



Degree attainment, ethnicity and gender: Interactions and the modification of effects A quantitative analysis

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1. Introduction

1.1 Objectives

This report is part of an investigation by the Higher Education Academy (the Academy) and the Equality Challenge Unit into issues relating to differences in degree attainment between students of different ethnic backgrounds, and between males and females. The Academy project as a whole will seek evidence underpinning the development of understanding and practical recommendations relating to these differences, raise awareness across the sector of the needs of students from all ethnic backgrounds, and promote greater engagement with issues concerning ethnicity and gender in relation to degree attainment.

The statistical modelling in this report examines the circumstances of degree attainment through the further analysis of relevant quantitative data from HESA (Higher Education Statistics Agency) and the National Student Survey (NSS). The analysis aims to build on existing published work with these datasets.

The objectives as stated by the Academy as the remit for this research are:

- 1) *To identify those regions, types of institutions, discipline areas, individual student characteristics and other variables that are most strongly associated with ethnic and gender differences in degree attainment.* Such differences have been established in recent work by Broecke and Nicholls (2007) for the DFES. Ethnic differences have also been established on many measures hypothesised to influence degree attainment, such as those reflected by the various satisfaction scales in the annual National Student Survey (NSS) (Surridge 2006).
- 2) *To conduct further analysis of the 2004-05 HESA student record data used by Broecke and Nicholls (2007).* This will use a multilevel approach to elucidate the role of factors such as institution, subject area and demographic background in relation to minority ethnic and gender-related differences in degree attainment. The focus of the analysis is to investigate how such factors interact with ethnicity (or gender) to modify the main effect of ethnicity (or gender) on the degree performance; for example, does the nature of the effect of prior qualification level on degree performance vary over ethnic groups?
- 3) *To conduct further analysis of the 2006 NSS dataset.* Again this will be multilevel, focusing on factors that may interact with minority ethnic and gender-related differences in relevant satisfaction measures. After discussions with the Academy (on 21 November 2007) it was decided to focus on a response scale summatively derived from the five items on the assessment and feedback scale.

1.2 The preparation and selection of sample datasets used

Data from HESA student records

We utilise data for 2004-05 on students who qualified for a course in higher education. We desired as far as possible to work with a filtered dataset comparable to that used by Broecke and Nicholls (2007). Starting with 341,412 in the qualifiers set, they analysed the 66,649 students remaining after filtering and including only according to the following criteria:

- those with only Level 3 qualifications as highest qualification on entry and only those students for which full information was available
- cases with UCAS tariff score not missing
- those starting their course in 2002-03 (effectively this meant restricting to full-time students completing a degree course in three years and excluding students repeating years, taking gap years, subject qualifications taking longer than three years, and large numbers of students in Scottish universities on four-year honours courses)
- only qualifiers whose qualification resulted in a classified degree
- English domiciled only (to allow use of Index of Multiple Deprivation (IMD))
- cases with IMD score not missing
- cases with realistic ages only.

Apart from practical consideration leading to the final manageable datasets capable of being analysed, one other advantage is that the final dataset, having been ‘controlled’ by selection for a number of covariates, became much more homogenous than the full set. Broecke and Nicholls (2007) discuss this, and additionally note it as a caveat to their selection.

We received two datasets and some SPSS syntax for the purpose of our analyses. Getting a dataset comparable to that above proved less straightforward than might at first be supposed, mainly because of gaps in postcode data and IMD data in the first dataset, and lack of institution and reference individual identifiers data in the second. The difficulties we had are outlined in Appendix 8. Suffice it to say that the 66,431 cases on which we eventually based our analyses almost exactly coincided with the 66,649 used in previous analyses.

Data from NSS 2006

Comparable filters were applied to this dataset to arrive at an analysed sample of 66,837 students in 119 institutions.

1.3 Analysis Strategy

In meeting the objectives above, we use statistical modelling as the framework for exploring patterns in the dataset. This is directed to illuminating factors that might mediate or moderate previously noted ethnic and gender differences in progress in higher education and related outcomes. We should stress that with the survey data used and without making unjustified assumptions, we focus on attempting to tease out these patterns of

relationship without making any pretence to the establishment of cause to effect types of relationship. By a variety of means we try to establish interesting features that might put ethnic and gender differences into perspective and perhaps provide pointers to future, more directed research.

