	Health, Social Work	0.002	(0.017)	-0.023	(0.037)	-0.108*	(0.061)	0.084*	(0.044)	0.132*	(0.070)	**-0.084** **	(0.035)

Notes: (1) Dep. Var. takes a value 1(0) if the subject is (not) taken. (2) Standard errors (in brackets) clustered by Postcode District. (3) Economic variables vary by Local Authority. All other variables as defined above. (4) *, ** and *** indicate significance at the 10%, 5% and 1% levels respectively. All regressions include 132,254 observations, as well as fixed effects for School (3,070), Domicile Postcode District (2,611), Age (5) and Ethnicity (5).

2D Appendix: Table D.1 (Cont): Males[1, 2, 4]

		Lang., Ling. & Classics		*European Languages*		*Other Languages*		*History*		*Art & Music*		*Education*	
Disability		**-0.009*** **	(0.002)	**-0.005*** **	(0.001)	-0.001*	(0.001)	-0.002	(0.003)	**0.023*** **	(0.003)	0.000	(0.001)
Parental Occ.	Top	0.003	(0.002)	-0.001	(0.001)	0.001	(0.001)	0.002	(0.004)	-0.001	(0.004)	**-0.005*** **	(0.002)
	Middle	0.002	(0.003)	-0.002	(0.001)	0.000	(0.001)	-0.006	(0.004)	0.000	(0.004)	-0.003	(0.002)
	Unknown	0.001	(0.003)	-0.001	(0.001)	0.001	(0.001)	-0.004	(0.004)	**0.012** **	(0.004)	**-0.005*** **	(0.002)
School Results	4th Quartile	**-0.011*** **	(0.001)	**-0.003*** **	(0.001)	**-0.001** **	(0.000)	**-0.019*** **	(0.002)	**0.013*** **	(0.003)	**0.005*** **	(0.001)
	3rd Quartile	**0.014*** **	(0.001)	**0.004*** **	(0.001)	0.001	(0.000)	**0.022*** **	(0.002)	**-0.019*** **	(0.002)	**-0.009*** **	(0.001)
	Top Quartile	**0.020*** **	(0.002)	-0.001	(0.001)	-0.001	(0.001)	**0.013*** **	(0.002)	**-0.035*** **	(0.002)	**-0.013*** **	(0.001)
Economic Effects[3]	Unemp. Rate	0.000	(0.001)	0.000	(0.000)	0.000	(0.000)	0.000	(0.001)	0.001	(0.001)	0.000	(0.000)
	Inactivity Rate	**0.001** **	(0.000)	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)	0.001	(0.000)	0.000	(0.000)
	Youth Unemp. Rate	-0.003	(0.002)	0.000	(0.001)	0.000	(0.001)	**0.009** **	(0.003)	**-0.008** **	(0.004)	**-0.003** **	(0.002)
Emp. Growth by Ind[3]	Agric., Hunting, For.	0.003	(0.004)	0.001	(0.002)	0.002	(0.002)	0.008	(0.007)	-0.006	(0.007)	0.004	(0.003)
	Mining & Quarrying	-0.002	(0.002)	0.001	(0.001)	0.000	(0.000)	-0.002	(0.002)	0.001	(0.002)	0.000	(0.000)
	Manufacturing	**-0.039** **	(0.018)	0.011	(0.009)	-0.009	(0.006)	-0.037	(0.026)	0.042	(0.027)	-0.002	(0.011)
	Elect., Gas, Water	-0.002	(0.001)	0.000	(0.001)	0.000	(0.001)	-0.003*	(0.002)	0.000	(0.002)	0.000	(0.001)
	Construction	0.008	(0.009)	0.000	(0.005)	-0.003	(0.003)	0.020	(0.012)	-0.012	(0.013)	-0.002	(0.005)
	Hotels, Restaurants	-0.006	(0.009)	0.003	(0.005)	-0.001	(0.004)	0.005	(0.015)	0.009	(0.014)	-0.007	(0.006)
	Transport, Comms.	-0.002	(0.010)	0.006	(0.005)	0.004	(0.004)	-0.005	(0.014)	0.006	(0.015)	-0.002	(0.005)
	Financial Intermed.	0.004	(0.009)	-0.003	(0.004)	-0.005	(0.003)	0.007	(0.014)	0.011	(0.012)	-0.006	(0.005)
	Other Business Act.	0.011	(0.010)	-0.001	(0.005)	-0.002	(0.004)	0.014	(0.016)	**-0.033** **	(0.015)	-0.008	(0.006)
	Business Activities	0.006	(0.008)	-0.006	(0.004)	-0.002	(0.003)	-0.006	(0.011)	0.003	(0.011)	-0.001	(0.004)
	Public Admin., Def.	-0.004	(0.009)	0.001	(0.004)	0.003	(0.005)	-0.020	(0.014)	0.010	(0.012)	0.011	(0.008)
	Education	-0.006	(0.013)	0.002	(0.006)	0.004	(0.004)	0.010	(0.019)	0.029*	(0.018)	0.007	(0.006)
	Health, Social Work	-0.021*	(0.011)	0.004	(0.006)	-0.002	(0.004)	-0.029*	(0.016)	0.012	(0.015)	0.008	(0.006)
Wages Growth by Ind.[3]	Agric., Hunting, For.	**-0.088** **	(0.035)	**0.101*** **	(0.016)	0.015	(0.010)	**-0.097** **	(0.049)	0.005	(0.048)	0.007	(0.019)
	Mining & Quarrying	-0.008	(0.016)	**-0.020*** **	(0.008)	0.003	(0.005)	0.010	(0.023)	**-0.053** **	(0.023)	-0.018	(0.011)
	Manufacturing	**-0.484*** **	(0.134)	**0.636*** **	(0.072)	**0.167*** **	(0.049)	**-1.158*** **	(0.193)	**-0.988*** **	(0.182)	-0.066	(0.072)
	Elect., Gas, Water	0.024	(0.024)	0.013	(0.012)	-0.011	(0.008)	-0.002	(0.034)	-0.029	(0.033)	0.006	(0.013)
	Construction	0.126*	(0.068)	0.000	(0.036)	0.018	(0.024)	**-0.402*** **	(0.099)	-0.097	(0.097)	0.055	(0.040)
	Hotels, Restaurants	0.046	(0.037)	-0.013	(0.017)	0.014	(0.011)	**-0.167*** **	(0.051)	**-0.199*** **	(0.052)	-0.033	(0.022)
	Transport, Comms.	0.004	(0.101)	**-0.199*** **	(0.049)	-0.058*	(0.032)	0.191	(0.151)	0.141	(0.142)	0.106	(0.069)
	Financial Intermed.	0.012	(0.060)	**-0.098*** **	(0.026)	-0.013	(0.018)	0.155*	(0.088)	-0.165*	(0.086)	**-0.077** **	(0.035)
	Other Business Act.	**-0.171*** **	(0.046)	**0.205*** **	(0.022)	0.009	(0.013)	**-0.278*** **	(0.067)	-0.063	(0.066)	-0.021	(0.027)
	Business Activities	-0.195	(0.123)	-0.075	(0.060)	**0.110*** **	(0.041)	0.084	(0.171)	-0.200	(0.161)	0.010	(0.075)
	Public Admin., Def.	**-0.355*** **	(0.122)	0.059	(0.060)	0.036	(0.042)	**0.441** **	(0.177)	**0.631*** **	(0.169)	**0.285*** **	(0.076)
	Education	-0.091	(0.096)	**0.214*** **	(0.047)	-0.012	(0.029)	-0.153	(0.136)	**0.336*** **	(0.129)	0.109	(0.067)
	Health, Social Work	0.034	(0.033)	**0.041*** **	(0.015)	0.018*	(0.011)	-0.056	(0.049)	-0.021	(0.045)	0.012	(0.024)

Notes: (1) Dep. Var. takes a value 1(0) if the subject is (not) taken. (2) Standard errors (in brackets) clustered by Postcode District. (3) Economic variables vary by Local Authority. All other variables as defined above. (4) *, ** and *** indicate significance at the 10%, 5% and 1% levels respectively. All regressions include 132,254 observations, as well as fixed effects for School (3,070), Domicile Postcode District (2,611), Age (5) and Ethnicity (5).

2D Appendix: Table D.2: Females[1, 2, 4]

		Medicine & Dent.		*Medicine Related*		*Biological Science*		*Veterinary Science*		*Physical Science*		*Mathematics*		*Engineering*	
Disability		-0.001	(0.108)	**0.007****	(0.275)	-0.001	(0.374)	0.000	(0.106)	**0.010*****	(0.233)	-0.001	(0.165)	**0.003*****	(0.106)
Parental Occ.	Top	**0.002****	(0.118)	**0.008****	(0.365)	-0.009*	(0.494)	0.000	(0.120)	0.001	(0.277)	-0.004	(0.260)	-0.001	(0.121)
	Middle	-0.001	(0.123)	**0.009****	(0.383)	-0.003	(0.512)	**0.003****	(0.128)	0.005	(0.294)	-0.003	(0.273)	0.000	(0.125)
	Unknown	**0.004*****	(0.142)	-0.002	(0.396)	**-0.014*****	(0.534)	-0.001	(0.131)	0.000	(0.312)	-0.003	(0.293)	0.000	(0.138)
School Results	4th Quartile	**-0.001****	(0.036)	**-0.020*****	(0.219)	**-0.023*****	(0.286)	**0.005*****	(0.092)	-0.003*	(0.160)	**0.007*****	(0.148)	**0.001****	(0.070)
	3rd Quartile	**0.014*****	(0.060)	0.001	(0.177)	**0.007*****	(0.226)	**-0.004*****	(0.064)	**0.005*****	(0.138)	**0.005*****	(0.101)	**0.002*****	(0.055)
	Top Quartile	**0.052*****	(0.156)	**-0.016*****	(0.224)	**-0.023*****	(0.292)	**-0.004*****	(0.084)	**0.017*****	(0.189)	**0.039*****	(0.176)	**0.006*****	(0.087)
Economic Effects[3]	Unemp. Rate	0.000	(0.045)	0.000	(0.092)	0.000	(0.129)	0.000	(0.032)	0.001	(0.072)	0.000	(0.058)	0.000	(0.029)
	Inactivity Rate	0.000	(0.017)	0.000	(0.037)	0.001	(0.048)	0.000	(0.015)	0.000	(0.029)	0.000	(0.023)	0.000	(0.012)
	Youth Unemp. Rate	**0.004****	(0.159)	0.005	(0.324)	**-0.010****	(0.476)	**0.004*****	(0.135)	0.004	(0.266)	0.000	(0.210)	0.001	(0.103)
Emp. Growth by Ind[3]	Agric., Hunting, For.	-0.002	(0.002)	0.008	(0.006)	0.002	(0.009)	-0.003	(0.002)	-0.006	(0.005)	0.002	(0.004)	0.000	(0.002)
	Mining & Quarrying	0.001	(0.001)	-0.001	(0.002)	0.003	(0.003)	0.000	(0.000)	0.000	(0.001)	0.000	(0.001)	0.000	(0.000)
	Manufacturing	-0.007	(0.011)	-0.032	(0.024)	0.054*	(0.032)	0.008	(0.009)	-0.033*	(0.019)	-0.015	(0.015)	0.001	(0.009)
	Elect., Gas, Water	0.001	(0.001)	-0.001	(0.002)	-0.001	(0.002)	0.001	(0.001)	0.001	(0.001)	0.000	(0.001)	**0.002*****	(0.001)
	Construction	-0.006	(0.005)	0.016	(0.012)	0.017	(0.016)	-0.003	(0.005)	0.001	(0.009)	-0.001	(0.007)	0.001	(0.004)
	Hotels, Restaurants	0.004	(0.006)	-0.002	(0.013)	-0.017	(0.017)	-0.002	(0.005)	0.004	(0.010)	**0.022*****	(0.008)	-0.003	(0.004)
	Transport, Comms.	0.003	(0.006)	-0.001	(0.014)	-0.014	(0.019)	0.003	(0.005)	-0.001	(0.011)	**0.018****	(0.008)	-0.002	(0.004)
	Financial Intermed.	-0.001	(0.006)	0.002	(0.011)	-0.012	(0.017)	**-0.012*****	(0.005)	-0.003	(0.010)	0.002	(0.007)	0.003	(0.003)
	Other Business Act.	0.005	(0.006)	-0.014	(0.013)	-0.028	(0.018)	0.001	(0.005)	-0.006	(0.012)	0.007	(0.008)	-0.003	(0.004)
	Business Activities	-0.005	(0.005)	0.016	(0.011)	0.001	(0.014)	-0.001	(0.004)	-0.003	(0.008)	-0.010	(0.006)	0.002	(0.004)
	Public Admin., Def.	0.006	(0.006)	0.006	(0.013)	-0.007	(0.019)	0.002	(0.006)	-0.002	(0.011)	-0.006	(0.008)	-0.007*	(0.004)
	Education	-0.002	(0.008)	0.011	(0.017)	0.009	(0.023)	0.000	(0.008)	-0.021	(0.013)	0.005	(0.011)	-0.009	(0.006)
	Health, Social Work	0.009	(0.007)	**0.048*****	(0.014)	-0.003	(0.019)	0.002	(0.006)	-0.016	(0.012)	-0.010	(0.009)	0.000	(0.005)
Wages Growth by Ind.[3]	Agric., Hunting, For.	**-0.122*****	(0.011)	**-0.060*****	(0.023)	**0.062****	(0.030)	**-0.023*****	(0.008)	**-0.036****	(0.018)	0.006	(0.015)	**-0.027*****	(0.008)
	Mining & Quarrying	**-0.057*****	(0.006)	**0.038****	(0.015)	-0.019	(0.020)	**-0.013****	(0.006)	0.017	(0.011)	**0.025****	(0.009)	0.003	(0.005)
	Manufacturing	**-0.708*****	(0.045)	**-0.265****	(0.107)	**0.439*****	(0.140)	**-0.106*****	(0.039)	**-0.202****	(0.082)	**-0.240*****	(0.068)	**-0.120*****	(0.034)
	Elect., Gas, Water	**0.119*****	(0.012)	0.014	(0.029)	-0.031	(0.039)	0.018	(0.012)	0.020	(0.023)	0.001	(0.018)	0.005	(0.010)
	Construction	**0.214*****	(0.018)	0.066*	(0.036)	**-0.114****	(0.051)	0.015	(0.016)	**0.112*****	(0.030)	0.031	(0.023)	**0.040*****	(0.013)
	Hotels, Restaurants	**-0.361*****	(0.029)	**-0.244*****	(0.067)	**0.215****	(0.084)	**-0.088*****	(0.022)	**-0.160*****	(0.049)	-0.037	(0.039)	**-0.146*****	(0.022)
	Transport, Comms.	**0.192*****	(0.035)	0.089	(0.077)	-0.067	(0.093)	0.022	(0.028)	0.057	(0.057)	0.022	(0.046)	**0.066****	(0.027)
	Financial Intermed.	**0.242*****	(0.036)	0.098	(0.079)	**-0.224****	(0.106)	0.033	(0.030)	0.063	(0.062)	**0.225*****	(0.050)	**0.094*****	(0.027)
	Other Business Act.	**0.231*****	(0.027)	0.004	(0.071)	-0.128	(0.087)	0.059*	(0.031)	0.025	(0.053)	**0.204*****	(0.042)	0.030	(0.022)
	Business Activities	**0.105*****	(0.026)	-0.032	(0.067)	0.084	(0.089)	0.030	(0.024)	**-0.165*****	(0.052)	0.005	(0.041)	-0.001	(0.020)
	Public Admin., Def.	**-1.194*****	(0.083)	**-0.354****	(0.180)	**0.820*****	(0.257)	**-0.246*****	(0.069)	**-0.510*****	(0.155)	**-0.249****	(0.119)	**-0.147****	(0.062)
	Education	**0.208*****	(0.059)	0.014	(0.163)	0.006	(0.223)	-0.027	(0.068)	-0.065	(0.129)	-0.019	(0.106)	-0.092*	(0.055)
	Health, Social Work	**-0.504*****	(0.031)	-0.080	(0.063)	**0.327*****	(0.087)	**-0.085*****	(0.024)	**-0.157*****	(0.052)	**-0.174*****	(0.041)	**-0.092*****	(0.022)

Notes: (1) Dep. Var. takes a value 1(0) if the subject is (not) taken. (2) Standard errors (in brackets) clustered by Postcode District. (3) Economic variables vary by Local Authority. All other variables as defined above. (4) *, ** and *** indicate significance at the 10%, 5% and 1% levels respectively. All regressions include 167,291 observations, as well as fixed effects for School (3,261), Domicile Postcode District (2,646), Age (5) and Ethnicity (5).

2D Appendix: Table D.2 (Cont): Females[1, 2, 4]

		Mineral Technology		*Architecture*		*Social Studies*		*Law*		*Business Studies*		*Communications*	
Disability		**0.002****	(0.074)	**0.004*****	(0.116)	-0.002	(0.312)	**-0.015*****	(0.230)	**-0.025*****	(0.278)	**-0.006*****	(0.206)
Parental Occ.	Top	0.000	(0.090)	0.001	(0.120)	0.000	(0.400)	-0.001	(0.369)	**-0.018*****	(0.439)	**0.008*****	(0.261)
	Middle	-0.001	(0.094)	0.001	(0.125)	-0.005	(0.421)	-0.002	(0.384)	-0.008*	(0.465)	**0.006****	(0.273)
	Unknown	-0.001	(0.101)	0.001	(0.133)	-0.004	(0.451)	0.001	(0.400)	-0.008	(0.495)	**0.011*****	(0.292)
School Results	4th Quartile	0.001	(0.061)	**-0.001****	(0.072)	**0.012*****	(0.260)	**-0.027*****	(0.189)	**0.053*****	(0.307)	**-0.005****	(0.190)
	3rd Quartile	**-0.002*****	(0.039)	0.000	(0.061)	**-0.012*****	(0.192)	**0.037*****	(0.167)	**-0.037*****	(0.184)	**-0.019*****	(0.130)
	Top Quartile	**-0.004*****	(0.044)	**0.002****	(0.086)	**-0.026*****	(0.241)	**0.071*****	(0.250)	**-0.066*****	(0.220)	**-0.036*****	(0.143)
Economic Effects[3]	Unemp. Rate	0.000	(0.021)	0.000	(0.034)	-0.001	(0.102)	0.001	(0.087)	0.000	(0.108)	-0.001*	(0.072)
	Inactivity Rate	0.000	(0.008)	0.000	(0.014)	0.000	(0.041)	0.000	(0.035)	0.000	(0.041)	0.000	(0.029)
	Youth Unemp. Rate	-0.001	(0.080)	-0.001	(0.125)	0.000	(0.366)	-0.004	(0.329)	0.005	(0.389)	-0.002	(0.236)
Emp. Growth by Ind[3]	Agric., Hunting, For.	-0.001	(0.001)	-0.002	(0.002)	**0.013****	(0.006)	0.003	(0.008)	-0.012*	(0.007)	0.000	(0.005)
	Mining & Quarrying	-0.001*	(0.000)	0.000	(0.001)	-0.002	(0.002)	0.000	(0.002)	0.000	(0.002)	0.000	(0.001)
	Manufacturing	0.004	(0.005)	0.005	(0.009)	0.036	(0.027)	0.027	(0.023)	0.040	(0.026)	-0.011	(0.018)
	Elect., Gas, Water	0.000	(0.000)	-0.001	(0.001)	-0.003	(0.002)	0.000	(0.001)	0.002	(0.002)	-0.001	(0.001)
	Construction	0.002	(0.003)	0.002	(0.004)	-0.016	(0.012)	-0.007	(0.011)	0.006	(0.013)	0.007	(0.009)
	Hotels, Restaurants	0.000	(0.003)	-0.001	(0.005)	0.019	(0.015)	-0.015	(0.012)	-0.016	(0.014)	0.010	(0.010)
	Transport, Comms.	0.000	(0.003)	0.005	(0.005)	-0.013	(0.015)	0.009	(0.013)	0.014	(0.014)	-0.003	(0.010)
	Financial Intermed.	-0.002	(0.003)	0.003	(0.004)	-0.009	(0.012)	0.011	(0.012)	-0.002	(0.013)	-0.003	(0.009)
	Other Business Act.	-0.003	(0.003)	-0.007	(0.005)	0.011	(0.015)	0.009	(0.012)	0.006	(0.015)	-0.004	(0.011)
	Business Activities	-0.002	(0.002)	-0.004	(0.004)	0.016	(0.012)	-0.007	(0.011)	0.009	(0.012)	-0.012	(0.008)
	Public Admin., Def.	0.000	(0.002)	0.004	(0.005)	-0.005	(0.014)	**-0.028****	(0.014)	-0.002	(0.018)	0.004	(0.011)
	Education	-0.005	(0.004)	0.008	(0.006)	-0.018	(0.019)	-0.008	(0.016)	0.015	(0.019)	-0.005	(0.012)
	Health, Social Work	-0.004	(0.004)	0.002	(0.006)	**-0.042****	(0.017)	-0.017	(0.014)	0.021	(0.016)	-0.015	(0.011)
Wages Growth by Ind.[3]	Agric., Hunting, For.	**0.011****	(0.005)	0.009	(0.008)	0.001	(0.024)	**0.062*****	(0.022)	-0.048*	(0.025)	0.012	(0.015)
	Mining & Quarrying	0.006*	(0.003)	0.000	(0.005)	-0.021	(0.017)	0.012	(0.013)	0.005	(0.016)	-0.001	(0.011)
	Manufacturing	0.030	(0.021)	0.031	(0.037)	0.202*	(0.112)	**0.402*****	(0.101)	**-0.307*****	(0.111)	**0.171****	(0.076)
	Elect., Gas, Water	-0.011	(0.007)	-0.017*	(0.010)	-0.030	(0.032)	-0.015	(0.028)	-0.034	(0.031)	0.018	(0.020)
	Construction	-0.012	(0.009)	-0.016	(0.014)	-0.072*	(0.041)	**-0.081****	(0.035)	0.043	(0.041)	-0.020	(0.026)
	Hotels, Restaurants	0.001	(0.012)	0.009	(0.023)	0.140*	(0.071)	**0.161*****	(0.061)	**-0.395*****	(0.073)	0.079*	(0.045)
	Transport, Comms.	-0.006	(0.013)	-0.007	(0.025)	-0.008	(0.080)	-0.100	(0.069)	0.035	(0.080)	0.016	(0.050)
	Financial Intermed.	-0.015	(0.017)	-0.036	(0.028)	0.000	(0.087)	-0.142*	(0.074)	0.116	(0.083)	-0.100*	(0.060)
	Other Business Act.	-0.006	(0.014)	-0.027	(0.025)	**-0.172****	(0.070)	**-0.226*****	(0.067)	0.102	(0.073)	-0.038	(0.046)
	Business Activities	0.003	(0.017)	0.037	(0.025)	**0.162****	(0.076)	-0.001	(0.065)	-0.105	(0.071)	0.084*	(0.051)
	Public Admin., Def.	-0.005	(0.037)	0.030	(0.072)	0.340	(0.208)	**0.599*****	(0.181)	0.100	(0.204)	0.132	(0.143)
	Education	**-0.076****	(0.036)	0.064	(0.061)	-0.170	(0.180)	0.103	(0.166)	**-0.607*****	(0.183)	0.169	(0.121)
	Health, Social Work	**0.032****	(0.014)	0.019	(0.023)	**0.219*****	(0.070)	**0.312*****	(0.063)	**-0.166****	(0.071)	0.076	(0.046)

Notes: (1) Dep. Var. takes a value 1(0) if the subject is (not) taken. (2) Standard errors (in brackets) clustered by Postcode District. (3) Economic variables vary by Local Authority. All other variables as defined above. (4) *, ** and *** indicate significance at the 10%, 5% and 1% levels respectively. All regressions include 167,291 observations, as well as fixed effects for School (3,261), Domicile Postcode District (2,646), Age (5) and Ethnicity (5).

2D Appendix: Table D.2 (Cont): Females[1, 2, 4]

		Lang., Ling. & Classics		*European Languages*		*Other Languages*		*History*		*Art & Music*		*Education*	
Disability		**-0.015*** **	(0.257)	**-0.008*** **	(0.128)	**-0.002*** **	(0.069)	**0.010*** **	(0.279)	**0.047*** **	(0.355)	**-0.007*** **	(0.198)
Parental Occ.	Top	0.002	(0.338)	-0.002	(0.166)	0.001*	(0.077)	**0.007** **	(0.281)	**0.013*** **	(0.346)	**-0.009*** **	(0.319)
	Middle	-0.002	(0.354)	**-0.003** **	(0.168)	0.000	(0.081)	0.001	(0.295)	**0.007** **	(0.364)	-0.002	(0.334)
	Unknown	-0.005	(0.371)	0.002	(0.185)	0.001	(0.088)	-0.003	(0.305)	**0.031*** **	(0.413)	**-0.012*** **	(0.343)
School Results	4th Quartile	**-0.017*** **	(0.179)	**-0.005*** **	(0.078)	**-0.001*** **	(0.051)	**-0.020*** **	(0.152)	**0.017*** **	(0.269)	**0.027*** **	(0.224)
	3rd Quartile	**0.028*** **	(0.168)	**0.010*** **	(0.088)	**0.001** **	(0.048)	**0.020*** **	(0.157)	**-0.017*** **	(0.178)	**-0.039*** **	(0.133)
	Top Quartile	**0.045*** **	(0.240)	**0.010*** **	(0.128)	0.000	(0.065)	**0.025*** **	(0.219)	**-0.036*** **	(0.228)	**-0.057*** **	(0.149)
Economic Effects[3]	Unemp. Rate	0.002*	(0.091)	0.000	(0.049)	**-0.001*** **	(0.025)	0.001	(0.081)	0.000	(0.097)	0.000	(0.072)
	Inactivity Rate	0.000	(0.038)	**-0.001*** **	(0.020)	**0.000*** **	(0.010)	0.000	(0.034)	0.000	(0.040)	0.000	(0.029)
	Youth Unemp. Rate	-0.002	(0.332)	**0.008*** **	(0.168)	0.001*	(0.082)	-0.004	(0.291)	**-0.008** **	(0.354)	0.000	(0.258)
Emp. Growth by Ind[3]	Agric., Hunting, For.	**-0.013** **	(0.005)	0.000	(0.003)	0.002	(0.001)	0.000	(0.005)	-0.005	(0.010)	**0.013** **	(0.006)
	Mining & Quarrying	-0.003	(0.002)	0.000	(0.001)	0.000	(0.000)	0.002	(0.002)	0.000	(0.002)	0.001	(0.001)
	Manufacturing	-0.036	(0.023)	0.014	(0.013)	**0.012** **	(0.006)	-0.019	(0.024)	-0.023	(0.026)	-0.025	(0.019)
	Elect., Gas, Water	0.001	(0.001)	**0.003*** **	(0.001)	-0.001*	(0.000)	**-0.003** **	(0.001)	0.001	(0.002)	-0.001	(0.001)
	Construction	-0.006	(0.011)	0.006	(0.006)	0.003	(0.003)	0.004	(0.011)	-0.008	(0.012)	-0.017*	(0.009)
	Hotels, Restaurants	0.010	(0.013)	0.008	(0.007)	-0.005	(0.004)	-0.009	(0.012)	0.005	(0.015)	-0.012	(0.010)
	Transport, Comms.	-0.009	(0.012)	0.010	(0.007)	-0.001	(0.003)	-0.010	(0.012)	0.005	(0.014)	-0.014	(0.010)
	Financial Intermed.	0.004	(0.011)	0.009	(0.006)	0.000	(0.003)	0.009	(0.010)	0.008	(0.013)	-0.006	(0.009)
	Other Business Act.	0.023*	(0.014)	-0.003	(0.008)	0.001	(0.004)	0.005	(0.013)	-0.005	(0.015)	0.003	(0.011)
	Business Activities	0.004	(0.010)	-0.005	(0.006)	-0.001	(0.003)	-0.004	(0.010)	0.009	(0.012)	-0.004	(0.008)
	Public Admin., Def.	0.003	(0.013)	0.009	(0.007)	-0.004	(0.003)	0.014	(0.012)	0.013	(0.014)	-0.003	(0.012)
	Education	0.010	(0.016)	**-0.021** **	(0.009)	0.006	(0.005)	0.023	(0.016)	0.014	(0.018)	-0.015	(0.013)
	Health, Social Work	-0.005	(0.013)	0.013*	(0.007)	0.003	(0.004)	-0.004	(0.014)	0.022	(0.015)	-0.004	(0.011)
Wages Growth by Ind.[3]	Agric., Hunting, For.	0.037*	(0.020)	**-0.051*** **	(0.011)	**-0.014** **	(0.006)	0.030	(0.020)	**0.103*** **	(0.022)	**0.047*** **	(0.018)
	Mining & Quarrying	**-0.037*** **	(0.013)	**0.030*** **	(0.008)	**0.008** **	(0.004)	-0.022*	(0.013)	0.003	(0.016)	**0.025** **	(0.012)
	Manufacturing	0.058	(0.099)	**-0.274*** **	(0.055)	-0.052*	(0.029)	**0.228** **	(0.096)	**0.511*** **	(0.114)	**0.201*** **	(0.076)
	Elect., Gas, Water	-0.044	(0.027)	0.015	(0.014)	0.011	(0.007)	-0.029	(0.026)	0.020	(0.029)	-0.030	(0.023)
	Construction	-0.036	(0.034)	**0.055*** **	(0.018)	0.013	(0.010)	**-0.070** **	(0.033)	**-0.147*** **	(0.039)	-0.024	(0.030)
	Hotels, Restaurants	**0.236*** **	(0.059)	**-0.428*** **	(0.032)	**-0.077*** **	(0.016)	**0.294*** **	(0.059)	**0.509*** **	(0.066)	**0.292*** **	(0.054)
	Transport, Comms.	-0.063	(0.064)	-0.047	(0.042)	0.005	(0.020)	-0.038	(0.066)	**-0.171** **	(0.078)	0.003	(0.063)
	Financial Intermed.	-0.121	(0.078)	**0.234*** **	(0.043)	**0.052** **	(0.022)	-0.052	(0.073)	**-0.355*** **	(0.083)	-0.112*	(0.060)
	Other Business Act.	**-0.151** **	(0.061)	**0.285*** **	(0.032)	**0.045*** **	(0.017)	-0.116*	(0.060)	-0.045	(0.068)	-0.078	(0.054)
	Business Activities	0.069	(0.064)	**-0.175*** **	(0.029)	**-0.052*** **	(0.016)	0.036	(0.062)	0.106	(0.069)	**-0.189*** **	(0.047)
	Public Admin., Def.	0.039	(0.181)	**-0.201** **	(0.091)	0.025	(0.052)	0.314*	(0.179)	**0.559*** **	(0.202)	-0.054	(0.140)
	Education	-0.026	(0.162)	-0.129*	(0.078)	-0.065	(0.047)	0.280*	(0.159)	**0.465*** **	(0.169)	-0.032	(0.117)
	Health, Social Work	0.109*	(0.060)	**-0.240*** **	(0.033)	**-0.058*** **	(0.019)	**0.164*** **	(0.062)	**0.278*** **	(0.067)	0.021	(0.048)

Notes: (1) Dep. Var. takes a value 1(0) if the subject is (not) taken. (2) Standard errors (in brackets) clustered by Postcode District. (3) Economic variables vary by Local Authority. All other variables as defined above. (4) *, ** and *** indicate significance at the 10%, 5% and 1% levels respectively. All regressions include 167,291 observations, as well as fixed effects for School (3,261), Domicile Postcode District (2,646), Age (5) and Ethnicity (5).

