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Access, Choice And Participation In Higher Education

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Executive Summary

Commuting or re-location costs could be an in important influence on students' university choices and might even deter some from going to university. The barriers presented by these costs may be high for lower-income students, and students for whom there are cultural incentives to remain in or close to the parental home. If this is the case, then the geographical accessibility of universities has an important bearing on differences in higher education choices for different income and ethnic groups, and, in turn, on their earnings and life chances.

Existing evidence has shown that university places are not evenly spatially distributed in Britain. Research has also found that 'non-traditional' students – those from backgrounds in which higher-education participation is emerging – cite the location of institutions as a factor affecting their decision to go in to higher education. However, it is easy to make the mistake of attributing behaviour to ethnicity, gender or income when these behaviours are really due to other differences, like academic achievement, or home location which will have strong bearing on if and where students go to university. In fact, there is no large scale, systematic evidence for the UK that shows that proximity to a university really matters for higher education participation or choice amongst universities, or that it matters more for specific ethnic or income groups.

Our research looks at these questions using administrative data on the population of school leavers and university entrants in England. These data allow us to link the choices of students from different ethnic and income backgrounds to distances between home and university, whilst accounting for schooling, neighbourhood and other background characteristics.

Our key findings are:

- Universities are not evenly distributed around the country but 90% of locations have three institutions and 4000 first degree places within 100km.

- Non-white ethnic groups and low-income students actually live closer to their nearest three higher education institutions and closer to their nearest three high-quality research institutions than their white and high-income counterparts. These facts suggest that disparities in geographical access are unlikely to be a source of disadvantage to ethnic minorities and poor students.

- Home-to-university distance has only a tiny influence on the probability of participation in higher education, relative to achievement and other background factors. Our statistical models imply that doubling the distance to the nearest institution would reduce the probability of white female participation by at most 4.5% in relative terms – reducing the probability of participation at the mean from 28.4% to 27.1%. For males, the effect is only half that, but there are no systematic differences by ethnic or income group.

- In contrast, distance is the strongest factor influencing university choice amongst those who participate. The probability that a student attends a specific university decreases by 8%-15% with each 10% increase in home-to-university distance. This distance cost is observed for all ethnic and income groups, but is highest for Pakistani and Bangladeshi girls and low income students, and lowest for Black students and those from Professional backgrounds.

- The influence of distance on choice of institution could make a difference to the type of higher education received by different demographic groups. This is a moot point for ethnic minorities, who have high participation rates at "elite" research intensive universities relative to whites, but provides a potential explanation for lower participation rates amongst women and low income groups in top ranked research universities.

The findings therefore offer no support for the idea that improving the accessibility of higher education institutions is an effective route to raising participation. However, targeting the accessibility of higher-quality institutions could increase uptake of high quality HE places amongst suitably qualified students from lower-occupational status backgrounds. Such policies might include action to reduce the role of distance (distance learning) but also policies to encourage higher status institutions to undertake outreach activities further afield. In any case, we find no evidence to suggest that such a policy need be gender or ethnically targeted.

One further important spatial implication from this work is that the type and quality of higher education in which students enrol is in part governed by the type and quality of local institutions, which in turn partly determines the skill composition of the local population. Given this, the local mix of institution types and quality could have a strong bearing on the quality and composition of the local human capital stock.

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Acknowledgments

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1. Introduction

Commuting or re-location costs could impose high barriers to university entrance, particularly for lower-income students, or students for whom there are cultural incentives to remain in or close to the parental home. Although, anecdotally, this has been said to have an important influence on higher education (college) [1] choices – and hence on earnings and life chances – there is relatively little good empirical evidence internationally.

Economic theory and evidence on migration and commuting suggests that greater distance increases direct, informational and psychic costs of travel, and makes it likely that people choose destinations close to home. In the case of university enrolment in England, this relationship is not self-evident, because a long move away from home was traditionally seen as part of the university experience, and part of the transition to adulthood. At least this was the case for the predominantly high-income, high-social-status students who historically enrolled in university. As participation by previously under-represented groups has increased, so expectations about the nature of the university experience may have changed. Distance from home could be an important factor affecting institution choice amongst these 'non-traditional' students, and increasingly important for all groups given the disincentive to leave home implied by rising housing costs and recent increases in university tuition costs in England[2]. Moreover, when migration or commuting is for a specific activity, like Higher Education (HE) participation, a lack of local institutions could make any form of participation less likely, especially

[1] Unless otherwise stated, this paper uses the terms university, college and higher education participation to refer specifically to enrolment in 3 year Bachelor degrees.

[2] Historically, students have not paid tuition fees to attend university or college in England. Fees, payable in advance, were introduced in 1998 but were initially kept very low, at around £1,000 per annum with poorer students exempt. Students now pay around £3,000 per annum via an income contingent loan. This is set to change as universities are now empowered to charge higher fees and to vary fees by subject. Nonetheless, students from low income backgrounds remain exempt from such fees.

amongst those who already face high costs. In labour and urban economics, a familiar and analogous idea is that distance to jobs deters participation or search in the labour market (see Gobillon, et al. 2005 for a recent survey of this spatial mismatch literature). Some limited international research has supported this idea that people living further away from universities are less likely to choose to enrol in university, more likely to attend local colleges, and that this distance 'discount' is higher for those from more disadvantaged backgrounds (e.g. Frenette 2004, 2006; Spiess and Wrohlich 2008)[3]. However, there is very little solid evidence on the role of distance in participation, and almost no international evidence on the effects of distance on institution choice specifically.

If distance matters for HE choices, then the local availability of institutions has important consequences. Firstly, inevitable geographical disparities in university proximity imply that pupils who live close to universities are more likely to enrol. As well as leading to individual inequalities in human capital accumulation, this process could lead in turn to geographical disparities between cities and between regions if students tend also to be quite immobile when they leave university. Secondly, if distance matters more for some groups of pupils (e.g. low income, ethnic minority) than it does for others, then the distribution of characteristics amongst those enrolling in HE will not reflect the distribution of characteristics amongst suitably qualified school-leavers. Therefore, equilibrium take up of HE amongst school-leavers for whom distance imposes low costs (e.g. the rich) will be greater than amongst school leavers with equivalent credentials who face high distance costs (e.g. the poor). Distance from an HE institution may also affect pupils' effort and achievement in school, if they see themselves as not being able to access a university, again reinforcing inequalities. This story, coupled with rising real re-location costs could partly explain why educational and income mobility has shown

[3]. Interestingly, the idea that proximity encourages college attendance has also been used as a strategy in empirical work on the labour market returns to education (Card 1995).

signs of decrease in England over the past decades (Blanden and Machin 2007), even though overall HE participation has expanded dramatically.

Even if distance has no effect on participation, it could affect choice of institution, and hence the sorting of students across institutions, both within and between cities. A school-leaver from a disadvantaged background may be less likely to enrol in a top-quality university than a school-leaver with identical credentials from a wealthier background, if top-ranked universities are on average further away from family homes. This tendency would have long term consequences for wage inequality, given recent evidence of the significant wage premium earned by graduates from elite universities (Hussain et al. 2008). Therefore, evidence of important interactions between family background and distance discounts supports a case for policy to reduce costs for low-income students, for example, by promoting geographical dispersion of top-rank university establishments, subsiding relocation costs, or extending the role of distance learning. Note that this is an efficiency issue, as well as an equity one, because students deterred by distance from university or high quality university attendance may have high economic returns to a university education, but be unable to offset the current costs of re-location against future labour market earnings.

The aim of our research is to examine empirically the role of distance in higher education participation and institution choice. We also assess whether home to institution distance matters more for some groups of students than others, focusing on three aspects of student background: gender, ethnicity and parental income/occupational group. The rest of this paper is organised as follows. In Section 2 we discuss the international literature that has considered geographical accessibility of HE and its consequences. In Section 3 we describe the methods we will use to analyse the issues and the administrative data on which we will apply them. Our results are split into two parts. In Section 4 we

present an empirical analysis of the role of HE accessibility on the decision to participate in HE, whilst in Section 5 we focus on the role of distance in choice of institution. Section 6 concludes.

2. Literature

There is a large and growing literature on widening participation in HE and it is largely focused on:

- barriers to entry and participation experienced by non traditional students and
- the extent to which the current policy framework facilitates or deters participation in HE by historically under represented groups (e.g. Jones and Thomas, 2005).

A number of important barriers to participation in HE have been widely cited in the literature, although there is no consensus on which factor is most important. Geographical distance to a higher education institution has been identified as one such potential factor in England (Dearing, 1997 and Gorard and Smith, 2006[4]).

The distribution of universities in the UK is not spatially even (see Tight, 2007 and we provide more evidence on this in our empirical work below). Other research has also suggested that non-traditional students, particularly first generation entrants, mature and ethnic minority applicants, cite the location of a higher education institution (HEI) and its distance from their home as important their decision to participate (Thomas and Quinn, 2007; Christie et al 2005; Connor et al. 1999). However, the quantitative evidence base on the relationship between the student's geographical location and their

[4] Gorard and Smith (2006) have made available a database of references on widening participation in HE at http://www.york.ac.uk/depts/educ/equity/barriers.htm .

participation or achievement in HE is limited[5]. Sa et al. (2004) investigated the link between proximity to a higher education institution and HE participation in the Netherlands. They found prior attainment and personal characteristics to be more important than proximity in determining HE participation. This is perhaps unsurprising given the density of higher education institutions in the Netherlands and the fact that over 90% of those graduating from secondary school with a diploma (and therefore qualified to enter HE) go on to higher education. Frenette (2004, 2006) uses similar methods to analyze higher education participation and institutional choice (college versus university) in Canada, where HE is rather sparse in some remote regions, and finds that increased distance between home and university is associated with lower participation in HE and a greater tendency to attend local colleges rather than university. Speiss and Wrohlich (2008) have similar findings for Germany. Frenette (2006) also found that the deterrent effects of distance are stronger for lower income families, although the models used have no controls for students' academic background.

Faggian et al. (2006; 2007) modelled the decision to migrate for university and the subsequent decision to migrate for employment. Although the focus of this work is not the HE participation decision per se, it does shed light on the sequential migration patterns of UK university students, highlighting the gender differences (Faggian et al. 2007) and ethnic differences (Faggian et al. 2006) in these patterns. Faggian et al. 2007, confirms previous findings in the literature that firstly those with more human capital (measured after graduation) are more likely to subsequently migrate, and secondly that those who have already migrated (by moving away to university) are more likely to be migrate again (e.g. by

[5] A number of studies have looked at the relationship between proximity to an HEI and student HE *outcomes* (drop out and degree classification or grade achieved). For example, a study for the UK by Johnes (1990) used data on the 1979 entry cohort to Lancaster University to examine the determinants of non-completion. She identified students' academic prior achievement, their preparation for HE and their parental social class as being particularly important in determining drop out. However, she also found that students whose homes were close to the university (i.e. generally poorer students who lived at home during their university studies) were more likely to drop out. This may of course not indicate that living at home is detrimental to students' studies but rather that the types of student who live at home struggle more with their higher education. This finding in particular is consistent with evidence from Woodward and Bradshaw (1989) and Johnes and McNabb (2004).

migrating to employment). Faggian et al. 2006 finds differences in migratory patterns across gender and ethnicity. However, this research, by necessity, relied on relatively sparse data that does not contain full information on prior achievement of students.

In our paper, we are able to go much further than previous work in specifying rich models which control for students' human capital prior to the HE decision, and we incorporate information on the proximity not just of the university chosen by the individual but also the proximity of other HEIs to the student's original home location. We also estimate models of student choice between all the major HE institutions in England. The next section describes our data and estimation strategy.

3. Methods And Data

The goal of this research is to estimate the relationship between home-university distance and students' higher education decisions. The methodological framework measures the sensitivity of individuals' decisions to the distance between their parental home and higher education institutions. More specifically, we consider a) the statistical association between the proximity of HE institutions to a student's home and their decision to participate in HE at Bachelors degree level; and, b) the statistical association between distance from home to each HE institution and a participating students' choice of institution.

The nature of the research question imposes constraints on the research design. The location of institutions is, by and large, fixed and decisions on whether and where to participate in HE are one-off, which explicitly limits us to a cross-sectional analysis. Hence our research design compares the

decisions of individuals who face different home-institution distance patterns according to where they lived (as a teenager) in relation to the spatial distribution of HE institutions. Using this variation in home location across individuals to infer behavioural traits is problematic because choice of residential location is determined by household and individual factors (like income) which may also determine HE decisions directly. We will thus need to rely on a regression-based strategy to control for observable factors – other than home-HE distance – that determine HE decisions and which may influence, or be influenced by, home location. Our data allows us to create a very rich set of variables by linking information on individuals' HE decisions to detailed records on their school test scores and qualifications, the school they attended, basic information on family background and Census data describing the characteristics of the neighbourhood in which their childhood home is located. We combine these data with information on the distances between each pupil's home (at age 16) and each major HE institution in England. These data are described in more detail in the Data section below.