Section 2 provides extensive scoping and gradually developing models for the degree outcome of increasing complexity. When focusing on potentially interesting pairwise interactions between variables, we gradually introduce them one at a time. This exploration allows us to see in an iterative way how patterns of relationship might ultimately combine in complex ways to relate to the outcome. Another aim in this section is to act as a preparatory stage to the building of more complete models in Section 4. Although the degree outcome is an ordered categorisation in this section, we explore relationships through models using continuous normal scores for the categories. Ordered category logit models are infeasible for model exploration for computational reasons. However, the strategy of using points models for model development and pattern uncovering, and switching to the more generalised model towards the end of the model selection phases has been justified and discussed by Fielding (1999).

To build feasible models that can be estimated with interactions between nominal level variables with large numbers of categories, as we have in this application, requires some attention to patterns of cases and complex relationships between such variables. Otherwise we may struggle to fit such models, and even if we do fit them we may find the results difficult to interpret. Thus in Section 4 we explore the data in various ways to describe complex patterns of relationship between potential explanatory factors. These inform us about how it may be manageable to handle the difficult variables in ultimate analyses. The role of subject of qualification and its representation across institutions presents particular issues unless carefully handled.

The exploratory step by step model trialling of possible effects and patterns in Section 2 and the descriptive analyses of the relationship complexities in Section 3 informed the final more comprehensive shape of the models in Section 4. Initially these use continuous points models to illustrate in an organised way the main patterns of effect and interactions, and how these combine. It is only when we have some clear ideas that we turn to fitting a single non-proportional odds model for ordered degree outcomes in Section 4.3. This model then directly extends to and can be compared with the earlier work of Broecke and Nicholls (2007). It will be seen, however, that broad findings from these models are directly parallel with those from the continuous points models; the main difference being that now effect results are also given as odds ratios rather than as direct effects on average outcomes. These can be seen as multipliers to the odds of being above certain thresholds of degree outcome in response to changes in certain covariate effects (Greene 2003).

Section 5 deals with data from the NSS 2006. It focuses on using scale values for the responses in the framework of continuous response models. The strategy for developing the analyses was similar to that outlined above for the progress data.

2. Exploration of relationships using normal scored responses

2.1 Introduction

The analytical models used in this section are continuous response linear multilevel models with higher education institutions at level 2 and graduating students at level 1. The degree class ordered category is replaced by a normal score to reflect the response distribution over the sample. Details of these are given in the table below.

Degree Class	Normal Score	Frequency	%
Pass/3rd	-2.01	2,936	4.4
2.2	-0.84	20,746	31.2
2.1	0.32	35,873	54.0
First	1.63	6,876	10.4
		66,431	100.00

As a consequence of the choice of standardised response score, the sizes of the effects in the model results are thus in terms of the scale of a response standard deviation and can therefore be interpreted relatively easily.

2.2 Main effects models

Full details of all models reported are in Appendix 1. In this text we present only pertinent extracts to illustrate the points being made. We start with basic models for the degree result which include only ethnic group dummy variables and gender as covariates. For these two variables the reference categories are White students and male respectively. The full results for these models are as in Table 1 below. As yet there are no control covariates to contextualise any effects noted, so these results are to be regarded as a baseline for the development of the exploratory models.

Model ME1 is the basic variance component model, which shows that 6.4% of variance in degree results is attributable to between institution variance. Model ME2 introduces gender and ME3 the Black and Minority Ethnic (BME) groups relative to the White reference category. Females perform better overall than males. As evidenced by the negative effects, which are all relative to the White reference group, all BME groups perform at a lower level than White students.

Some of these effects are quite large, and there are differences from the White reference group of the order of 0.3 standard deviations in the response for most groups. The lowest performing groups are clearly Black African and Black Caribbean. The gender differences appear not to be confounded with any potential differences in gender make-up of different ethnic groups, since the gender effect is little changed between fitted models ME2 and ME3. This

is more or less the same starting point as in Broecke and Nicholls (2007) and tells the same story, although here the response is differently scaled. This is unsurprising since the filters we apply (see Section 1) have resulted in much the same dataset. We might also note that the introduction of gender and ethnicity as covariates has reduced the student variation, but by very little. For potential further explanation there still remains considerable residual heterogeneity among students.