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

Postgraduate education is a large and growing part of the higher education system in the UK. In 2000/01 there were 168,235 full-time postgraduates at universities in Great Britain. By 2010/11 the number of full-time students had grown to 304,320, taking the total number of postgraduates in higher education to more than 575,000 (HESA 2010). Around 10% of graduating first-degree students progressed directly into study for a higher qualification between 2004/05 and 2008/09.[16]

Recent reforms have focussed academic and policy-maker attention on first-degree students (Johnstone 2004, Chowdry *et al.* 2010, Barr 2010a, 2010b, Dearden *et al*. 2011). 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 and 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, pp.55). 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' (Browne 2010, pp.55). In an earlier review of postgraduate training in the UK, Department for Business, Innovation and Skills (BIS) (2010) calls for research to examine whether finance presents a barrier for potential postgraduate students, arguing that at present 'there is little in the way of robust

[16] Based on Destinations of Leavers from Higher Education survey from the Higher Education Statistics Agency and author's own calculations. See Section 3.5.

evidence on whether the cost of postgraduate study and the lack of student support prevent those who would otherwise have pursued postgraduate education from doing so' (BIS 2010, pp.48).

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

The paper makes a number of findings. Firstly, postgraduate fees increased faster than inflation between 2003/04 and 2008/09. Secondly, there are significant differences in tuition fees within and between institutions. Thirdly, the results suggest that higher fees reduce student demand for postgraduate places. In my preferred specification, a 10% increase in tuition fees is associated with a reduction in the probability of progressing to a postgraduate degree of between 1.7% and 4.5%. Finally, the results also suggest that there are significant differences in progression probabilities between students from different socio-economic groups, even after controlling for observable differences in academic attainment. The results raise questions about the relative lack of public funding to support research students above undergraduate level.

The remainder of this paper is structured as follows. Section 3.1 provides a brief examination of higher education funding in the UK. Section 3.2 surveys existing

academic work. Section 3.3 examines trends in postgraduate participation, while Section 3.4 introduces the empirical model. Section 3.5 summarises the data, Section 3.6 documents the results and Section 3.7 describes my robustness checks. Section 3.8 offers some discussion, conclusions and areas for future research.

3.1 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 and Dearden 2010, Dearden *et al.* 2011, Barr 2009, 2010a, 2010b, Adnett and Tlupova 2007). Starting in 1998/99, a series of reforms 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.[17]

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 qualifications (Table 3.1). At undergraduate level, students pay a common, centrally set tuition fee regardless of the subject they study or the institution they attend.[18] The larger proportion of teaching funding comes through formula-based grants

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

[18] The Higher Education Act 2004 introduced a number of changes which are detailed in Section 1.3 and elsewhere (Barr 2010a). Undergraduate institutions have had the ability to vary fees by subject up to a centrally set cap since 2006/07. In practice the majority of institutions priced their courses at this maximum fee. The only institution not to do so was Leeds Metropolitan University, which offered courses at a discounted rate between 2006/07 and 2008/09 (Times Higher Education 2011).

Table 3.1: Public & private per-student funding (£) for undergraduate & postgraduate study 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 Fee Income[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%)

Note(s): (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 Fee Income reflects 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 details.

from the HEFCs. These aim to equalise the amount of funding per equivalent full-time student within each subject area (HEFCE 2010). As shown in Table 3.1, the HEFCs make up the difference between the estimated costs of teaching (A) and the expected average contribution of the student (B), given in 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 3.1, the public subsidy for postgraduate students is substantial – particularly for students in the more expensive, band A subjects – but it is smaller than the undergraduate subsidy across the range of subjects and zero for the

'base' subjects. Based on Table 3.1, 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 3.1. 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 3.6 sets out my findings with regard to tuition fees, but it is clear that postgraduate fees differ from the type 'D' standard resource in the majority of cases.

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, the range of funding sources available to postgraduates is more limited. The primary providers of financial support for postgraduate study are the publicly funded Research Councils. These specialise along academic lines and offer a limited number of scholarships for postgraduate study, allowing students domiciled in the UK who intend to study for a Masters and continue to a PhD, to compete for public support to cover both living and tuition costs. Professional and Career Development Loans (PCDLs) are also available to cover postgraduate study, but the number of students taking these up is very small.[19] Some institutions also offer financial assistance or early payment discounts, while others offer their Bachelors students preferential rates if they progress

[19] BIS (2010) presents data suggesting that just 1,750 individuals, or 0.5% of the UK-domiciled postgraduate population, used PCDLs to fund their postgraduate study in 2008/09.

to postgraduate study at their undergraduate institution. BIS (2010) suggests that around 30% of postgraduate researchers and around 60% of taught postgraduate students receive no funding from either public or private providers.

3.2 Literature review

A rigorous analysis of the determinants of participation must confront a series of empirical challenges. Selection into universities and courses based on unobservable characteristics (Black and Smith 2004, Ehrenberg 2004, Hoxby 1997, Arcidiacono 2004, Chevalier and Conlon 2003, Long 2004) 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 my approach.

3.2.1 Undergraduate participation

Several recent papers examine post-secondary progression rates in the context of family income and socio-economic group. Galindo-Rueda, Marcenaro-Gutierrez and 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 wealthier 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 groups, 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 and Davies (2002) also use YCS data, and conclude that parental education, socio-economic class and State-school attendance all affect participation probabilities. Blanden and 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, differences between socio-economic groups 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 and 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.

3.2.2 Tuition fees

The introduction of undergraduate tuition fees in the UK created the potential for new papers examining student responses. Crawford and 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 and 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: tuition fees are of second order importance.

Dearden *et al.* (2011) use data on potential university entrants from the Labour Force Survey to examine the impact of reforms to tuition fees, grants and loans between 1992 and 2007. They attempt to control for differences in unobservable characteristics by dividing their data into cells of individuals who are observably similar and estimating for each cell separately. Their results suggest that a £1,000 increase in undergraduate fees is associated with a 3.9% reduction in demand for undergraduate places, while a £1,000 increase in maintenance grants is associated with a 2.6% increase in demand. Dolton and Lin (2011) use a large time-series dataset to look for structural breaks in participation rates in the UK and similarly conclude that student's participation behaviour does respond to financial incentives.

International evidence on the impact of fees on demand for higher education is more plentiful. Flannery and 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 and Ryan (2005) examine the impact of the Australian Higher Education Contribution Scheme on access, while Christofides, Hoy and Yang (2010) examine higher education participation in Canada. Chapman and 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 and 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 and Brinkman 1987, Heller 1997). Carneiro and 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 and Dearden 2010).

Recent work has also 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 concludes 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 individuals 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.

3.2.3 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 and 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 and Murphy (2010) estimate that achieving a 'good' degree 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%.[20]

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

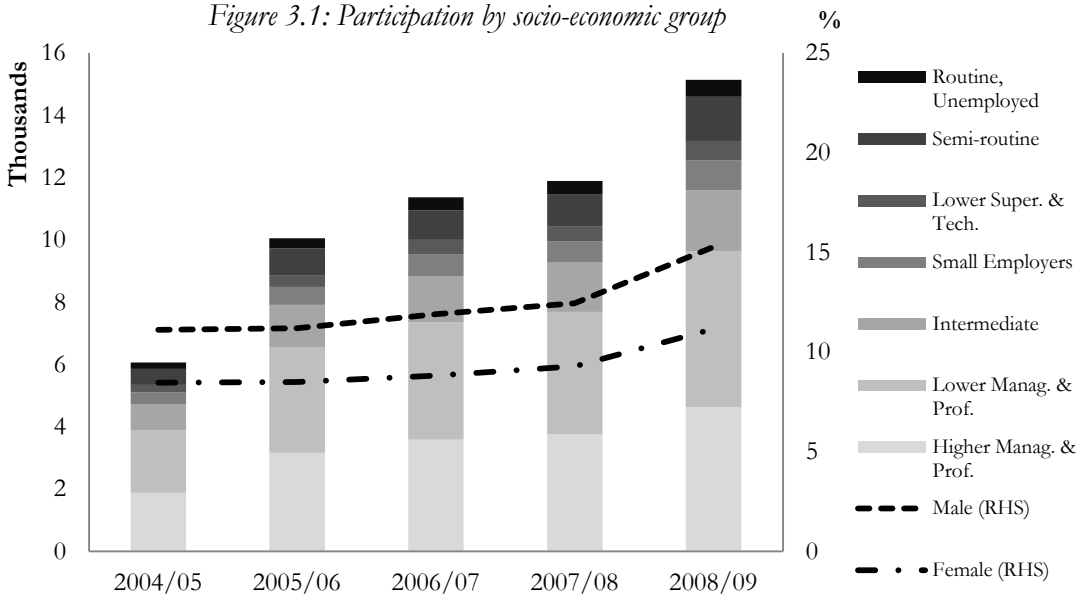
[20] Machin and Murphy (2010) define a 'good degree' as either First or Upper Second class honours.

3.3 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 and Lemeiux 2000), but the definition used in this paper is dictated by the 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 six- to nine-months after graduating with a first undergraduate degree. My 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 3.8 and is a potential limitation of this paper, but is similar to other work in the field (Kane 2004).

Figures 3.1 to 3.3 show descriptive statistics for my measure of participation based on the Destination of Leavers from Higher Education survey (see Section 3.5). Figure 3.1 shows the proportion of surveyed students who progress to a postgraduate degree. Average participation rates grew slowly until the final year of data, rising from 9.6% in 2004/05 to 12.8% in 2008/09. The male enrolment rate exceeded the female enrolment rate in every year, although participation rates for both genders increased sharply in 2008/09. Figure 3.1 also demonstrates that the surveyed student population progressing to postgraduate study is heavily weighted in favour of students from higher occupational groups. Students from Managerial and 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 and 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 3.1: Participation by socio-economic group



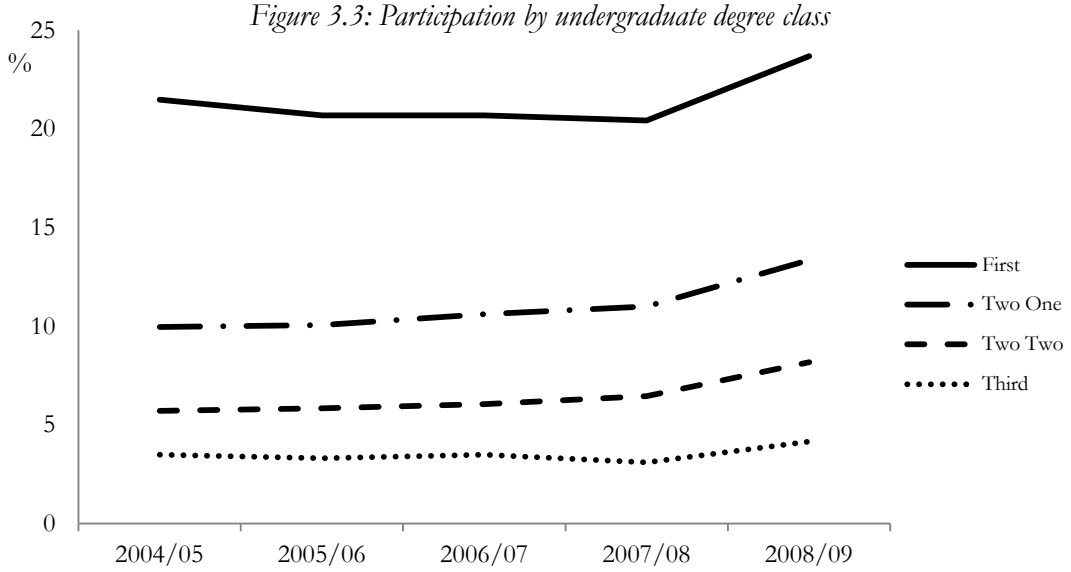
Note(s): (1) Based on HESA DLHE data and author's own calculations.

Figure 3.2: Cohort participation rates by socio-economic group

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

Figure 3.2 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 3.1, which implies that barriers to progression for poorer students earlier in education must play an important role (Galindo-Rueda, Marcenaro-Gutierrez and Vignoles, 2004). If

Figure 3.3: Participation by undergraduate degree class



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

postgraduate 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 3.3 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.

3.4 Empirical model

The empirical model is built around the reduced form human capital investment model set out in Rice (1999) and developed in Card and Lemieux (2000). The demand of an individual (n) for a postgraduate place to read a particular subject (s) at a particular institution (i), in year t, is given by:

$$x^*_{n,s,i,t} = A_0 + A_1 D_n + A_2 B_{s,i,t} + A_3 C_{s,i,t} \quad (1)$$

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

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

This specification presents several empirical challenges. Firstly, measures of the discounted future benefits and costs of a higher degree are likely to be (a) measured with significant error and (b) subject to uncertainty, both from the perspective of the researcher and the potential student. Secondly, unobserved characteristics are likely to influence students' choices about whether to pursue a particular postgraduate 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 $C_{s,i,t}$ poses two problems. Firstly, the choice to progress is usually binary: students either select into further study or opt out – which prevents analysis of how marginal changes in price bring about marginal changes in quantity. The binary nature of the decision is complicated because information about prices is incomplete. Postgraduate fees are only paid by graduates who choose to progress. For these students, it is possible to estimate how much they are likely to have paid for their course. However, no information is available about what fee

non-progressing students considered paying (and then rejected). As a result, undergraduates divide into two groups: those who progressed (and paid postgraduate fees) and those who did not (for whom no price information is available).

A further problem arises for those who do progress as 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 courses. 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 relationship between fees and student demand.

To help to mitigate these problems, the basic specification in (1) and (2) is modified and developed. An instrumental variables approach is implemented. My main equation is a linear probability model of the form:

$$Pr(x_{n,si,g,t} = 1) = \alpha_0 + \alpha_1 D_n + \alpha_2 O_{si,g,t} + \alpha_3 \bar{P}_{si,t} + f_{si} + f_t + f_g \qquad (3)$$

On the left-hand-side is the probability that a student enrolled in an undergraduate program defined by a particular subject-institution combination,[21] si, domiciled in a labour market area, g, at time t, chooses to progress to a higher degree. On the right-hand-side are the student's characteristics, D_n, and opportunity cost of a further course of study, excluding the costs of tuition fees, $O_{si,g,t}$. Tuition costs are included in $\bar{P}_{si,t}$, alongside fixed effects for each undergraduate subject-institution combination, f_{si}, each graduating cohort, f_t, and each labour market area of pre-university domicile, f_g.

Incorporating the arrays of fixed effects in (3) has several important consequences. Firstly, the fixed effects for each subject-institution combination control

[21] See Appendix 3A for a detailed breakdown of the subject classification used in this paper.

for the common, time invariant unobserved characteristics of both undergraduate students and the department at which they are studying. This helps to reduce the impact of confounding effects in the analysis which follows, but requires two additional assumptions: (a) that students reveal information about their unobserved characteristics, including their preference for research and innate ability, when they select into their undergraduate courses, and (b) that the unobserved characteristics of the courses and the students on them are time-invariant. Secondly, as set out in the previous paper, the arrays of fixed effects for domicile and cohort help to control for selection into areas of residence and cohort specific effects.

3.4.1 Predicting fees for participating and non-participating students

To avoid the problems associated with imperfect price information detailed above, the tuition fee variable, $\bar{P}_{si,t}$, is designed to capture the price that each student might reasonably expect to pay for a course of higher study. This approach allows me to assign an 'expected fee' to each student regardless of whether they choose to progress to postgraduate study and is consistent with an intention to treat approach. The assumed underlying process is one in which a student's progression behaviour is conditioned by the perceived costs and benefits of a course of further study. A negative, significant coefficient on $\bar{P}_{si,t}$ is therefore interpreted as evidence that higher expected tuition fees discourage students from remaining in higher education. Conversely, a positive, significant coefficient on $\bar{P}_{si,t}$ is interpreted as evidence that higher tuition fees encourage students to progress to further study.

A wide range of plausible mechanisms may be used to estimate student's expectations about the costs of a higher degree. Details of the micro-level data are provided in the following section, but Table 3.2 analyses the destinations of the subset

of students for whom information is available on both their undergraduate and postgraduate universities. Columns (1)-(4) demonstrate that a majority of male (57.3%) and a large minority of female students (46.8%) choose to stay at their undergraduate institution for postgraduate study.

To examine student destinations in more detail, I calculated the share of undergraduates from each university, i, progressing to each other university, j, for postgraduate study. The final column of Table 3.2 suggests that the undergraduate institution, i, retains the largest fraction of progressing students in the vast majority of cases. As a result I expect the cost of postgraduate courses at the student's undergraduate institution to play an important role in determining fee expectations.

Unfortunately the micro-level data does not contain information about the subject the student chooses to study at postgraduate level, which prevents me from assigning fees with precision. This is a limitation of the paper which is returned to in Section 3.8. With this information, there are several possible methods of calculating expected postgraduate fees:

DEFINITION [1]: Use the average cost of a postgraduate degree in the student's undergraduate subject at their undergraduate institution. Adopting the subscripts s, i and t to denote subjects, institutions and time, and specifying P as the price of a higher degree course: Def. 1: $E(P_{s,i,t}) = \bar{P}_{s,i,t}$

DEFINITION [2]: Use the average cost of a postgraduate degree at the student's undergraduate institution. This approach allows students to switch subjects between Bachelors and Masters levels. Def. 2: $E(P_{s,i,t}) = \bar{P}_{i,t}$

DEFINITION [3]: Students may change institutions between undergraduate and postgraduate levels (Table 3.2). To allow for this, I assign to each progressing student the cost of a higher degree in their undergraduate subject at their observed postgraduate

Table 3.2: Stayers and movers: Undergraduate to postgraduate study[1,2]

	Male – (%)		Female – (%)		% Institutions retaining largest share of their undergraduates[3]
	Stay	Move	Stay	Move	
2004/05	55.8	44.2	45.0	55.0	84.9
2005/06	56.4	43.6	45.9	54.1	89.3
2006/07	58.2	41.8	47.3	52.7	90.7
2007/08	57.3	42.7	47.4	52.6	91.8
2008/09	58.4	41.6	48.1	51.9	92.4
Total	57.3	42.7	46.8	53.2	89.8

Note(s): (1) Based on Destination of Leavers from Higher Education (DLHE) survey provided by HESA. See Section 3.5 for details. (2) Total sample size: 93,025. (3) Proportion of undergraduate institutions in which the largest fraction of undergraduates remain at the institution for postgraduate study.

institution, j. I analyse this fee as a function of the student's individual characteristics and the cost of a course in their undergraduate subject at their undergraduate institution: $P_{s,j,t} = f(D_n, \bar{P}_{s,i,t})$. Using the coefficients from this regression, I predict the price each undergraduate (both those students who continue and those who do not) would need to pay for a postgraduate degree in their undergraduate subject. This approach allows students to change institutions.

DEFINITION [4]: The final possible definition allows students to change subjects and institutions between undergraduate and postgraduate levels. I begin by assigning to each progressing student the average cost of a higher degree at their observed postgraduate institution, j. This fee is then analysed as a function of the student's characteristics and the average cost of a postgraduate course at their undergraduate institution: $P_{j,t} = f(D_n, \bar{P}_{i,t})$. Using the coefficients from this regression I predict the price each undergraduate (both those students who continue and those who do not) would need to pay for a postgraduate degree.

To ensure the robustness of my results, I adopt all four definitions.

3.4.2 Instrumenting for expected postgraduate fees

Having established an 'expected fee' for each student, regardless of whether they progress or not, I instrument for the expected fee in a first stage. To help to mitigate the likely endogeneity of fee levels, a strategy is designed to capture variation in fees which is not attributable to changes in home student demand. To this end (4) is estimated in addition to (3):

$$\bar{P}_{si,t} = \beta_0 + \beta_1 D_n + \beta_2 O_{si,g,t} + \beta_3 \left(FX_t * OV_{si,t=0}\right) + \beta_4 \left(t_{si,t} * S_{si,t=0}\right) + f_{si} + f_t + f_g \quad (4)$$

Equation (4) models expected postgraduate tuition fees as a function of the other explanatory variables in (3) and two instrumental variables. First, following a shift-share approach (see Bartik 1991), the proportion of students on each subject-institution combination who are from overseas in the two years preceding my analysis ($OV_{si,t=0}$) is interacted with the trade-weighted movement in the Sterling exchange rate (FX_t). 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. Consequently I expect β_3 to be negative.

The second instrument is the level of the total HEFC teaching grant received by each institution divided by the number of full-time academic staff, $t_{si,t}$. 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 in the two years prior to my regression analysis ($S_{si,t=0}$). 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. As a result I expect the estimate of β_4 to

be positive. For the system of equations to be identified, I need β_3 and β_4 to be both individually and jointly significant at conventional levels.

3.5 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 and McCann 2006, 2009, Faggian, McCann and Sheppard, 2006, 2007a, 2007b, Naylor and Smith 2004, Smith and Naylor 2005, Wales 2010). The DLHE is a large survey of graduates from universities in the UK six to nine 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 district of domicile. The DLHE also provides the 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', six to nine months after completing their first undergraduate degree.

Starting with all full-time, undergraduate students taking subjects other than Medicine & Dentistry, domiciled in Great Britain who take between three and five years to complete their degree, graduating between 2004/05 and 2008/09, who respond to the DLHE yields a sample of 786,750 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, the remaining sample size is 563,740. Some further attrition occurs as the data on fees, university staff records and HEFC funding is incomplete, leaving a sample of students which slightly over-represents

younger students from well-off backgrounds, although these differences are relatively slight.[22] Summary statistics on included students are shown in Table 3.3.

3.5.1 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 no systematic 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 2003/04 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 Academic Classification of Subjects (JACS) level (Appendix 3A). 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.

[22] 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.

Table 3.3: Summary statistics of student characteristics

	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				
Higher Manag. & Prof.	59,680	*20.6*	71,830	*19.5*
Lower Manag. & Prof.	69,620	*24.0*	91,850	*24.9*
Intermediate	30,260	*10.4*	40,140	*10.9*
Small Employers	14,880	*5.1*	20,720	*5.6*
Lower Super. & Tech.	10,500	*3.6*	14,410	*3.9*
Semi-routine	20,930	*7.2*	29,480	*8.0*
Routine, Unemployed	9,440	*3.3*	13,530	*3.7*
Unknown	74,490	*25.7*	86,870	*23.6*

Note(s): (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 3.5 and 3.8.

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.[23] 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 55,419, or 85.5%. Among the missing data are a small number of institutions who 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.[24] Finally, to reduce the potential for bias introduced through human error, the dataset was aggregated to the JACS 1 level of detail (See Appendix 3A for details of the subject breakdown).

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 (Table 3.4) increased 31.8% between 2003/04 and 2009/10, from £3,232 to just over £4,261. This rate of increase is significantly higher than the general price level, which was just 18.4% higher in 2010 than in 2003 (ONS 2012).[25] However, this average masks significant differences in across subjects. Business Studies courses (comprising Business Studies, Management, Marketing, Finance, Accounting and Human Resource Management) were the most expensive over the period, ranging from £4,920 in 2003/04

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

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

[25] This figure is based on the Consumer Prices Index provided by the Office for National Statistics and the author's own calculations.

Table 3.4: UK tuition fees 2003/04-2009/10

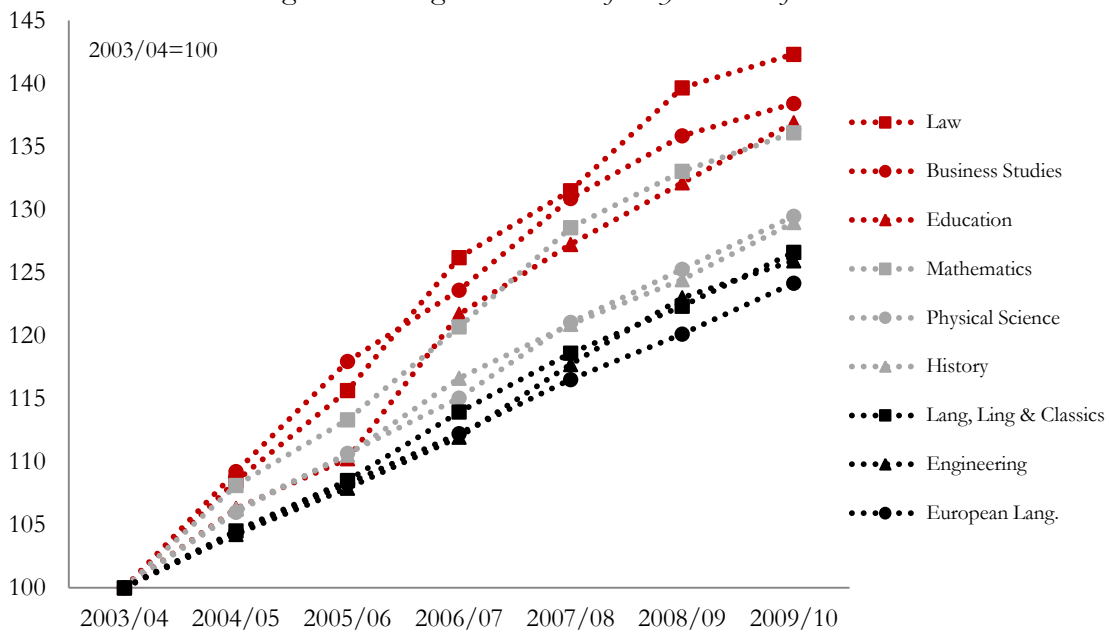
	£, current			*£, current by institutional group*			
	UG[1]	Public Goods[2]	FOI Dataset[3]	Russell Group[5]	1994 Group[6]	Million+[7]	University Alliance[8]
2003/04	1125	3048	3232	3339	3200	3079	3151
2004/05	1150	3031	3439	3684	3326	3233	3320
2005/06	1175	3441	3620	3919	3566	3397	3471
2006/07	3000[4]	3730	3801	4104	3666	3595	3666
2007/08	3070	3970	3970	4266	3772	3819	3833
2008/09	3145	3989	4121	4487	3909	3882	3948
2009/10	3225	4191	4261	4595	4107	4145	4095

Note(s): (1) Regulated undergraduate annual fee levels for students starting in that academic year. (2) 'Standard' 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 polytechnics. (8) University Alliance is a group of 23 universities which focus on business courses.

to a little over £6,810 in 2009/10. Least expensive were Education courses, which varied from an average of £2,780 in 2003/04 to £3,720 in 2009/10. Among the fastest climbing courses (Figure 3.4) were Law degrees (rising 42% during the period) and Business Studies (38%), while the lowest relative increases came in European Languages (24%) and Engineering (26%). The Russell Group of research institutions has charged the highest average fees throughout the period, rising from £3,339 in 2003/04 to £4,595 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 3.1 and 3.5). 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. The deregulated nature of postgraduate tuition fees allows me to side-step the empirical difficulties that a single, universal policy shift presents for estimating changes in student demand (Crawford and Dearden, 2010).