The main results presented are elasticities of the probabilities of HE attendance (either participation at any institution, or choice of a specific institution) with respect to home-HE distance. The elasticities are estimated from individual-level logit models of HE participation, and conditional/multinomial models of institution choice. These models are well known, and we will not discuss them at length. The probability of a choice j being made by individual i (P i chooses j) is expressed in terms of the natural logarithm of home-HE distance ($\ln d_{ij}$), vectors of observable characteristics of individual i and choice j (x_i, z_j) and estimable parameters (α, β, γ) such that:

$$P \ i \text{ chooses } j \ = \exp \ V_{ij} \Big/ \sum_k \exp \ V_{ij} \quad \text{where } V_{ij} = \ln d_{ij}\alpha + x_i'\beta_j + z_j'\gamma \qquad (1)$$

The parameters are estimated by maximum likelihood methods using standard statistical software.

These logit models have an underlying theoretical economic justification in which V_{ij} represents a deterministic component to the individual's utility or net benefits, associated with choice j (the random utility model). The coefficients correspond to the marginal costs and benefits of the choice attributes. In our empirical results, we report the mean percentage change in attendance probability that is associated with a percentage change in home-HE distance, which can easily be derived from the data and estimated parameters[6]. We estimate these elasticities for various student subgroups (by ethnicity, SES and income) either by estimating the models (1) separately by group, or by allowing for interactions between personal characteristics in the linear index V_{ij}, for example by specifying

$$V_{ij} = \ln d_{ij}\alpha_0 + \ln d_{ij} x_i' \alpha_1 + \ln d_{ij} z_j \alpha_2 + z_j' \gamma .$$

An underlying assumption of these models is that individuals view alternatives as similar along those dimensions that are unobservable to the researcher, and hence not represented by variables in (1). For example, if a student is only making choices amongst top-rated research institutions in physics, then the distance to a low ranked institution not offering physics will not be relevant. It is necessary to fully control for all salient institutional characteristics that could influence choices, and allow for differences in preferences over these characteristics to fully overcome this problem. Alternative, more flexible formulations (multinomial probit, mixed logit) are infeasible given the number of students and pupils we have in our dataset. A 'nested' logit structure offers one way forward, but requires that we predefine groups of institutions that we consider as comparable alternatives e.g. top research rated universities offering physical sciences. However, individual decisions over subjects and institution types are likely to depend on the distances to institutions, and it is not straightforward to specify a sensible nested

[6] E.g. the elasticity of attendance at institution j w.r.t log home-institutional distance for student i is $\hat{\alpha}\ 1-\hat{P}_{ij}$ where $\hat{P}_{ij}$ is the predicted probability of i attending j.

structure in terms of home-to-HE-institution distance[7]. In the absence of a feasible better alternative, we will use the standard conditional logit framework, but fully control, as far as is feasible, for the average preferences for each institution (using institution-specific dummy variables), and differences in these preferences across salient individual characteristics using interactions between institution, or institution type and personal characteristics.

Note that our specification of home-HE distance in logs means that the elasticity with respect to distance varies with the probability of attendance, but is otherwise constant at different distances, and implies that the marginal costs of distance are decreasing with distance, if V_{ij} is interpreted as a utility or net benefits term. This assumption has precedent in the transport and migration literature (e.g. for "gravity" models of aggregated flows of migrants between regions)[8]. The setup outlined above for modelling institution choices has an analogous aggregate representation in which the flow of students between one residential zone and a given institution depends on the log of distance between that residential zone and institution. We will provide some non-parametric evidence that the chosen functional form for our choice models is appropriate.

Note that when we consider students' choice of institution, we ask whether living closer to a particular university makes it more likely that a student attends that university, given where they live in relation to all other institutions. This approach, in part, takes account of differences in student background that are linked to residential location. In the case of the participation decision, we compare potential university students who live close to institutions with those who live further away, and it will obviously be difficult to rule out unobserved individual differences between residents in dense locations (e.g. cities)

[7] There is no specific distance that relates to an institutional group that is not just some aggregation of the members of that group, which would make identification very tenuous.

[8] See for example Fotheringham and O'Kelly (1989) on gravity models, or McGann (2005) on the possible relevance for New Economic Geography models.

and those elsewhere (e.g. rural) as explaining any association between HE distances and participation. However, because we are interested primarily in marginal participants for whom access to the closest universities is presumably the deciding factor, we have some scope to include geographical fixed effects (Local Authority or Region[9]) to control for broader geographical differences in participation. In addition, we can estimate the influence of distance to nearest institutions, whilst controlling for average distance to all HE institutions.

3.1. Data

The empirical analysis is based on a composite data set linked together from a number of administrative sources. The core of this dataset is a national cohort of English school pupils, sitting their age-16 exams (when compulsory schooling ends) in summer 2002, and whose demographic details are recorded in England's first Pupil Level Annual Census (PLASC). The PLASC is a national pupil census that has been carried out by the Department of Children Schools and Families since 2002, and contains information on school attended, pupil home address, ethnic group, gender, age and free school meal eligibility (a basic indicator of low family income). Importantly, these data include pupils' home address postcode[10], which pinpoints home location to the nearest 10 or so housing units.

In England, school children are tested periodically throughout their schooling, sitting nationally assessed tests in a number of core subjects. It is possible to link the PLASC data on our cohort of students to information on their academic achievement, recorded at age 11 and age 14[11], at age 16 when pupils take General Certificates of Secondary Education or GCSE exams (academic) and National

[9] These are administrative areas. There are 388 Local Authorities in England. There are 9 English regions.

[10] Akin to a zipcode.

[11] When pupils take the statutory Key Stage Assessments (part of the English National Curriculum assessment).

Vocational Qualifications or NVQs (vocational) at the end of compulsory schooling, and at age 18 when those pupils who continue in education take Advanced Levels (A levels) or other post-16 higher level qualifications. These attainment data, when combined with PLASC, provide a comprehensive longitudinal record of each child's secondary schooling.

For the first time, it is possible to match[12] this school information to additional data on each individual's subsequent decision to enrol (or not) in a higher education institution at age 18 or 19[13]. These college data are provided by the Higher Education Statistics Agency. As well as institutional details, the data include individual level information on course type, subject choice, student disabilities etc. We then link in other data sources to this composite data set, namely an indicator of institution research quality based on the UK's 2001 Research Assessment Exercise (the periodic administrative review of the quality of research outputs produced by each university department), institution drop out rates, and a description of university type. In England, universities fall into two broad categories: 'old' traditional academically focused universities, and 'new' universities that were formerly called polytechnics and were more vocationally oriented[14]. We then further sub-divide the 'old' university group into the 'Russell Group' – an elite group of high status research-intensive institutions, and the '1994 group' –a broader group of traditionally research intensive universities – and 'other' institutions. We also separately indicate universities that are specialist institutions offering a narrow range of subject choices, although we drop most specialist institutions from our final dataset. From the full set of around 128 higher education institutions in England we select the largest in terms of intake (accounting for 99% of enrolment), drop institutions that enrol mainly postgraduate students and a few highly specialised

[12] The matching process was undertaken by the Department for Children, Schools and Families. Further information available on request.

[13] Some members of the cohort will enrol in HE later in life and we cannot include this late enrolment in our analysis.

[14] These two formerly different types of institution acquired the same description of "university" in 1992.

institutions[15]. Institutions in Wales and Scotland are excluded from the analysis because we do not have data on enrolments, but only 1.5% of English students attend university in Scotland, and only 3.3% attend institutions in Wales. The full set of 96 institutions used in our analysis is listed in Appendix Table A1.

To this dataset, we further add geographic data from the 2001 population Census (at the smallest Output Area level) to characterise pupil's home neighbourhood. We also include "Travel to Work Area" level information to characterise housing costs and future labour market opportunities and costs in the vicinity of HE institutions (e.g. wages, housing prices).

The central element in our empirical analysis of HE choice is the distance between a pupil's parental (or carer's) home and each higher education institution. We compute the distances between each home address of the 400,000 pupils in our data and each of the 96 HE institutions, via the rail network. These home-HE distances are calculated using rail-network distances rather than straight line distances, to avoid errors arising from infeasible shortcuts across river estuaries and the like[16]. In summary, this complex combined dataset provides a new and unique opportunity to study higher education choices at the pupil level, combining institutional information with detailed information on students' academic achievements at school, demographic background and details of home location. In the next section we move on to present our empirical results.

[15] For example, the Royal Veterinary College, and the Open University which uses primarily distance-based learning.

[16] We measure distances along the rail track that comprises the network, so these distances should be interpreted as the shortest possible rail distance, rather than the actual distance that would be travelled. The correlation between straight line distances and rail network distances is very high (around 0.99) and both give almost identical results. The chosen mechanism for calculating distances is therefore unlikely to be a source of error (akin to Combes and Lafourcade (2005)'s findings for the French transport network).

4. Empirical Results And Discussion: Participation

4.1. Mapping university accessibility and participation

A first step is to consider the spatial distribution of institutions and the geographical accessibility of these institutions to pupils' homes. We focus on the set of 96 major higher education institutions listed in Appendix A1 (described in Section 3.1).

Figure 1 maps key indicators of the geographical accessibility of HE institutions from pupil homes. In the first panel (A) we show how distance to the nearest three institutions (regardless of size of institution) varies across England. In the second panel (B) we show mean distance to all HE institutions. In Panel C, we estimate geographical accessibility based on the number of first degree places available within 100km of each pupil residence. In both cases the HE accessibility indicators are calculated for each pupil residential postcode, and the maps are created by GIS interpolation of these data on to a 1km square raster.

As we might expect, Panel A suggests that proximity to HE institutions is higher in urban areas. The white areas (3 HEs within 20 km) tend to delineate the main urban centres in England. Having said that, few areas have very poor geographical access to HE and residents in most of England have 3 institutions within 80 kilometres by rail (50 miles). Only in a few peripheral rural areas (10% of England's land area) around The Wash, north Norfolk, Lincolnshire to the East, north Devon and Somerset to the South West, and Cumbria in the far north west, are the nearest 3 institutions on average over 100km away (in the north, and central south west regions this figure may be slightly distorted by

the fact that we do not include Scotland and Wales in the analysis). Panel, B, shows for comparison, how far pupils are away on average from all institutions and highlights the fairly obvious point that living centrally in England gives students closer access to the full set of institutions. The maps in Panels A and B ignore differences in institution size. Panel C maps the distribution of university places. This makes it transparent that the centre of mass of higher education access in England is located in London and the Midlands and central North West, where distances to large urban universities are short and up to 100,000 first degree places are to be found within 100km of a pupil's home. This pattern is hardly surprising, given that the population of England is predominantly urban in location, and university supply has evolved to meet demand. However, a large number of places are accessible even in the peripheral areas of England's coasts and borders: 90% of locations (based on land area) in England are within 100km of 4000 first degree places.

Figure 2 shows the spatial distribution of actual HE participation. This map gives an indication of the geographical distribution of HE participation, but it is not sensible to infer any relationship between the accessibility of HE and participation from simple visual comparisons. On the one hand there is a temptation to read the relatively low participation rates in peripheral areas (particularly the South West, and eastern coastal areas) as symptomatic of poor institutional accessibility. On the other hand, accessible urban areas (the South East, central midlands and North West) have a mixture of high and low participation pockets. These patterns are likely to depend to a large extent on the residential sorting of households of different types (incomes, academic achievements etc.) into different geographical areas. We will consider the links between accessibility and participation in the statistical analysis that follows.

4.2. Descriptive statistics

Table 1 shows 4 indices of the geographical accessibility of HE institutions, summarised by pupil characteristics and by HE participation status. Figures are means, with standard deviations in parentheses. Looking at the White British ethnic group first, we see that individuals live, on average, quite close to HE. The average distance to the nearest three institutions is around 36 km (22 miles), but there is almost no difference in the mean distance between non-participant and participant groups. Participating pupils, do, however come from homes that are slightly closer (by about 1%) on average, and where there are 1-1.5 thousand more first degree places within 100km. One factor that could make a difference to the participation decision is the quality of local institutions, so we consider too the distances to 'high quality' institutions, categorised as those receiving a top 20% Research Assessment Exercise grading averaged across all academic departments. Again, participants and non-participants are not strikingly different in terms of their distance from high quality institutions.

Non-White British students are predominantly urban and live, on average, much closer to HE and closer to high quality research institutions. Their average distance to three institutions is under half that for White British students. Otherwise, the pattern across participants and non-participants for these ethnic groups is broadly similar to that for White British, with only small differences between participant and non-participant pupils in terms of HE proximity, and in some cases (e.g. Black, and 'other' ethnic groups – which includes Chinese) participants have poorer HE access. The most notable gaps occur for access to top RAE institutions – for example, Pakistani and Indian females who participate are around 4-4.5 km (9%) closer to their nearest three, high rated institutions than those who do not participate. The magnitudes of any differences between participants and non-participants are slightly stronger for women than men.