Table 1: Basic uncontrolled models: Gender and BME effects on scored and normalised degree result

	Model ME1		Model ME2		Model ME3	
Fixed effects	Estimate	Std error	Estimate	Std error	Estimate	Std error
Intercept	-0.066		-0.158		-0.118	
Female			0.154	(0.007)***	0.156	(0.007)***
Other White					-0.089	(0.029)***
Black Caribbean					-0.401	(0.037)***
Black African					-0.465	(0.029)***
Other Black ethnic group					-0.289	(0.078)***
Indian					-0.296	(0.016)***
Pakistani					-0.336	(0.023)***
Bangladeshi					-0.328	(0.038)***
Chinese					-0.341	(0.029)***
Other Asian ethnic group					-0.253	(0.031)***
Mixed ethnic					-0.096	(0.023)***
Other ethnic group					-0.217	(0.041)***
Unknown/Refused ethnic group					-0.121	(0.030)***
Random effects variance						
Between institution variance	0.044	(0.006)***	0.046	(0.007)***	0.050	(0.007)
Between student within institution variance	0.690	(0.004)***	0.684	(0.004)***	0.674	(0.004)

Key: standard errors in parentheses; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

We now consider introducing control covariates that are much the same factors expected to affect attainment as used by Broecke and Nicholls (2007). Some of them may also be related to ethnicity. Control enables us to consider investigating the possible confounding of the ethnic and gender effects in Table 1 with these other factors. Broecke and Nicholls (2007) model them all at once in a fully controlled model, and conclude that altogether there is some confounding. Their controlled analysis demonstrates that taken altogether the controls partly (but not completely) explain the BME gaps in attainment. Here, we go into a little more detail by considering developing a series of models that introduce the control variables in various steps. This enables us to go into

more detail about the specific confounding influences that may relate to the gaps for various BME groups. This is also important in contextualising important interactions that we will eventually examine.

In most studies of educational effectiveness, a major predictor of outcomes might be the ability of a student as indicated by some prior measure of achievement. This is often the most important form of control we can exercise. A suitable indicator in this dataset relates to the level of qualification at entry, the UCAS tariff score², although Broecke and Nicholls (2007) do include a caveat about its quality as a measure of prior attainment. In our analyses we normalise this score to have mean zero and standard deviation unity, and so net effects reported will be for changes in one standard deviation of the variable (scaled in standard deviation units of the response). Again, in much educational progress modelling the effects of a prior measure may be quite nonlinear. We accommodate this in our analyses by using up to a fourth order polynomial in the standardised UCAS score. The full results for Model ME4 (see Appendix 1, Table A1b) show the patterns and demonstrate that the effect of the entry measure is quite strong.

However, here we are particularly interested in the impact of this additional UCAS control on the gender and ethnicity effects, as shown in Model ME4 summary results in Table 2. In this Table we show only the net gender and ethnicity effects, but indicate what additional covariates have been included. It will be seen that the gender effect conveying an advantage to females is now somewhat reduced on the introduction of the UCAS score. This may be due the generally higher qualifications on entry of females. It will also be noted that the net negative effects of all the BME groups compared to White are still prevalent and highly significant statistically. However, the differentials are all reduced quite considerably reflecting the different prior entry patterns of the different BME groups (see the further exploration of this in Section 3 of the report.). Thus we have some evidence of confounding of the ethnicity effect with entry qualifications. In this model we can also note the expected reduction in student level residual heterogeneity. We can also note the relatively large reduction in institution level variance, since part of that variance may have been previously due to different entry standard levels among institutions.

Model ME5 (in Table 2 and Appendix 1) adds in the two dummy variable covariates 'disabled' and 'living at home full-time'. It might be noted that overall there are considerable significant marginal effects of both these variables on degree performance. These differences persist when only ethnicity effects are taken into account (the results are not reported here), but when control is exercised for UCAS score the different pattern for 'living at home' students is much reduced and is not then statistically significant. Thus the noticed effect of living at home may be largely due to the much lower prior attainment of such students. The lower UCAS score of disabled students partly explains their lower performance, but some significant net effect of being disabled is still evident. As seen in Table 2 the effects for the BME

² Reference to UCAS tariff score: http://www.ucas.com/students/ucas_tariff/tarifftables/

groups are much the same after adjusting for ‘disabled’ and ‘living at home’ as they were before. Thus there is no confounding here and possible differential patterns on these variables for differing ethnic groups cannot explain the persisting ethnicity effects.

The age of a student has been shown in previous research to be a potential factor influencing achievement. There is also some evidence that BME groups in general have slightly different age profiles than the White reference group.