Figure 3.4: Postgraduate tuition fees by academic field



Note(s): Based on FOI data requested for this paper and author's own calculations

Table 3.5: 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

Note(s): Based on data gathered by FOI requests and author's own calculations. Each observation is an observed course of study.

Finally, to estimate expected fees using definitions [3] and [4] above, two preliminary regressions were run as detailed in Section 3.4. Definition [3] involves regressing the average cost of a higher degree in the student's undergraduate subject at their observed postgraduate institution, against individual characteristics and the average cost of a course in their undergraduate subject at their undergraduate institution.

Definition [4] involves a similar regression of the average cost of a higher degree at the student's observed postgraduate institution, against individual characteristics and the average cost of a higher degree at their undergraduate institution. Both regressions include only those students who are observed progressing to postgraduate education and who report both their undergraduate and postgraduate institutions.

The results of these analyses are shown in Table 3.6. In both regressions, the student's undergraduate institution fees have a large, positive and significant impact on expected postgraduate fees. Higher than average fees are recorded for students with stronger academic results, students who attended private secondary schools and students who are from higher socio-economic groups. Undergraduates from ethnic minorities also appear to pay more on average than white students. These coefficients are used to predict expected postgraduate fees for all students, regardless of whether they choose to progress or not. Controls for all student and local economic characteristics included in Table 3.6 are also included in the subsequent participation regressions.

3.5.2 Local economic data

The empirical specification set out in (3) also demands measures of the opportunity cost 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 in my regressions to capture (1) the likelihood of a student finding of employment if they choose 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

Table 3.6: Estimated postgraduate tuition fees: Fees definitions [3] and [4][1, 3]

		Definition [3]		*Definition [4]*	
		β	*s.e*	*β*	*s.e*
Av. PG Fee in UG Subj. at PG Inst.[2]		**0.593*** **	(0.022)		
Av. PG Fee at PG Inst.[2]				**0.572*** **	(0.004)
Female		**-0.004** **	(0.002)	**-0.005*** **	(0.002)
Ethnicity	Black	**0.021*** **	(0.007)	**0.014** **	(0.006)
	Asian	**0.034*** **	(0.004)	**0.031*** **	(0.004)
	Other	**0.014*** **	(0.005)	**0.014*** **	(0.005)
	Unknown	0.004	(0.007)	-0.002	(0.007)
School Type	Private	**0.019*** **	(0.003)	**0.031*** **	(0.003)
	Unknown	0.002	(0.004)	0.004	(0.003)
UG Degree Class	1	**0.036*** **	(0.003)	**0.042*** **	(0.003)
	2-1	**0.021*** **	(0.003)	**0.019*** **	(0.002)
	Third	-0.017*	(0.009)	-0.006	(0.006)
	Unknown	0.003	(0.009)	0.004	(0.01)
Socio-economic group	Lower Manag. & Prof.	-0.004*	(0.002)	-0.003	(0.002)
	Intermediate	**-0.009*** **	(0.002)	**-0.009*** **	(0.002)
	Small Employers	-0.006*	(0.003)	-0.007*	(0.003)
	Lower Super. & Tech.	-0.004	(0.004)	-0.003	(0.004)
	Semi-routine	**-0.011*** **	(0.003)	**-0.006** **	(0.003)
	Routine, Unemployed	**-0.013*** **	(0.004)	**-0.012*** **	(0.004)
	Unknown	-0.003	(0.003)	-0.002	(0.003)
School Results	2nd Quartile	-0.004	(0.003)	-0.002	(0.002)
	3rd Quartile	-0.001	(0.003)	0.002	(0.003)
	4th Quartile	0.002	(0.004)	0.003	(0.003)
UG Degree Duration		0.001	(0.003)	0.003	(0.002)
Dom. Econ.	Unemployment[2]	-0.021	(0.039)	-0.004	(0.036)
	Hourly Earnings[2]	-0.002	(0.012)	-0.014	(0.011)
	Year 2005	**-0.012*** **	(0.003)	**-0.014*** **	(0.003)
	Year 2007	**0.019*** **	(0.003)	**0.022*** **	(0.003)
	Year 2008	**0.037*** **	(0.003)	**0.043*** **	(0.003)
	Year 2009	**0.049*** **	(0.004)	**0.056*** **	(0.004)
Controls	Age	YES		YES	
	Domicile TTWA FE	YES		YES	
	Subject*Institution FE	YES		YES	
Observations		51,270		52,440	
F-stat		**34.61*** **		**51.70*** **	

Note(s): (1) Dep. Var. is the average cost of a postgraduate course in the student's undergraduate subject at their observed postgraduate institution (Definition Three) and the average cost of a postgraduate course at the student's observed postgraduate institution (Definition Four). Std. Errors Clustered at the subject-institution level. (2) These variables are continuous. (3) *, ** and ** reflect significance at the 10%, 5% and 1% levels respectively.

the UK based on the 1998 definitions.[26] These definitions (see Panel A of Figure A1 in Appendix 3A) 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

[26] 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. See Appendix 3A.

are defined as the natural logarithm of average reported gross hourly earnings in each geographical area.

3.6 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) of 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 expected 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 3.7, 3.8 and 3.9. The full results using fee definition [1]-[4] are available in Appendices [B]-[E].

3.6.1 Expected tuition fees

Table 3.7 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, six to nine months after graduating with their first undergraduate degree, and zero otherwise. Explanatory variables were introduced gradually to allow comparison of the estimated coefficients in both the OLS (Specifications 1-6) and IV (7-12) estimations. Each specification is run for each definition of expected postgraduate fees. The coefficients reported in Table 3.7 therefore reflect the results of 48 separate regressions.

Details of how expected postgraduate tuition fees are calculated are included in Section 3.4. The first definition assigns each student the cost of taking a higher degree

in the student's undergraduate subject at their undergraduate institution. The second assigns the average cost of taking a postgraduate degree at their undergraduate institution (allowing students to switch subjects). The third and fourth definitions estimate expected fees using the results of supplementary analysis. This work, reported in Section 3.5, analyses the price paid by continuing students on each undergraduate course as a function of their individual and academic characteristics as well as the average cost of courses at their undergraduate institution.

Across the range of specifications, the coefficients estimated by OLS tend to be smaller than those produced by the IV procedure. Using simple averaging, Fee Definitions [1] and [2] produce a small, negative but insignificant coefficients on expected fees. Using the results of the preliminary regressions in Fee Definitions [3] and [4] yields more interesting results. These measures initially suggest that students who expect to pay higher tuition costs are more likely to progress to further study. In specification (1), a 1% point increase in expectations of postgraduate tuition fees raises the likelihood of progressing to higher study by between 0.30% (Definition [3]) and 0.51% (Definition [4]). This counter-intuitive finding is reversed once controls for academic performance and parental background are introduced in specifications (3), (4) and (5). In these regressions, expected postgraduate fees have a small, negative but statistically significant impact on participation probabilities.

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 effects) and institution-by-subject fixed effects (1,381) in specification (7), the results suggest that a 1% increase in expected tuition fees is associated with a reduction of between 0.14% and 0.48% in the probability of participation. Fee Definitions [1]-[3] are significant at the 1% level and

Table 3.7: Expected postgraduate tuition fees & participation probabilities[1,8]

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*	*(12)*
ln(Exp. Fees Def. One)[2]	-0.007	-0.006	-0.005	-0.006	-0.007	-0.006	**-0.140*** **	**-0.130*** **	**-0.167** **	**-0.172** **	**-0.167** **	**-0.171** **
	(0.007)	(0.007)	(0.007)	(0.007)	(0.008)	(0.008)	(0.034)	(0.034)	(0.070)	(0.072)	(0.071)	(0.073)
ln(Exp. Fees Def. Two)[2]	-0.009	-0.008	-0.006	-0.007	-0.008	-0.007	**-0.271*** **	**-0.251*** **	**-0.280** **	**-0.287** **	**-0.283** **	**-0.288** **
	(0.010)	(0.010)	(0.012)	(0.011)	(0.012)	(0.012)	(0.083)	(0.076)	(0.112)	(0.114)	(0.113)	(0.115)
ln(Exp. Fees Def. Three)[2]	**0.304*** **	**0.265*** **	**-0.038*** **	-0.020	-0.020	-0.008	**-0.273*** **	**-0.268** **	**-0.257** **	**-0.255** **	**-0.250** **	**-0.258** **
	(0.042)	(0.039)	(0.012)	(0.012)	(0.012)	(0.014)	(0.104)	(0.113)	(0.106)	(0.105)	(0.106)	(0.110)
ln(Exp. Fees Def. Four)[2]	**0.506*** **	**0.460*** **	**-0.095*** **	**-0.054*** **	**-0.055*** **	-0.016	**-0.480** **	**-0.466** **	**-0.439** **	**-0.435** **	**-0.433** **	**-0.447** **
	(0.042)	(0.041)	(0.019)	(0.019)	(0.019)	(0.023)	(0.201)	(0.189)	(0.179)	(0.177)	(0.177)	(0.182)
Controls												
Subject*Inst., Year FE	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
Sch. Type & Performance[4]			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[5]				Y	Y	Y				Y	Y	Y
Domicile TTWA FE[6]						Y						Y
Sample[7]	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
Multivariate F-test:												
Def. One:							**54.95*** **	**54.96*** **	**29.09*** **	**28.83*** **	**28.71*** **	**28.74*** **
Def. Two:							**65.70*** **	**65.80*** **	**79.74*** **	**81.18*** **	**83.69*** **	**83.27*** **
Def. Three:							**32.26*** **	**34.05*** **	**34.43*** **	**34.88*** **	**34.47*** **	**34.75*** **
Def. Four:							**73.54*** **	**78.99*** **	**83.24*** **	**85.24*** **	**77.93*** **	**83.03*** **

Note(s): (1) Dep. Var. 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 defined in four different ways. Each specification is estimated separately for each expected fees definition, see Section 3.4. (3) Personal characteristics include dummy variables for age, gender, ethnicity and disability status. (4) School type is defined as State, Private or Unknown. School Performance includes dummies for the quartile position of students in the A-level point score distribution in their year of undergraduate commencement. (5) Labour market effects consist of average hourly earnings and the rate of unemployment in the student's domicile travel-to-work-area. (6) 219 domicile travel to work areas are included, see Section 3.4. (7) Specifications (5)-(6) and (11)-(12) include only students obtaining Lower Second Class UG degrees or above. (8) *, ** and ** reflect significance at the 10%, 5% and 1% levels respectively.

are only marginally affected by the introduction of individual level characteristics in (8), while Fee Definition [4] is significant at the 5% level.

Specification (9) incorporates controls for the student's socio-economic group and academic characteristics, including their secondary school type, exam performance aged 18 and their undergraduate degree class. These variables serve to increase the magnitude and standard error of the coefficients 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 between 0.17% and 0.44%.

To more accurately focus on the effective demand for postgraduate places, specifications (5), (6), (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 (11) nor (12) significantly alters the results of (10). (12), which reflects the preferred specification, suggests that a 1% increase in expected tuition costs is associated with a reduction in the probability of progression by between 0.17% and 0.45%.

The disparity between the OLS and IV results is significant and suggests that 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. My broader measures of expected fees which make use of limited information about undergraduate destinations are superior in this respect and offer the most intuitive results. Secondly, the smaller OLS results are consistent with a mechanism for setting fees which is sensitive to patterns of demand. Stronger demand for a particular institution-subject combination will lead to higher fee levels.

Conversely, weaker demand for a postgraduate course will lead to lower fee levels (or lower rates of increase). 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 dependent upon several 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 the first stage regressions are shown in full in the Appendix and summarised in Tables 3.7 and 3.8. In Table 3.7, the results of multivariate F-tests for the exclusion restrictions are shown (Angrist and Pischke 2009, Stock, Wright and Yogo 2002), while Table 3.8 reports the estimated coefficients on the instruments from the most detailed specifications.

These results bear out expectations. The teaching salary instrument is positively and significantly correlated with postgraduate tuition fees in each specification and for each Fees Definition, 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 Stock, Wright and Yogo (2002) recommended level of 10.

Table 3.8: First stage IV results for expected postgraduate fees[1,6]

Fees Definition:	*[1]*	*[2]*	*[3]*	*[4]*
Instruments				
Teaching grant per academic staff FPE, subject weighted[2]	**0.040*** ** (0.009)	**0.039*** ** (0.003)	**0.024*** ** (0.005)	**0.023*** ** (0.002)
Overseas share * Trade weighted Sterling[3]	**-0.033** ** (0.015)	**-0.018** ** (0.008)	**-0.021** ** (0.009)	**-0.012** ** (0.005)
Controls (see Table 3.7)[4]	Y	Y	Y	Y
Specification	(12)	(12)	(12)	(12)
Sample[5]	Selection	Selection	Selection	Selection
Diagnostics				
Observations	463,197	463,197	430,091	432,003
F-stat	**16.60*** **	**28.86*** **	**1786.27*** **	**5074.29*** **
Multivariate F-test of Excl. Res.	**28.74*** **	**83.27*** **	**34.75*** **	**83.03*** **

Note(s): (1) Dependent variable is the natural logarithm of the average cost of a course of higher study by subject and institution, see Section 3.4. 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 2003/04. (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 3.7. (5) Specification shown (12) includes only students obtaining Lower Second Class UG degree classification or above. (6) *, ** and ** reflect significance at the 10%, 5% and 1% levels respectively.

3.6.2 Socio-economic group

Table 3.9 summarises the findings with respect to socio-economic group,[27] reporting the estimated coefficients on group dummies from specification (12) across each definition of expected fees. In each case the base category are students from Higher Managerial & Professional occupations and the estimated coefficients reflect the change in participation probabilities associated with a student coming from a different socio-

[27] 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 3.9 for categories.

Table 3.9: Socio-economic group and participation probabilities[1,4]

Fees Definition:	*[1]*	*[2]*	*[3]*	*[4]*
Socio-economic group				
Lower managerial & Professional occupations	**-0.005***** (0.001)	**-0.005***** (0.001)	**-0.006***** (0.002)	**-0.007***** (0.002)
Intermediate occupations	**-0.012***** (0.002)	**-0.012***** (0.002)	**-0.015***** (0.002)	**-0.017***** (0.002)
Small employers & own account workers	**-0.016***** (0.002)	**-0.016***** (0.002)	**-0.018***** (0.002)	**-0.020***** (0.002)
Lower supervisory & technical occupations	**-0.015***** (0.002)	**-0.015***** (0.002)	**-0.017***** (0.002)	**-0.017***** (0.002)
Semi-routine occupations	**-0.013***** (0.002)	**-0.013***** (0.002)	**-0.017***** (0.002)	**-0.017***** (0.002)
Routine occupations & Never worked and long-term unemployed	**-0.018***** (0.002)	**-0.018***** (0.002)	**-0.022***** (0.003)	**-0.024***** (0.003)
Not classified	-0.001 (0.002)	0.000 (0.002)	-0.002 (0.002)	-0.001 (0.002)
Controls (see Table 3.7)[2]	Y	Y	Y	Y
Specification	(12)	(12)	(12)	(12)
Sample[3]	Selection	Selection	Selection	Selection
Estimation Method	IV	IV	IV	IV

Note(s): (1) Dep. Var. 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. Excluded category is Higher managerial and Professional occupations. (2) Controls included are shown in Table 3.7. (3) Results shown are drawn from regressions using specification (12) which includes only students obtaining Lower Second Class UG degree classification or above. (4) *, ** and ** reflect significance at the 10%, 5% and 1% levels respectively.

economic group. In contrast to the results on expected tuition fees, these coefficients are relatively stable across specifications.

Compared to students from Higher Managerial & Professional occupations, students from lower socio-economic groups appear less likely to progress to postgraduate study. The magnitude of this effect varies, from between -0.5% and -0.7% for students from Lower Managerial & Professional occupations, to between -1.8% and -2.4% for students from the 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 between 1.5% and 2.0% less likely to progress to postgraduate study. As can be seen in full in

the Appendices, these results are consistent across specifications and estimation methods.

3.6.3 Other results

In addition to the core results with respect to fees and socio-economic background, the findings of this paper shed light on a range of other factors which affect the probability of progressing to postgraduate study. As is shown in the Appendix, the results suggest that women are between 3.1% and 3.4% less likely to progress to postgraduate study than men, while students from non-white backgrounds are significantly more likely to remain in higher education. After controlling for common, time-invariant unobservable characteristics, Specification (12) suggests that Black and Asian students are 5.8-6.6% and 5.2-6.8% more likely respectively to progress to a further degree than equivalent white students. Students who report having a disability are also significantly more likely to remain in higher education.

The effect of academic performance on the probability of a student progressing to a higher degree is broadly as expected. Students who obtained First Class or Upper Second Class undergraduate degrees are 13.4-16.0% and 4.1-5.3% more likely to remain in higher education than students who obtained Lower Second Class degrees. School level results also appear to have a residual significant effect, with better performing students more likely to remain in higher education. Attendance at a Private school prior to university significantly increases the likelihood of progression by between 0.9% and 2.4%, confirming the findings of Machin and Murphy (2010).

Finally, the effect of local economic conditions on student's decisions varies across specifications. In specifications (5) and (11), before the introduction of fixed effects to control for endogenous residential selection, earnings around the student's

domicile are found to have a significant if relatively small impact on progression probabilities. In specification (11), a 10% increase in the level of hourly earnings is associated with a reduction of between 0.2% and 0.3% in the probability of remaining in higher education. A similar increase in youth unemployment is associated with an increase in progression probabilities of between 0.2% and 0.5%.

Including an array of fixed effects for domicile travel to work area in specifications (6) and (12) has the effect of shifting the identification strategy onto changes in unemployment and earnings over time. These results vary across Fee Definitions. Using definitions [1] and [2], earnings growth has no statistically significant impact on progression rates, while growing rates of youth unemployment reduce the probability of participation. Using definitions [3] and [4], youth unemployment continues to exert downwards pressure on participation probabilities, but growing earnings also reduces the likelihood of progression. Both effects are relatively slight. Taken together, these coefficients suggest that students from relatively wealthy areas are marginally more likely to remain in higher education after completing their undergraduate degrees, but that a poorer economic outlook encourages students to look for employment rather than pursue further study.

3.7 Heterogeneity and robustness of the effects

To check that these results are not the product of my assumptions, a number of robustness checks were carried out. Firstly, as reported in Section 3.4, a number of different methods were used to calculate the expected postgraduate tuition fee for each student. Adopting different assumptions allowed me to control for students who change subject, institution or both between undergraduate and Masters levels. The consistency

of the findings across expected fee definitions provides strong evidence that expected postgraduate fees do influence student behaviour.

Secondly, to examine the robustness of my results to changes in the instrumental variables, IV regressions were performed for each fee definition using one instrument at a time. Using just the teaching cost instrument, the magnitude and significance of the coefficient on expected fees remained similar to that produced using both instruments. In each case teaching costs are positively and significantly correlated with expected postgraduate fees and in each case the variable produces an F-stat greater than ten. Using only the trade-weighted Sterling index in the first stage produced coefficients on fees of a similar magnitude, but a slightly lower level of significance. In each case, trade-weighted movements in Sterling are significantly and negatively associated with expected postgraduate fees and in two of the four definitions, the coefficient on expected fees is significant at the 10% level. However, on its own the exchange rate instrument is not sufficiently powerful to pass the first-stage multivariate F-test (Stock, Wright and Yogo 2002).

To examine whether students from different backgrounds differ in their responses to expected postgraduate tuition fees a further set of IV regressions were run using interaction terms between expected tuition fees and (1) gender, (2) socio-economic background and (3) ethnic group. In the first case, the two fees terms (expected postgraduate fee and expected postgraduate fees interacted with the Female dummy variable) were instrumented for using the interacted teaching costs and exchange rate variables (teaching costs and exchange rate movements, and these terms interacted with the Female dummy variable). The results of this process suggest that men and women respond to expected postgraduate fees in broadly the same way, as none of the interacted fees terms were significant across the different expected fee definitions.

In the second case, a similar identification strategy was adopted, interacting both the fees variable and the instruments. As before, none of the expected fee interaction terms were significant, suggesting that fees have a similar impact across students from different socio-economic groups. The ethnic group interactions suggest that Asian students are significantly more affected by expected postgraduate fees than white students, although the magnitude and significance of this effect varies. The coefficient on expected postgraduate fees interacted with the Asian dummy variable is negative and significant at the 5% level using three of the four fees definitions, while the fourth is significant at the 10% level. The magnitude of the coefficient on the interacted variable ranges between -0.09 and -0.14, although as with the other robustness regressions, the interacted instruments perform relatively poorly in the first stage, placing the reliability of this result in question.

Finally, a set of IV regressions were estimated including more detailed variables examining the return to specific types and levels of qualification. In a preliminary stage (unreported), micro-level Labour Force Survey data was used to model (a) undergraduate earnings, (b) postgraduate earnings and (c) unemployment risk for those aged 18-24 as a function of individual, academic and geographical characteristics. The coefficients from these regressions were used to impute forgone earnings (if the student chose not to progress), likely earnings (if the student chose to take a higher degree) and the risk of unemployment (if the student chose not to progress), and capture variation in the labour market returns of different qualifications over time. By their construction, these variables go some way towards addressing the risk that the unobserved returns to particular courses vary significantly over time. In practice, these measures had little impact on the significance of the estimated fees coefficient, but did marginally attenuate the size of the effect. Using these more detailed measures of the return to different levels of qualification produced coefficients of between -0.146 and -0.375 depending on

the definition of expected fees adopted. In each case the estimated coefficient is statistically significant at conventional levels.

3.8 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 bias to assess the extent to which postgraduate tuition fees impact on the 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. The preferred specification, which partially controls for unobserved individual and departmental characteristics and which attempts to deal with the endogeneity of postgraduate fees, suggests that a 10% increase in expected postgraduate tuition fees is associated with a reduction in the probability of progressing to postgraduate study of between 1.7% and 4.5% depending on the approach adopted. 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 between 1.8% and 2.4% 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.

Two areas present scope for future work. Firstly, the definition of participation used here only captures 'direct entry' postgraduate students. As a consequence, those who study for a higher degree after a spell of other activity are outside the scope of this paper. 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. Secondly, 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 the 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 these 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. My 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 reconsider 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.

3A Appendix A

Table A.1: 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

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

Figure A.1: 1998 Travel to work areas: Original

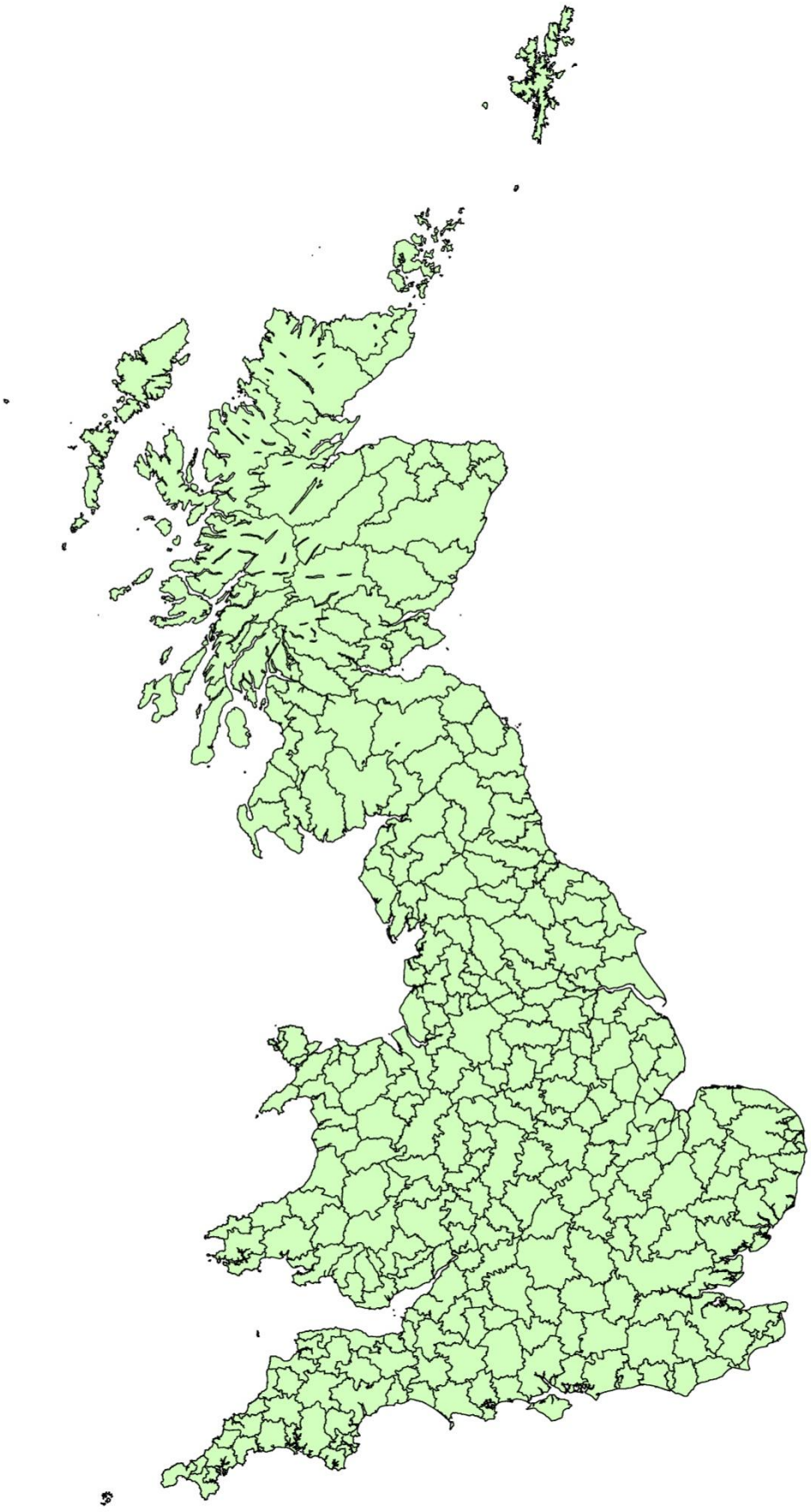
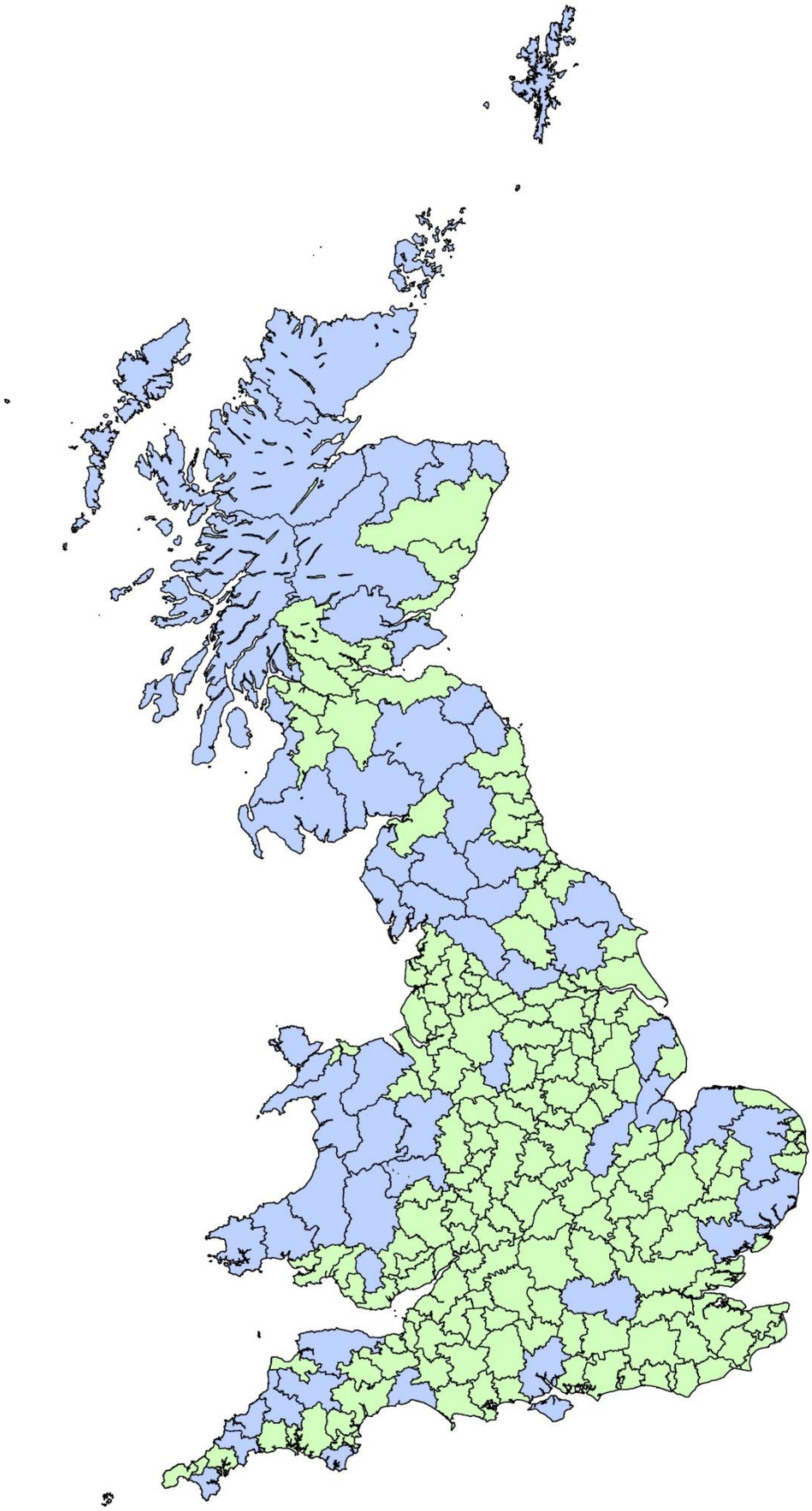


Figure A.1: 1998 Travel to work areas: Modified



Note(s): Combined TTWAs are shown in blue. Maintained, original TTWA shown in green.