In the last two columns of Table 1, we look only at White British students, and investigate associations with income using an indicator of free school meal entitlement for the pupil when s/he was aged 16. This indicator is the best individual level measure of income disadvantage available in our data for our non-participant sample. Although less marked than for ethnic groups, low income students tend to be closer to their nearest university (again reflecting their relatively higher rate of urbanisation) and closer to their nearest high quality institution, although White FSM teenagers tend to live marginally further away on average from all universities on average.

These simple comparisons provide no compelling evidence that accessibility affects the participation decisions for any of these student groups. As yet, we have not controlled for family socioeconomic characteristics that may lead those with high HE participation propensities to live relatively near to HE institutions (e.g. in cities) or equally that may lead poorer students with potentially lower HE participation propensities to live in urban areas. In the next section we extend these findings using regression analysis to control for other observable student and area characteristics.

4.3. Regression models of HE participation

Table 2 reports the elasticity of participation with respect to three HE access indicators: distance to the nearest HE institution, distance to the next two, and distance to those remaining (controlling for characteristics of students, schools and neighbourhoods in individual level logit models). This elasticity gives the relative percentage change in participation probability with respect to a one percent relative increase in home-HE distance. The coefficients on the control variables (listed in the table notes) are not reported for reasons of space and clarity. Note that the specification estimates the relationship between each distance variable, conditional on the others. Hence, the elasticity with respect to nearest

HE corresponds to a conceptual experiment which moves the nearest institution closer whilst keeping all the rest where they are. We also report the results of two statistical tests: (i) that all the coefficients on the distance variables are zero and (ii) that they sum to zero, which would imply that a 1% change in mean distance to the nearest, next two and remaining institutions has no effect on participation.

First, in Table 2 we estimate the model by ethnicity. For White British teenagers (Column 1) participation probabilities decrease with distance to closest institutions, for both females and males, and these are strongly statistically significant effects. In contrast, the positive coefficient on the variable measuring the mean distance to institutions beyond the nearest three suggests that it is students who are more generally remote from HE that participate more. We interpret this variable as a control for unobservable factors that affect participation and residential location, rather than as an indicator of the likely effects of HE accessibility on participation[17]. The coefficients on closest institutions can, arguably, be given a more causal interpretation. In these cases, the effects are statistically significant, but magnitudes are very small. For White British females, doubling of distance to the nearest institution reduces the probability of participation by about only 4.5% in relative terms – changing participation at the mean from 28.4% to 27.1%. For males, the effect is smaller still. In the context of other work (Chowdry et al. 2008), which has found a strong relationship between prior attainment and HE participation, these geographical effects seem particularly trivial.

Across the different ethnic minority groups, the coefficients are of a similar order of magnitude for the first two distance measures (although distance is not always significant for all groups). It is hard to spot any systematic relationship with gender or ethnic group. There is no evidence here that ethnic minority girls, a group that has often been identified as potentially sensitive to geographical barriers to HE, are

[17] The magnitude and sign of this coefficient varies tremendously across the different ethnic minority groups, which may also support this interpretation given the different geographical clustering of different ethnic minority groups.

any less likely to participate than white girls because they live far away from their *nearest* institutions. In fact, the coefficients for Bangladeshi students are all individually and jointly insignificant. However, Black, Bangladeshi and Indian pupils are much less likely to participate if they live further away from institutions *beyond* the nearest three. This result may occur because ethnic minority families with a high propensity to participate coincidentally live in places that have large numbers of institutions close by, e.g. in the centre of England's major cities.

The last Column of Table 2 presents analogous results for low income families, that is, White British students entitled to FSM. The distance elasticity for FSM pupils is generally larger than for the White British group as a whole (Column 1). Overall though, the patterns are qualitatively similar and provide only weak evidence that for low-income students distance is a more important barrier to participation. For example, doubling the distance to the nearest institution would reduce the probability of participation by 5.7% for FSM girls, which would reduce FSM participation from 7.6% to 7.2%, at the sample mean.

These findings are robust to measuring distance to nearest or nearest three 'high quality' research institutions. Also, inclusion of Local-Authority-of-residence dummy variables in these models tends to render all distance-to-HE variables insignificant, or unsystematically signed. This suggests that marginal variation in HE distance between pupils in a given Local Authority is unrelated to the decision to participate, and also means we cannot be confident that the small distance effects shown are not simply due to unobserved differences between the pupils living in different Local Authorities, or even local policy or administrative factors. On balance, the regression results indicate that geography has a very limited role to play in the HE participation decision, in line with the findings in Sa et al. (2004) for the Netherlands.

5. Empirical Results And Discussion: Institution Choice

5.1. Visualisation and descriptive statistics

In this section we move on to consider the role of home-institution distance on choice of institution.

To motivate the analysis, Figure 3 presents the geographical picture, showing the distance (by rail network) between home and the actual institution attended for students in our dataset. The map gives a very similar picture to the first panel of Figure 1 (the map showing the distance to the nearest three institutions). This immediately hints that the there is a strong tendency for students to choose institutions that are closer to home. As we might expect, it is students in the peripheral areas of the South West, East Anglia and the North that make the longest migrations to attend university.

Table 3 presents some descriptive statistics for distance to HE attended, split by gender and ethnicity and by parents' occupational group[18] and FSM status (for White British students). Average distance to institution attended (Table 3) is considerably greater than the average distance to the nearest three institutions (Table 1), but considerably less than the average distance to all institutions, for all groups. For White British females the distance attended is 133.5 km, which is 3.7 times the distance to the nearest three institutions and 55% of the mean distance to all institutions. For men, the distance is 141.5km, and the corresponding ratios are 3.9 and 59% respectively, indicating a tendency for men to migrate or travel slightly further to HE.

[18] For HE participants we have parental occupation. For non-participants we only have their FSM status. Hence we used the latter in section 4, where we considered the HE participation decision.

Across the ethnic groups these ratios differ widely. Black students attend institutions at a shorter distance (79.6km for females, 74.7 km for males), but this is because they live in places close to universities. Attended distance is over five times the distance to the nearest three, and just over 40% of the average distance to all institutions. Evidently, the average Black student tends to pick an institution that is relatively far away from home. For Pakistani and Bangladeshi students the situation is reversed and they pick relatively nearby institutions. Males and females of Indian ethnic group travel far, considering that they have institutions close by.

For White British students, low income students who are entitled to FSM (middle panel) travel less far than students from non-FSM backgrounds, both in absolute terms (about 30% less) and relative to average institutional distances. The pattern for parental occupational groups also suggests an association between distance travelled and parental occupational status, with children of Professional parents attending institutions furthest away.

None of these descriptive findings indicates whether the differences in travel/migration distances are due to constraints on travel behaviour (e.g. by income or cultural background) or due to institutional preferences for these different groups. For example, a student may prefer a city university to a campus-based one. If this preference is prevalent amongst students from low income backgrounds, and low-income families tend to reside in cities, then we will find that low income students attend nearby institutions (those in their home city), even though distance is not the factor driving their choice. In the next section we extend the institutional choice analysis to control for institutional preferences and background characteristics, particularly students' prior attainment.

5.2. Regression models of institution choice

The conditional logit framework outlined in Section 3 provides our method for estimating the effect of distance on attendance probabilities, whilst controlling for personal and institutional factors[19]. These estimates are based on the 'dyadic' pupil-institution dataset in which each observation is a pupil-institution pair (i.e. with all possible pupil – institution combinations in the sample). Home-HE distance varies within institutions, between pupils, but also between all possible HE institutions for each pupil. We use a specification that includes a full set of institutional dummy variables, which account for general differences in the attractiveness of each institution to students in the estimation sample. In addition, institutional characteristics can be interacted with pupil characteristics (including home-HE distance). The effect of *individual* characteristics on institution choice cannot be measured unless individual characteristics are interacted either with institution dummies, indicators of groups of institutions, or with some other characteristic that varies across institutions for a given pupil. The first option is computationally infeasible because it would require estimation of 2500 parameters. We instead report estimates in which we allow a limited set of personal characteristics to influence specific institutional choices via: (a) interactions between pupil characteristics and key institutional characteristics; and (b) interactions between home-institution distance and key personal and institutional characteristics. We estimate our models separately by ethnic, income and parental occupational groups allowing all the preference parameters to be group-specific.

[19] We also undertook a non-parametric kernel regression, of an 0-1 indicator of institution attendance on home-HE distance, to show how the probability of attending an institution changes with the distance between a student's family home and institution. These analyses suggest that the parametric conditional logit specification provides a reasonable approximation to observed choice behaviour (see also Appendix Figure A1, where we plot the predictions from the logit model against the non-parametric estimates for an example population group (White British females)).

These results, split by gender, are provided in Table 4, for ethnic groups, and Table 5 by parental occupational groups and FSM status. The top panel of each table reports results for females and the bottom panel for males, and each pair of columns reports elasticity estimates and the t-statistic for the underlying coefficient on which it is based[20]. Each pair of cells is an estimate from a separate regression, and we report results for three specifications for each group. Firstly, we report an unconditional elasticity, with no student or institution control variables. Below that, we report the elasticity conditional on the following set of control variables: institution dummies to allow for general preferences for different institutions; institution dummies interacted with student GCSE point[21] scores to allow university admission criteria to affect the probability of attendance; and interactions between institution characteristics (RAE 2001 score and institution type) with a limited set of pupil characteristics (age, English Additional Language, FSM, school proportion on FSM, A-Level scores, occupational group in ethnic models or occupational group in the ethnic models).

The specification in the third row in each panel allows for interactions between home-institution distance and personal and institution characteristics. In this case, the attendance-distance elasticity varies by personal and institution characteristics. Thus, the reported elasticity corresponds to a specific baseline group of pupils who are non-FSM, English first language, with parents in non-managerial/professional/administrative/skilled occupations, from Community non-selective schools, enrolled on a business, creative, or administrative degree, at a 'new' university that is not a specialist institution. This baseline elasticity is estimated at the mean of continuous variables (GCSE scores, RAE

[20] Given that there are around 96 institutions, the probability of choosing any one at random is 1.04%. The elasticity is calculated by multiplying the estimated coefficient on log distance by (1-probability of attendance), hence the average elasticity is not very different from the underlying coefficient in magnitude.

[21] We use GCSE (age-16) point scores rather than A-Level (age-18) scores, because the former provide the finest possible measure of student prior achievement/ability, predate students' choice of HE institution, and are non-missing for a higher proportion of students in our source data A-Level and GCSE scores are, in any case, highly correlated. We do however include A-Level scores interacted with institution *characteristics.*

rating, neighbourhood characteristics etc). A more complete set of results for these specifications is shown in Appendix Tables A2 and A3.

Looking down the column for White British females and males, the first two elasticity estimates are all very close to minus one and the coefficients very precisely estimated. The point estimates are not very sensitive to inclusion or otherwise of pupil or institution characteristics. Interestingly, this elasticity is comparable with estimates of the costs of distance found in the extensive literature on 'gravity' models of commuting, migration and trade e.g. Disdier and Head 2003 perform a meta analysis of 103 trade papers find an elasticity of -0.90 to -0.95 since the 1970s. If given a causal interpretation, doubling the distance between a student's parental home and an institution picked at random halves the probability of the student attending that institution. To an approximation, from Table 1, this means that a White British student is over 6.5 times more likely to attend an institution located at the average distance of their nearest three, than an institution at the average distance of all institutions ($241/36$ from Table 1). Gender has no bearing on this relationship for White British students.

For the other ethnic groups in Table 4, we see some important differences in the first two rows. Distance is less of a barrier for Black students, especially Black females, but imposes a considerably higher cost for Bangladeshi and Pakistani students, especially females. Indian, 'other white' and other ethnic groups are little different from White British students in the sensitivity of their choices to distance. The higher elasticity for Bangladeshi and Pakistani women is in line with anecdotal, qualitative and earlier statistical evidence that students in these groups tend to stay close to home in inner cites. The figure of -1.5 for these students implies that doubling the distance between home and institution reduces the probability of attending that institution by a factor of 35%, ($= 2^{-1.5}$) and means that a Bangladeshi woman is over 50 times more likely to attend one of her nearest three institutions than an institution at the average distance of all institutions ($200/14^{1.5}$ from Table 1). Even if

Bangladeshi women faced the same distribution of HE distances as White British females, they would be over 2.5 times more likely to attend one of their nearest institutions than their White British counterparts ($241/36^{1.5-1}$). This feature is less marked, but still present, for Bangladeshi and Pakistani men.