Table 2: Models with additional controls introduced sequentially
(See notes below table for included covariates in each model)

	Model ME4		Model ME5		Model ME6	
Fixed effects	Estimate	Std error	Estimate	Std error	Estimate	Std error
Intercept	-0.041		-0.032		-0.126	
Female	0.129	(0.006)***	-0.127	(0.006)**	0.129	(0.006)***
Other White	-0.060	(0.028)*	-0.058	(0.028)*	-0.083	(0.028)**
Black Caribbean	-0.305	(0.036)***	-0.301	(0.036)***	-0.283	(0.035)***
Black African	-0.349	(0.029)***	-0.348	(0.029)***	-0.340	(0.028)***
Other Black ethnic group	-0.206	(0.076)***	-0.203	(0.076)***	-0.197	(0.075)**
Indian	-0.234	(0.015)***	-0.230	(0.015)***	-0.182	(0.015)***
Pakistani	-0.243	(0.022)***	-0.233	(0.023)***	-0.197	(0.022)***
Bangladeshi	-0.245	(0.037)***	-0.236	(0.037)***	-0.189	(0.037)***
Chinese	-0.317	(0.028)***	-0.316	(0.028)***	-0.300	(0.027)***
Other Asian ethnic group	-0.194	(0.031)***	-0.191	(0.031)***	-0.176	(0.030)***
Mixed ethnic	-0.064	(0.022)***	-0.064	(0.022)***	-0.061	(0.022)**
Other ethnic group	-0.150	(0.040)***	-0.146	(0.040)***	-0.123	(0.039)**
Unknown/Refused ethnic group	-0.072	(0.029)**	-0.073	(0.029)**	-0.100	(0.029)***
Random effects variance						
Between institution variance	0.028	(0.004)	0.028	(0.004)	0.022	(0.003)
Between student within institution variance	0.637	(0.003)	0.637	(0.004)	0.617	(0.003)

Key: standard errors in parentheses; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Notes:

Model ME4 includes terms of up to a fourth-order polynomial in normalised UCAS tariff score.

Model ME5 further adds in the control dummies ‘disabled’ and ‘living at home full-time’. Disabled students are only 7% of the cases, and as with the previous report no distinction is made for the different types of disability due to small numbers that would ensue. Students living at home full-time according to the HESA record are 18% of cases.

Model ME6 further adds in age dummy variables for the groups Age 21, Age 22, Age 23, Age 24, Age 25-29, Age 30 or over ; all are relative to the reference group Age 20 or younger.

Thus, next we consider ‘age of student’ as a potential background influence that may be partly confounded with ethnicity effects. Some two-thirds of cases in the sample are aged 20 or under, and 91% are 21 or under with a skew distribution to the right. Thus we treat age in the models as an ordered category variable with age group dummies, and effects are relative to the reference group ‘Age 20 or younger’. In all models fitted with age dummies the effects on the response monotonically increase with age; the more mature a student is the higher the achievement. Model ME6 introduces this variable. The summary gender and ethnic net effects are shown in Table 2, with full results again in Appendix 1, Table A1b. There is some small further reduction in the net gap of the various BME groups below the White reference group, with the largest impact being on effects of Asian groups. It seems it is for the latter groups that the age confounder is most prevalent. We might also note some further reduction not only in residual student heterogeneity, but also in the institution variance. Differences in age profiles of institutions may explain the latter. Although we do not fully illustrate it here, there is also evidence of a partial confounding of age and UCAS tariff score in their impact on degree result. Indeed there is a clear monotonic negative relationship between the two. Thus any impact of age differences between BME groups is partly evidenced by the earlier control for UCAS score. What we observe in the BME effects in ME6 is a sequential combination of the effect of the way both age and entry qualifications are intertwined with ethnicity.