3B Appendix: Table B.1: Fees Definition [1]: Main Equation[1, 4, 5]

		(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, 3]		-0.007	0.007	-0.006	0.007	-0.005	0.007	-0.006	0.007	-0.007	0.008	-0.006	0.008
Female				**-0.022*** **	0.001	**-0.029*** **	0.001	**-0.029*** **	0.001	**-0.031*** **	0.001	**-0.031*** **	0.001
Disability				**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
	Asian			**0.033*** **	0.002	**0.050*** **	0.003	**0.051*** **	0.003	**0.052*** **	0.003	**0.052*** **	0.003
	Other			**0.033*** **	0.003	**0.035*** **	0.003	**0.037*** **	0.003	**0.037*** **	0.003	**0.037*** **	0.003
	Unknown			**0.021*** **	0.004	**0.027*** **	0.005	**0.027*** **	0.005	**0.028*** **	0.005	**0.027*** **	0.005
School Type	Private					**0.008*** **	0.002	**0.009*** **	0.002	**0.009*** **	0.002	**0.010*** **	0.002
	Unknown					0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Parental Occ.	Lower Manag., Prof.					**-0.004*** **	0.001	**-0.005*** **	0.001	**-0.005*** **	0.001	**-0.005*** **	0.001
	Intermediate					**-0.012*** **	0.002	**-0.012*** **	0.002	**-0.012*** **	0.002	**-0.012*** **	0.002
	Small Employers					**-0.015*** **	0.002	**-0.015*** **	0.002	**-0.016*** **	0.002	**-0.015*** **	0.002
	Super., & Tech.					**-0.014*** **	0.002	**-0.015*** **	0.002	**-0.014*** **	0.002	**-0.015*** **	0.002
	Semi-routine					**-0.011*** **	0.002	**-0.012*** **	0.002	**-0.012*** **	0.002	**-0.012*** **	0.002
	Routine, Unemp.					**-0.017*** **	0.002	**-0.018*** **	0.002	**-0.018*** **	0.002	**-0.018*** **	0.002
	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
	Upper Second					**0.084*** **	0.003	**0.084*** **	0.003	**0.041*** **	0.002	**0.041*** **	0.002
	Lower Second					**0.043*** **	0.002	**0.043*** **	0.002				
	Unknown					0.008	0.007	0.008	0.007				
Sch. Results	2nd Quartile					**-0.009*** **	0.001	**-0.009*** **	0.001	**-0.009*** **	0.001	**-0.009*** **	0.001
	3rd Quartile					**-0.013*** **	0.002	**-0.013*** **	0.002	**-0.013*** **	0.002	**-0.013*** **	0.002
	4th Quartile					0.000	0.002	-0.001	0.002	-0.002	0.002	-0.002	0.002
Dom. Econ.	Unemployment[3]							0.015	0.013	0.018	0.013	**-0.050** **	0.024
	Hourly Earnings[3]							**-0.028*** **	0.003	**-0.030*** **	0.004	-0.011	0.008
Controls		Cohorts, Age		Cohorts, Age		Cohorts, Age		Cohorts, Age		Cohorts, Age		Cohorts, Age, Dom. TTWA	
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*** **	

Note(s): (1) Dep. Var. is a binary indicator of whether the student progressed to postgraduate higher education. Std err. clustered at the Institution-by-subject level. All specifications include Institution-by-subject fixed effects. (2) Expected Fees are defined as the average postgraduate fee in the student's undergraduate subject at their undergraduate institution. See Section 3.4. (3) These variables are continuous. (4) Specifications (5), (6), (11) and (12) include only students achieving at least a Lower Second Class UG degree. Specifications (1)-(6) are estimated by OLS. Specifications (7)-(12) are estimated by IV. (5) *, ** and ** reflect significance at the 10%, 5% and 1% levels respectively.

3B Appendix: Table B.1 (Cont): Fees Definition [1]: Main Equation[1, 4, 5]

		(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, 3]		**-0.140*** **	0.034	**-0.130*** **	0.034	**-0.167** **	0.070	**-0.172** **	0.072	**-0.167** **	0.071	**-0.171** **	0.073
Female				**-0.022*** **	0.001	**-0.029*** **	0.001	**-0.029*** **	0.001	**-0.031*** **	0.001	**-0.031*** **	0.001
Disability				**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
	Asian			**0.033*** **	0.002	**0.050*** **	0.003	**0.051*** **	0.003	**0.052*** **	0.003	**0.052*** **	0.003
	Other			**0.034*** **	0.003	**0.036*** **	0.003	**0.038*** **	0.003	**0.038*** **	0.003	**0.038*** **	0.003
	Unknown			**0.022*** **	0.004	**0.028*** **	0.005	**0.028*** **	0.005	**0.029*** **	0.005	**0.029*** **	0.005
School Type	Private					**0.008*** **	0.002	**0.009*** **	0.002	**0.009*** **	0.002	**0.009*** **	0.002
	Unknown					0.003	0.002	0.002	0.002	0.003	0.002	0.002	0.002
Parental Occ.	Lower Manag., Prof.					**-0.005*** **	0.001	**-0.005*** **	0.001	**-0.005*** **	0.001	**-0.005*** **	0.001
	Intermediate					**-0.012*** **	0.002	**-0.012*** **	0.002	**-0.012*** **	0.002	**-0.012*** **	0.002
	Small Employers					**-0.015*** **	0.002	**-0.016*** **	0.002	**-0.016*** **	0.002	**-0.016*** **	0.002
	Super., & Tech.					**-0.014*** **	0.002	**-0.015*** **	0.002	**-0.015*** **	0.002	**-0.015*** **	0.002
	Semi-routine					**-0.012*** **	0.002	**-0.013*** **	0.002	**-0.013*** **	0.002	**-0.013*** **	0.002
	Routine, Unemp.					**-0.017*** **	0.002	**-0.018*** **	0.002	**-0.018*** **	0.002	**-0.018*** **	0.002
	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
	Upper Second					**0.084*** **	0.007	**0.084*** **	0.007	**0.041*** **	0.002	**0.041*** **	0.002
	Lower Second					**0.043*** **	0.007	**0.043*** **	0.007				
	Unknown					0.008	0.007	0.008	0.007				
Sch. Results	2nd Quartile					**-0.010*** **	0.001	**-0.010*** **	0.001	**-0.010*** **	0.002	**-0.010*** **	0.002
	3rd Quartile					**-0.013*** **	0.002	**-0.013*** **	0.002	**-0.014*** **	0.002	**-0.013*** **	0.002
	4th Quartile					-0.001	0.003	-0.002	0.003	-0.002	0.003	-0.002	0.003
Dom. Econ.	Unemployment[3]							0.020	0.013	0.023*	0.013	**-0.053** **	0.025
	Hourly Earnings[3]							**-0.028*** **	0.004	**-0.030*** **	0.004	-0.012	0.008
Controls		Cohorts, Age		Cohorts, Age		Cohorts, Age		Cohorts, Age		Cohorts, Age		Cohorts, Age, Dom. TTWA	
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*** **	

Note(s): (1) Dep. Var. is a binary indicator of whether the student progressed to postgraduate higher education. Std err. clustered at the Institution-by-subject level. All specifications include Institution-by-subject fixed effects. (2) Expected Fees are defined as the average postgraduate fee in the student's undergraduate subject at their undergraduate institution. See Section 3.4. (3) These variables are continuous. (4) Specifications (5), (6), (11) and (12) include only students achieving at least a Lower Second Class UG degree. Specifications (1)-(6) are estimated by OLS. Specifications (7)-(12) are estimated by IV. (5) *, ** and ** reflect significance at the 10%, 5% and 1% levels respectively.

3B Appendix: Table B.2: Fees Definition [1]: First Stage Equation[1,3]

		(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
Female				0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Disability				-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
	Asian			0.001	0.001	0.001	0.001	0.001	0.001	0.000	0.001	0.000	0.001
	Other			0.000	0.000	0.000	0.001	0.000	0.001	0.000	0.001	0.000	0.001
	Unknown			-0.001	0.002	-0.002	0.003	-0.002	0.003	-0.002	0.003	-0.002	0.003
School Type	Private					-0.001	0.000	-0.001	0.000	0.000	0.000	-0.001	0.000
	Unknown					0.000	0.002	0.000	0.002	-0.001	0.002	-0.001	0.002
Parental Occ.	Lower Manag., Prof.					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Intermediate					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Small Employers					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Super., & Tech.					0.000	0.001	0.000	0.001	0.000	0.001	0.000	0.001
	Semi-routine					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Routine, Unemp.					0.000	0.001	0.000	0.001	0.000	0.001	0.000	0.001
	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
	Upper Second					0.003	0.004	0.003	0.003	0.000	0.000	0.000	0.000
	Lower Second					0.003	0.004	0.003	0.003				
	Unknown					0.003	0.004	0.003	0.004				
Sch. Results	2nd Quartile					0.001	0.001	0.001	0.001	0.001*	0.001	0.001	0.001
	3rd Quartile					0.000	0.001	0.000	0.001	0.000	0.001	0.000	0.001
	4th Quartile					0.000	0.001	0.000	0.001	0.001	0.001	0.001	0.001
Dom. Econ.	Unemployment[2]							0.005	0.004	0.004	0.004	0.002	0.013
	Hourly Earnings[2]							-0.001	0.001	-0.001	0.001	**-0.006** **	0.003
Controls		Cohorts, Age		Cohorts, Age		Cohorts, Age		Cohorts, Age		Cohorts, Age		Cohorts, Age, Dom. TTWA	
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** **	

Note(s): (1) Dep. Var. is natural logarithm of the average cost of a course of higher study by subject and institution, see Section 3.4. Std. err clustered at the Institution-by-subject level. All specifications include Institution-by-subject fixed effects. (2) These variables are continuous. (3) *, ** and ** reflect significance at the 10%, 5% and 1% levels respectively.

3C Appendix: Table C.1: Fees Definition [2]: Main Equation[1, 4, 5]

		(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, 3]		-0.009	0.010	-0.008	0.010	-0.006	0.012	-0.007	0.011	-0.008	0.012	-0.007	0.012
Female				**-0.022*** **	0.001	**-0.029*** **	0.001	**-0.029*** **	0.001	**-0.031*** **	0.001	**-0.031*** **	0.001
Disability				**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
	Asian			**0.033*** **	0.002	**0.050*** **	0.003	**0.051*** **	0.003	**0.052*** **	0.003	**0.052*** **	0.003
	Other			**0.033*** **	0.003	**0.035*** **	0.003	**0.037*** **	0.003	**0.037*** **	0.003	**0.037*** **	0.003
	Unknown			**0.021*** **	0.004	**0.027*** **	0.005	**0.027*** **	0.005	**0.028*** **	0.005	**0.027*** **	0.005
School Type	Private					**0.008*** **	0.002	**0.009*** **	0.002	**0.009*** **	0.002	**0.010*** **	0.002
	Unknown					0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Parental Occ.	Lower Manag., Prof.					**-0.004*** **	0.001	**-0.005*** **	0.001	**-0.005*** **	0.001	**-0.005*** **	0.001
	Intermediate					**-0.012*** **	0.002	**-0.012*** **	0.002	**-0.012*** **	0.002	**-0.012*** **	0.002
	Small Employers					**-0.015*** **	0.002	**-0.015*** **	0.002	**-0.016*** **	0.002	**-0.015*** **	0.002
	Super., & Tech.					**-0.014*** **	0.002	**-0.015*** **	0.002	**-0.014*** **	0.002	**-0.015*** **	0.002
	Semi-routine					**-0.011*** **	0.002	**-0.012*** **	0.002	**-0.012*** **	0.002	**-0.012*** **	0.002
	Routine, Unemp.					**-0.017*** **	0.002	**-0.018*** **	0.002	**-0.018*** **	0.002	**-0.018*** **	0.002
	Unknown					-0.001	0.002	-0.001	0.002	-0.001	0.002	-0.001	0.002
UG Class	First					**0.169*** **	0.008	**0.169*** **	0.008	**0.134*** **	0.004	**0.134*** **	0.004
	Upper Second					**0.076*** **	0.007	**0.076*** **	0.007	**0.041*** **	0.002	**0.041*** **	0.002
	Lower Second					**0.035*** **	0.007	**0.035*** **	0.007				
	Unknown					-0.008	0.007	-0.008	0.007				
Sch. Results	2nd Quartile					**-0.009*** **	0.001	**-0.009*** **	0.001	**-0.009*** **	0.001	**-0.009*** **	0.001
	3rd Quartile					**-0.013*** **	0.002	**-0.013*** **	0.002	**-0.013*** **	0.002	**-0.013*** **	0.002
	4th Quartile					0.000	0.002	-0.001	0.002	-0.002	0.002	-0.002	0.002
Dom. Econ.	Unemployment[3]							0.015	0.013	0.018	0.013	**-0.050** **	0.024
	Hourly Earnings[3]							**-0.028*** **	0.003	**-0.030*** **	0.004	-0.011	0.008
Controls		Cohorts, Age		Cohorts, Age		Cohorts, Age		Cohorts, Age		Cohorts, Age		Cohorts, Age, Dom. TTWA	
Observations		658,618		658,618		528,430		524,941		495,996		495,996	
F-stat		**128.61*** **		**73.18*** **		**72.42*** **		**68.53*** **		**69.84*** **		**14.13*** **	

Note(s): (1) Dep. Var. is a binary indicator of whether the student progressed to postgraduate higher education. Std err. clustered at the Institution-by-subject level. All specifications include Institution-by-subject fixed effects. (2) Expected Fees are defined as the average postgraduate fee at the student's undergraduate institution. See Section 3.4. (3) These variables are continuous. (4) Specifications (5), (6), (11) and (12) include only students achieving at least a Lower Second Class UG degree. Specifications (1)-(6) are estimated by OLS. Specifications (7)-(12) are estimated by IV. (5) *, ** and ** reflect significance at the 10%, 5% and 1% levels respectively.

3C Appendix: Table C.1 (Cont): Fees Definition [2]: Main Equation[1, 4, 5]

		(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, 3]		**-0.271*** **	0.083	**-0.251*** **	0.076	**-0.280** **	0.112	**-0.287** **	0.114	**-0.283** **	0.113	**-0.288** **	0.115
Female				**-0.022*** **	0.001	**-0.029*** **	0.001	**-0.029*** **	0.001	**-0.031*** **	0.001	**-0.031*** **	0.001
Disability				**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	**0.057*** **	0.004	**0.057*** **	0.004	**0.058*** **	0.004
	Asian			**0.033*** **	0.002	**0.050*** **	0.003	**0.051*** **	0.003	**0.052*** **	0.003	**0.052*** **	0.003
	Other			**0.034*** **	0.003	**0.036*** **	0.003	**0.038*** **	0.003	**0.038*** **	0.003	**0.038*** **	0.003
	Unknown			**0.023*** **	0.004	**0.028*** **	0.005	**0.028*** **	0.005	**0.029*** **	0.005	**0.029*** **	0.005
School Type	Private					**0.008*** **	0.002	**0.009*** **	0.002	**0.009*** **	0.002	**0.009*** **	0.002
	Unknown					0.003	0.002	0.003	0.002	0.003	0.002	0.003	0.002
Parental Occ.	Lower Manag., Prof.					**-0.005*** **	0.001	**-0.005*** **	0.001	**-0.005*** **	0.001	**-0.005*** **	0.001
	Intermediate					**-0.012*** **	0.002	**-0.012*** **	0.002	**-0.012*** **	0.002	**-0.012*** **	0.002
	Small Employers					**-0.015*** **	0.002	**-0.016*** **	0.002	**-0.016*** **	0.002	**-0.016*** **	0.002
	Super., & Tech.					**-0.014*** **	0.002	**-0.015*** **	0.002	**-0.014*** **	0.002	**-0.015*** **	0.002
	Semi-routine					**-0.012*** **	0.002	**-0.013*** **	0.002	**-0.013*** **	0.002	**-0.013*** **	0.002
	Routine, Unemp.					**-0.017*** **	0.002	**-0.018*** **	0.002	**-0.018*** **	0.002	**-0.018*** **	0.002
	Unknown					0.000	0.002	-0.001	0.002	0.000	0.002	0.000	0.002
UG Class	First					**0.168*** **	0.008	**0.168*** **	0.008	**0.134*** **	0.005	**0.134*** **	0.005
	Upper Second					**0.075*** **	0.007	**0.075*** **	0.007	**0.041*** **	0.002	**0.041*** **	0.002
	Lower Second					**0.034*** **	0.007	**0.034*** **	0.007				
	Unknown					-0.009	0.007	-0.009	0.007				
Sch. Results	2nd Quartile					**-0.010*** **	0.001	**-0.010*** **	0.001	**-0.010*** **	0.002	**-0.010*** **	0.002
	3rd Quartile					**-0.013*** **	0.002	**-0.013*** **	0.002	**-0.013*** **	0.002	**-0.013*** **	0.002
	4th Quartile					-0.001	0.003	-0.001	0.003	-0.002	0.003	-0.002	0.003
Dom. Econ.	Unemployment[3]							0.020	0.013	0.023*	0.013	**-0.050** **	0.025
	Hourly Earnings[3]							**-0.028*** **	0.004	**-0.029*** **	0.004	-0.012	0.008
Controls		Cohorts, Age		Cohorts, Age		Cohorts, Age		Cohorts, Age		Cohorts, Age		Cohorts, Age, Dom. TTWA	
Observations		612,531		612,531		493,664		490,358		463,197		463,197	
F-stat		**94.52*** **		**67.49*** **		**67.92*** **		**64.15*** **		**65.59*** **		**13.67*** **	

Note(s): (1) Dep. Var. is a binary indicator of whether the student progressed to postgraduate higher education. Std err. clustered at the Institution-by-subject level. All specifications include Institution-by-subject fixed effects. (2) Expected Fees are defined as the average postgraduate fee at the student's undergraduate institution. See Section 3.4. (3) These variables are continuous. (4) Specifications (5), (6), (11) and (12) include only students achieving at least a Lower Second Class UG degree. Specifications (1)-(6) are estimated by OLS. Specifications (7)-(12) are estimated by IV. (5) *, ** and ** reflect significance at the 10%, 5% and 1% levels respectively.

3C Appendix: Table C.2: Fees Definition [2]: First Stage Equation[1, 3]

		(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]		**0.044*** **	0.006	**0.044*** **	0.006	**0.040*** **	0.003	**0.040*** **	0.003	**0.039*** **	0.003	**0.039*** **	0.003
Trade Weighted GBP[2]		**-0.019*** **	0.007	**-0.019*** **	0.007	**-0.018** **	0.008	**-0.018** **	0.008	**-0.018** **	0.008	**-0.018** **	0.008
Female				0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Disability				-0.001*	0.000	-0.001	0.000	-0.001*	0.000	-0.001*	0.000	-0.001*	0.000
Ethnicity	Black			-0.001	0.001	**-0.002** **	0.001	**-0.002** **	0.001	**-0.002** **	0.001	**-0.002** **	0.001
	Asian			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Other			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Unknown			0.001	0.002	0.000	0.002	0.000	0.002	0.000	0.002	0.000	0.002
School Type	Private					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Unknown					0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Parental Occ.	Lower Manag., Prof.					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Intermediate					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Small Employers					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Super., & Tech.					0.001*	0.000	0.001*	0.000	0.001	0.000	0.001*	0.000
	Semi-routine					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Routine, Unemp.					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Unknown					**0.002** **	0.001	**0.002** **	0.001	**0.001** **	0.001	**0.001** **	0.001
UG Class	First					-0.002	0.002	-0.002	0.002	0.000	0.000	0.000	0.000
	Upper Second					-0.002	0.002	-0.002	0.002	0.000	0.000	0.000	0.000
	Lower Second					-0.002	0.002	-0.002	0.002				
	Unknown					-0.002	0.002	-0.002	0.002				
Sch. Results	2nd Quartile					0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	3rd Quartile					0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	4th Quartile					0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Dom. Econ.	Unemployment[2]							0.003	0.003	0.002	0.003	0.013	0.011
	Hourly Earnings[2]							0.000	0.001	0.000	0.001	-0.004	0.003
Controls		Cohorts, Age		Cohorts, Age		Cohorts, Age		Cohorts, Age		Cohorts, Age		Cohorts, Age, Dom. TTWA	
Observations		612,531		612,531		493,664		490,358		463,197		463,197	
F-stat		**415.66*** **		**175.33*** **		**113.87*** **		**108.67*** **		**115.07*** **		**28.86*** **	

Note(s): (1) Dep. Var. is natural logarithm of the average cost of a course of higher study by institution, see Section 3.4. Std. err clustered at the Institution-by-subject level. All specifications include Institution-by-subject fixed effects. (2) These variables are continuous. (3) *, ** and ** reflect significance at the 10%, 5% and 1% levels respectively.

3D Appendix: Table D.1: Fees Definition [3]: Main Equation[1, 4, 5]

		(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, 3]		**0.304*** **	0.042	**0.265*** **	0.039	**-0.038*** **	0.012	-0.020	0.012	-0.020	0.012	-0.008	0.014
Female				**-0.025*** **	0.001	**-0.031*** **	0.001	**-0.031*** **	0.001	**-0.032*** **	0.001	**-0.032*** **	0.001
Disability				**0.029*** **	0.002	**0.032*** **	0.002	**0.032*** **	0.002	**0.034*** **	0.003	**0.034*** **	0.003
Ethnicity	Black			**0.033*** **	0.004	**0.058*** **	0.004	**0.060*** **	0.004	**0.059*** **	0.004	**0.061*** **	0.004
	Asian			**0.029*** **	0.003	**0.053*** **	0.003	**0.054*** **	0.003	**0.055*** **	0.003	**0.055*** **	0.003
	Other			**0.026*** **	0.003	**0.037*** **	0.003	**0.038*** **	0.003	**0.038*** **	0.003	**0.038*** **	0.003
	Unknown			**0.024*** **	0.005	**0.028*** **	0.005	**0.028*** **	0.005	**0.029*** **	0.005	**0.029*** **	0.005
School Type	Private					**0.009*** **	0.002	**0.010*** **	0.002	**0.010*** **	0.002	**0.010*** **	0.002
	Unknown					0.004	0.002	0.004	0.002	0.004	0.002	0.003	0.002
Parental Occ.	Lower Manag., Prof.					**-0.005*** **	0.001	**-0.005*** **	0.001	**-0.005*** **	0.001	**-0.005*** **	0.001
	Intermediate					**-0.013*** **	0.002	**-0.012*** **	0.002	**-0.012*** **	0.002	**-0.012*** **	0.002
	Small Employers					**-0.015*** **	0.002	**-0.016*** **	0.002	**-0.017*** **	0.002	**-0.016*** **	0.002
	Super., & Tech.					**-0.014*** **	0.002	**-0.015*** **	0.002	**-0.015*** **	0.002	**-0.015*** **	0.002
	Semi-routine					**-0.013*** **	0.002	**-0.013*** **	0.002	**-0.013*** **	0.002	**-0.013*** **	0.002
	Routine, Unemp.					**-0.017*** **	0.002	**-0.018*** **	0.002	**-0.019*** **	0.003	**-0.018*** **	0.002
	Unknown					-0.001	0.002	-0.001	0.002	-0.001	0.002	0.000	0.002
UG Class	First					**0.142*** **	0.005	**0.142*** **	0.005	**0.142*** **	0.005	**0.142*** **	0.005
	Upper Second					**0.045*** **	0.002	**0.044*** **	0.002	**0.045*** **	0.002	**0.045*** **	0.002
	Lower Second					**-0.047*** **	0.003	**-0.046*** **	0.003				
	Unknown					**-0.041*** **	0.007	**-0.041*** **	0.007				
Sch. Results	2nd Quartile					**-0.010*** **	0.002	**-0.010*** **	0.002	**-0.010*** **	0.002	**-0.010*** **	0.002
	3rd Quartile					**-0.013*** **	0.002	**-0.013*** **	0.002	**-0.014*** **	0.002	**-0.014*** **	0.002
	4th Quartile					-0.001	0.003	-0.002	0.003	-0.002	0.003	-0.002	0.003
Dom. Econ.	Unemployment[3]							0.015	0.013	0.018	0.014	**-0.051** **	0.026
	Hourly Earnings[3]							**-0.029*** **	0.004	**-0.031*** **	0.004	-0.013	0.008
Controls		Cohorts, Age		Cohorts, Age		Cohorts, Age		Cohorts, Age		Cohorts, Age		Cohorts, Age, Dom. TTWA	
Observations		487,519		487,519		487,519		487,519		461,927		461,927	
F-stat		**86.82*** **		**62.64*** **		**74.47*** **		**70.68*** **		**71.40*** **		**14.90*** **	

Note(s): (1) Dep. Var. is a binary indicator of whether the student progressed to postgraduate higher education. Std err. clustered at the Institution-by-subject level. All specifications include Institution-by-subject fixed effects. (2) Expected Fees are estimated using the average postgraduate fee paid by students on the same undergraduate course (assuming they continue with their undergraduate subject). See Section 3.4. (3) These variables are continuous. (4) Specifications (5), (6), (11) and (12) include only students achieving at least a Lower Second Class UG degree. Specifications (1)-(6) are estimated by OLS. Specifications (7)-(12) are estimated by IV. (5) *, ** and ** reflect significance at the 10%, 5% and 1% levels respectively.

3D Appendix: Table D.1 (Cont): Fees Definition [3]: Main Equation[1, 4, 5]

		(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, 3]		**-0.273*** **	0.104	**-0.268** **	0.113	**-0.257** **	0.106	**-0.255** **	0.105	**-0.250** **	0.106	**-0.258** **	0.110
Female				**-0.026*** **	0.001	**-0.031*** **	0.001	**-0.031*** **	0.001	**-0.033*** **	0.001	**-0.033*** **	0.001
Disability				**0.030*** **	0.003	**0.033*** **	0.003	**0.033*** **	0.003	**0.034*** **	0.003	**0.035*** **	0.003
Ethnicity	Black			**0.046*** **	0.005	**0.065*** **	0.005	**0.067*** **	0.005	**0.065*** **	0.005	**0.066*** **	0.005
	Asian			**0.045*** **	0.005	**0.061*** **	0.005	**0.062*** **	0.005	**0.062*** **	0.005	**0.063*** **	0.005
	Other			**0.037*** **	0.004	**0.042*** **	0.004	**0.043*** **	0.003	**0.043*** **	0.004	**0.043*** **	0.003
	Unknown			**0.027*** **	0.005	**0.030*** **	0.005	**0.030*** **	0.005	**0.031*** **	0.006	**0.031*** **	0.006
School Type	Private					**0.014*** **	0.003	**0.015*** **	0.003	**0.014*** **	0.003	**0.015*** **	0.003
	Unknown					0.005*	0.002	0.004*	0.002	0.005*	0.003	0.004*	0.003
Parental Occ.	Lower Manag., Prof.					**-0.006*** **	0.002	**-0.006*** **	0.002	**-0.006*** **	0.002	**-0.006*** **	0.002
	Intermediate					**-0.015*** **	0.002	**-0.015*** **	0.002	**-0.015*** **	0.002	**-0.015*** **	0.002
	Small Employers					**-0.018*** **	0.002	**-0.018*** **	0.002	**-0.018*** **	0.002	**-0.018*** **	0.002
	Super., & Tech.					**-0.016*** **	0.002	**-0.016*** **	0.002	**-0.016*** **	0.002	**-0.017*** **	0.002
	Semi-routine					**-0.016*** **	0.002	**-0.016*** **	0.002	**-0.016*** **	0.002	**-0.017*** **	0.002
	Routine, Unemp.					**-0.021*** **	0.003	**-0.022*** **	0.003	**-0.022*** **	0.003	**-0.022*** **	0.003
	Unknown					-0.002	0.002	-0.002	0.002	-0.002	0.002	-0.002	0.002
UG Class	First					**0.150*** **	0.006	**0.151*** **	0.006	**0.150*** **	0.006	**0.151*** **	0.006
	Upper Second					**0.049*** **	0.003	**0.049*** **	0.003	**0.049*** **	0.003	**0.050*** **	0.003
	Lower Second					**-0.050*** **	0.003	**-0.050*** **	0.003				
	Unknown					**-0.040*** **	0.007	**-0.040*** **	0.007				
Sch. Results	2nd Quartile					**-0.012*** **	0.002	**-0.012*** **	0.002	**-0.012*** **	0.002	**-0.012*** **	0.002
	3rd Quartile					**-0.014*** **	0.002	**-0.014*** **	0.002	**-0.015*** **	0.002	**-0.014*** **	0.002
	4th Quartile					-0.002	0.003	-0.002	0.003	-0.003	0.003	-0.002	0.003
Dom. Econ.	Unemployment[3]							0.021	0.013	0.024*	0.014	**-0.061** **	0.027
	Hourly Earnings[3]							**-0.017*** **	0.006	**-0.019*** **	0.006	**-0.014*** **	0.008
Controls		Cohorts, Age		Cohorts, Age		Cohorts, Age		Cohorts, Age		Cohorts, Age		Cohorts, Age, Dom. TTWA	
Observations		454,853		454,853		454,853		454,853		430,091		430,091	
F-stat		**79.71*** **		**63.71*** **		**70.35*** **		**66.59**		**67.41*** **		**14.85*** **	

Note(s): (1) Dep. Var. is a binary indicator of whether the student progressed to postgraduate higher education. Std err. clustered at the Institution-by-subject level. All specifications include Institution-by-subject fixed effects. (2) Expected Fees are estimated using the average postgraduate fee paid by students on the same undergraduate course (assuming they continue with their undergraduate subject). See Section 3.4. (3) These variables are continuous. (4) Specifications (5), (6), (11) and (12) include only students achieving at least a Lower Second Class UG degree. Specifications (1)-(6) are estimated by OLS. Specifications (7)-(12) are estimated by IV. (5) *, ** and ** reflect significance at the 10%, 5% and 1% levels respectively.