Looking down to the 3rd row in each panel, the elasticity changes because the estimate no longer corresponds to the mean in the sub-sample, but to the baseline group of pupils defined three paragraphs above. At least part of the difference in attendance-distance elasticities that we observed across ethnic groups is attributable to factors other than ethnic group, e.g. prior achievement. For example, the institution choices made by baseline White British girls and baseline Bangladeshi girls show a similar response to distance now that we compare students who have family and educational backgrounds that are alike. On the other hand, comparable Black students still respond less to distance than White British students, and Bangladeshi boys and Pakistani students of both genders are more sensitive to distance. Many factors turn out to be more important than ethnicity in determining willingness to travel. For example, the elasticity is -1.5 for White British students at the bottom of the achievement distribution (2 s.d. below the mean in GCSEs and A-Levels – see Appendix Table A2 and A3) implying that *low-achieving* students are less likely to travel far.

Institutional factors measuring aspects of university quality are sometimes strong attractors that mitigate the deterrent effects of distance: a top RAE rating (2.s.d. above the mean) reduces the distance elasticity of students by about 15-20 percentage points for White British students, whilst low institution drop out rates – an indicator of institution quality - are strongly associated with greater willingness to travel. However, factors such as high-RAE ratings, low drop-out rates and high prior achievement do little to mitigate the costs of distance in institution choice for Bangladeshi and Pakistani minority groups.

We now turn attention to differences by parental occupational and by FSM status (looking at White British students only). These results appear in Table 5, which has the same structure as Table 4. Students from Managerial and Administrative parental backgrounds tend to exhibit a university choice behaviour that is representative of the White British group as whole with a distance-elasticity close to minus one. The elasticities are smaller (implying greater willingness to travel) for Professionals and larger for the lower ranked occupational groups (implying less willingness to travel) even controlling for institutions and their interaction with personal characteristics. There are clearly fairly marked differences in travel behavior across income groups – for example, students from FSM backgrounds would be nearly 12 times more likely to attend an institution at the average distance of the nearest three, than at the average distance of all institutions. We are, given our data, unable to determine whether these differences are causally related to income, or whether they are due to other factors embedded in these occupation and income definitions (expectations, cultural traditions, norms etc.).

Note however, that when we allow interactions between distance and other background/educational characteristics in the 3rd row of each panel in Table 5, the occupational and FSM-related differences become far less marked – particularly for boys. Distance is largely irrelevant to White British students from any parental occupational background if students have high qualifications, and enter a university with a top RAE-rating and a low drop out rate (from Appendix Table A4-A5). This is what we might expect of 'traditional' British university student behaviour but it is interesting that the same pattern is observed for lower income students. That said, lower income students who have achieved good entry qualifications and enrol in top ranked universities are clearly a selective group and not representative of lower income students generally.

Putting issues of selectivity aside, a strong finding clearly emerges from these regressions: home-institution distance is the single most important factor determining institution choice. Compare for

example, distance with GCSE scores (our preferred measure of ability and prior achievement). GCSE scores have a large and significant association with institution choice (as we would expect) and a one-tenth of one-standard deviation decrease in GCSE score reduces the probability of attending the most prestigious institutions by about 7 percentage points, due presumably to a combination of institutional entrance requirements and student preferences. But in terms of its effect on institution choice, the costs imposed by this fall in GCSE points is equivalent to a mere 7% increase in home-HE distance.

In the introduction, we discussed potential reasons why distance might matter so strongly for university choice – e.g. cultural ties to family home, accommodation costs, psychic costs and informational costs. From a policy perspective, an important consideration is whether housing costs are key factor behind reluctance to travel. If they are then subsidisation of housing costs or provision of university accommodation during term time may be a useful instrument to widen choice amongst disadvantaged groups. We were able to test this argument using some results which we have not reported in the tables. Firstly, quality-adjusted house prices in the vicinity ("travel-to-work area") of the institution show no systematic effect on the distance elasticity, implying that high housing costs do not deter students from attending. Secondly, data on term-time accommodation shows that availability of university accommodation has only very slight mitigating effect on distance for the majority white British group, whilst minority ethnic groups and low income (FSM) groups are unaffected. We therefore conclude that housing costs and availability of accommodation are certainly not the main factors that deter students from travelling to university. Future research needs to investigate the role of other potential factors, such as cultural proclivities.

One health warning must accompany these results: we cannot rule out the possibility that an attendance-distance relationship arises because parents choose where to live on the basis of which university they expect their children to attend, rather than university choices being made conditional on home location

(decided upon for other reasons). However, introspection suggests that university choice is not an important factor in residential choice, and to our knowledge no previous literature has raised this possibility (this is in stark contrast to the case of school choice, where how close a family lives to a school affects the probability of admission). Moreover, the lack of association between participation and distance (Tables 1 and 2) makes it unlikely that families choose where to live based on their intention to participate in HE. It therefore seems most unlikely that residential sorting matters for specific institutional choices.

5.3. Implications for the distribution of students across institutions

Are these differences across ethnic and income groups of policy concern? On the one hand the estimated elasticities are the result of preferences and rational economic behaviour, since it makes sense to minimise the financial or psychic costs of travelling to university if perfectly good local options are available. On the other hand, if distance has such a strong impact on institutional choice it does lay open the possibility that choice is inherently restricted by where a person lives.

In line with previous work on the representation of ethnic minority students in high status institutions (Chowdry et al. 2008), the common conjecture that distance *constrains* access and deters enrolment in high-quality HE by ethnic minorities does not bear close scrutiny. If we look at Table 6 – which tabulates the proportion of students scoring in the top 20% of the national distribution in GCSEs who go to top 20% ranked research universities (by 2001 RAE score), we see that high-achieving pupils in all ethnic minority groups[22] are *over-represented* in top research institutions relative to White British[23].

[22] Apart from Pakistani girls, where the difference is not significant relative to non Pakistani girls.

[23] Chowdry et al. (2008) found that controlling fully for personal characteristics and prior achievement, Indian, Bangladeshi and Chinese men and women were more likely to participate in a high RAE institution than their White

Moreover, in Table 1, ethnic minorities generally live closer to high quality institutions than the average White British student. So, distance seems to be important, but in the sense that proximity is probably a factor driving the high representation of ethnic minorities in high-status HE institutions.

Can distance to HE explain any other patterns of institution attendance in Table 6? A striking feature for all ethnic, occupation and income groups is that high-achieving women are under-represented in top research institutions. Distance could contribute if a) women live further away from top research institutions than men or b) if distance acts as a stronger deterrent to attendance than it does for men. The first conjecture is both theoretically unlikely, and empirically unsupported (see Table 1). On the second conjecture, quite small gender elasticity differences in the range shown in Tables 4 and 5 could be responsible for part of the gender gap in attendance rates at top research institutions. For some ethnic groups, the gender elasticity differences could explain all this gap – e.g. for Bangladeshi and Pakistani students. However, for White British students and other ethnic groups the gender are, for the most part, well below what would be necessary to explain the gap in enrolment at top institutions.

Similar reasoning points to a much stronger role for parental occupation and income differences in willingness to travel to university. Table 6 shows substantial differences across occupational groups in students' attendance at top research institutions, even for high achievers at GCSE level. High achieving FSM pupils have a particularly low probability – only 48%. Looking back at Table 5, the elasticity differences across occupation and income groups can explain these attendance differences. For example, a high-qualified woman from a professional parental background is 24 percentage points more likely to attend a top-RAE institution than a woman from a skilled-trades background (Table 6). The distance elasticity difference between professional background and skilled-trades background women

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counterparts. Further, Pakistani, Other Asian and Mixed females were also more likely to participate in a high status institution than Whites.

(Table 5) is as high as 42 percentage points, which can more than explain this difference in attendance probability.

In summary, income, gender and ethnic differences in the probability of enrolment in top-quality higher education can be explained, at least in part, by differences in where these groups live in relation to high-quality institutions, and differences in the 'costs' imposed by distance.

6. Summary And Concluding Remarks

This paper has provided empirical evidence on the costs of distance in college participation, and in choice of institution. Our results suggest that participating and non-participating pupils' homes are similarly distributed in relation to the location of HE institutions in England, and there is, at most, a very weak link between home-HE distance and the decision to participate. Geographical proximity is not an important factor relative to others, particularly early academic achievement (Chowdry et al. 2008), in determining higher educational participation. This would imply very little scope for policy to widen participation through increased geographical accessibility. As a corollary, it seems that university location plays no role in forming geographical disparities in basic human capital accumulation through the channel of enrolment, although the migration decisions of students after leaving HE may still be an important factor in this respect (Faggian et al 2006, 2007).

In contrast, home-institution distance is strongly linked to institution choice. In fact, distance emerges as the most important general factor in institution choice. The elasticity of attendance with respect to distance is around -1, which is in line with previous work on the costs of distance in migration and

trade. University intakes are, on average, skewed disproportionately towards those students whose parents live relatively close-by. This in itself is likely to explain the apparent over-representation of some ethnic minority groups in inner-urban universities. Some ethnic groups – especially Bangladesh and Pakistani girls – appear to be considerably more sensitive than others to distance, and possible reasons for this have been documented elsewhere (for example, Mac an Ghaill and Haywood, 2005). This greater distance sensitivity does not appear to have adverse consequences for the quality of institution attended given these groups' proximity to high RAE score institutions.

White British students from different socio-economic backgrounds differ too in the sensitivity of their choices to distance, with (to a rough approximation), the sensitivity increasing as income and occupational 'status' decreases. Moreover, students from low income/status backgrounds have a low probability of attending high research-quality institutions relative to their equally qualified peers from better-off backgrounds. This pattern is consistent with the facts that: a) high quality institutions are further away on average for these students, and that b) poorer students are more sensitive to distance when it comes to institution choice. The higher distance sensitivity of poor students may be the result of cost barriers, although we find no evidence that housing costs or availability of university accommodation matters. The costs of distance may therefore be predominantly psychic or information-based. Low-income students may choose to reduce these costs by choosing a proximate institution, even if this is of lower quality. The findings therefore offer some support for the idea that improving the accessibility of higher-quality institutions could increase uptake of high-quality HE amongst suitably qualified students from lower-occupational status backgrounds. Such policies might include action to reduce the role of distance (distance learning) but also policies to encourage higher status institutions to undertake outreach activities further a-field.

The crucial spatial implication coming out of this research is that the type and quality of higher education in which students enroll is governed by the type and quality of local institutions, which will in turn partly determine the skill composition of the local population. Given this, the local mix of HE institution types and quality could have a strong bearing on the quality and composition of the local human capital stock in cities, labour markets and regions.

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Figure 1: Higher education access and participation in England: Distance to English institutions and geographical accessibility of First degree places in English institutions