3D Appendix: Table D.2: Fees Definition [3]: First Stage Equation[1, 3]

		(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]		**0.023*** **	(0.005)	**0.024*** **	(0.004)	**0.024*** **	(0.004)	**0.024*** **	(0.004)	**0.024*** **	(0.004)	**0.024*** **	(0.005)
Trade Weighted GBP[2]		**-0.022** **	(0.009)	**-0.022** **	(0.009)	**-0.021** **	(0.009)	**-0.021** **	(0.009)	**-0.021** **	(0.009)	**-0.021** **	(0.009)
Female				**-0.003*** **	(0.000)	**-0.004*** **	(0.000)	**-0.004*** **	(0.000)	**-0.004*** **	(0.000)	**-0.004*** **	(0.000)
Disability				0.000	(0.000)	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)
Ethnicity	Black			**0.023*** **	(0.001)	**0.030*** **	(0.001)	**0.024*** **	(0.001)	**0.024*** **	(0.001)	**0.020*** **	(0.001)
	Asian			**0.031*** **	(0.001)	**0.037*** **	(0.000)	**0.034*** **	(0.000)	**0.034*** **	(0.000)	**0.034*** **	(0.000)
	Other			**0.017*** **	(0.000)	**0.019*** **	(0.000)	**0.016*** **	(0.000)	**0.015*** **	(0.000)	**0.014*** **	(0.000)
	Unknown			0.002	(0.002)	0.003*	(0.002)	0.003	(0.002)	0.003	(0.002)	0.002	(0.002)
School Type	Private					**0.021*** **	(0.000)	**0.020*** **	(0.000)	**0.020*** **	(0.000)	**0.019*** **	(0.000)
	Unknown					0.001	(0.001)	0.002	(0.001)	0.001	(0.001)	0.002	(0.001)
Parental Occ.	Lower Manag., Prof.					**-0.004*** **	(0.000)	**-0.004*** **	(0.000)	**-0.004*** **	(0.000)	**-0.004*** **	(0.000)
	Intermediate					**-0.009*** **	(0.000)	**-0.009*** **	(0.000)	**-0.009*** **	(0.000)	**-0.009*** **	(0.000)
	Small Employers					**-0.006*** **	(0.000)	**-0.005*** **	(0.000)	**-0.005*** **	(0.000)	**-0.006*** **	(0.000)
	Super., & Tech.					**-0.005*** **	(0.000)	**-0.004*** **	(0.000)	**-0.004*** **	(0.000)	**-0.004*** **	(0.000)
	Semi-routine					**-0.013*** **	(0.000)	**-0.011*** **	(0.000)	**-0.011*** **	(0.000)	**-0.011*** **	(0.000)
	Routine, Unemp.					**-0.015*** **	(0.000)	**-0.013*** **	(0.000)	**-0.013*** **	(0.000)	**-0.013*** **	(0.000)
	Unknown					**-0.005*** **	(0.001)	**-0.004*** **	(0.001)	**-0.005*** **	(0.001)	**-0.004*** **	(0.001)
UG Class	First					**0.037*** **	(0.000)	**0.037*** **	(0.000)	**0.037*** **	(0.000)	**0.036*** **	(0.000)
	Upper Second					**0.022*** **	(0.000)	**0.021*** **	(0.000)	**0.021*** **	(0.000)	**0.021*** **	(0.000)
	Lower Second					**-0.017*** **	(0.000)	**-0.017*** **	(0.000)				
	Unknown					0.002	(0.002)	0.002	(0.002)				
Sch. Results	2nd Quartile					**-0.004*** **	(0.000)	**-0.004*** **	(0.000)	**-0.004*** **	(0.000)	**-0.004*** **	(0.000)
	3rd Quartile					**-0.002*** **	(0.000)	**-0.002*** **	(0.000)	**-0.002*** **	(0.000)	-0.001*	(0.000)
	4th Quartile					**-0.002*** **	(0.001)	-0.001	(0.001)	-0.001	(0.001)	**0.002*** **	(0.001)
Dom. Econ.	Unemployment[2]							0.006*	(0.003)	0.006*	(0.003)	**-0.022*** **	(0.007)
	Hourly Earnings[2]							**0.048*** **	(0.001)	**0.048*** **	(0.001)	**-0.004** **	(0.002)
Controls		Cohorts, Age		Cohorts, Age		Cohorts, Age		Cohorts, Age		Cohorts, Age		Cohorts, Age, Dom. TTWA	
Observations		454,853		454,853		484,853		454,853		430,091		430,091	
F-stat		**343.62*** **		**571.40*** **		**1634.59*** **		**1917.53*** **		**1899.86*** **		**1786.27*** **	

Note(s): (1) Dep. Var. is natural logarithm of the average price for a postgraduate course paid by students on a given undergraduate course (assuming they continue with their undergraduate subject), estimated as a function of their academic and individual characteristics. See Section 3.4. Std. err clustered at the Institution-by-subject level. All specifications include Institution-by-subject fixed effects. (2) These variables are continuous. (3) *, ** and ** reflect significance at the 10%, 5% and 1% levels respectively.

3E Appendix: Table E.1: Fees Definition [4]: Main Equation[1, 4, 5]

		(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, 3]		**0.506*** **	0.042	**0.460*** **	0.041	**-0.095*** **	0.019	**-0.054*** **	0.019	**-0.055*** **	0.019	-0.016	0.023
Female				**-0.024*** **	0.001	**-0.031*** **	0.001	**-0.031*** **	0.001	**-0.032*** **	0.001	**-0.032*** **	0.001
Disability				**0.029*** **	0.002	**0.032*** **	0.002	**0.032*** **	0.002	**0.034*** **	0.003	**0.034*** **	0.003
Ethnicity	Black			**0.029*** **	0.004	**0.059*** **	0.004	**0.060*** **	0.004	**0.059*** **	0.004	**0.060*** **	0.004
	Asian			**0.023*** **	0.003	**0.055*** **	0.003	**0.055*** **	0.003	**0.056*** **	0.003	**0.055*** **	0.003
	Other			**0.022*** **	0.003	**0.038*** **	0.003	**0.039*** **	0.003	**0.038*** **	0.003	**0.038*** **	0.003
	Unknown			**0.025*** **	0.005	**0.028*** **	0.005	**0.028*** **	0.005	**0.029*** **	0.005	**0.029*** **	0.005
School Type	Private					**0.012*** **	0.002	**0.011*** **	0.002	**0.011*** **	0.002	**0.011*** **	0.003
	Unknown					0.004*	0.002	0.004	0.002	0.004*	0.002	0.004	0.002
Parental Occ.	Lower Manag., Prof.					**-0.005*** **	0.001	**-0.005*** **	0.001	**-0.005*** **	0.001	**-0.005*** **	0.001
	Intermediate					**-0.013*** **	0.002	**-0.013*** **	0.002	**-0.013*** **	0.002	**-0.012*** **	0.002
	Small Employers					**-0.016*** **	0.002	**-0.016*** **	0.002	**-0.017*** **	0.002	**-0.016*** **	0.002
	Super., & Tech.					**-0.015*** **	0.002	**-0.015*** **	0.002	**-0.015*** **	0.002	**-0.015*** **	0.002
	Semi-routine					**-0.013*** **	0.002	**-0.013*** **	0.002	**-0.013*** **	0.002	**-0.013*** **	0.002
	Routine, Unemp.					**-0.019*** **	0.002	**-0.019*** **	0.002	**-0.019*** **	0.003	**-0.019*** **	0.002
	Unknown					-0.001	0.002	-0.001	0.002	-0.001	0.002	-0.001	0.002
UG Class	First					**0.145*** **	0.005	**0.143*** **	0.005	**0.143*** **	0.005	**0.142*** **	0.005
	Upper Second					**0.046*** **	0.002	**0.045*** **	0.002	**0.045*** **	0.002	**0.045*** **	0.002
	Lower Second					**-0.046*** **	0.003	**-0.046*** **	0.003				
	Unknown					**-0.040*** **	0.007	**-0.040*** **	0.007				
Sch. Results	2nd Quartile					**-0.010*** **	0.002	**-0.010*** **	0.002	**-0.010*** **	0.002	**-0.010*** **	0.002
	3rd Quartile					**-0.013*** **	0.002	**-0.013*** **	0.002	**-0.014*** **	0.002	**-0.014*** **	0.002
	4th Quartile					-0.001	0.003	-0.002	0.003	-0.002	0.003	-0.002	0.003
Dom. Econ.	Unemployment[3]							0.019	0.013	0.021	0.014	-0.049*	0.026
	Hourly Earnings[3]							**-0.026*** **	0.004	**-0.028*** **	0.004	-0.013	0.008
Controls		Cohorts, Age		Cohorts, Age		Cohorts, Age		Cohorts, Age		Cohorts, Age		Cohorts, Age, Dom. TTWA	
Observations		488,863		488,863		488,863		488,863		463,146		463,146	
F-stat		**116.33*** **		**69.08*** **		**74.44*** **		**70.66*** **		**71.47*** **		**14.83*** **	

Note(s): (1) Dep. Var. is a binary indicator of whether the student progressed to postgraduate higher education. Std err. clustered at the Institution-by-subject level. All specifications include Institution-by-subject fixed effects. (2) Expected Fees are estimated using the average postgraduate fee paid by students on the same undergraduate course. See Section 3.4. (3) These variables are continuous. (4) Specifications (5), (6), (11) and (12) include only students achieving at least a Lower Second Class UG degree. Specifications (1)-(6) are estimated by OLS. Specifications (7)-(12) are estimated by IV. (5) *, ** and ** reflect significance at the 10%, 5% and 1% levels respectively.

3E Appendix: Table E.1 (Cont): Fees Definition [4]: Main Equation[1, 4, 5]

		(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, 3]		**-0.480****	0.201	**-0.466****	0.189	**-0.439****	0.179	**-0.435****	0.177	**-0.433****	0.177	**-0.447****	0.182
Female				**-0.028*****	0.002	**-0.033*****	0.002	**-0.033*****	0.002	**-0.034*****	0.002	**-0.034*****	0.002
Disability				**0.031*****	0.003	**0.033*****	0.002	**0.033*****	0.002	**0.034*****	0.003	**0.035*****	0.003
Ethnicity	Black			**0.049*****	0.006	**0.069*****	0.006	**0.068*****	0.005	**0.067*****	0.005	**0.066*****	0.005
	Asian			**0.051*****	0.006	**0.067*****	0.007	**0.067*****	0.006	**0.067*****	0.006	**0.068*****	0.006
	Other			**0.041*****	0.005	**0.046*****	0.005	**0.046*****	0.004	**0.045*****	0.004	**0.045*****	0.004
	Unknown			**0.026*****	0.005	**0.029*****	0.005	**0.029*****	0.005	**0.030*****	0.006	**0.029*****	0.006
School Type	Private					**0.023*****	0.007	**0.023*****	0.006	**0.023*****	0.006	**0.024*****	0.007
	Unknown					**0.005****	0.002	**0.006****	0.002	**0.006****	0.003	**0.005****	0.003
Parental Occ.	Lower Manag., Prof.					**-0.007*****	0.002	**-0.007*****	0.002	**-0.007*****	0.002	**-0.007*****	0.002
	Intermediate					**-0.017*****	0.002	**-0.017*****	0.002	**-0.017*****	0.002	**-0.017*****	0.002
	Small Employers					**-0.019*****	0.002	**-0.019*****	0.002	**-0.020*****	0.002	**-0.020*****	0.002
	Super., & Tech.					**-0.016*****	0.002	**-0.016*****	0.002	**-0.016*****	0.002	**-0.017*****	0.002
	Semi-routine					**-0.016*****	0.002	**-0.016*****	0.002	**-0.016*****	0.002	**-0.017*****	0.002
	Routine, Unemp.					**-0.024*****	0.004	**-0.024*****	0.003	**-0.024*****	0.003	**-0.024*****	0.003
	Unknown					-0.001	0.002	-0.001	0.002	-0.001	0.002	-0.001	0.002
UG Class	First					**0.160*****	0.009	**0.160*****	0.009	**0.160*****	0.009	**0.160*****	0.009
	Upper Second					**0.052*****	0.004	**0.052*****	0.004	**0.052*****	0.004	**0.053*****	0.004
	Lower Second					**-0.048*****	0.003	**-0.048*****	0.003				
	Unknown					**-0.038*****	0.007	**-0.037*****	0.007				
Sch. Results	2nd Quartile					**-0.012*****	0.002	**-0.012*****	0.002	**-0.012*****	0.002	**-0.011*****	0.002
	3rd Quartile					**-0.013*****	0.002	**-0.013*****	0.002	**-0.014*****	0.002	**-0.013*****	0.002
	4th Quartile					-0.002	0.003	-0.002	0.003	-0.002	0.003	-0.001	0.003
Dom. Econ.	Unemployment[3]							**0.044*****	0.016	**0.047*****	0.017	-0.051*	0.027
	Hourly Earnings[3]							-0.001	0.012	-0.003	0.012	**-0.020****	0.009
Controls		Cohorts, Age		Cohorts, Age		Cohorts, Age		Cohorts, Age		Cohorts, Age		Cohorts, Age, Dom. TTWA	
Observations		456,071		456,071		456,071		456,071		432,003		432,003	
F-stat		**75.26*****		**61.08*****		**70.07*****		**66.49*****		**67.48*****		**14.60*****	

Note(s): (1) Dep. Var. is a binary indicator of whether the student progressed to postgraduate higher education. Std err. clustered at the Institution-by-subject level. All specifications include Institution-by-subject fixed effects. (2) Expected Fees are estimated using the average postgraduate fee paid by students on the same undergraduate course. See Section 3.4. (3) These variables are continuous. (4) Specifications (5), (6), (11) and (12) include only students achieving at least a Lower Second Class UG degree. Specifications (1)-(6) are estimated by OLS. Specifications (7)-(12) are estimated by IV. (5) *, ** and ** reflect significance at the 10%, 5% and 1% levels respectively.

3E Appendix: Table E.2: Fees Definition [4]: First Stage Equation[1,3]

		(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]		**0.021*** **	(0.002)	**0.022*** **	(0.002)	**0.023*** **	(0.002)	**0.023*** **	(0.002)	**0.023*** **	(0.002)	**0.023*** **	(0.002)
Trade Weighted GBP[2]		**-0.012*** **	(0.005)	**-0.012** **	(0.005)	**-0.012** **	(0.005)	**-0.012** **	(0.005)	**-0.012** **	(0.005)	**-0.012** **	(0.005)
Female				**-0.005*** **	(0.000)	**-0.006*** **	(0.000)	**-0.005*** **	(0.000)	**-0.005*** **	(0.000)	**-0.005*** **	(0.000)
Disability				**0.001*** **	(0.000)	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)
Ethnicity	Black			**0.020*** **	(0.001)	**0.027*** **	(0.001)	**0.018*** **	(0.001)	**0.018*** **	(0.001)	**0.013*** **	(0.000)
	Asian			**0.030*** **	(0.000)	**0.035*** **	(0.000)	**0.031*** **	(0.000)	**0.031*** **	(0.000)	**0.031*** **	(0.000)
	Other			**0.019*** **	(0.000)	**0.020*** **	(0.000)	**0.016*** **	(0.000)	**0.016*** **	(0.000)	**0.014*** **	(0.000)
	Unknown			-0.001	(0.001)	0.000	(0.001)	-0.002	(0.001)	-0.002	(0.001)	-0.002	(0.001)
School Type	Private					**0.033*** **	(0.000)	**0.031*** **	(0.000)	**0.031*** **	(0.000)	**0.031*** **	(0.000)
	Unknown					**0.003*** **	(0.000)	**0.004*** **	(0.000)	**0.003*** **	(0.000)	**0.004*** **	(0.000)
Parental Occ.	Lower Manag., Prof.					**-0.004*** **	(0.000)	**-0.003*** **	(0.000)	**-0.003*** **	(0.000)	**-0.003*** **	(0.000)
	Intermediate					**-0.009*** **	(0.000)	**-0.009*** **	(0.000)	**-0.009*** **	(0.000)	**-0.009*** **	(0.000)
	Small Employers					**-0.007*** **	(0.000)	**-0.006*** **	(0.000)	**-0.006*** **	(0.000)	**-0.006*** **	(0.000)
	Super., & Tech.					**-0.004*** **	(0.000)	**-0.003*** **	(0.000)	**-0.003*** **	(0.000)	**-0.003*** **	(0.000)
	Semi-routine					**-0.008*** **	(0.000)	**-0.007*** **	(0.000)	**-0.007*** **	(0.000)	**-0.006*** **	(0.000)
	Routine, Unemp.					**-0.015*** **	(0.000)	**-0.012*** **	(0.000)	**-0.012*** **	(0.000)	**-0.012*** **	(0.000)
	Unknown					**-0.002*** **	(0.000)	**-0.001** **	(0.000)	**-0.001** **	(0.000)	**-0.001** **	(0.000)
UG Class	First					**0.044*** **	(0.000)	**0.044*** **	(0.000)	**0.044*** **	(0.000)	**0.043*** **	(0.000)
	Upper Second					**0.020*** **	(0.000)	**0.019*** **	(0.000)	**0.019*** **	(0.000)	**0.019*** **	(0.000)
	Lower Second					**-0.006*** **	(0.000)	**-0.006*** **	(0.000)				
	Unknown					**0.005*** **	(0.001)	**0.005*** **	(0.001)				
Sch. Results	2nd Quartile					**-0.002*** **	(0.000)	**-0.002*** **	(0.000)	**-0.001*** **	(0.001)	**-0.001** **	(0.001)
	3rd Quartile					0.000	(0.001)	0.001*	(0.001)	0.001*	(0.001)	**0.002*** **	(0.001)
	4th Quartile					-0.001*	(0.001)	0.001	(0.001)	0.001	(0.001)	**0.004*** **	(0.001)
Dom. Econ.	Unemployment[2]							**0.055*** **	(0.003)	**0.055*** **	(0.003)	0.003	(0.006)
	Hourly Earnings[2]							**0.066*** **	(0.001)	**0.066*** **	(0.001)	**-0.016*** **	(0.002)
Controls		Cohorts, Age		Cohorts, Age		Cohorts, Age		Cohorts, Age		Cohorts, Age		Cohorts, Age, Dom. TTWA	
Observations		456,071		456,071		456,071		456,071		432,003		432,003	
F-stat		**1470.91*** **		**1259.70*** **		**3769.27*** **		**5185.19*** **		**5063.77*** **		**5074.29*** **	

Note(s): (1) Dep. Var. is natural logarithm of the average price for a postgraduate course paid by students on a given undergraduate course, estimated as a function of their academic and individual characteristics. See Section 3.4. Std. err clustered at the Institution-by-subject level. All specifications include Institution-by-subject fixed effects. (2) These variables are continuous. (3) *, ** and ** reflect significance at the 10%, 5% and 1% levels respectively.

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4. Would you like a degree with that? Graduate labour market outcomes in the context of local economic disparities in the United Kingdom

The expansion of higher education in the UK and recent reforms to the funding of undergraduate teaching have led to a resurgence of academic and policy-maker interest in the pecuniary returns to a degree. Between 2000/01 and 2010/11, the number of full-time undergraduates at universities in Great Britain increased by 32.1%. The number of full-time postgraduate students increased by 80.9% over the same period, taking the total number of UK domiciled students in higher education to more than two million (HESA 2011). The increased supply of graduates, the economic downturn and reforms intended to shift the costs of undergraduate teaching from tax-payers to individual students (Barr 2010a, 2010b), have raised questions about whether a higher education qualification remains a 'good investment'.

Labour economists have long been interested in the returns to education and to an undergraduate degree in particular (Card 1999). The pecuniary benefits of a qualification are a function of both (1) the wage obtained and (2) the likelihood of finding work after graduating. As is widely recognised, the empirical difficulty of calculating these benefits lies in identifying the appropriate counterfactual (Angrist and Krueger 1999): the pecuniary return to a degree is given by the difference in earned wages relative to what the same individual would have obtained without the qualification. Appropriately accounting for the impact of unobserved individual heterogeneity makes this work particularly challenging.

This paper examines two specific graduate labour market outcomes: (1) the likelihood of a student finding employment after graduation and (2) the likelihood that their qualification was a requirement for their job. In the first case, students who are more successful in finding employment after graduation are likely to have a higher

return, everything else being equal. The second case concerns the 'quality' of the match between the graduate's skills and their employer's technology. Ex ante, students who achieve better quality matches in the labour market also seem likely to have a higher return.

This paper makes several contributions to the existing literature. Firstly, it presents a critical discussion of the methods previously employed by researchers examining the incidence and effects of 'over-education'. Secondly, it estimates a series of linear probability models using several waves of a survey of recent graduates from British universities. Using the repeated cross-sectional nature of this dataset, it includes a large number of fixed effects for university courses and areas of residence which partially control for several forms of endogeneity bias. Finally, it considers the empirical difficulties of the field and offers a set of thoughts for further study.

The results suggest that graduate labour market outcomes vary widely across observably different groups, even after controlling for common unobserved characteristics. Students from ethnic minorities, disabled students and students graduating from shorter courses are less likely to find employment after graduation. Males are less likely to find employment than females, while recent graduates from higher socio-economic groups are more likely to be outside the workforce than their less well-off peers.

The results also suggest that the males who do enter employment are more likely to be mismatched in their role than an equivalent female. Students who achieve better academic results and students from wealthy backgrounds also appear to have greater access to Professional & Managerial vacancies. Taken together, the results raise questions about how graduates make the transition from university to the labour market.

The rest of this paper is organised as follows. Section 4.1 provides a review of the literature on graduate labour market outcomes. Section 4.2 discusses my conceptual

framework and highlights the empirical challenges of work in this field. Section 4.3 presents the data, Section 4.4 describes the results and Section 4.5 considers the limitations of the analysis. Section 4.6 provides some discussion and conclusions.

4.1 Literature review

The literature on graduate outcomes in the United Kingdom is substantial. Significant research attention has focussed on students' migration decisions (Faggian and McCann 2006, 2009, Faggian, McCann and Sheppard 2007a, 2007b), starting salaries (Blundell *et al.* 2000, Dolton and Makepeace 1990), subsequent earnings (Dolton and Makepeace 1990, Bratti, Naylor and Smith 2005, Bratti and Mancini 2003, Fengliang *et al.* 2009, Behrman, Rosenzweig and Taubman 1996, Dearden, McIntosh, Myck and Vignoles 2002), their likelihood of employment (Smith, McKnight and Naylor 2000, Bratti, McKnight, Naylor and Smith 2004, Unwin and Di Pietro 2005) as well as their choice of occupation and industry (Davies and Guppy 1997). Less attention has been paid to their choice of academic field (Montmarquette *et al.* 2002, Bratti 2006, Wales 2010), their likelihood of progressing to postgraduate study (Machin and Murphy 2011) and the effect of tuition fees on their behaviour (Crawford and Dearden 2010).

A substantial volume of research has also examined the incidence and effects of 'over-education' in the labour market: a phenomenon in which an individual's acquired human capital, skills or qualifications exceed the requirements of the job in which he/she is employed. This review begins with the theoretical approaches which are frequently invoked to motivate studies of labour market mismatch. It briefly discusses different measures of 'over-education', before proceeding to review papers which have investigated either the incidence or impact of labour market mismatch. Particular

attention is given to the empirical methods used by different researchers and their results.[28]

4.1.1 Theoretical framework

Researchers have used several different theoretical devices to motivate their empirical work on over-education. However, the concept remains a difficult one for economists. At an aggregate level, economists expect an increase in the supply of skilled labour to lead to a fall in price and higher graduate employment. At the level of the firm, if a worker's skills are not being fully exploited then the firm should change its technology to make use of its under-utilised resources. Confronted with a firm which refuses to alter its technology to make best use of his skills, a rational yet over-educated worker will move to another firm which can use his greater skills and, consequently, pay him a higher wage. As a result, over-education is primarily a short-run phenomenon: no worker should find himself permanently over-educated.

Several researchers have motivated their studies of over-education as a test of the standard Mincerian wage equation (Mincer 1974). Building on previous work, they distinguish between 'required' schooling – the number of years of education required to do the job; 'over' schooling – the number of years of education in excess of required schooling; and 'under' schooling' – the number of years of education less than the required level. All three are entered into a wage regression with the aim of testing Mincer's central hypothesis: that acquired schooling determines individual productivity and therefore the wage. In this case, the coefficients on over-, under- and required-schooling are of equal absolute value. However, it should be clear that in this theoretical

[28] For comprehensive meta-analyses of the over-education literature see Hartog (2000), Groot and van den Brink (2000) and McGuinness (2006).

framework there is no explicit explanation for over-education: education simply affects wages and productivity.

Several researchers motivate their empirical analysis by comparing this Mincerian approach with an 'Assignment' model of the labour market, in which characteristics of both the individual and the job affect the wage offer. Building on the work of Thurow (1975) this approach conceives of the labour market as two 'queues' – one consisting of workers organised by ability, one consisting of jobs organised by difficulty. The most difficult job is assigned to the most able worker, while easier jobs are assigned to less able workers. In this context, if qualifications and ability are partial substitutes, several researchers have argued that individuals may 'over-invest' in education to move forward in this queue to get a better job. In these models, over-education may be the dominant strategy for individuals of lesser ability.[29]

Search costs and labour market frictions have also formed the basis of an explanation for over-education. Ordine and Rose (2011) construct a model composed of heterogeneous workers and firms, in which worker productivity and firm technology are not observed by the other party until after the worker has joined the firm. Workers are attached to firms on the basis of their observable education 'signals' in a process which assigns students of differing innate ability the same probability of a successful match. This pooling equilibrium for observably similar workers who have different levels of ability creates the potential for over-education. Albrecht and Vroman (2002) and Dodaldo, Jansen and Jimeno (2009) also offer models of over-education arising from search costs and matching frictions. Albrecht and Vroman (2002) propose a model in

[29] McGuiness (2006) identifies three approaches – 'Human Capital,' 'Job Competition' and 'Assignment'. He argues that these models differ in their predictions about the factors which affect wages. Human capital theory suggests that the worker's productivity entirely determines the wage, while the job competition model argues that only characteristics of the job are relevant. Assignment models, he argues, offer a middle way in which both characteristics of the worker and of the job should be included in wage regressions.

which highly skilled workers may take either skilled or unskilled positions, depending on the extent of productivity differences between the high- and low-skilled workers and the relative size of the highly-skilled worker population. Doldaldo, Jansen and Jimeno (2009) develop Albrecht and Vroman's (2002) model to include on the job search motivated by the desire to find a better match and highlight the consequences of transitory mismatch on less educated workers.

While these papers offer explanations for temporary mismatch among a single cohort of workers, they do not explain the persistence of over-education for some individuals. Based on a relatively small sample, Grip *et al.* (2008) present evidence that over-educated workers suffer from more rapid cognitive decline than well-matched workers. Applying cognitive ability tests to the same subjects at six year intervals, they conclude that over-educated workers may remain in mismatched positions because these positions are detrimental to their development.

4.1.2 Measurement issues

The measurement of over-education is fraught and variable choice is often driven by available data rather than the merits of a particular measure. In each case the researcher elicits the level of education required for a given role and compares it to the educational attainment of those actually in employment. Troublingly, papers which have used more than one measure have found their results to be sensitive to the use of different indicators (Dolton and Silles 2008, McGoldrick and Robst 1996).