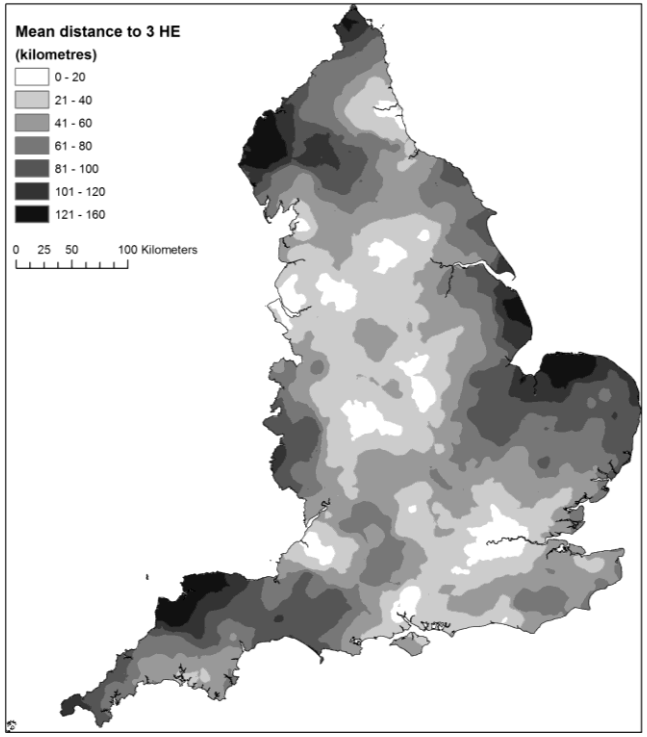	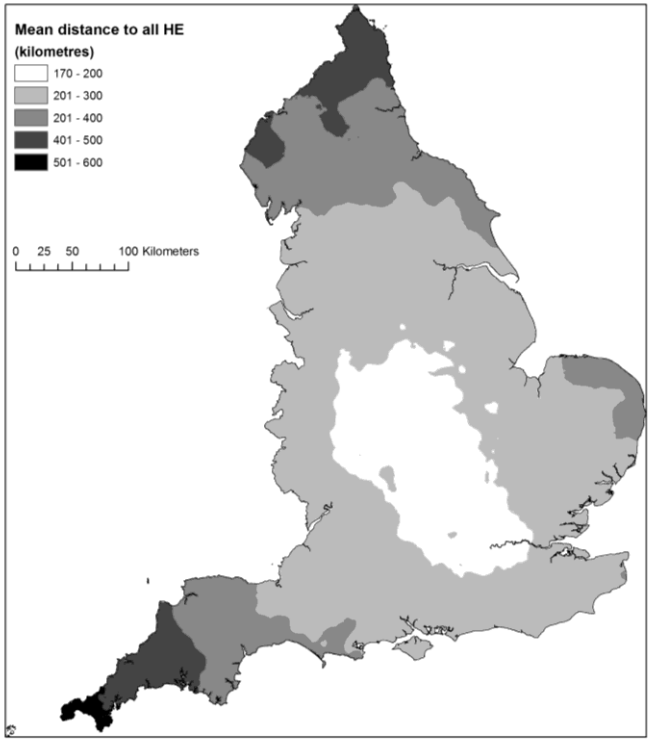	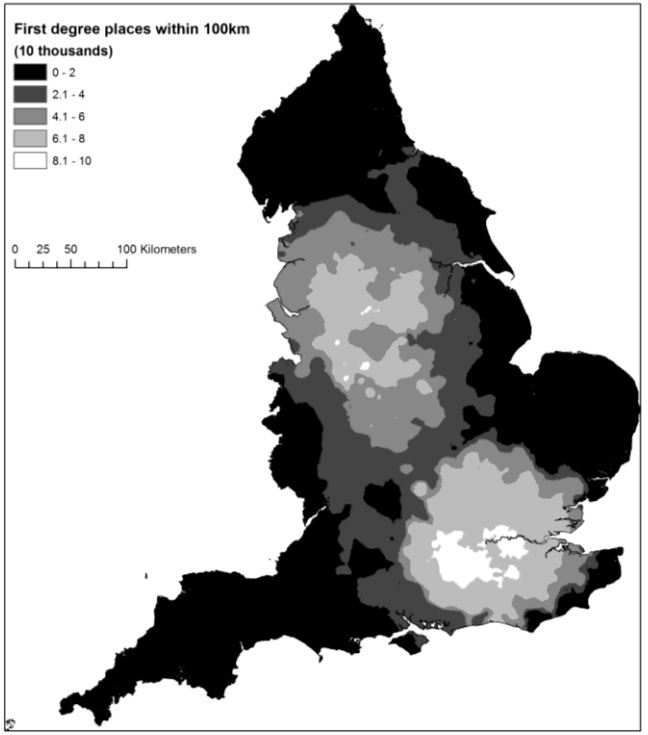
Figure shows interpolated mean rail-network distance distance to nearest three higher education institutions, based on postcodes of residence of age-16 pupils in 2002. Interpolation based on inverse distance weighting of nearest 100 neighbouring pupils, on 1km grid.	Figure shows interpolated mean rail-network distance distance to all major higher education institutions (as defined in text, based on postcodes of residence of age-16 pupils in 2002. Interpolation based on inverse distance weighting of nearest 100 neighbouring pupils, on 1km grid	Figure shows interpolation of estimated number of first degree places within 100km rail-network distance, based on postcodes of residence of age-16 pupils in 2002. Interpolation based on inverse distance weighting of nearest 100 neighbouring pupils, on 1km grid.

Figure 2: HE participation rates by locality

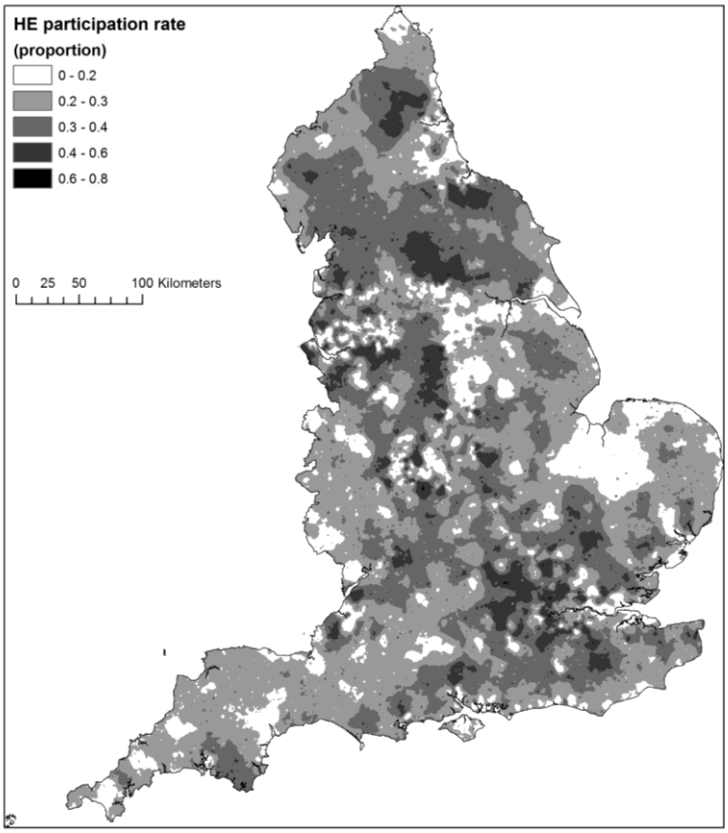

Figure shows interpolated HE participation rates based on postcode of residence of age-16 pupils in 2002. Interpolation based on inverse distance weighting of nearest 1000 neighbouring pupils, on 1km grid.

Figure 3: Average distances from home to HE institution attended, by locality

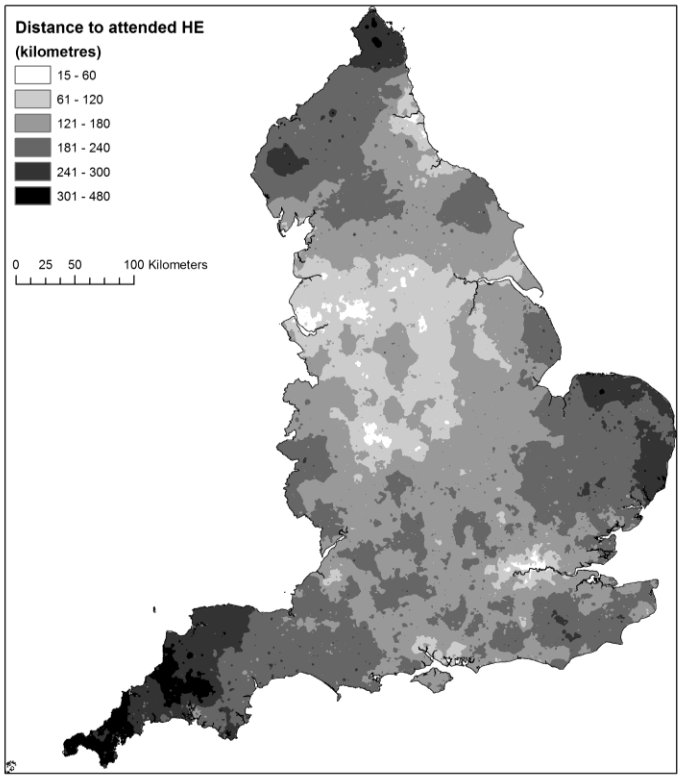

Figure shows interpolated mean distance to attended HE institution based on postcode of residence of age-16 pupils in 2002. Interpolation based on inverse distance weighting of nearest 1000 neighbouring pupils, on 1km grid.

Figure A1: Logit functional form fit: White females

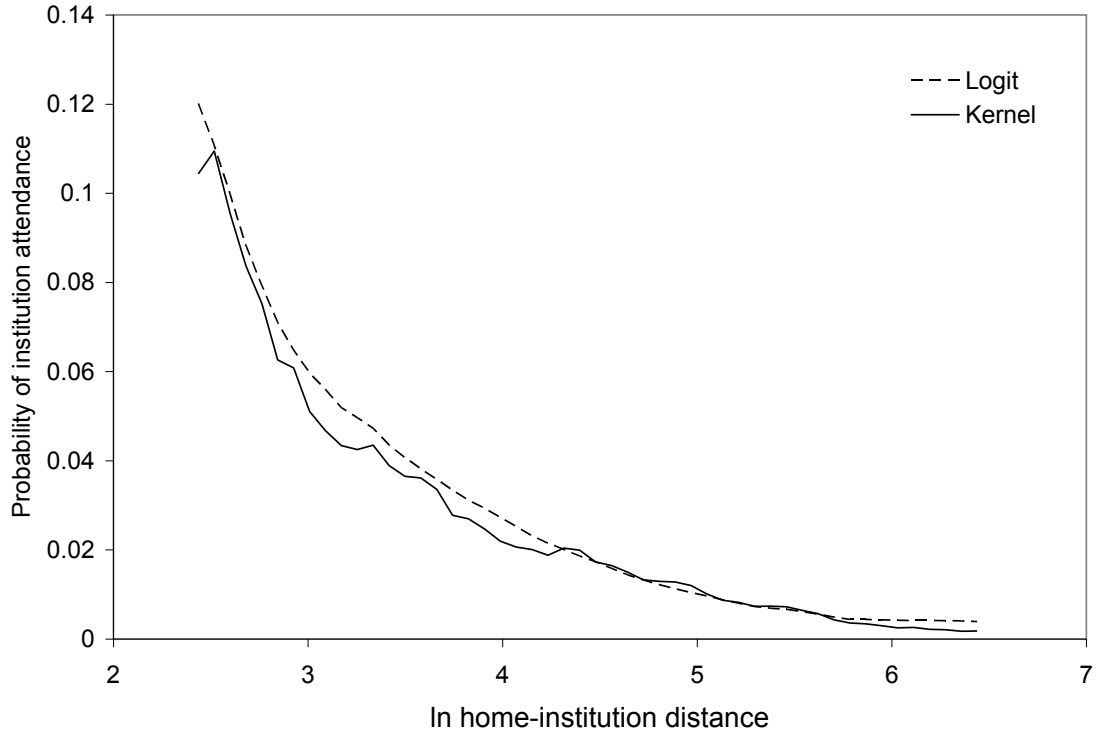

Table 1: Home university distances, summary statistics for participants and non-participants

	White British	Black	Bangla-desh	Pakistan	India	Other white	Other	White Non-FSM	White FSM
Female non-participants									
Nearest 3 HEs	36.2	14.1	14.0	20.3	17.3	27.1	19.3	37.0	31.5
	(24.4)	(12.5)	(14.3)	(14.0)	(12.3)	(23.7)	(16.9)	(24.4)	(23.9)
Nearest 3 top 20% RAE	81.6	31.2	34.8	51.7	46.9	53.7	42.7	81.8	80.6
	(48.1)	(29.4)	(31.7)	(21.5)	(29.3)	(39.7)	(35.6)	(48.2)	(47.5)
All Hes	241.3	192.7	200.8	212.4	199.0	211.7	200.5	240.8	243.8
	(59.7)	(23.7)	(37.1)	(36.2)	(32.7)	(42.3)	(35.4)	(59.5)	(60.5)
HE places (1000s) within 100km	45.3	71.1	69.9	61.7	63.1	57.7	64.6	45.0	46.8
	(25.4)	(17.2)	(18.6)	(14.4)	(17.0)	(25.9)	(20.9)	(25.6)	(24.5)
	141869	5361	1448	3708	1964	3750	3182	120356	21513
Female participants									
Nearest 3 Hes	36.2	14.3	13.7	19.0	17.6	24.3	21.5	36.3	31.4
	(23.2)	(12.3)	(13.6)	(12.5)	(11.5)	(19.8)	(17.4)	(23.2)	(24.9)
Nearest 3 top 20% RAE	80.2	28.2	33.1	47.0	42.5	47.2	43.2	80.1	84.7
	(47.2)	(26.6)	(32.4)	(22.8)	(26.5)	(40.2)	(36.6)	(47.0)	(52.3)
All Hes	238.8	191.6	199.2	207.5	192.9	206.7	202.4	238.5	246.3
	(58.3)	(21.5)	(35.9)	(34.2)	(24.1)	(40.0)	(36.7)	(58.2)	(62.8)
HE places (1000s) within 100km	46.4	72.7	71.2	64.9	65.8	62.4	65.5	46.5	46.4
	(25.3)	(15.8)	(18.5)	(14.3)	(15.1)	(23.8)	(20.5)	(25.3)	(24.9)
	56321	2494	762	2154	3857	1972	2845	54560	1761
Male non-participants									
Nearest 3 Hes	36.5	13.9	13.4	19.6	17.7	26.2	19.7	37.3	31.9
	(24.6)	(12.0)	(14.3)	(13.1)	(12.4)	(22.9)	(17.8)	(24.6)	(24.3)
Nearest 3 top 20% RAE	82.2	30.1	35.3	51.4	46.1	50.9	43.4	82.3	81.3
	(48.5)	(29.1)	(32.9)	(21.0)	(27.0)	(40.0)	(36.3)	(48.4)	(48.9)
All Hes	241.2	191.6	200.2	212.9	196.3	210.6	201.1	240.9	244.6
	(60.0)	(23.1)	(37.3)	(35.7)	(27.6)	(42.2)	(36.4)	(59.7)	(61.7)
HE places (1000s) within 100km	44.9	71.4	69.2	61.6	63.7	59.7	64.3	44.7	46.6
	(25.4)	(17.0)	(19.7)	(14.1)	(16.3)	(25.5)	(21.4)	(25.5)	(24.7)
	159550	6221	1591	4311	2694	4453	3766	138129	21421
Male participants									
Nearest 3 Hes	36.4	14.3	12.2	19.8	18.1	25.5	22.4	36.6	30.9
	(23.2)	(11.8)	(11.4)	(13.7)	(11.6)	(20.3)	(19.0)	(23.1)	(25.5)
Nearest 3 top 20% RAE	79.6	28.1	31.0	48.3	44.3	48.5	45.7	79.5	80.8
	(46.1)	(26.2)	(31.0)	(24.3)	(27.3)	(39.2)	(40.1)	(45.9)	(51.9)
All Hes	238.2	191.9	197.0	208.7	194.4	207.9	205.2	238.1	242.5
	(57.7)	(21.7)	(35.3)	(35.8)	(26.3)	(39.6)	(41.6)	(57.5)	(62.0)
HE places (1000s) within 100km	46.5	73.2	71.9	63.9	65.0	62.0	64.3	46.5	47.7
	(25.3)	(15.0)	(18.0)	(15.5)	(15.7)	(23.7)	(21.8)	(25.4)	(25.1)
	44381	1592	612	1938	3480	1647	2416	43128	1253

Table reports means, standard deviations and numbers of observations

Table 2: Association between institution accessibility and participation, by ethnicity and income

	White British		Black		Bangladesh		Pakistan		Indian		Other white		Other		White FSM	
	ε	t	ε	t	ε	t	ε	t	ε	t	ε	z	ε	t	ε	t
Females																
Distance to nearest	**-0.066**	-9.79	*-0.082*	-2.30	-0.089	-1.61	**-0.075**	-3.97	*-0.044*	-2.19	*-0.088*	-2.43	**-0.086**	-3.15	*-0.098*	-2.49
Mean distance next 2	**-0.038**	-8.99	-0.038	-1.89	0.010	-0.26	-0.019	-1.29	-0.009	-0.65	**-0.074**	-3.66	-0.011	-0.67	-0.011	-0.44
Mean distance all the rest	*0.047*	1.98	*-0.494*	-2.42	-0.356	-1.13	0.052	0.24	**-0.689**	-6.84	-0.024	-0.15	0.020	0.15	0.131	0.91
F test all zero, p-value	0.000		0.016		0.232		0.001		0.000		0.006		0.014		0.058	
F test zero sum, p-value	0.025		0.005		0.173		0.001		0.000		0.006		0.059		0.888	
Participation rate	0.284		0.318		0.345		0.367		0.663		0.347		0.472		0.076	
Observations	198189		7855		2209		5860		5819		5679		6024		23272	
Males																
Distance to nearest	**-0.025**	-3.13	-0.038	-0.80	-0.094	-1.39	*-0.081*	-2.32	**-0.078**	-3.28	**-0.153**	-3.57	-0.059	-1.87	**-0.051**	-1.16
Mean distance next 2	**-0.040**	-8.02	-0.017	-0.62	-0.091	-1.94	*-0.053*	-2.15	-0.016	-1.05	**-0.077**	-3.19	**-0.057**	-2.96	**-0.105**	-3.74
Mean distance all the rest	0.072	*2.55*	-0.252	-0.87	0.143	0.46	-0.147	-0.86	-0.178	-1.40	0.040	-0.84	0.144	1.00	0.277	1.71
F test, all zero, p-value	0.000		0.726		0.210		0.065		0.009		0.000		0.009		0.001	
F test, zero sum, p-value	0.844		0.316		0.900		0.125		0.047		0.051		0.859		0.483	
Participation rate	0.218		0.204		0.276		0.310		0.562		0.270		0.391		0.055	
Observations	203926		7809		2197		6247		6157		6093		6182		22677	

Logit models. Distance variables in natural logarithms. Table reports mean elasticity of HE participation respect to home-institution distances. t-statistics based on standard errors clustered at postcode level. Bold significant at 1% level. Italic significant at 5% level. Control variables are listed in detail in Appendix A: age, FSM, English additional language, school type, grammar school, age-11 key stage 2 Levels in English, maths and science, GCSE points, school mean GCSE points, school mean FSM, school proportion white, school pupil number, residential population density, residential average rooms per dwelling, residential proportion economically active, residential proportion social housed, residential proportion qualified Level 4, residential proportion unqualified.

Table 3: Home university distances, summary statistics for HE participant sample

	Females			Males		
	Distance to HE attended		Obs	Distance to HE attended		Obs
	Mean (s.d.)	Min/Max		Mean (s.d.)	Min/Max	
All ethnicities						
White British	133.5	0.1	47175	142.1	0.3	37715
	(111.6)	806.2		(113.0)	764.5	
Black	79.6	0.1	2008	74.7	0.3	1293
	(91.2)	527.3		(93.5)	501.8	
Bangladesh	31.2	0.2	670	39.5	0.4	534
	(57.0)	415.5		(67.3)	470.1	
Pakistan	41.6	0.3	1842	57.1	0.35	1635
	(56.3)	402.5		(73.3)	504.0	
India	73.4	0.4	3428	73.5	0.4	3026
	(79.2)	555.9		(78.8)	491.1	
Other white	119.0	0.7	1683	122.5	2.15	1435
	(112.5)	683.6		(111.1)	583.6	
Other	95.9	0.4	2480	104.0	0.4	2075
	(103.0)	538.0		(105.9)	656.3	
White British						
Managerial	141.5	0.4	9812	149.2	0.3	7644
	(110.0)	806.6		(109.4)	680.9	
Professional	161.0	0.4	9874	163.7	1.1	8565
	(115.0)	799.4		(114.8)	684.7	
Administrative	136.0	0.7	9805	146.1	0.7	7712
	(111.4)	688.1		(114.7)	754.0	
Skilled trades	120.0	1.5	4517	130.1	0.5	3440
	(105.7)	633.1		(110.1)	637.8	
Other occupation	110.5	0.1	7180	120.2	0.3	5268
	(106.1)	739.8		(108.8)	764.5	
No/unknown	112.8	0.3	5196	123.6	0.3	4479
occupation	(109.0	803.2		(111.6)	709.3	
White British						
Non-FSM	134.7	0.3	45789	143.2	0.3	36741
	(111.6)	709.3		(112.9)	764.5	
FSM	91.8	0.3	1356	103.7	0.4	974
	(101.8)	593.6		(111.2)	566.4	

Table reports means, standard deviations, maxima and minima and numbers of observations

Table 4: University choice: home-institution distance elasticities, by ethnicity

	White British		Black		Bangladesh		Pakistan		Indian		Other white		Other	
	ε	t	ε	t	ε	t	ε	t	ε	t	ε	t	ε	t
Females														
Log distance	**-1.02**	-223	**-0.76**	-44.5	**-1.25**	-34.5	**-1.44**	-64.1	**-1.00**	-76.0	**-0.79**	-35.4	**-0.90**	-52.9
| institutions × characteristics[1]	**-1.11**	-235	**-0.82**	-33.7	**-1.48**	-26.3	**-1.47**	-46.1	**-0.95**	-54.2	**-1.00**	-32.9	**-1.02**	-44.8
| insts +distance×characteristics[2]	**-1.20**	-68.1	**-0.81**	-10.7	**-1.22**	-5.6	**-1.36**	-10.7	**-0.72**	-10.6	**-1.20**	-13.3	**-0.96**	-14.0
Institutions × students	96 ×	4714 5	90 ×	2008	74 ×	670	86 ×	1842	91 ×	3428	96 ×	1683	94 ×	2480
Males														
Log distance	**-0.95**	-182	**-0.82**	-38.6	**-1.09**	-31.6	**-1.24**	-60.8	**-1.00**	-72.8	**-0.72**	-30.1	**-0.84**	45.1
| institutions × characteristics[1]	**-1.05**	-198	**-0.93**	-28.0	**-1.27**	-21.8	**-1.27**	-42.6	**-0.98**	-51.1	**-1.00**	-32.3	**-0.98**	-40.0
| insts +distance×characteristics[2]	**-1.12**	-54.6	**-0.83**	-7.8	**-1.39**	-6.2	**-1.30**	-10.7	**-0.81**	-11.4	**-0.99**	-9.8	**-1.07**	-13.5
Institutions × students	96 ×	3771 5	86 ×	1293	72 ×	534	85 ×	1635	88 ×	3026	96×	1435	91 ×	2075

Conditional logit estimation. Table reports elasticity of institution attendance with respect to home-institution distance. [1]Includes institution dummy variables. t-statistics based on robust standard errors. Bold significant at 1% level. Specicication[1] includes institution dummy variables; age, FSM, EAL, social class, school FSM, and A-Level points interacted with institution type and RAE score; GCSE points interacted with institution dummy interactions. Specification[2] allows for interaction between log-distance and the full set of pupil and institutional characteristics: See Appendix Table A2, A3 for the full specification.

Table 5: University choice: home-institution distance elasticities, by occupation group and income, white British ethnic group

	Managerial		Professional		Administrative		Skilled trades		Other occupation		No occupation or unknown		FSM-eligible	
	ε	t	ε	t	ε	t	ε	t	ε	t	ε	t	ε	t
Females														
Log distance	**-0.93**	-89.2	**-0.75**	-72.2	**-0.97**	-96.5	**-1.19**	-79.9	**-1.23**	-105	**-1.21**	-88.7	**-1.30**	-48.3
| institutions × characteristics[1]	**-1.06**	-100	**-0.85**	-83.6	**-1.08**	105.5	**-1.27**	-81.6	**-1.28**	-103	**-1.22**	-81.3	**-1.34**	-43.9
| insts +distance×characteristics[2]	**-1.14**	-37.9	**-1.07**	-36.0	**-1.04**	-36.3	**-1.18**	-26.7	**-1.10**	-31.1	**-1.18**	-29.5	**-1.14**	-12.6
Institutions × students	96 ×	9812	96 ×	9874	96×	9805	96 ×	4517	96 ×	7180	96 ×	5196	95	1356
Males														
Log distance	**-0.86**	-70.4	**-0.72**	-63.6	**-0.89**	-77.8	**-1.11**	-63.1	**-1.17**	-85.8	**-1.12**	-75.7	**-1.21**	-39.4
| institutions × characteristics[1]	**-1.01**	-81.6	**-0.82**	-74.3	**-1.01**	-87.4	**-1.21**	-64.6	**-1.23**	-86.0	**-1.19**	-76.4	**-1.24**	-38.1
| insts +distance×characteristics[2]	**-0.98**	-26.6	**-0.97**	-27.9	**-0.93**	-27.2	**-1.10**	-20.3	**-1.08**	-25.5	**-1.17**	-25.6	**-1.06**	-10.1
Institutions × students	96 ×	7644	96 ×	8565	96 ×	7712	96 ×	3440	96 ×	5268	96×	4479	94	974

Conditional logit estimation. Table reports elasticity of institution attendance with respect to home-institution distance. [1]Includes institution dummy variables. t-statistics based on robust standard errors. Bold significant at 1% level. Specicication[1] includes institution dummy variables; age, FSM, EAL, social class, school FSM, and A-Level points interacted with institution type and RAE score; GCSE points interacted with institution dummy interactions. Specification[2] allows for interaction between log-distance and the full set of pupil and institutional characteristics: See Appendix Table A2, A3 for the full specification.