The literature distinguishes between three approaches to measuring the required schooling for a particular position – two 'objective' and one 'subjective'. In the latter, individual workers are asked to assess the level of education required to perform their work to an acceptable standard. The precise form and wording used varies across

studies. In some cases, individuals are asked to report the level of education required for their position ('What was the minimum formal qualification for (entering) this job?' (Dolton and Vignoles 2000, pp.182)), in others they are asked what kind of education is the best preparation for taking on their position ('Which education, according to you, is the best preparation for the work you are doing?' (Hartog and Oosterbeek 1988, pp.188-189)), while in yet others they are asked to relay the level of education required of someone starting a position like theirs now ('What type of formal schooling is now normally required for people who do your type of work?' (Vahey 2000, pp.220). Finally, in some cases researchers ask workers whether their skill-set qualifies them to work in a more senior position ('Do you feel that you have skills or qualifications to do a more demanding job than the one you have now?' (Budria and Moro-Egido 2008, pp.334).

Several problems with this approach are self-evident. Firstly, the wording of the question may substantively change the results, as the different emphases in each question may plausibly draw different responses from the same individual (Leuven and Oosterbeek 2011, Green *et al.* 1999). Secondly, individuals may have an interest in over-stating the difficulty of their role, or the importance of their skills and qualifications. Thirdly, the approach assumes that all agents measure work 'difficulty' on a common scale. Each is likely to lead to a subjective bias in responses.

The two 'objective' measures of over-education involve measuring individually reported education against a standard for the field set by either (1) formal occupational classifications or (2) the workers observed in the relevant position. In the first case, researchers use dictionaries of occupational titles (for example, see DOT 2011) to identify the required level of educational attainment for a given position. This is converted into years of schooling and used as a yardstick against which to judge whether individuals are over- or under-educated. However, occupational dictionaries are

published infrequently and the method used to convert required education into years of schooling is not universally accepted (Leuven and Oosterbeek 2011). Researchers are also forced to assume that all employers have similar educational requirements and, therefore, similar technology (Chevalier 2003).

In the second case, researchers compare individual educational attainment to the modal qualification or mean years of education among workers in a particular occupation. Individuals who are 'significantly' above or below the chosen benchmark are deemed to be over- or under-educated respectively. Difficulty arises here in determining how much more or less than the benchmark constitutes 'real' over- or under-education.

In addition to the individual difficulties which affect all of these measures, several conceptual problems blight attempts to gather clear evidence on the quality of labour market matches. Firstly, employers may specify a formal qualifying level of education to be eligible for a position which does not reflect the education required to carry out the tasks (Dolton and Vignoles 2000). Consequently, a graduate might enter a position for which their qualification was a formal requirement, but in which their acquired skills and knowledge are not utilised. Secondly, the increased supply of skilled labour has led to concerns about 'qualification inflation'. This arises if employers increase the level of education required for a given position while the job's content remains the same. Both these effects may lead to significant under-reporting of poor quality matches.

This discussion points to a broader conceptual problem regarding the extent to which the terms 'over-education', 'over-qualification' and 'over-skilled' are interchangeable. Over-education and over-qualification both appear to imply that an individual has acquired more education than is strictly required for a given position. In the former, the worker has more years of schooling than necessary, while in the latter

they hold qualifications above the formal requirements. Over-skilling suggests something tangibly different: that a worker has more skills than are strictly needed for their work. If, as seems likely, skills and qualifications are only imperfectly correlated, in some cases the indicators of mismatch may diverge.

As more attention has been devoted to unobserved individual heterogeneity, a growing number of researchers have sought to distinguish 'over-skilling' from 'over-education'. This approach leads to a more detailed classification of graduates, in which students can report under-utilization of skills separately from the requirements of the job. Green and Zhu (2010) use this approach to identify four groups of graduates: (1) those in graduate jobs using their skills, (2) those in graduate jobs under-utilizing their skills, (3) those in non-graduate jobs using their skills and (4) those in non-graduate jobs under-utilizing their skills. Allen and van der Velden (2001) adopt a similar approach using European data to classify graduates on the basis of (a) whether they meet the skill requirements for their position and (b) whether they could perform better with additional skills. Green and McInstosh (2007) use UK data to show that only around half of those who report themselves as over-qualified are actually over-skilled and find evidence of significant skill heterogeneity within qualifications. Chevalier (2003) also attempts to step beyond the boundaries of 'formal' over-education by asking graduates to report how satisfied they are with the match between their skills and their position. However, all of these are subjective individual responses and so these papers remain affected by many of the problems detailed above.

4.1.3 Incidence of over-education

Partly as a result of the different measures adopted, researchers have generated varying estimates of the incidence of over-education and its determinants. Problems of

measurement have been compounded by the use of inadequate or inappropriate methods (Leuven and Oosterbeek 2011) and as a consequence there is no consensus about how to assess the quality of labour market matches. The following section is framed around the various different methods which have been employed elsewhere.

The simplest approach used to model the incidence of labour market mismatch involves a binary choice framework, in which students either obtain a matched opening or are over-educated in their first job. The substantial empirical literature which has developed from Freeman's (1976) original over-education contribution has sought to relate individual, academic and parental characteristics to the likelihood of being over-educated. Dolton and Silles (2001) use data on recent graduates from Newcastle University to estimate a series of probit regressions in the probability of a student being over-educated. They find that graduates of different academic subjects have different mismatch propensities, with Education graduates significantly less likely to be over-educated than graduates of other subjects. Students achieving First Class degrees also appear less likely to be mismatched, in both their initial and subsequent jobs.

Dolton and Silles (2008) extend their earlier analysis using an ordinary least squares (OLS) approach and several different definitions of over-education. They again conclude that there are significant differences in mismatch propensities between graduates of different academic disciplines and between students entering different sectors, occupations and firm sizes. Students entering Managerial and Professional roles at smaller firms outside the Education sector appear significantly more likely to report themselves over-educated in both their first and subsequent jobs. However, the magnitude and significance of many of their estimated effects vary depending on the definition adopted. Frenette (2004) supports these findings using a logit model and data on Canadian graduates. Examining mismatch probabilities two and five years after

graduation, he finds significant differences among students entering different industries with different types of qualification.

Several researchers have developed extended models which consider the incidence of over- and under-education together. Battu and Sloane (2004) estimate a multinomial logit model in the probabilities of being (1) over-educated, (2) matched and (3) under-educated. Their results suggest that non-white individuals are significantly more likely to be over-educated than equivalent white workers. Younger individuals, holding qualifications from foreign universities are also more likely to be over-educated, although this effect is smaller for UK-born second generation migrants.

Chevalier (2003) also estimates a multinomial logit, but among a classification based on both required qualifications and job-match satisfaction. His potential outcomes include (1) matched (students are employed in a graduate level occupation), (2) apparently over-educated (students are in a non-graduate job, but satisfied with their match), and (3) genuinely over-educated (students are in a non-graduate job and report themselves dissatisfied with their match). He concludes that graduates achieving First Class or Upper Second Class degrees, in Mathematics, Engineering or Education are significantly less likely to be 'genuinely' over-educated. Battu, Bellfield and Sloane (1999, 2000) and Chevalier and Lindley (2009) also report significant differences in over-education propensities across academic subjects. None of these papers find evidence that the incidence of over-education is affected by either the individual's gender or socio-economic background.

Alongside individual and academic characteristics, several papers have investigated the spatial incidence of over-education. Frank (1978) argued that married women may be more vulnerable to over-education if household location decisions are based on their spouse's career options. This effect may be amplified if families locate in relatively small urban centres, where the number and range of labour market openings is

more limited. McGoldrick and Robst (1996) test this theory using three measures of over-education and data from the United States. Estimating a multinomial logit model and comparing married white males and females, they find no convincing evidence either that (1) women are more likely to be over-educated or (2) that labour market mismatch is spatially mediated. Consistent with several other papers, their results vary depending on the measure of over-education they adopt.

Büchel and Battu (2003) use German data to examine whether labour market characteristics influence the probability of being mismatched. Estimating a logit regression, they find that married women in rural areas of Germany are almost twice as likely to be over-educated as equivalent single males. However, controlling for the proximity of local employment centres eliminates the gender difference and suggests that both males and females in small labour markets may be more at risk of over-education than equivalent individuals in urban areas.

Büchel and van Ham (2003) also investigate whether local labour markets affect the quality of worker-job matches. Using German data, they estimate a two-stage model of the probability of over-education, controlling for selection into the labour market in the first stage. They conclude that the characteristics of local labour markets can influence both the probability of employment and the likelihood of being over-educated. Specifically, they find that the level of unemployment in the area around the worker's residence affects the probability of them finding work, while (1) the distance to an agglomeration and (2) access to a car both affect the quality of the labour market match. These findings suggest that workers with relatively limited mobility, both in terms of their ability to commute and their ability to migrate for employment, may be more at risk of over-education.

The use of multi-stage models, in particular to control for selection into the labour market, has become more prevalent among recent contributions as authors have

recognised the sample selection bias present in their work.[30] Where the choice to participate in the labour market is endogenous, parameter estimates in over-education regressions may be biased and inconsistent. However, the difficulty of finding appropriate exclusion restrictions – variables which affect the probability of employment but not the quality of the labour market match – has led to a dependence on often questionable instruments. In their first-stage model, Büchel and van Ham (2003) argue that age and its square affect selection into employment but not the quality of job obtained. However, older individuals may be more likely to find a good quality match if (a) experience is valued by employers or (b) if individuals get better at job search with greater practice.

Ordine and Rose (2011), who offer a similar two-stage empirical analysis using a Heckman model to control for selection into the labour market, use the square of the student's university grade, attendance at a technical school and whether the individual has a child as instruments for participation. However, the former instruments – university grade squared and attendance at a technical school – could both affect wages directly. The final instrument seems more plausible, and follows the example of several others in the field, notably Dolton and Vignoles (2000). However, in these studies identification rests on the maintained assumption that the choice to start a family is exogenous to labour market conditions. If a couple's choice to start a family is a function of their economic circumstances then this too may be a weak instrument.

An alternative approach to controlling for unobservable skills is adopted by Chevalier (2003). To account for idiosyncratic differences in productivity, Chevalier (2003) estimates expected starting wages for each student in his dataset. He calculates the difference between expected and actual starting wages and includes this in his multinomial logit specification, arguing that this variable captures individual

[30] This is discussed further in the next section.

productivity. This measure of unobserved skills has a significant, negative impact on the probability of an individual being 'genuinely over-educated' relative to the 'well-matched' base case, providing further evidence that mismatched individuals are not a random draw from the population.

4.1.4 Impact of over-education

Recent work on the impact of over-education on wages has been heavily criticised for a range of empirical short-comings (Leuven and Oosterbeek 2011). Indeed, a large number of papers proceed directly from a descriptive examination of the incidence of over-education to estimating its effects on wages, without considering the likely endogeneity of either participating in the labour market or being poorly matched. This section examines recent papers which have adopted methods designed to partially control for these effects.

Dolton and Vignoles (2000) offer the first of several papers which attempt to control for selection effects as they examine the impact of over-education on wages using the 1980 National Survey of Graduates and Diplomates. Although they treat the individual's quality of labour market match as exogenous, Dolton and Vignoles (2000) recognise that the women in employment in their 1986 sample are a non-random draw of the original 1980 survey. To control for this, they estimate the effect of over-education on female wages in two stages: first running a participation regression to model the likelihood that a woman chooses to remain in the labour market, and then using the Inverse Mills Ratio (from the first stage) in the second-stage, wage equation (Heckman 1979).

As set out in the previous section, this approach depends on finding an appropriate exclusion restriction. Dolton and Vignoles (2000) use (1) the number of

children in the household, (2) the woman's starting wage (in 1980) and (3) their industry of employment (in 1980) to estimate the likelihood of a given female participating in the labour market in 1986. They argue that the participation decision may be influenced by domestic factors or by the opportunity cost of not participating. In practice, controlling for selection into the labour market makes little difference to their parameter of interest and they consequently report the OLS estimates. They conclude that being over-educated reduces graduate starting salaries by between 3.0% and 13.3%, with jobs which require much lower levels of qualification carrying the larger penalty. Examining the subsequent (1986) employment of their sample, Dolton and Vignoles (2000) find that those who are over-educated still carry a slightly reduced pay penalty of between 1.7% and 11.0%.

While selection into the labour market is important, Leuven and Oosterbeek (2011) are especially critical of papers which do not account for omitted variable bias arising from unobserved individual heterogeneity. Their concern derives from the risk that students who are of lower (unobserved) ability may choose to work in positions for which they are 'over-qualified', but not 'over-skilled'. A number of different strategies have been adopted to try to control for the likely endogeneity of over-education. Firstly, some papers have adopted an instrumental variables approach to try to reduce the effect of unobserved ability. The difficulty with this approach lies in finding an appropriate exclusion restriction for the first stage equation – a variable which affects the probability of being over-educated but not the level of the wage.

Dolton and Silles (2001) is one such study. Using data on recent graduates, they include three instruments in their first-stage regressions: (1) whether the student relocated for their first job, (2) family commitments – including whether the individual has children or a partner prior to getting their first job and (3) the level of debt the student has on graduation. Chevalier (2003) argues that migration behaviour may be a

weak instrument – especially given that wages are likely to affect migration choices themselves. Their family commitment instruments also appear relatively weak (only the presence of children is significant in the first stage, and then only at the 10% level), but student debt seems more plausible. Using their IV approach, Dolton and Silles (2001) estimate that over-education imposes an 18% wage penalty in their first job, and around a 30% penalty in their job five years later.

The difficulty of finding plausible instruments for over-education has encouraged some researchers to adopt panel data methods which exploit longitudinal datasets. These studies start with a set of wage equations for two time periods of the form:

$$Y_{i,t=0} = a_0 + a_1 O_{i,t=0} + \sigma_i + \mu_{i,t=0} \quad (1)$$

$$Y_{i,t=1} = a_0 + a_1 O_{i,t=1} + \sigma_i + \mu_{i,t=1} \quad (2)$$

Equations (1) and (2) relate individual income, Y_i, to an agent's unobserved and time-invariant ability, σ_i, and over-education status, O_i. Differencing (1) and (2) allows researchers to cancel out unobserved individual ability, and to estimate equation (3):

$$\Delta Y_i = (Y_{i,t=1} - Y_{i,t=0}) = b_0 + b_1\left(O_{i,t=1} - O_{i,t=0}\right) + (\sigma_i - \sigma_i) + v_i \quad (3)$$

Frenette (2004) uses this approach with longitudinal data on three cohorts of Canadian graduates. Differencing out unobserved ability, identification in his model depends on individual transitions between over-educated and well-matched positions. His results suggest that the wage penalty estimated by OLS is biased upwards. For a college graduate, the estimated effect of being over-educated in his first position falls from -11.1% to -6.0% when using the differencing approach. For Bachelors degree

students the differenced coefficient remains relatively large, but only half as big as that from the OLS procedure: -10.9% compared to -19.4%.

Dolton and Silles (2008) combine a panel data and an instrumental variables approach to both (a) difference out individual ability and (b) control for measurement error in their over-education variables. Anticipating a central criticism of Leuven and Oosterbeek (2011), they argue that if their over-education variables are affected by measurement error, then the estimated coefficients will be biased towards zero. To partially control for this effect they use two indicators of the education required for a position: the qualification required to secure the job and the qualification required to do the job. Their strategy therefore involves two stages – first differencing across initial and current jobs and then instrumenting for the change in one over-education measure using the change in the other. Their results confirm Frenette's (2004) findings, as their estimates of the wage penalty decline after controlling for individual heterogeneity. However, using multiple over-education variables to control for measurement error has the opposite effect on their mismatch coefficients. While controlling for just individual heterogeneity produces a wage penalty of between 18.7% and 21.7%, accounting for both unobserved individual characteristics and measurement error generates wage penalties of between 34.6% and 39.7%.

4.2 Conceptual and empirical framework

The central empirical focus of this paper is on the factors which determine the probabilities that a student (a) finds employment after completing their undergraduate degree and (b) that the student is mismatched, in the sense that their qualification was not a requirement for their position. Following previous work, which was hampered by

endogeneity arising from multiple forms of sample selection bias (Leuven and Oosterbeek 2011), I begin the discussion with a simple linear model:

$$\Pr\left(E_{i,j,k} = 1\right) = A_0 + A_1 X_i + A_2 Y_j + A_3 Z_{j,k} \quad (4)$$

Equation (4) states that the probability that a student finds employment is a function of their individual characteristics, X_i, the characteristics of their institution, Y_j, and conditions in the labour market, $Z_{j,k}$. i, j and k index individuals, institutions and labour market areas respectively. The probability of a student entering a mismatched position can be defined similarly:

$$\Pr\left(M_{i,j,k} = 1\right) = B_0 + B_1 X_i + B_2 Y_j + B_3 Z_{j,k} \quad (5)$$

While the estimation of (4) and (5) is practically straightforward, there are several conceptual problems which threaten to bias estimates of the parameter sets A and B. Firstly, as is now widely recognised, individuals are likely to self-select into the labour market based on a combination of observable and unobservable characteristics (Dolton and Vignoles 2000). All else equal, students with stronger academic credentials and greater unobservable ability may systematically choose different outcomes from less well-qualified, lower ability students. As a result, the students which appear in either (4) or (5) are not a random sample of the population. In (4), only students who choose to enter the labour market are included. In (5), only students who enter employment are included in the analysis. In both cases, parameter estimates are based on an endogenously selected sub-sample of the student body and cannot be generalised to the population as a whole. Applying equations (4) and (5) without appropriately controlling for selection risks parameter bias and inconsistency.

Secondly, the literature has yet to incorporate controls for potentially endogenous selection into universities. Researchers frequently estimate A_2 and B_2 depending on selection on observables for identification (Perna 2003, 2005, Monks 2000, Ciriaci and Muscio 2010). However, as has been argued persuasively elsewhere (Black and Smith 2004, Ehrenberg 2004, Hoxby 1997, Arcidiacono 2004, Chevalier and Conlon 2003, Long 2004), students exhibit substantial sorting when choosing where to study, much of which may also be based on unobserved characteristics. This sorting renders it very difficult if not impossible to separate the time-invariant characteristics of universities from the unobserved characteristics of individuals. To see this problem, envisage a sorting method into universities, in which students sort into the distribution of universities (good to bad) based on their ability (high to low). Without reliable measures of ability, the impact of attending a 'good' institution on either employment probabilities or earnings is inseparable from the impact of the student's characteristics. Coefficient estimates of parameters A_2 and B_2 are therefore likely to be biased through endogeneity.[31]

Thirdly, an analogous problem affects estimates of A_3 and B_3. Several papers in the field examine the impact of local economic characteristics on individual behaviour by including measures of earnings or unemployment rates in regressions such as (4) or (5). However, this over-looks the problem of residential sorting. As has been documented by Gobillon, Selod and Zenou (2007) and Dujardin, Selod and Thomas (2008), individuals may differ in terms of their preferences for residential areas. If these preferences over neighbourhoods also influence the probability of labour market outcomes, then the parameter estimates A_3 and B_3 will be similarly biased.

[31] This argument is the intuitive insight behind Black and Smith's (2004) 'Common Support' problem. They argue that OLS estimates of the returns to university quality may be biased if selection is near perfectly based on ability. Unless some high (low) ability students are observed in the less good (the best) universities, then the regression suffers from a lack of common support, with detrimental consequences for parameter estimates.

Finally, equation (5) may also suffer from the standard omitted variable problem. Unless all of an individual's relevant skills and abilities are included amongst the explanatory variables, then there remains a risk that the estimated coefficients are biased by the covariance between the measured and unobserved variables. In particular, unless all the relevant skills and abilities of individuals are included in (5), the risk of omitted variable bias remains.

4.2.1 Empirical framework

To partially mitigate against these effects, equations (4) and (5) are modified and two identifying assumptions are introduced. Equation (4) is replaced with a linear probability model such that:

$$E^*_{i,j,k,t} = A_0 + A_1 X_i + A_2 Y_{j,t} + A_3 Z_{j,k,t} + f_j + f_k + f_t$$
$$\Pr\left(E_{i,j,k,t} = 1\right) = \begin{cases} 0 \; if \; E^*_{i,j,k,t} \leq 0 \\ 1 \; if \; E^*_{i,j,k,t} > 0 \end{cases} \quad (6)$$

Equation (6) specifies the probability of employment as a latent variable E^*, which is again a function of individual (X_i), institutional ($Y_{j,t}$) and labour market characteristics ($Z_{j,k,t}$). Three arrays of fixed effects, for domicile region (f_k), institution (f_j) and cohort (f_t), complement the variables in (6). The subscripts i, j, k, and t denote individuals, institutions, domicile labour market areas and time respectively. In common with other models of revealed preference, E takes a value zero if the latent term is negative and a value one otherwise. Equation (7) shows the equivalent specification for the probability of being in a mismatched position:

$$M^{*}_{i,j,k,t} = B_0 + B_1 X_i + B_2 Y_{j,t} + B_3 Z_{j,k,t} + f_j + f_k + f_t$$

$$\Pr\left(M_{i,j,k,t} = 1\right) = \begin{cases} 0 \; if \; M^{*}_{i,j,k,t} < 0 \\ 1 \; if \; M^{*}_{i,j,k,t} > 0 \end{cases} \tag{7}$$

Introducing these arrays of fixed effects goes some way towards reducing the identification problems outlined in the previous section. Exploiting the time variation in the dataset, I make three additional assumptions which when combined with the arrays of fixed effects, allow me to partially control for endogenous university and residential selection. Firstly, I assume that students sort into university courses based on both individual characteristics and characteristics of the institution, which may either be observed or unobserved by the researcher. These might include ability, interest in research or the extent of work experience gained during their undergraduate degree. Secondly, I assume that the individual's unobserved characteristics, which I cannot directly control for, are common among all students making the same choice of university and subject. Introducing a fixed effect for each university course controls for these unobserved characteristics to the extent to that they are time-invariant, allowing all students on a given subject-institution combination to share a single, intercept shifting effect on the probability of (a) employment and (b) mismatch.

Thirdly and analogously, I assume that students who share a common region of domicile share a set of unobserved characteristics which may affect both their residential location and the probability of a given labour market outcome. Introducing an array of fixed effects for each domicile region helps to condition out the impact of these unobservables. Identification therefore depends on variation in local economic conditions through time. This is a significant methodological innovation compared to prior work (Frank 1978, McGoldrick and Robst 1996, Büchel and Battu 2003, Büchel and Ham 2003) and permits a more causal interpretation of the coefficients.

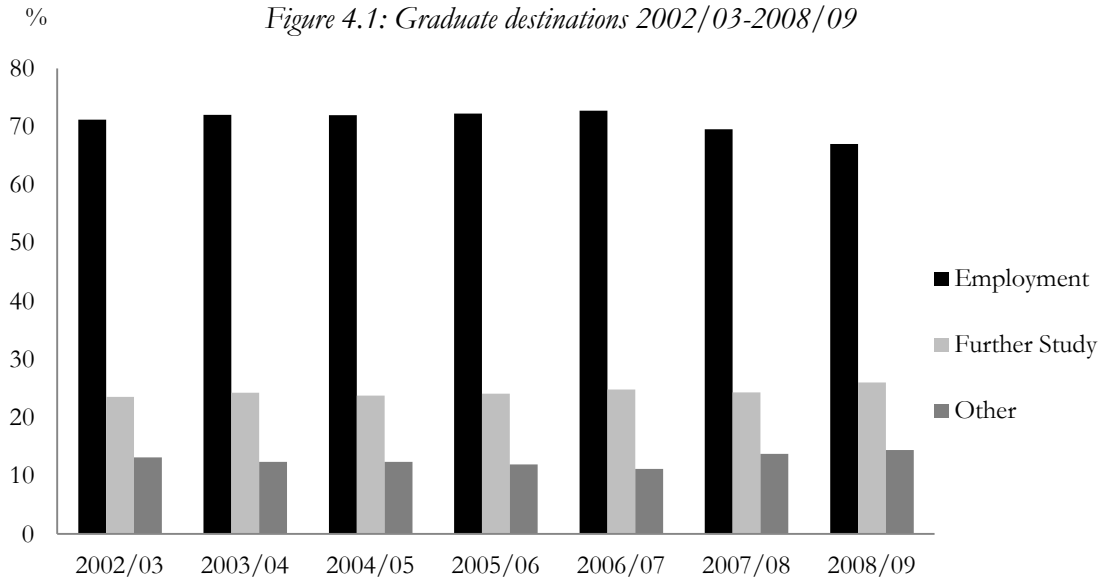
As in the previous chapters of this thesis, the linear approach I adopt represents a compromise between the methodologically desirable and the practically possible. A series of fixed-effect conditional logit models were also estimated for a random subset of students to ensure that the results are not a consequence of the method employed. These produced similar estimates to the linear probability models presented here.

4.3 Data

The primary dataset used in this paper is the Destination of Leavers from Higher Education (DLHE) survey provided by the Higher Education Statistics Agency (HESA), which has been used and analysed extensively elsewhere (Faggian and McCann 2006, 2009, Faggian, McCann and Sheppard, 2006, 2007a, 2007b, Naylor and Smith 2004, Smith and Naylor 2005, Wales 2010). The DLHE is a rich, micro-level dataset based on a combination of institutional information and the results of a large survey of graduates carried out six to nine months after they graduate. It includes a broad range of individual level information, such as age, gender and ethnicity, as well as information about the student's institution, subject and degree classification. Alongside these variables, geographical information on the student's domicile and employment postcode districts is included.

The survey component of the DLHE provides the dependent variables for my analysis of employment outcomes. Graduates are asked to report their activity based on a classification including various forms of employment (full-time, part-time, voluntary/unpaid, work & studying), further study, unemployed or other activity. Figure 4.1 shows the proportion of students who enter Employment, go on to Further Study or who report Other Activity between 2002/03 and 2008/09. The proportion entering employment fell slightly in the last two years of available data, from a peak of 72.8% in

Figure 4.1: Graduate destinations 2002/03-2008/09

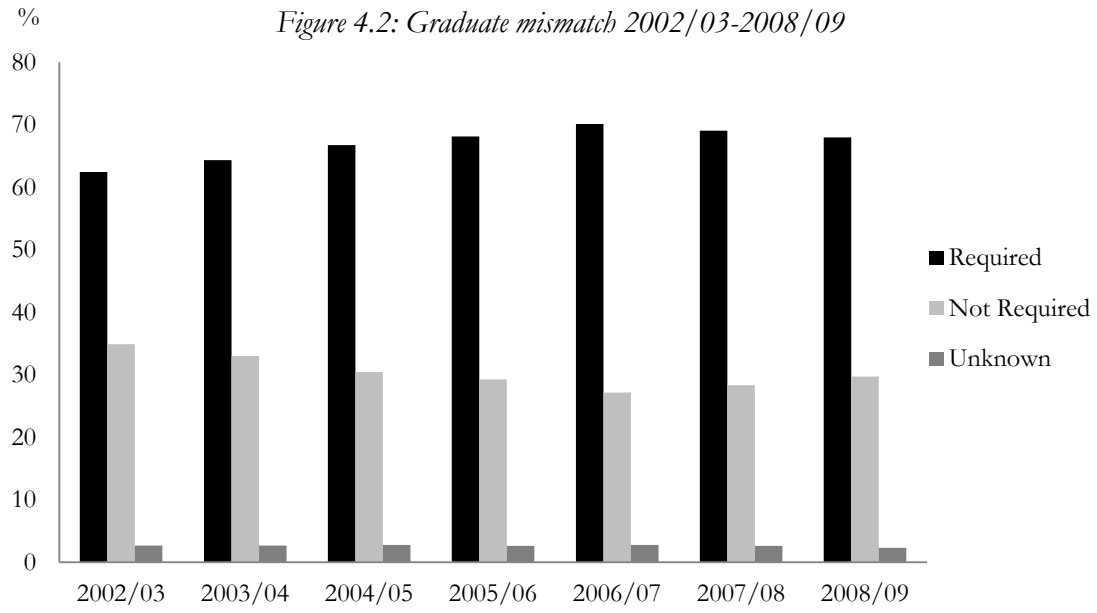


Note(s): (1) Proportion of all responding students. Sample size: 1.2m students. (2) Employment includes all modes (FT, PT, Voluntary, etc). (3) Percentages do not sum because students reporting 'Working & Studying' are allocated to both 'Employment ' and 'Further Study'.

2006/07 to just over 67.0% in 2008/09. The proportion entering Further Study increased slightly in the final two years, from an average of 24.1% between 2002/03 to a little over 26.0% in 2008/09.