Table 6: Attendance at top ranked institutions: top ranked pupils, by ethnicity, gender, occupation and class

	Females in top 20% GCSE		Males in top 20% GCSE	
	% in top 20% RAE	Obs	% in top 20% RAE	Obs
All ethnicities				
White British	**58.7**	9646	**67.9**	5973
Black	60.5	129	64.8	54
Bangladesh	69.0	58	76.0	50
Pakistan	55.6	151	67.4	98
India	60.9	412	*73.9*	318
Other white	**66.4**	354	72.2	223
Other	65.2	138	72.2	90
White British				
Managerial	*60.1*	2248	67.7	1298
Professional	**63.5**	3182	**73.6**	2054
Administrative	*55.8*	1138	68.4	1223
Skilled trades	**51.1**	663	59.3	425
Other occupation	**52.2**	893	**61.8**	587
No/unknown occupation	**44.8**	540	**60.3**	350
White British				
FSM	48.7	76	**48.1**	52
All	59.0	11465	68.8	7123

Table reports means, standard deviations, maxima and minima and numbers of observations

Significantly different from complementary group at : § 10%, *italic* 5%, **bold** 1% or better

Table A1: List of Higher Education Institutions included in the empirical analysis

Anglia Ruskin University
Aston University
Bath Spa University
Bournemouth University
Brunel University
Buckinghamshire Chilterns University
Canterbury Christ Church University
City University
College of St Mark and St John
Coventry University
Cumbria Institute of the Arts
De Montfort University
Edge Hill College of Higher Education
Goldsmiths College
Harper Adams University College
Homerton College
Imperial College of Science, Technology
King's College London
Kingston University
Leeds Metropolitan University
Liverpool Hope University
Liverpool John Moores University
London Metropolitan University
London School of Economics and Political Science
London South Bank University
Loughborough University
Manchester Metropolitan University
Middlesex University
Newman College of HE
Nottingham Trent University
Oxford Brookes University
Queen Mary and Westfield College
Roehampton University
Royal Holloway and Bedford New College
Sheffield Hallam University
Southampton Solent University
St Martin's College
St Mary's College
Staffordshire University
Thames Valley University
Trinity and All Saints College
University College Falmouth
University College London
University of Bath
University of Birmingham
University of Bolton
University of Bradford
University of Brighton
University of Bristol
University of Cambridge
University of Central England in Birmingham
University of Central Lancashire
University of Chester
University of Chichester
University of Derby
University of Durham
University of East Anglia
University of East London
University of Essex
University of Exeter
University of Gloucestershire
University of Greenwich
University of Hertfordshire
University of Huddersfield
University of Hull
University of Keele
University of Kent
University of Lancaster
University of Leeds
University of Leicester
University of Lincoln
University of Liverpool
University of Luton
University of Manchester
University of Newcastle-upon-Tyne
University of Northampton
University of Northumbria at Newcastle
University of Nottingham
University of Oxford
University of Plymouth
University of Portsmouth
University of Reading
University of Salford
University of Sheffield
University of Southampton
University of Sunderland
University of Surrey
University of Sussex
University of Teesside
University of Warwick
University of Westminster
University of Winchester
University of Wolverhampton
University of Worcester
University of York
University of the Arts, London
University of the West of England, Bristol
York St John College

Table A2 University choice: home-institution distance elasticity heterogeneity, by ethnic group. Females

		White British		Black		Bangladesh		Pakistan		Indian		Other white		Other	
		ε	z	ε	z	ε	z	ε	z	ε	z	ε	z	ε	Z
Log distance		**-1.204**	-68.13	**-0.809**	-10.67	**-1.217**	-5.63	**-1.362**	-10.69	**-0.720**	-10.60	**-1.204**	-13.27	**-0.957**	-13.96
Individual	× Age	-0.006	-1.46	0.004	0.20	-0.076	-1.88	0.050	2.06	0.003	0.25	-0.026	-1.16	0.028	1.68
	× FSM	-0.001	-0.04	**-0.155**	-3.34	0.077	0.88	0.003	0.06	0.026	0.52	0.026	0.33	0.040	0.79
	× EAL	-0.024	-0.54	**0.128**	3.11	-0.349	-2.23	-0.212	-2.47	-0.061	-1.45	**-0.265**	-4.69	-0.059	-1.64
	× Managers	**0.092**	5.83	-0.116	-1.66	-0.100	-0.72	0.128	1.63	0.083	1.87	0.033	0.43	-0.004	-0.07
	× Professional	**0.192**	12.23	-0.002	-0.03	-0.041	-0.22	0.127	1.28	0.097	1.87	**0.237**	3.02	0.078	1.35
	× Admin	**0.098**	6.31	-0.006	-0.12	0.041	0.20	0.066	0.71	0.018	0.37	0.070	0.90	0.121	2.26
	× Skilled	-0.011	-0.57	**-0.348**	-3.49	-0.021	-0.20	0.078	0.65	-0.010	-0.19	-0.001	-0.01	-0.060	-0.84
	× Occ. NA	-0.034	-1.92	-0.081	-1.66	-0.052	-0.52	-0.071	-1.10	-0.028	-0.69	-0.077	-0.98	-0.065	-1.16
	× GCSEs (sd)	**0.111**	14.42	0.047	1.97	0.076	1.02	**0.131**	3.62	0.079	3.53	0.087	2.57	0.028	0.87
	× KS5 (sd)	**0.108**	15.21	**0.083**	2.85	-0.035	-0.50	0.044	1.13	0.035	1.51	0.059	1.67	**0.120**	3.95
School	× VA	0.011	0.90	0.093	2.02	-0.063	-0.51	0.099	0.88	-0.113	-2.05	0.011	0.18	-0.083	-1.76
	× VC	0.007	0.30	0.294	0.97	0.017	0.05	0.260	1.56	-0.214	-1.67	0.004	0.03	0.292	2.55
	× Foundation	**-0.062**	-4.84	0.068	1.11	-0.243	-1.54	0.011	0.14	-0.007	-0.19	0.013	0.18	-0.057	-1.17
	× Grammar	0.032	1.32	0.098	0.74	-0.123	-0.27	0.309	2.09	0.005	0.05	0.120	1.03	0.070	0.83
	× GCSEs (sd)	**0.041**	4.28	0.045	1.60	-0.025	-0.39	-0.104	-2.48	-0.021	-0.79	-0.073	-1.81	0.029	0.98
	× FSM (sd)	**-0.028**	-2.87	0.002	0.11	-0.092	-2.10	-0.018	-0.53	**-0.095**	-4.36	**-0.165**	-4.57	-0.043	-1.71
	× White (sd)	-0.003	-0.26	-0.055	-2.39	-0.129	-2.09	0.000	-0.01	-0.039	-2.29	**0.093**	3.87	0.002	0.08
	× Pupils (sd)	**0.018**	3.46	-0.043	-1.64	-0.023	-0.41	**0.114**	3.48	0.010	0.54	0.001	0.02	0.015	0.74
	× Entry in 05/06	**0.108**	10.30	-0.014	-0.31	0.123	1.24	**0.218**	3.41	**0.175**	4.43	0.125	2.38	0.082	1.87
Degree × Medic., biology		0.000	-0.03	-0.056	-1.12	-0.210	-1.68	0.155	2.09	-0.006	-0.15	-0.004	-0.06	-0.087	-1.81
	× Physical, and technical	**0.083**	4.83	0.025	0.34	-0.428	-2.49	-0.015	-0.17	-0.048	-0.92	0.036	0.39	0.035	0.57
	× Social, buildings, legal	0.015	1.10	0.048	1.05	-0.135	-1.28	0.057	0.77	-0.047	-1.24	**0.239**	3.68	0.096	1.94
	× Languages humanities	**0.102**	7.56	0.086	1.17	-0.241	-1.63	0.125	1.22	-0.005	-0.08	0.146	2.12	0.098	1.70
Institution × Russel group		**0.095**	3.80	0.051	0.42	0.565	2.15	-0.067	-0.43	**-0.310**	-2.85	**0.397**	2.76	-0.201	-1.80
	× Other old	-0.003	-0.13	0.014	0.12	**0.651**	3.41	-0.066	-0.46	**-0.240**	-3.02	0.233	1.86	-0.135	-1.52
	× 94 group	**-0.138**	-8.42	-0.051	-0.70	-0.114	-0.55	-0.110	-1.09	-0.159	-2.28	-0.103	-1.08	**-0.300**	-3.92
	× Specialist	-0.053	-2.47	0.231	1.63	**0.877**	3.60	-0.536	-2.02	-0.407	-2.54	-0.148	-1.16	-0.141	-1.09
	× RAE 2001 (sd)	**0.075**	7.17	0.040	0.75	-0.154	-1.25	0.052	0.75	**0.158**	3.53	0.006	0.10	0.092	2.04
	× Drop out (sd)	**-0.149**	-16.19	**-0.117**	-2.81	-0.074	-0.77	-0.071	-1.46	**-0.230**	-6.48	-0.119	-2.16	**-0.196**	-4.70

Conditional logit estimation. Table reports elasticity of institution attendance with respect to home-institution distance. Continuous variables are zero mean and standardised on population. All models include institution dummy variables and residential area characteristics. Z-statistics based on robust standard errors. Bold significant at 1% level. Baseline group is non-FSM, English first language, other occupation, Community school, business, creative, business or administrative degree, other new university. Unreported control variables: home OA population density, rooms per hh, econ active, social renting, high qualified, no qualified, LA share in HE, institution employment rate, institution TTWA wages, house prices, jobs. Observations as Table 1.

Table A3 University choice: home-institution distance elasticity heterogeneity by ethnic group. Males

	White British		Black		Bangladesh		Pakistan		Indian		Other white		Other	
	ε	z	ε	z	ε	z	ε	z	ε	z	ε	z	ε	Z
Log distance	**-1.118**	-54.58	**-0.833**	-7.78	**-1.391**	-6.24	**-1.302**	-10.66	**-0.809**	-11.37	**-0.989**	-9.81	**-1.072**	-13.49
Individual × Age	0.003	0.62	-0.004	-0.16	0.004	0.10	0.015	0.66	-0.010	-0.65	0.022	0.88	-0.001	-0.08
× FSM	0.001	0.04	-0.088	-1.39	-0.067	-0.81	**-0.153**	-3.03	-0.075	-1.36	0.015	0.15	-0.074	-1.23
× EAL	-0.061	-1.18	-0.062	-1.10	-0.320	-1.80	0.072	0.85	-0.058	-1.26	**-0.207**	-3.40	-0.115	-2.80
× Managers	0.099	5.51	0.061	0.64	0.337	2.55	0.012	0.15	-0.028	-0.61	-0.020	-0.23	-0.016	2.41
× Professional	**0.187**	10.80	0.092	1.16	-0.035	-0.17	0.027	0.25	-0.011	-0.19	0.019	0.23	0.155	1.06
× Admin	**0.1**12	6.44	0.109	1.58	0.103	0.64	-0.054	-0.51	0.041	0.83	0.095	1.18	0.070	-0.53
× Skilled	0.002	0.08	0.225	2.01	-0.248	-1.71	0.043	0.49	0.002	0.03	-0.083	-0.88	-0.034	1.45
× Occ. NA	-0.037	-1.89	-0.133	-1.92	-0.132	-1.46	-0.072	-1.26	**-0.162**	-3.54	0.089	1.04	0.105	-0.92
× GCSEs (sd)	**0.087**	10.60	**0.098**	3.04	0.057	1.17	0.084	2.56	**0.100**	4.38	0.090	2.42	0.047	1.45
× KS5 (sd)	**0.112**	15.14	0.085	2.20	0.052	0.92	0.032	0.90	0.034	1.45	0.093	2.36	0.060	2.13
School × VA	0.018	1.29	-0.002	-0.04	0.204	1.29	0.021	0.20	0.075	1.35	0.008	0.13	0.051	0.96
× VC	0.003	0.11	0.275	1.24	0.085	0.45	-0.084	-0.37	0.157	1.05	0.115	0.65	0.011	0.11
× Foundation	-0.017	-1.16	0.026	0.36	-0.019	-0.14	0.023	0.34	0.028	0.66	0.015	0.19	-0.052	-0.91
× Grammar	-0.021	-0.84	-0.098	-0.71	0.125	0.42	0.036	0.24	0.011	0.13	-0.101	-0.85	0.077	0.87
× GCSEs (sd)	0.044	4.05	0.016	0.40	-0.050	-0.62	-0.030	-0.69	-0.047	-1.46	0.070	1.54	0.023	0.66
× FSM (sd)	**-0.062**	-5.58	-0.011	-0.38	0.030	0.96	0.050	1.74	**-0.090**	-3.54	-0.064	-1.47	0.003	0.12
× White (sd)	-0.012	-1.09	0.017	0.64	0.015	0.31	0.069	2.10	-0.045	-2.47	**0.083**	3.38	0.035	1.36
× Pupils (sd)	**0.016**	2.89	-0.067	-1.91	0.128	2.27	0.025	0.83	**0.058**	3.15	0.008	0.22	0.036	1.51
× Entry in 05/06	**0.109**	9.23	0.107	1.82	0.133	1.05	0.074	1.24	0.093	2.18	**0.228**	3.98	**-0.059**	3.21
Degree × Medic., biology	-0.028	-1.68	-0.028	-0.39	0.057	0.37	**0.254**	3.40	-0.008	-0.15	0.022	0.26	0.161	1.40
× Physical, and technical	0.009	0.68	-0.022	-0.36	-0.061	-0.54	-0.051	-0.83	**-0.107**	-2.80	0.064	0.98	0.087	-0.76
× Social, buildings, legal	0.026	1.73	0.087	1.30	0.108	0.96	0.161	2.47	0.085	2.06	**0.235**	3.02	**-0.040**	5.30
× Languages humanities	**0.104**	5.92	-0.049	-0.33	0.651	2.36	0.245	1.71	-0.083	-0.81	0.149	1.78	**0.307**	3.26
Institution × Russel group	-0.005	-0.19	0.288	1.63	0.444	1.14	0.075	0.44	-0.094	-0.77	-0.161	-0.97	0.301	1.61
× Other old	-0.038	-1.42	0.243	1.45	0.662	2.56	0.206	1.31	-0.114	-1.24	-0.136	-1.02	0.197	1.59
× 94 group	**-0.118**	-6.27	-0.058	-0.54	-0.121	-0.45	-0.092	-0.94	-0.210	-2.71	-0.263	-2.69	0.161	-2.12
× Specialist	0.062	2.21	-0.277	-1.34	0.668	1.95	-0.127	-0.31	-0.015	-0.04	0.206	1.21	-0.171	0.13
× RAE 2001 (sd)	**0.105**	8.58	0.062	0.82	-0.109	-0.74	0.090	1.09	**0.167**	3.45	0.142	2.27	0.024	0.53
× Drop out (sd)	**-0.129**	-12.35	-0.061	-1.06	0.008	0.07	-0.055	-1.07	**-0.187**	-3.81	-0.110	-1.75	**0.028**	-3.70

Conditional logit estimation. Table reports elasticity of institution attendance with respect to home-institution distance. Continuous variables are zero mean and standardised on population. All models include institution dummy variables and residential area characteristics. Z-statistics based on robust standard errors. Bold significant at 1% level. Baseline group is non-FSM, English first language, other occupation, Community school, business, creative, business or administrative degree, other new university. Unreported control variables: home OA population density, rooms per hh, econ active, social renting, high qualified, no qualified, LA share in HE, institution employment rate, institution TTWA wages, house prices, jobs. Observations as Table 1.

Table A4 University choice: home-institution distance elasticity heterogeneity by SOC. White British Females

		Managerial		Professional		Administrative		Skilled trades		Other occupation		No occ. or NA		FSM-eligible	
		ε	z	ε	z	ε	z	ε	z	ε	z	ε	z	ε	Z
Log distance		**-1.139**	-37.92	**-1.071**	-35.96	**-1.042**	-36.32	**-1.183**	-26.74	**-1.103**	-31.05	**-1.179**	-29.53	**-1.139**	-12.62
Individual	× Age	-0.007	-0.67	-0.001	-0.14	-0.004	-0.46	-0.004	-0.25	-0.011	-0.93	-0.011	-0.79	0.046	1.73
	× FSM	-0.072	-0.59	-0.100	-0.74	0.006	0.08	0.073	0.68	-0.027	-0.59	-0.006	-0.10	-	-
	× EAL	-0.074	-0.68	0.022	0.24	-0.028	-0.26	0.007	0.05	0.084	0.79	-0.151	-1.12	0.215	1.69
	× Managers													0.024	0.19
	× Professional													0.030	0.23
	× Admin													0.102	1.27
	× Skilled													0.140	1.33
	× Occ. NA													-0.051	-0.74
	× GCSEs (sd)	**0.116**	6.97	**0.129**	8.39	**0.088**	5.65	**0.106**	4.68	**0.081**	4.35	**0.107**	5.00	0.081	2.06
	× KS5 (sd)	**0.097**	6.07	**0.114**	7.84	**0.118**	7.61	**0.101**	4.56	**0.104**	5.55	**0.072**	3.35	0.060	1.55
School	× VA	0.030	1.07	-0.021	-0.81	-0.003	-0.09	0.085	2.07	-0.023	-0.69	0.041	1.07	-0.003	-0.04
	× VC	0.080	1.58	0.009	0.19	0.023	0.47	-0.118	-1.54	-0.007	-0.10	-0.030	-0.41	0.253	1.32
	× Foundation	-0.023	-0.83	-0.020	-0.72	-0.042	-1.54	-0.084	-2.05	**-0.118**	-3.39	**-0.127**	-2.99	-0.164	-1.84
	× Grammar	0.018	0.33	0.042	0.81	0.002	0.03	-0.021	-0.26	0.002	0.02	0.101	1.23	0.084	0.50
	× GCSEs (sd)	0.040	1.88	0.006	0.28	**0.055**	2.76	0.031	1.06	**0.063**	2.70	0.036	1.30	0.099	2.06
	× FSM (sd)	-0.024	-1.32	-0.014	-0.84	-0.018	-1.18	-0.022	-1.03	-0.022	-1.40	-0.011	-0.53	-0.039	-0.95
	× White (sd)	-0.002	-0.17	-0.010	-0.94	-0.003	-0.26	0.014	0.75	-0.006	-0.43	0.023	1.33	0.011	0.20
	× Pupils (sd)	0.010	0.90	0.019	1.71	0.018	1.58	**0.045**	2.73	0.015	1.12	0.013	0.81	-0.041	-1.25
	× Entry in 05/06	**0.117**	4.90	**0.080**	3.68	**0.102**	4.51	**0.092**	2.63	**0.124**	4.50	**0.172**	5.42	0.100	1.53
Degree × Medic., biology		-0.010	-0.37	0.011	0.40	-0.052	-2.00	0.036	0.92	-0.023	-0.71	0.062	1.59	-0.016	-0.21
× Physical, and technical		**0.112**	2.82	0.073	2.06	0.037	0.96	**0.145**	2.81	0.034	0.81	0.130	2.17	0.144	1.59
× Social, buildings, legal		0.056	1.91	**0.091**	3.08	-0.020	-0.68	-0.035	-0.79	**-0.080**	-2.31	0.017	0.42	-0.135	-1.75
× Languages humanities		**0.110**	3.76	**0.147**	5.19	**0.078**	2.70	-0.024	-0.52	0.053	1.49	**0.200**	4.66	0.008	0.08
Institution × Russel group		0.096	1.64	0.021	0.37	-0.016	-0.28	0.132	1.57	0.038	0.58	**0.194**	2.81	0.060	0.44
	× Other old	-0.011	-0.20	-0.015	-0.31	-0.070	-1.40	-0.026	-0.34	-0.004	-0.06	0.072	1.01	-0.029	-0.21
	× 94 group	**-0.116**	-3.13	**-0.145**	-3.89	**-0.177**	-5.00	**-0.149**	-2.75	**-0.197**	-4.64	-0.026	-0.55	-0.108	-1.11
	× Specialist	0.029	0.57	0.026	0.53	-0.021	-0.45	**-0.170**	-2.43	-0.055	-0.98	**-0.215**	-3.67	-0.048	-0.41
	× RAE 2001 (sd)	**0.054**	2.30	**0.103**	4.27	**0.089**	3.93	0.003	0.09	**0.079**	2.90	0.076	2.45	0.024	0.37
	× Drop out (sd)	**-0.166**	-7.62	**-0.142**	-7.16	**-0.162**	-8.06	**-0.165**	-5.45	**-0.129**	-5.72	**-0.080**	-3.13	-0.119	-2.53

Conditional logit estimation. Table reports elasticity of institution attendance with respect to home-institution distance. Continuous variables are zero mean and standardised on population. All models include institution dummy variables and residential area characteristics. Z-statistics based on robust standard errors. Bold significant at 1% level. Baseline group is non-FSM, English first language, other occupation, Community school, business, creative, business or administrative degree, other new university. Unreported control variables: home OA population density, rooms per hh, econ active, social renting, high qualified, no qualified, LA share in HE, institution employment rate, institution TTWA wages, house prices, jobs. Observations as Table 1.

Table A5 University choice: home-institution distance elasticity heterogeneity by SOC. White British Males

		Managerial		Professional		Administrative		Skilled trades		Other occupation		No occ. or NA		FSM-eligible	
		ε	z	ε	z	ε	z	ε	z	ε	z	ε	z	ε	Z
Log distance		**-0.976**	-26.62	**-0.966**	-27.86	**-0.928**	-27.18	**-1.101**	-20.29	**-1.077**	-25.47	**-1.165**	-25.64	**-1.057**	-10.12
Individual	× Age	-0.003	-0.29	0.008	0.75	-0.004	-0.33	0.030	1.77	0.002	0.14	0.002	0.14	0.026	0.91
	× FSM	-0.277	-1.99	-0.144	-1.06	0.175	1.93	0.077	0.77	-0.001	-0.02	0.050	0.72		
	× EAL	-0.154	-1.26	0.060	0.54	0.014	0.13	-0.114	-0.57	-0.116	-0.95	-0.157	-1.31	-0.078	-0.46
	× Managers													-0.100	-0.70
	× Professional													0.113	0.84
	× Admin													**0.304**	3.00
	× Skilled													0.136	1.32
	× Occ. NA													-0.080	-0.96
	× GCSEs (sd)	**0.068**	3.73	**0.100**	6.19	**0.065**	3.83	**0.097**	3.64	0.045	2.29	**0.127**	5.68	0.015	0.40
	× KS5 (sd)	**0.123**	7.18	**0.102**	6.99	0.136	8.55	0.061	2.41	**0.131**	6.74	**0.056**	2.48	0.093	2.15
School	× VA	-0.006	-0.20	-0.054	-1.91	0.040	1.30	0.053	1.04	0.080	2.17	0.033	0.80	0.000	0.00
	× VC	0.010	0.18	-0.068	-1.33	-0.003	-0.04	0.114	1.24	0.001	0.01	0.099	1.17	0.128	0.44
	× Foundation	-0.074	-2.26	-0.055	-1.76	0.038	1.22	0.020	0.40	0.005	0.13	-0.005	-0.11	-0.126	-1.20
	× Grammar	0.050	0.87	-0.134	-2.56	-0.003	-0.06	0.069	0.76	-0.010	-0.13	0.019	0.24	-0.039	-0.21
	× GCSEs (sd)	0.021	0.83	0.039	1.71	0.028	1.26	**0.117**	3.24	0.057	2.13	0.015	0.48	0.055	0.98
	× FSM (sd)	-0.043	-1.99	**-0.077**	-4.26	**-0.050**	-2.97	0.005	0.20	-0.028	-1.53	-0.040	-1.93	0.006	0.15
	× White (sd)	-0.005	-0.38	**-0.039**	-3.22	0.008	0.61	0.018	0.91	0.019	1.19	-0.020	-1.07	0.052	0.90
	× Pupils (sd)	0.016	1.29	0.002	0.18	**0.032**	2.61	0.031	1.65	0.007	0.43	0.014	0.78	-0.058	-1.49
	× Entry in 05/06	**0.093**	3.29	**0.096**	3.93	**0.125**	4.77	**0.119**	2.85	**0.105**	3.27	**0.131**	4.02	0.048	0.67
Degree × Medic., biology		-0.029	-0.75	0.014	0.41	**-0.105**	-2.94	-0.016	-0.29	-0.001	-0.02	0.003	0.08	-0.141	-1.42
× Physical, and technical		0.021	0.65	0.060	2.02	-0.023	-0.78	0.029	0.62	0.033	0.96	-0.021	-0.53	-0.122	-1.47
× Social, buildings, legal		0.050	1.46	**0.089**	2.69	-0.010	-0.31	0.059	1.10	0.095	2.22	-0.043	-0.99	-0.019	-0.20
× Languages humanities		**0.140**	3.42	**0.095**	2.65	0.061	1.67	0.074	1.18	0.122	2.42	**0.169**	3.40	0.126	1.15
Institution × Russel group		-0.060	-0.86	0.027	0.43	**-0.187**	-2.89	-0.121	-1.27	-0.137	-1.78	**0.249**	3.20	0.168	1.03
	× Other old	-0.096	-1.55	-0.032	-0.57	-0.147	-2.49	-0.167	-1.87	-0.150	-2.06	**0.245**	3.15	-0.033	-0.21
	× 94 group	-0.096	-2.15	-0.069	-1.69	**-0.200**	-4.90	**-0.177**	-2.72	**-0.226**	-4.48	-0.019	-0.36	0.070	0.67
	× Specialist	0.027	0.37	0.118	1.77	0.145	2.31	0.004	0.05	0.135	1.84	-0.030	-0.47	0.037	0.25
	× RAE 2001 (sd)	**0.112**	3.84	**0.081**	2.95	**0.147**	5.42	**0.146**	3.63	**0.136**	4.12	0.039	1.15	-0.005	-0.08
	× Drop out (sd)	**-0.144**	-5.80	**-0.123**	-5.69	**-0.144**	-6.16	**-0.115**	-3.19	**-0.159**	-5.64	-0.062	-2.15	-0.123	-2.00

Conditional logit estimation. Table reports elasticity of institution attendance with respect to home-institution distance. Continuous variables are zero mean and standardised on population. All models include institution dummy variables and residential area characteristics. Z-statistics based on robust standard errors. Bold significant at 1% level. Baseline group is non-FSM, English first language, other occupation, Community school, business, creative, business or administrative degree, other new university. Unreported control variables: home OA population density, rooms per hh, econ active, social renting, high qualified, no qualified, LA share in HE, institution employment rate, institution TTWA wages, house prices, jobs. Observations as Table 1.