Of those who are in employment, the DLHE requests further details about the nature of that employment. My analysis of graduate mismatch is based on the answer provided to the question 'Would you have been able to get the job you will be doing on … without the qualification you have recently obtained (the actual qualification, not the subject of study)?' (HESA 2006, pp.2). Five possible responses were provided: (1) 'No: the qualification was a formal requirement', (2) 'No: successful applicants were expected to have the qualification', (3) 'Possibly: but the qualification did give me an advantage', (4) 'Yes', and (5) 'Don't know'. Individuals who agreed with statements (1)-(3) are coded as 'Matched', while individuals who responded to (4) 'Yes', are coded as 'Mismatched'. Figure 4.2 shows the proportion of students in employment who fall into each category between 2002/03 and 2008/09, and suggests that between 60% and 70% of graduates take up positions for which they are well-qualified. The proportion

Figure 4.2: Graduate mismatch 2002/03-2008/09



Note(s): (1) Proportion of all responding students in FT employment.

reporting that their qualification was not required for their current position fell from 34.9% in 2002/03 to a low of 27.1% in 2006/07 before rising again to 29.7% in 2008/09.

In the context of the earlier discussion of measures of over-education, this is a subjective indicator which depends on the student's interpretation of the qualifications required for the job. I neither claim that this is a perfect measure, nor argue that this wording will induce students to use some common measure of difficulty. Instead I make two assumptions which frame the following analysis. Firstly, the responses to this question, however subjective, capture a noisy indicator of the quality of the labour market match by the student. Secondly, no group is inherently more likely to report that their qualifications were not required for their position. For the analysis to be valid, two individuals who made identical education choices and who enter the same jobs have an identical likelihood of reporting themselves mismatched. For clarity, I make the maintained assumption that no group howsoever defined (ethnic, socio-economic, age or gender) is more likely than any other to report themselves over-educated given the

same educational choices, attainment and eventual employment. This is strong assumption and a key limitation of this paper which is discussed further in Section 4.5

The starting sample of students from the DLHE, including all first degree undergraduates domiciled in and graduating from a university in Great Britain between 2004/05 and 2008/09, aged between 20 and 24 on graduation, yields observations on 1,191,430 students. Eliminating part-time students, those studying Medicine or an indeterminate subject,[32] or whose area of domicile is missing reduces the sample to 864,930.[33] Of these, 22.7% failed to respond to the survey.[34] Further attrition occurs through missing data.

As the explanatory variables are introduced gradually, the final sample size varies across specifications. The employment regressions include only students who opted not to pursue Further study, yielding a sample of between 540,700 and 510,190 observations. The mismatch regressions, which include only those in employment, include between 454,560 and 402,080 observations. Comparing those who respond to the survey to those who are excluded or do not respond suggests that the analysis slightly over-samples younger students from wealthy backgrounds, although these differences are relatively slight.

[32] Students who reported that they divided their time equally between two academic subjects, as defined by the Joint Academic Classification of Subjects level two (JACS2), are considered to studied an indeterminate subject. Students are assigned the subject on which they spent most of their time. 86.3% of the initial sample report a single subject specialism.

[33] Students may be missing domicile information for four reasons. (1) They failed to provide a domicile postcode sector (1.4% of the initial sample). (2) They report a Non-UK address (12.9%). (3) They provide an inaccurate postcode sector (8 observations). (4) Their domicile postcode district is split among multiple Travel to Work Areas (TTWA). In these cases, Census data on the number of 17, 18 and 19 year olds in each Output Area is used to calculate the likelihood of students coming from each possible TTWA. 0.31% of the initial sample is dropped owing to uncertainty over domicile. 96.7% of the initial sample can be assigned to a single TTWA with greater than 70% certainty. 90.0% can be assigned to a single TTWA with greater than 90% certainty.

[34] The non-response rate to the DLHE survey varies between 21.0% and 24.3% across the five academic years considered. These fluctuations are assumed to be random as they do not appear to differ systematically across sub-groups.

4.3.1 Other data sources

Alongside the DLHE, a range of information about local economic conditions was gathered from the Office for National Statistics. Specifically, average hourly wages for both men and women were extracted from the Annual Survey of Hours and Earnings and the Claimant Count rate of unemployment was gathered from the Department of Work and Pensions local level datasets. Information about vacancies by occupation was taken from the Job Centre Plus vacancy data and broken into 'high occupations' – including Managerial and Professional vacancies – and 'low occupations' – which is composed of Elementary, Process, Plant & Machine Operative, Sales & Customer Service and Personal Service vacancies. Total employment was taken from the Annual Business Inquiry, while the working age population was taken from the Mid-Year Population Estimates.

To examine the impact of housing costs on the propensity for students to enter employment, data was gathered on rents in each of the 408 Local Authority Districts of Great Britain. As data on private rents are not publicly available, information was gathered on the level of rents charged by Registered Social Landlords (RSL) in each area of England, Wales and Scotland. RSLs are landlords who provide housing for vulnerable groups and those who cannot afford to rent privately. They provide a range of different sorts of accommodation, but generally charge a below-market rent. For this application, identification is achieved using spatial and temporal variation in RSL rents, on the assumption that changes through time reflect marginal changes in local housing markets. These data were used in preference to house price information which is highly correlated with local economic conditions.

While data on unemployment and vacancies was available at the travel to work area level, the rental, population and employment data was gathered at the Local

Authority District level and aggregated using usual resident population shares from the 2001 census. The resulting dataset offers a range of indicators for the 297 travel to work areas (TTWA) between 2003 and 2009. In addition to these measures of local economic conditions, a further set of data on institutions was gathered from the Higher Education Information Database for Institutions (HEIDI). This source provided information on the level of teaching funds and the total number of undergraduate students, between 2003/04 and 2008/09, from which I calculated teaching funds per student.

4.4 Results

The primary empirical focus of this paper is on examining the determinants of graduate labour market outcomes in the United Kingdom. A series of linear probability models were estimated to identify the effects of individual, academic and local economic characteristics on (a) the probability of a student finding employment after graduation and (b) the probability that he is mismatched. The variables were introduced gradually and the full results are shown in Tables 4.1 and 4.2.

4.4.1 Employment

Table 4.1 shows the impact of individual, academic and local economic characteristics on the probability that a student is in employment six to nine months after graduation. Each specification includes a set of cohort dummy variables (five effects), and specifications (1), (2), (3) and (5) all include fixed effects for each observed subject-institution combination (between 1,764 and 1,702 effects). Specification (5) also includes fixed effects for each domicile TTWA (297 effects) and represents my preferred specification. As discussed above, these effects go some way towards

controlling for unobserved characteristics of the individual and of the institution, and help to mitigate against parameter bias arising from selection into universities and residential areas. (4) is estimated free of these controls to contrast the results before and after controlling for selection effects. Each reported regression includes only those students who choose to enter the labour market following the graduation, excluding students who progress to Further study.

The results shown in Table 4.1 suggest significant heterogeneity among observably different students, even after controlling for their common, time-invariant unobserved characteristics. Firstly, women are more likely to be in employment six to nine months after graduating than equivalent male students, who are significantly more likely to be unemployed or unavailable for employment. This effect is broadly consistent across the specifications, varying between 3.9% and 5.2%. Older students are also more likely to be in employment, with an additional year of age adding between 7.4% and 15.3% to the probability that a graduate is in work. Students who report some form of disability are significantly less likely to be in employment.

The impact of ethnicity is one of the larger estimated effects and suggests that non-white students are significantly less likely to find work than equivalently qualified white graduates. In specification (5), Black and Asian students are 4.1% and 7.2% less likely to find employment respectively, while students from Other ethnic backgrounds are 3.8% less likely to be in work. While these effects are broadly similar across the specifications, amongst the greatest differences arise between (4) and (5). This suggests that there is significant sorting into different degree subjects and institutions based on ethnic background, which is controlled for more completely in specification (5).

Compared to the coefficients on ethnic group, the impact of socio-economic background is relatively small. The coefficients suggest that students from relatively less well-off backgrounds are significantly more likely to enter employment than

Table 4.1: Results: Employment probabilities[1, 2, 5]

	(1)		(2)		(3)		(4)		(5)	
Female	**0.042**[a]	(0.001)	**0.042**[a]	(0.001)	**0.039**[a]	(0.001)	**0.052**[a]	(0.003)	**0.043**[a]	(0.006)
Age[3]	**0.140**[a]	(0.019)	**0.153**[a]	(0.019)	**0.108**[a]	(0.020)	**0.074**[a]	(0.022)	**0.112**[a]	(0.020)
Age-Squared[3]	**-0.003**[a]	(0.000)	**-0.003**[a]	(0.000)	**-0.003**[a]	(0.000)	**-0.002**[a]	(0.000)	**-0.003**[a]	(0.000)
Disability	**-0.030**[a]	(0.002)	**-0.030**[a]	(0.002)	**-0.026**[a]	(0.002)	**-0.030**[a]	(0.002)	**-0.026**[a]	(0.002)
Ethnicity										
Black	**-0.052**[a]	(0.004)	**-0.052**[a]	(0.004)	**-0.045**[a]	(0.004)	**-0.046**[a]	(0.004)	**-0.041**[a]	(0.004)
Asian	**-0.078**[a]	(0.003)	**-0.078**[a]	(0.003)	**-0.072**[a]	(0.003)	**-0.062**[a]	(0.005)	**-0.072**[a]	(0.003)
Other	**-0.044**[a]	(0.004)	**-0.043**[a]	(0.004)	**-0.039**[a]	(0.004)	**-0.042**[a]	(0.004)	**-0.038**[a]	(0.004)
Unknown	**-0.033**[a]	(0.003)	**-0.030**[a]	(0.003)	**-0.026**[a]	(0.004)	**-0.023**[a]	(0.004)	**-0.020**[a]	(0.004)
Socio-economic group										
Lower Manag. & Prof.			**0.004**[a]	(0.002)	**0.004**[a]	(0.002)	**0.006**[a]	(0.002)	**0.005**[a]	(0.002)
Intermediate			**0.012**[a]	(0.002)	**0.012**[a]	(0.002)	**0.014**[a]	(0.002)	**0.012**[a]	(0.002)
Small Employers			**-0.007**[a]	(0.002)	**-0.007**[a]	(0.003)	-0.003	(0.003)	-0.005[c]	(0.003)
Lower Super. & Tech.			**0.010**[a]	(0.003)	**0.009**[a]	(0.003)	**0.013**[a]	(0.003)	**0.009**[a]	(0.003)
Semi-routine			**0.010**[a]	(0.002)	**0.010**[a]	(0.002)	**0.013**[a]	(0.002)	**0.010**[a]	(0.002)
Routine & Unemp.			**0.009**[a]	(0.003)	**0.009**[a]	(0.003)	**0.013**[a]	(0.003)	**0.009**[a]	(0.003)
Unknown			-0.003	(0.002)	-0.002	(0.002)	0.000	(0.002)	-0.001	(0.002)
Academic Characteristics										
Sch. Type *Private*					**-0.025**[a]	(0.002)	**-0.031**[a]	(0.002)	**-0.024**[a]	(0.002)
Unknown					**-0.005**[b]	(0.002)	-0.003	(0.002)	**-0.004**[b]	(0.002)
Sch. Res. *1st Quartile*					**-0.008**[a]	(0.002)	0.001	(0.002)	**-0.008**[a]	(0.002)
2nd Quartile					-0.001	(0.002)	**0.006**[a]	(0.002)	-0.001	(0.002)
4th Quartile					0.002	(0.002)	**-0.008**[a]	(0.002)	0.002	(0.002)
Unknown					**-0.005**[b]	(0.002)	0.001	(0.003)	**-0.005**[b]	(0.002)
UG Class *1*					**0.036**[a]	(0.002)	**0.032**[a]	(0.002)	**0.035**[a]	(0.002)
2-1					**0.017**[a]	(0.001)	**0.013**[a]	(0.001)	**0.016**[a]	(0.001)
3					**-0.027**[a]	(0.003)	**-0.030**[a]	(0.003)	**-0.027**[a]	(0.003)
Other					0.007	(0.005)	**0.024**[a]	(0.007)	0.007	(0.005)
Three Year UG					**-0.028**[a]	(0.004)	**-0.039**[a]	(0.005)	**-0.029**[a]	(0.004)
Four Year UG					**-0.012**[a]	(0.004)	**-0.013**[a]	(0.004)	**-0.012**[a]	(0.004)
Funds per student[4]					0.003	(0.002)	**0.007**[a]	(0.002)	0.005[c]	(0.003)
Dom. Econ. Characteristics										
Unemployment 18-24[4]							**0.178**[a]	(0.042)	-0.010	(0.065)
Average FT Earnings[4]							-0.006	(0.007)	0.017	(0.017)
Low Occ. Vac[4]							0.004[c]	(0.002)	**0.006**[b]	(0.003)
Manag. & Prof. Vac[4]							**0.005**[a]	(0.002)	-0.002	(0.002)
Total Employment[4]							**-0.008**[a]	(0.003)	0.010	(0.023)
RSL Rent[4]							**-0.028**[a]	(0.009)	0.027	(0.030)
Working Age Pop[4]							0.003[c]	(0.002)	**-0.172**[b]	(0.068)
Inst. Econ. Characteristics										
Unemployment 18-24[4]							**-0.021**[a]	(0.007)	0.006	(0.014)
Average FT Earnings[4]							0.021	(0.019)	0.013	(0.027)
Low Occ. Vac[4]							0.006	(0.005)	0.003	(0.004)
Manag. & Prof. Vac[4]							-0.003	(0.002)	0.002	(0.002)
Total Employment[4]							-0.011	(0.007)	-0.067[c]	(0.038)
RSL Rent[4]							**0.038**[b]	(0.019)	-0.010	(0.042)
Working Age Pop[4]							-0.006[c]	(0.004)	-0.115	(0.082)
Controls & Observations										
Year FE	YES – (5)		YES – (5)		YES – (5)		YES – (5)		YES – (5)	
Inst.*Sub. FE	YES – (1,764)		YES – (1,764)		YES – (1,703)				YES – (1,702)	
Domicile TTWA FE									YES – (297)	
Observations	540,701		540,701		523,372		510,189		510,189	

Note(s): (1) Dep. Var is binary, taking a value 1 if the student reports being over-educated. Regressions include only students who report a specific activity other than full-time study. (2) Standard errors in brackets, clustered at the inst*sub level. (3) These variables are quasi-continuous. (4) These variables are continuous. (5) a, b and c indicate significance at the 1%, 5% & 10% levels respectively.

equivalent students of Higher Managerial & Professional parents. While the broadest differences again arise between specifications (4) and (5) – suggesting significant sorting into residence and university courses – the absolute magnitude of these effects never exceeds 1.3%. This result suggests that students from relatively more affluent backgrounds may be able to take more time to decide on their next career steps after graduation than students from less wealthy households.

The results also highlight the importance of academic success to the likelihood of employment. Achieving a First Class (Upper Second Class) undergraduate degree increases the probability of a student finding employment by 3.2%-3.6% (1.3%-1.7%) relative to achieving a Lower Second Class undergraduate degree. Graduates of longer degrees are also significantly more likely to find employment: relative to a graduate of a five-year degree course, students graduating in three (four) years are 2.9% (1.2%) less likely to be in employment six to nine months after completion. According to specification (5), school results seem to have little bearing on labour market outcomes, while attendance at a Private school is associated with a higher probability of being outside the workforce.

Examining the effects of local economic conditions on student behaviour in specifications (4) and (5) suggests that controlling for selection into university courses and TTWAs of residence is important. Whereas (4) detects a series of effects arising from unemployment and rental rates, (5) isolates just two effects which are significant at the five percent level. Identifying using variation in economic characteristics over time, these results suggest that students in areas with growing numbers of Low Occupation Vacancies are marginally more likely to find employment, while students from areas with a growing supply of labour are significantly less likely to find employment. Economic conditions around the student's institution make very little difference to labour market outcomes.

4.4.2 Over-education

Table 4.2 shows the results of a second set of linear probability models examining the impact of individual, academic and local economic characteristics on the probability that a student who is in employment six to nine months after graduation reports that he is over-educated in that position. As before, the variables are entered gradually with the most detailed specification reflecting the preferred set of results. Each regression includes a set of cohort dummies (five effects), and all but specification (5) include a full set of fixed effects for each observed subject-institution combination (between 1,761 and 1,696 effects). Further controls for the industry (16 effects), employer size (five effects) and the TTWA of the student's domicile (297 effects) are also incorporated in the later specifications. Supporting empirical work suggested that a further set of fixed effects were required for the TTWA of the student's employer, adding a further set of 297 variables to specification (6). Once again, the penultimate specification is estimated without controls for university and residential selection to allow the impact of the fixed effects to be assessed.

The results in Table 4.2 confirm the findings of some prior work, but also present several new effects. Firstly, in the most detailed specification women are found to be significantly less likely to report that they are mismatched in their first position than men. The magnitude of this effect varies across specifications, ranging from 1.4% in regression (3) to -5.8% in regression (6). These differences are largely attributable to the inclusion of a detailed set of variables on the nature of the student's work in equation (4) and a complete set of controls for the student's TTWAs of domicile and employment in (6). This result stands in contrast to the results of Battu, Bellfield and Sloane (1999, 2000), Chevalier (2003) and Chevalier and Lindley (2009), none of

Table 4.2: Results: Mismatch probabilities[1, 2, 3, 13]

		(1)		(2)		(3)		(4)		(5)		(6)	
Female		**0.007**[a]	(0.002)	**0.007**[a]	(0.002)	**0.014**[a]	(0.002)	-0.002	(0.002)	**-0.022**[a]	(0.005)	**-0.058**[a]	(0.008)
Age[4]		**-0.177**[a]	(0.028)	**-0.168**[a]	(0.028)	0.019	(0.026)	0.033	(0.023)	**0.061**[b]	(0.027)	**0.050**[b]	(0.024)
Age-Squared[4]		**0.004**[a]	(0.001)	**0.004**[a]	(0.001)	-0.001	(0.001)	-0.001	(0.001)	**-0.001**[b]	(0.001)	-0.001[c]	(0.001)
Disability		0.000	(0.003)	0.000	(0.003)	-0.002	(0.003)	0.001	(0.002)	0.002	(0.003)	0.000	(0.002)
Ethnicity	*Black*	**0.028**[a]	(0.006)	**0.027**[a]	(0.006)	**0.011**[b]	(0.005)	**0.018**[a]	(0.005)	**0.026**[a]	(0.006)	**0.025**[a]	(0.005)
	Asian	0.006[c]	(0.004)	0.003	(0.004)	-0.006[c]	(0.003)	-0.003	(0.003)	-0.009[c]	(0.005)	0.000	(0.003)
	Other	0.006	(0.004)	0.006	(0.004)	0.002	(0.004)	**0.008**[b]	(0.004)	**0.015**[a]	(0.004)	**0.011**[a]	(0.004)
	Unknown	**-0.031**[a]	(0.004)	**-0.030**[a]	(0.004)	**-0.032**[a]	(0.004)	**-0.014**[a]	(0.004)	0.009	(0.005)	0.004	(0.005)
Socio-economic group	*Lower Manag. & Prof.*			**0.007**[a]	(0.002)	**0.005**[a]	(0.002)	0.002	(0.002)	0.002	(0.002)	0.001	(0.002)
	Intermediate			**0.018**[a]	(0.002)	**0.016**[a]	(0.002)	**0.007**[a]	(0.002)	**0.006**[b]	(0.002)	**0.006**[a]	(0.002)
	Small Employers			**0.020**[a]	(0.003)	**0.017**[a]	(0.003)	**0.008**[a]	(0.003)	**0.007**[b]	(0.003)	**0.008**[a]	(0.003)
	Lower Super. & Technical			**0.019**[a]	(0.004)	**0.017**[a]	(0.004)	**0.007**[b]	(0.003)	0.004	(0.003)	0.005	(0.003)
	Semi-routine			**0.024**[a]	(0.003)	**0.020**[a]	(0.003)	**0.008**[a]	(0.003)	**0.006**[b]	(0.003)	0.005[c]	(0.003)
	Routine, Never Worked & Unemp.			**0.031**[a]	(0.004)	**0.026**[a]	(0.004)	**0.009**[a]	(0.004)	0.006	(0.004)	**0.008**[b]	(0.004)
	Unknown			**0.009**[a]	(0.002)	**0.011**[a]	(0.003)	**0.008**[a]	(0.002)	**0.006**[b]	(0.003)	**0.007**[a]	(0.002)
School Type	*Private*					**-0.023**[a]	(0.003)	**-0.009**[a]	(0.002)	-0.003	(0.002)	-0.004[c]	(0.002)
	Unknown					**-0.008**[a]	(0.003)	-0.003	(0.002)	0.004	(0.004)	-0.002	(0.003)
School Results	*1st Quartile*					0.001	(0.003)	-0.004	(0.002)	-0.006[c]	(0.003)	-0.003	(0.002)
	2nd Quartile					-0.004[c]	(0.002)	**-0.004**[b]	(0.002)	**-0.006**[a]	(0.002)	-0.004[c]	(0.002)
	4th Quartile					**-0.005**[b]	(0.002)	-0.003	(0.002)	-0.001	(0.002)	**-0.005**[b]	(0.002)
	Unknown					**-0.010**[a]	(0.003)	**-0.007**[a]	(0.003)	**-0.016**[a]	(0.004)	**-0.007**[a]	(0.003)
UG Degree Class	*1*					**-0.109**[a]	(0.003)	**-0.049**[a]	(0.003)	**-0.047**[a]	(0.003)	**-0.046**[a]	(0.003)
	2-1					**-0.049**[a]	(0.002)	**-0.024**[a]	(0.002)	**-0.020**[a]	(0.002)	**-0.023**[a]	(0.002)
	3					**0.048**[a]	(0.004)	**0.021**[a]	(0.003)	**0.023**[a]	(0.004)	**0.022**[a]	(0.004)
	Other					-0.011	(0.010)	-0.013[c]	(0.007)	**-0.034**[a]	(0.009)	-0.012	(0.008)
UG Degree Duration	*Three Year*					**0.057**[a]	(0.006)	**0.023**[a]	(0.004)	**0.038**[a]	(0.005)	**0.025**[a]	(0.005)
	Four Year					0.004	(0.005)	-0.002	(0.004)	-0.002	(0.005)	0.000	(0.004)
Teaching funds per student[5]						-0.002	(0.007)	-0.005	(0.007)	**-0.009**[a]	(0.003)	-0.004	(0.007)
Occupation of Employment	*Professional*							**-0.144**[a]	(0.005)	**-0.158**[a]	(0.006)	**-0.147**[a]	(0.005)
	Lower Professional							**-0.068**[a]	(0.005)	**-0.075**[a]	(0.005)	**-0.069**[a]	(0.005)
	Admin. & Secretarial							**0.169**[a]	(0.005)	**0.179**[a]	(0.005)	**0.168**[a]	(0.005)
	Skilled							**0.231**[a]	(0.014)	**0.236**[a]	(0.015)	**0.224**[a]	(0.014)
	Personal Service							**0.145**[a]	(0.007)	**0.153**[a]	(0.007)	**0.138**[a]	(0.007)
	Sales & Customer Service							**0.298**[a]	(0.006)	**0.307**[a]	(0.007)	**0.291**[a]	(0.006)
	Process & Plant Operatives							**0.294**[a]	(0.015)	**0.296**[a]	(0.016)	**0.284**[a]	(0.015)

Cont.		*(1)*	*(2)*	*(3)*	*(4)*		*(5)*		*(6)*	
	Elementary				**0.301[a]**	(0.007)	**0.308[a]**	(0.008)	**0.294[a]**	(0.007)
	Unknown				0.027	(0.021)	**0.059[b]**	(0.026)	0.048[c]	(0.026)
Dom. Econ. Characteristics[5, 12]	*Unemployment 18-24*[6]						-0.091	(0.080)	-0.021	(0.083)
	Average FT Earnings[7]						0.003	(0.009)	-0.020	(0.020)
	Low Occupation Vacancies[8]						**-0.007[a]**	(0.003)	-0.004	(0.004)
	Manag. & Prof. Vacancies[8]						0.002	(0.002)	-0.002	(0.002)
	Total Employment[9]						**0.009[a]**	(0.003)	0.025	(0.030)
	RSL Rent[10]						**0.045[a]**	(0.012)	-0.032	(0.038)
	Working Age Population[11]						0.003	(0.002)	0.001	(0.096)
Inst. Econ. Characteristics[5, 12]	*Unemployment 18-24*[6]						0.009	(0.012)	**-0.050[a]**	(0.016)
	Average FT Earnings[7]						-0.065[c]	(0.037)	0.046	(0.038)
	Low Occupation Vacancies[8]						-0.003	(0.008)	0.001	(0.007)
	Manag. & Prof. Vacancies[8]						-0.006	(0.005)	0.000	(0.005)
	Total Employment[9]						0.020[c]	(0.012)	-0.065	(0.070)
	RSL Rent[10]						0.026	(0.033)	**0.261[a]**	(0.070)
	Working Age Population[11]						-0.008	(0.006)	**0.566[a]**	(0.154)
Emp. Econ. Characteristics[5, 12]	*Unemployment 18-24*[6]						**-0.021[a]**	(0.003)	**-0.029[a]**	(0.007)
	Average FT Earnings[7]						**-0.081[a]**	(0.013)	0.001	(0.026)
	Low Occupation Vacancies[8]						**0.007[b]**	(0.003)	-0.002	(0.004)
	Manag. & Prof. Vacancies[8]						0.003	(0.002)	0.000	(0.003)
	Total Employment[9]						0.002	(0.005)	-0.017	(0.039)
	RSL Rent[10]						**-0.060[a]**	(0.015)	-0.023	(0.046)
	Working Age Population[11]						**0.010[a]**	(0.003)	-0.080	(0.100)
Controls & Observations	*Year FE*	YES – (5)	YES – (5)	YES – (5)	YES – (5)		YES – (5)		YES – (5)	
	*Institution*Subject*	YES – (1,761)	YES – (1,761)	YES – (1,700)	YES – (1,700)				YES – (1,696)	
	Industry of Employment FE				YES – (16)		YES – (16)		YES – (16)	
	Firm Size FE				YES – (5)		YES – (5)		YES – (5)	
	Domicile TTWA FE								YES – (297)	
	Employer TTWA FE								YES – (297)	
	Observations	454,562	454,562	440,357	439,346		402,083		402,083	

Note(s): (1) Dep. Var. is binary, taking a value 1 if the student reports being over-educated. (2) Std. Errors in brackets, clustered at the inst*sub level. (3) Excluded categories include male, white, state-school educated, Higher Manag. & Prof. background, Managerial role in their first job, achieved third-quartile sch. results, Third Class degree, 2005/06. (4) These variables are quasi-continuous. (5) These variables are continuous. (6) Measure of unemp. is the natural logarithm of the number of people aged 18-24 who are claiming Job Seekers Allowance. (7) Av. FT Earnings are the natural logarithm of per hour earnings. (8) Low Occupation Vacancies and Manag. & Prof. Vacancies are defined from Job Centre Plus data, see Section 4.3. (9) Total Emp. is the natural logarithm of total employment from the Annual Business Inquiry. (10) RSL Rents are the av. rents in each Local Authority District in Great Britain aggregated to TTWA level and expressed in as the natural logarithm of av. weekly rents. (11) Working Age Pop. is the natural logarithm of the working age pop. in each TTWA taken from the Mid-Year Population Estimates. (12) These variables are defined at the TTWA level. (13) a, b and c indicate significance at the 1%, 5% & 10% levels respectively.

whom find evidence of a significant difference between males and females. This difference seems likely to stem from the relatively more detailed set of control variables included in this analysis.

The results also suggest significant variation in mismatch propensities between different ethnic groups. Table 4.2 adds detail to previous findings, suggesting that those Black students who do find employment are 1.1% to 2.8% more likely to be mismatched than equivalent white students, as are students from Other non-white ethnic groups (0.8% to 1.5%).

The impact of socio-economic background varies across the estimated specifications. In (2) and (3), students from less wealthy backgrounds appear to be significantly more likely to be over-educated in their first positions relative to students from Higher Managerial & Professional backgrounds. In specification (3), students whose parents are in the Semi-routine occupational groups are 2.0% more likely to be over-educated in their first job, while students from the lowest two occupational groups are 2.6% more likely to be mismatched.

However, the effect of socio-economic background diminishes in both size and significance with the introduction of job-specific variables. Controlling for the occupation, industry and size of the student's chosen firm reduces the magnitude of five of the seven socio-economic group coefficients by more than half, suggesting a correlation between student background and the job opportunities which they access. In specification (6), just four socio-economic group variables are significant, each contributing less than 1% to the probability of a student being over-educated.

A similar pattern of attenuation is apparent among the estimated effects of academic background. In (3), First Class (Upper Second Class) undergraduate degree students are 10.9% (4.9%) less likely to be mismatched than Lower Second Class students, while attendance at a Private school is associated with a 2.3% reduction in the

probability of being over-educated. After the inclusion of job characteristics all of these effects remain significant, but are substantially attenuated.

These results are consistent with a process of endogenous selection into labour market openings, in which academically stronger students, students from relatively wealthy backgrounds and those from Private schools are best placed to access jobs which make use of their skills, even after controlling for the unobservable characteristics common to students on each university course.

4.4.3 Spatial labour markets and over-education

Specifications (5) and (6) in Table 4.2 report the impact of labour market conditions around the student's domicile, their institution and their eventual labour market of employment, on the probability of mismatch. In (5), the impact of economic conditions is estimated in terms of level effects. Specification (6), unlike prior work in the field (Frank 1978, McGoldrick and Robst 1996, Büchel and Battu 2003, Büchel and van Ham 2003), introduces controls for the common, time-invariant unobserved characteristics of residence, moving the coefficients towards a more causal interpretation.

While several economic characteristics of domicile are significantly correlated with the likelihood of mismatch in (5), the results in column (6) suggest that after controlling for residential selection, economic conditions in the student's domicile TTWA make no significant contribution to the probability of over-education. This finding is consistent with a substantial literature which reports that relatively highly-qualified people are thought to be among the most mobile section of the population. Students from relatively unfavourable areas may simply not return after graduation (Faggian and McCann 2006, Faggian, McCann and Sheppard 2006, 2007a, 2007b).

In contrast, economic conditions around the student's institution appear to play a greater role in determining graduate outcomes. Higher youth unemployment has a negative impact on the probability of mismatch, while the positive, significant coefficient on the cost of renting suggests that students from areas with growing housing costs are significantly more likely to be over-educated in their first job. This second result in particular is consistent with individuals accepting inappropriate employment as a means of servicing a growing stock of housing-related debt.

Finally, the relatively large impact of economic conditions around the student's eventual employer is substantially reduced following the inclusion of controls for residential selection. Where five coefficients are significant at conventional levels in specification (5), only one retains its size and significance in (6). Further research is needed to establish whether this result is a consequence of the relatively short time period used here.

4.5 Limitations

Given recent criticism of work in the over-education field, the empirical ambitions of this paper are constrained to the safest econometric ground. Using a comprehensive set of controls my approach has tried to limit the impact of unobserved individual heterogeneity arising through endogenous selection into universities and residential areas. This approach allows a more causal interpretation of the coefficients than earlier papers.

The limitations of the analysis concern several issues raised in Section 4.1.[35] Firstly, my results do not control for selection into the labour market as others have sought to do (Dolton and Vignoles 2000). If, as seems plausible, the individuals who

[35] A survey of supporting empirical work intended to address some of these issues is included in Appendix 4A.

choose to enter into employment are a non-random sample of the student population, then parameter estimates may be biased and inconsistent.

Secondly, even if the students included in my analysis are representative of the population, there remains the potential for significant differences in unobserved characteristics within each fixed effects group. This effect may be particularly important given the subjective nature of the mismatch indicator. The maintained assumption that an individual's propensity to report themselves mismatched is independent of all observed non-employment characteristics may not hold. In particular, perceived or actual labour market discrimination directed towards observably different groups may influence their propensity to report themselves mismatched.

Thirdly, the data offers a single snap-shot of student activity six to nine months after graduation, which limits our analysis to students' first destinations. As more data becomes available for single cohorts at multiple points through time (Abreu, Faggian and McCann 2010), panel data methods which substantially mitigate the effect of unobserved individual heterogeneity offer significant scope for further work.

Finally, a concern for this work and other papers in the field is that the analysis here simply detects the different jobs that individuals are doing within a given firm. This risk is greatest if, as seems likely, students with better academic qualifications and stronger innate ability are appointed to the most challenging positions in an organisation, while weaker students tend to be appointed to 'easier' positions. Future work should (1) include as many characteristics of the job as possible and (2) ensure that there are sufficient observations in each cell for inference. This second condition is especially challenging, as for effective analysis the data must contain within-cell variation in over-education status which is unlikely in a regression which includes solely individuals who hold just one level of qualification.

To see this problem, suppose we run a regression of over-education status against individual characteristics and a set of dummy variables for each observed combination of industry, occupation, employer size and employer location. Unless there is variation in over-education status within each fixed effect group, then individual characteristics can have no role to play.

4.6 Discussion and conclusions

This paper set out to examine the factors which determine the probability of a student (a) finding employment after graduation and (b) entering a position for which their higher-level qualification was not a requirement. In the first case, students who are more successful in finding employment after graduation are likely to have a higher return, everything else equal. The second case concerns the 'quality' of the match between the graduate's skills and their employer's technology. Ex ante, students who achieve better quality matches in the labour market also seem likely to have a higher return.

Over-education is a difficult concept for economists. At an aggregate level, an increase in the supply of skills is expected to lead to a fall in the skilled wage and a consequent increase in demand. At the firm level, if a company has technology which does not exploit all of its worker's skills and abilities then it is operating inside its production possibility frontier and – in the long run – will go out of business as other firms enter. At the individual level, workers who are confronted by employers who systematically under-use their skills cannot be earning their marginal product. The optimal strategy for these workers is to leave and join an employer who will use their skills and pay them their marginal product in return. Therefore, individuals should not find themselves permanently 'over-educated.'

To examine the incidence of over-education among recent graduates from British universities, this paper estimated a series of ordinary least squares regressions in the probability that (a) a student finds employment after graduation and (b) that he is mismatched in that employment. In so doing, this paper makes several contributions. Firstly, it offers a detailed micro-level analysis of graduate labour market outcomes in the UK. Secondly, it offers a critical discussion of research in this field and some guidance for further work. Thirdly, it controls for a broad array of possible sources of endogeneity. In particular, it attempts to control for both selection into courses based on common, time-invariant unobservables of students, and selection into labour market areas of domicile and employment.

Taken together, the results suggest that labour market outcomes for observably different students are markedly varied. While academic attainment is amongst the most important determinant of labour market success, the results also suggest that male students, students with disabilities and students from ethnic minorities are all significantly less likely to find employment after completing their undergraduate degrees. Students from lower socio-economic groups appear marginally more likely to enter employment than students from relatively wealthy backgrounds.

Alongside differences in employment propensities, the results also suggest that the quality of matches students achieve in the labour market varies significantly. After controlling for selection into university courses and academic attainment, students from relatively wealthy backgrounds are significantly less likely to be mismatched and appear more likely to enter high-level occupations. Students from ethnic minorities are significantly more likely to be mismatched, as are younger, male students. Local economic characteristics also appear to have a role in determining individual outcomes, although these effects are smaller in magnitude than personal characteristics. From a policy perspective, these findings raise questions about how graduates make the

transition from full-time study into employment. In particular they raise concerns about equality of access to graduate level positions for students from different ethnic groups and socio-economic backgrounds.

4A Appendix A: Unreported empirical work and results

In addition to the results presented in this paper, several attempts were made to (a) unify the student's choice of first destination within a single framework and (b) to find an appropriate exclusion restriction to allow me to estimate the impact of over-education on the initial wage. This section details these efforts and explains the reasons why they were abandoned.

Upon graduation, students choose between three broad options: (a) to enter employment, (b) to continue to further study or (c) to remain outside the labour market. Students who enter employment are associated with a wage and provide an assessment of whether they are well-matched with their employer's technology.

As set out above, Dolton and Vignoles (2000) argue that selection into the labour market is likely to be non-random, with detrimental consequences for parameter estimates based on an analysis of the sample of employed students. To control for labour market selection, attempts were made to develop a two stage model. In the first stage, students would choose whether to enter employment. In the second, the incidence of mismatch would be modelled, following Heckman (1979). This approach requires an exclusion restriction in the first stage: a variable which affects whether the student enters the labour market but not the quality of the job match.

To that end, several candidate variables were tested. These included (1) the number of low-occupation job openings around the student's undergraduate institution, (2) the level of rents around the student's undergraduate institution and (3) the type of accommodation in which the student was housed during their undergraduate degree. In the first case, the number of low occupation job openings was proposed as a measure of the access each student had to low-skill employment opportunities. In the second and third cases, the intent was to capture how urgently a student needed a source of income. Students attending university in areas with rising rents, or in particular forms of housing

might have differing levels of housing-related debt. Students with larger debts might, logically, need employment more urgently to service that debt.

Other candidate variables which were tested measured the attractiveness of further study. These variables – (4) average postgraduate fee levels, (5) the number of research students at each institution and (6) the league table rank of the institution – were intended to help identify the first stage through changes to the probability of further study. However, none of these variables approached the significance required to identify a second stage equation.

To avoid identification problems, an alternative approach was attempted which collapsed the two stages into a single multinomial choice framework. In this specification, the student would choose between four options: (a) Further Study, (b) Well-matched Employment, (c) Mismatched Employment and (d) Unemployment. However, the only feasible estimation option for this framework was the multinomial logit, which requires the Independence of Irrelevant Alternatives (IIA) assumption. This condition is unlikely to hold, as the probabilities of outcomes (c) and (d) in particular are likely to be correlated.

Finally, in response to Leuven and Oosterbeek's (2011) criticisms of the over-education literature, a search was conducted to find an instrument for mismatch so that the wage penalty associated with over-education could be consistently estimated. This involved identifying a variable which influences the likelihood of over-education, but not the wage. Attention was again focussed on factors which might encourage students to enter employment – such as rental costs and types of housing. However, none of the tested variables had sufficient explanatory power to identify the second stage wage equation.

4.7 References

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5. Conclusion

This thesis considers three aspects of graduate behaviour in the light of differences in individual, academic and local economic characteristics. Using a substantial micro-level dataset, the three papers of this thesis examine graduate decisions about (1) the type of training to acquire at university level, (2) the level of university training to acquire and (3) the labour market outcomes which they achieve at the end of their studies. In each paper the methodology is designed to control as comprehensively as possible for several different forms of sample selection bias. This concluding section (1) briefly reviews the findings of each paper and synthesises them to draw some broader conclusions, (2) provides a discussion of some limitations of the work and (3) offers some thoughts for future study.

5.1 The findings

The three papers of this thesis examine the type and level of qualification to which students in higher education in the UK aspire and the labour market outcomes which they achieve following graduation. In the first paper (Section 2), each student's choice of degree specialism is modelled as a function of their individual and academic characteristics, as well as conditions in their local labour market of domicile. The primary contributions of this paper include (1) an examination of degree choice using a highly disaggregated classification of academic fields, (2) providing a more rigorous empirical approach to pre-university sorting and (3) a carefully specified examination of the effects of local economic conditions, controlling for selection into areas of residence.

The results suggest that gender, ethnicity and prior academic attainment all have a significant impact on degree choice. Female students are more likely to take degrees in Biological Sciences, Languages, Linguistics & Classics and Law, while male students are more likely to study Mathematics, Engineering and Physical Science. Students from non-white ethnic backgrounds are concentrated in Business Studies, Law and Degrees Related to Medicine, although there is significant variation between ethnic groups and between male and female students within ethnic groups. Students who achieve higher school leaving grades are significantly more likely to take Mathematics, Medicine & Dentistry and Law degrees, while weaker students are concentrated in Business Studies, Art & Music and Biological Science.

The second paper (Section 3) extends the analysis of the first by modelling whether or not students choose to progress directly from their undergraduate studies to a higher, postgraduate degree as a function of similar individual, academic and local economic variables. Special attention is given to the role of postgraduate fees in determining the demand for course places above undergraduate level. The primary contributions of this paper include (1) the introduction of a large, new dataset of postgraduate tuition fees by subject and institution, (2) a detailed micro-level examination of participation in higher education above undergraduate level and (3) a more rigorous approach to controlling for selection effects arising from student sorting into universities and residential locations.

Building on limited prior work, the results of this paper again suggest that individual and academic characteristics play an important role in determining progression behaviour. Male students, students from ethnic minorities and students with disabilities are all significantly more likely to progress to postgraduate study, as are students who achieve more highly at undergraduate level. Adopting several different methods to estimate expected postgraduate tuition fees, the results of the analysis

suggest that fees have a significant, negative impact on the probability of a student choosing to progress to higher study. This result in particular carries implications for policy.

The final paper (Section 4) moves away from examining the determinants of investment in human capital and instead considers the labour market outcomes achieved by graduates once their studies are complete. Building on prior work, this paper models the likelihood (a) that a student finds employment after graduation and (b) that their qualification was a formal requirement for their first, post-university labour market position. The primary contributions of this paper include (1) an extended critical discussion of the 'over-education' literature, (2) a contextual framework which highlights the empirical challenges of this field and (3) a limited micro-level assessment of the determinants of graduate labour market outcomes.

The results of this paper suggest that even after controlling for several sets of common, time-invariant unobservable characteristics, graduate labour market outcomes vary markedly across observably different groups. Male students, younger students and students from ethnic minorities are less likely to find employment than female, older and white students respectively. Eliminating those students who pursue further study, I find that attendance at a Private school increases the likelihood that a student chooses not to be employed, while students who achieve greater academic success are more likely to be in work six to nine months after graduation. Female students and students entering higher level occupations in their first jobs are also significantly less likely to report that they are over-educated in their first labour market positions.

Across all three papers, significant attention has been devoted to the impact of socio-economic background in determining individual level outcomes. Table 5.1 summarises and collates these findings. In Panel A, the coefficients on socio-economic group dummy variables from several selected regressions of subject choice are shown.

Table 5.1: Socio-economic group effects[1]

	Lower Manag. & Prof.	Intermed.	Small Employers	Lower Super. & Tech.	Semi-routine	Routine, Unemp.	Unknown
Panel A: Subject Choice[2]							
Medicine & Dentistry (M)	**-0.012*** **	**-0.012*** **	**-0.015*** **	**-0.012*** **	**-0.015*** **	**-0.012*** **	**-0.012*** **
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Medicine & Dentistry (F)	**-0.014*** **	**-0.012*** **	**-0.017*** **	**-0.012*** **	**-0.016*** **	**-0.018*** **	**-0.014*** **
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Business Studies (M)	**0.015*** **	**0.011*** **	**0.019*** **	0.007	0.005	**0.013*** **	**0.009*** **
	(0.002)	(0.002)	(0.003)	(0.004)	(0.005)	(0.004)	(0.002)
Business Studies (F)	**0.008*** **	**0.006*** **	**0.021*** **	**0.014*** **	**0.009*** **	**0.017*** **	**0.013*** **
	(0.001)	(0.001)	(0.003)	(0.003)	(0.002)	(0.003)	(0.002)
History (M)	0.002	0.000	**-0.010*** **	**-0.010*** **	**-0.006*** **	0.000	**-0.004** **
	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.003)	(0.002)
History (F)	-0.001	-0.003	**-0.011*** **	**-0.009*** **	-0.003*	**-0.006** **	**-0.007*** **
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Education (M)	0.001	**0.003*** **	**0.002** **	**0.003*** **	**0.003*** **	**0.004*** **	0.001
	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Education (F)	**0.005*** **	**0.009*** **	**0.012*** **	**0.017*** **	**0.013*** **	**0.017*** **	**0.003** **
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.001)
Panel B: Progression Probabilities[3]							
Expected Fee Def [1]	**-0.005*** **	**-0.012*** **	**-0.016*** **	**-0.015*** **	**-0.013*** **	**-0.018*** **	-0.001
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Expected Fee Def [2]	**-0.005*** **	**-0.012*** **	**-0.016*** **	**-0.015*** **	**-0.013*** **	**-0.018*** **	0.000
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Expected Fee Def [3]	**-0.006*** **	**-0.015*** **	**-0.018*** **	**-0.017*** **	**-0.017*** **	**-0.022*** **	-0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)
Expected Fee Def [4]	**-0.007*** **	**-0.017*** **	**-0.020*** **	**-0.017*** **	**-0.017*** **	**-0.024*** **	-0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)
Panel C: Labour Market Outcomes							
Employment[4]	**0.005*** **	**0.012*** **	-0.005*	**0.009*** **	**0.010*** **	**0.009*** **	-0.001
	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.003)	(0.002)
Mismatch (before controls for entry occupation)[5]	**0.005*** **	**0.016*** **	**0.017*** **	**0.017*** **	**0.020*** **	**0.026*** **	**0.011*** **
	(0.002)	(0.002)	(0.003)	(0.004)	(0.003)	(0.004)	(0.003)
Mismatch (after controls for entry occupation)[5]	0.001	**0.006*** **	**0.008*** **	0.005	0.005*	**0.008** **	**0.007*** **
	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.004)	(0.002)

Note(s): (1) Coefficients reported with standard errors in brackets underneath. (2) Dependent variable in these regressions is a binary variable taking a value one if the student chooses this subject, zero otherwise. Results from OLS regressions with fixed effects for schools and travel to work areas of residence. For other control variables see Appendix 2B. Standard errors clustered at the travel to work area level. (3) Dependent variable in these regressions is a binary variables taking a value one if the student is in full time study for a higher degree six to nine months after graduating with a first undergraduate degree. Results from IV regressions, Specification (12) for each definition of expected fees. Fixed effects for subject-institution combinations and travel to work areas of residence. For other control variables see Table 3.7, Appendix 3B, Appendix 3C, Appendix 3D and Appendix 3E. Standard errors clustered at the subject-institution level. (4) Dependent variable in this regression is a binary variable taking a value one if the student is in employment six to nine months after graduating. Results from OLS regression, Specification (5), see Section 4.4.1. (5) Dependent variable in these regressions is a binary variable taking a value one if the student reported themselves mismatched in their labour market position at time of survey. Results from OLS regression including fixed effects for subject-institution combinations, and travel to work areas. See Section 4.4.2 for control variables. Standard errors clustered at the subject-by-institution level.

In Panel B, the estimated effects of socio-economic group on progression probabilities are shown for each definition of expected postgraduate tuition fees, while in Panel C their estimated impact on graduate labour market outcomes is summarised.

The results reported in Table 5.1 suggest that socio-economic background has a significant impact on all three aspects of graduate behaviour studied here. Students from higher occupational backgrounds are relatively more likely to take degrees in Medicine & Dentistry and History, and less likely to take Business Studies or Education degrees. Students from higher occupational groups are also significantly more likely to pursue higher study, even after controlling for academic achievement and expected postgraduate tuition fees. Finally, while students from less wealthy backgrounds are more likely to enter employment than students from the highest occupational groups, they are (1) significantly more likely to be mismatched in their positions and (2) appear less able to access Higher Managerial and Professional posts. Taken together, these results suggest that the well-established benefits of parental wealth persist beyond the completion of formal schooling into the early labour market experiences of young graduates in the UK.

Finally, as set out in the introduction, significant research attention has been devoted to a rigorous examination of the impact of local labour market conditions on graduate behaviour. Tables 5.2 and 5.3 offers a synthesis of the core results of this work. Panels A and B of Table 5.2 set out the impact of unemployment and earnings around the individual's domicile on students' degree choice and progression probability respectively. Table 5.3 sets out the impact of local economic characteristics around the individual's domicile, institution and eventual employment location on graduate labour market outcomes. Each set of results is taken from the most complete, preferred specifications, which include a full set of fixed effects for each travel to work area of domicile (Table 5.2), institution and eventual employment (Table 5.3).

Table 5.2: Local labour market effects[1]

TTWA region of:	Domicile	
	Unemployment	Earnings
Panel A: Subject Choice[2]		
Social Studies (M)	**0.028*** **	**0.465*** **
	(0.009)	(0.045)
Social Studies (F)	**0.018** **	**0.392*** **
	(0.007)	(0.037)
Mathematics (M)	**-0.031*** **	**-0.262*** **
	(0.009)	(0.040)
Mathematics (F)	-0.002	**-0.036** **
	(0.003)	(0.014)
History (M)	**0.038*** **	**0.372*** **
	(0.006)	(0.036)
History (F)	**0.021*** **	**0.233*** **
	(0.005)	(0.026)
Art & Music (M)	**0.026*** **	**0.286*** **
	(0.006)	(0.027)
Art & Music (F)	**0.018*** **	**0.323*** **
	(0.006)	(0.029)
Panel B: Progression Probabilities[3]		
Expected Fee Def [1]	**-0.053** **	-0.012
	(0.025)	(0.008)
Expected Fee Def [2]	**-0.050** **	-0.012
	(0.025)	(0.008)
Expected Fee Def [3]	**-0.061** **	-0.014*
	(0.027)	(0.008)
Expected Fee Def [4]	-0.051*	**-0.020** **
	(0.027)	(0.009)

Note(s): (1) Coefficients reported with standard errors in brackets underneath. (2) Dependent variable in these regressions is a binary variable taking a value one if the student chooses this subject, zero otherwise. Results from OLS regressions with fixed effects for schools and travel to work areas of residence. For other control variables see Appendix 2B. Standard errors clustered at the travel to work area level. Unemployment here captures Youth Unemployment. (3) Dependent variable in these regressions is a binary variables taking a value one if the student is in full time study for a higher degree six to nine months after graduating with a first undergraduate degree. Results from IV regressions, Specification (12) for each definition of expected fees. Fixed effects for subject-institution combinations and travel to work areas of residence. For other control variables see Table 3.7 Appendix 3B, Appendix 3C, Appendix 3D and Appendix 3E. Standard errors clustered at the subject-institution level.

Table 5.2 suggests that after controlling for selection into areas of residence, local labour market conditions play a significant role in determining individual student behaviour, although the magnitude of their impact is relatively small. Youth unemployment in the student's travel to work area of domicile enters significantly in 13 (10) of the nineteen detailed subject choice regressions for male (female) students, but

the estimated coefficients for both genders are very small. Average full-time hourly earnings appear to play a more substantial role in determining subject selection. Students from areas with growing incomes are more likely to take Social Studies, History and Art & Music degrees, while students from areas with relatively poor earnings growth are more likely to take degrees in Mathematics (males), Engineering (males) and Medicine & Dentistry (males and females). This result is particularly striking, as it suggests that students from areas of growing wealth are more likely to take arguably less vocational, arts subjects, while students from relatively less affluent areas are seeking the specific skill-sets associated with Medicine & Dentistry, Mathematics and Engineering. Combined with the significance of several estimated coefficients on the industrial composition of employment around student's domicile, the results presented here suggest that labour market conditions play a significant if secondary role in determining degree choice.

Table 5.2 also presents some evidence that labour market conditions around the student's domicile affect their probability of progression to a higher degree. Youth unemployment is significant at the five percent level in three of the four reported specifications and significant at the ten percent level in the fourth, suggesting that growing rates of youth unemployment reduce the probability that students progress to higher study. Average earnings appear to play a smaller role in determining progression rates, but are significant at the ten percent level or above in two of the four estimated specifications. Where previous research had found a positive relationship between unemployment and progression probabilities (Rice 1999, 2000), after controlling for selection effects the results presented here find the opposite: that students respond to uncertainty about the return to a higher qualification by choosing to enter the labour market rather than take on a costly course of higher study. Economic conditions around

Table 5.3: Local economic effects on labour market outcomes[1]

TTWA of:	Domicile		Institution		Employer	
	Unemp	Earnings	Unemp	Earnings	Unemp	Earnings
Employment[2]	-0.010	0.017	0.006	0.013		
	(0.065)	(0.017)	(0.014)	(0.027)		
Mismatch[3]	-0.021	-0.020	**-0.050*** **	0.046	**-0.029*** **	0.001
	(0.083)	(0.020)	(0.016)	(0.038)	(0.007)	(0.026)

Note(s): (1) Coefficients reported with standard errors in brackets underneath. (2) Dependent variable in this regression is a binary variable taking a value one if the student is in employment six to nine months after graduating. Results from OLS regression, Specification (5), see Section 4.4.1. (3) Dependent variable in these regressions is a binary variable taking a value one if the student reported themselves mismatched in their labour market position six to nine months after graduating. Results from OLS regression including fixed effects for subject-institution combinations, and travel to work areas. See Section 4.4.2 for control variables. Standard errors clustered at the subject-by-institution level.

the student's institution were found to play no significant role in determining progression probabilities.

Finally, Table 5.3 shows the role which local economic conditions play in determining graduate labour market outcomes. Growing rates of unemployment around the student's institution and eventual area of employment both significantly reduce the likelihood of mismatch, but the magnitude of this effect is of a similar order to that reported in Table 5.2. Average wages enter insignificantly in both the employment and mismatch regressions.

Taken together, these findings suggest that while there are significant effects of place, they are of second order importance to individual and academic characteristics such as gender, ethnicity and prior schooling success. After controlling for patterns of spatial sorting, local economic conditions make a marginal contribution to student choices, which instead tend to reflect the impact of the student's own characteristics.

5.2 Limitations

As a discussion of specific limitations is included in each paper, this section is focused on three areas which present difficulties in each of the three chapters above. The first of

these arises from the problem of unobserved individual heterogeneity, which has the capacity to bias any or all of the coefficients estimated in each paper. In common with much research in labour economics, if there are relevant individual level characteristics which are both (a) unobserved and (b) correlated with other variables of interest, then the estimated coefficients on those variables of interest reflect both their causal impact and their covariance with the unobserved characteristic. To partially control for these effects, the papers presented here depend on three identifying assumptions. Firstly, I assume that all individuals on the same university course, from the same school or labour market area have a common set of unobservables. Secondly, I assume that these are time-invariant and thirdly, I assume that any remaining unobservable characteristics are orthogonal to the other explanatory variables. As has been set out at length, incorporating fixed effects for schools, subject-institution combinations and labour market areas enacts these assumptions empirically and helps to move the interpretation of the coefficients estimates closer to a causal effect.

However, this approach has several undesirable properties, among which a neglect of within group heterogeneity is possibly the most serious (Card 1999). To see this problem in the context of the first paper, consider two alternative systems for allocating students to secondary schools before students choose what subject to study at university. In the first case, students are imperfectly sorted into schools based on their ability, resulting in large differences in average ability across institutions. In the second, students are randomly assigned to secondary schools, causing average ability at each school to be equal. In the first case, the fixed effects condition out the average level of ability at each school and largely purge the subsequent analysis of omitted variable bias. In the latter case, introducing fixed effects also conditions out average ability, but as students within each school exhibit significant heterogeneity, the impact of above or below average ability remains. Consequently, this approach is most effective when

within school variation is less than between school variation. If, as is often the case, student assignment is more random than systematic, the effect of unobserved ability may remain.

The logic of this problem applies equally to the other variables used to define sets of fixed effects in the papers presented here. While students partially sort into university courses based on (imperfectly revealed) ability, the balance of within and between group variation by travel to work area presents some cause for concern. If, as is plausible, students vary more within travel to work areas than they do between travel to work areas, my subsequent analysis may still be affected by endogenous residential selection. In this light, the additional results reported in Section 2, which use postcode district level fixed effects, provide some reassurance. Using a much smaller spatial scale seems likely to shift the balance decisively in favour of greater between group variation, improving the effectiveness of the identification strategy. In practice, there are relatively few differences between the results from the two specifications.

The second identifying assumption I make – that the unobserved characteristics associated with selection into schools, university courses and labour market areas are constant over time – presents a second cause for concern. In the event of a school improving significantly or the return on a given university qualification changing significantly during the time period, the approach will fail to detect these differences which leads to further risk of parameter bias. To control for this problem, descriptive statistics were compiled on the observable characteristics of students at particular universities, from particular school types and from different labour market areas. While across-time variation in these characteristics appeared relatively slight, there remains a risk of temporal variation in unobservables.

The third limitation of the work presented here arises from uncertainty about the underlying causes of some of my estimated effects. While the results suggest that

students of different genders, ethnicities and from different socio-economic groups vary systematically in their behaviour, it remains unclear to what extent these differences reflect variation in preferences or constrained individual decision-making. These effects are particularly important as they have strong implications for policy.

5.3 Future research

In the context of the preceding discussion, several areas of research offer the potential to build on the findings presented in this thesis. Firstly, to address concerns about unobserved individual heterogeneity, many of the methods of labour economics reviewed in the first chapter have significant potential for future research (Card 1999, Angrist and Krueger 1999). Studies which can incorporate proxies for a student's numerical ability, verbal reasoning or the results of cognitive tests into datasets such as those used here would help to assess the extent to which my results are affected by omitted variable bias. Equally, studies which build plausible identification strategies based on the different educational decisions of pairs of identical twins offer significant potential. Identification strategies based on within-pair variation in subject choice, postgraduate participation and labour market outcomes can expect to move even closer to estimating causal effects than can be achieved here.

The nature of the dataset used in this thesis limited the scope of my research to students who (a) chose to attend university and (b) completed their courses. Incorporating school level data offers a second area for future research. This would permit an examination of subject choice, postgraduate participation and labour market outcomes for marginal higher education entrants. Incorporating the likelihood of entrance to university after the completion of secondary school would allow researchers to understand whether marginal entrants make the same choices as other students. Do marginal entrants study the same subjects at the same institutions? Are they more or less

likely to remain in higher education beyond undergraduate level and how are they affected by tuition fees? Do they enjoy the same degree of success in the labour market? In the context of the recent rapid growth in the higher education sector, these issues are particularly important.

A third area for future research concerns more careful modelling work to address selection into university courses and into labour market areas of residence, institution and employment. The approach in this thesis has been to accept the choices individual students have made and to control for them using large arrays of fixed effects. Future work may develop a more detailed approach to these effects, specifically modelling the choice of university course or area of residence in a preliminary stage of analysis. Dahl (2002) offers one such study of the returns to education, conditional on a first stage model of residential choice among the states of the USA. This approach offers a more detailed insight into student behaviour than was possible here.

Finally, the results of this research suggest that graduate behaviour differs significantly across observably different groups. Students of different genders, ethnic groups and socio-economic backgrounds who achieve varying degrees of academic success choose to take different subjects, to a range of levels of study, with varying labour market outcomes. Future research should examine the extent to which these differences reflect variation in the underlying preferences of these groups, or constrained individual behaviour.

5.4 References

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