Table 3: Models with further controls
(See notes below table for included covariates in each model)

	Model ME7		Model ME8	
Fixed effects	Estimate	Std error	Estimate	Std error
Intercept	-0.142		-0.170	
Female	0.126	(0.007)***	0.127	(0.007)***
Other White	-0.079	(0.027)**	-0.081	(0.028)**
Black Caribbean	-0.262	(0.035)***	-0.254	(0.035)***
Black African	-0.304	(0.028)***	-0.295	(0.029)***
Other Black ethnic group	-0.166	(0.075)*	-0.161	(0.075)*
Indian	-0.152	(0.015)***	-0.146	(0.015)***
Pakistani	-0.159	(0.022)***	-0.148	(0.023)***
Bangladeshi	-0.165	(0.037)***	-0.151	(0.037)***
Chinese	-0.282	(0.027)***	-0.277	(0.028)***
Other Asian ethnic group	-0.154	(0.030)***	-0.153	(0.030)***
Mixed ethnic	-0.056	(0.022)*	-0.055	(0.022)*
Other ethnic group	-0.103	(0.039)**	-0.101	(0.039)**
Unknown/Refused ethnic group	-0.098	(0.028)***	-0.096	(0.028)***
Random effects variance				
Between institution variance	0.019	(0.003)	0.019	(0.003)
Between student within institution variance	0.610	(0.003)	0.610	(0.003)

Key: standard errors in parentheses; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Notes:

Model ME7 adds in to ME6 type of qualification and degree subject controls.

Model ME8 further adds in normalised rank of neighbourhood IMD score and proportion of adults in the neighbourhood with a degree.

In the sample, 90% of the students overall had ‘only A-level’ as their entrance qualification. There is some evidence that this percentage is smaller for some specific BME groups. In previous work the nature of entrance qualification was also shown to influence achievement. Thus the type of entrance qualification was included in the next set of controls, along with the subject area of the degree study. Type was represented by two dummy variables, vocational qualifications only and a mix of vocational qualifications and A-levels, relative to the reference category of A-levels only. The 19 subject groups were represented relative to the reference category of Social Studies. The full results for model ME7 are shown in Appendix 1, Table A1c, with the relevant ethnic and gender effects summarised in Table 3. Both ‘type’ dummies effects are significant, with the differential effect of ‘vocational only’ relative to ‘A-levels only’ quite a bit larger than the effect of a mix of qualifications. The net subject differential effects relative to Social Studies were quite variable. The subjects where achievement was lowest (effects relative to Social Studies <0.1) were Veterinary Science, Law, Mathematical Sciences and Physical Sciences. Those with highest net achievement (effects relative to Social Studies >0.08) were Languages, Computer Science, Historical and Philosophical Studies and Mass Communications. The very highest, with a net relative effect of 0.12, was Creative Arts and Design. In ME7 both sources of variance are also now reduced.

It will be seen that, compared to ME6, the introduction of these further controls has little impact on the gender difference. However, the gaps of various BME groups from the White reference group are again reduced in a fairly consistent way. Thus these additional controls have again explained a further part of the overall ethnicity effect.

Ideally, we would also like to additionally control for a range of characteristics relating to family circumstances, such as parental income, that are known to be related both to ethnicity and educational achievement. For similar reasons to Broecke and Nicholls (2007), we eschewed measures of family socio-economic circumstances (SEC) in favour of measures based on the Index of Multiple Deprivation (IMD) of areas of home residence of the students. However, rather than use a broad set of ordered categories as they did, we used directly the rank on IMD of the census Lower Super Output Area (LSOA) neighbourhood of the student’s parental home. To make interpretation easier, the rank score was converted into a normalised scale score. Since LSOA are very small areas the proxy is quite close to family circumstances, although we must be aware of potential interpretational dangers of applying aggregate area measures to individuals. It might be noted that the rank of an LSOA is unique, so that although we had no area of residence information on the students in the data made available to us, it proved possible to identify the LSOA. Hence we were able to consider a range of potential LSOA area measures at the neighbourhood level, which we were able to merge with our

data from census sources. One area contextual measure that proved influential in addition to IMD was the neighbourhood level proportion of adults with a degree, which is very close to the measure used until recently for applying widening participation premiums to university funding.

Model ME8 then additionally includes the normalised IMD rank and the LSOA proportion of adults with a degree. The full results in Appendix 1 indicate that although the effect of IMD is significant, its net effect considering all the other individual characteristics already included is very small (-0.010). The significant effect of the other indicator at the small neighbourhood level, the density of graduates, is real, but also relatively small when we consider the proportion scale of the measure; the effect size of 0.108 implies only 0.01 standard deviation increase in response for a change of 10 points in percentage of graduates. The effect on the ethnic coefficients of introducing these covariates at the neighbourhood level is seen directly in Table 3. A small decrease in the gaps is noticed, but these are not startling. There is no noticeable influence on any of the other effects already included in the model, including the variance components.

The next group of models (ME9 and ME10), for which full details are available in Appendix 1, introduce institutional level variables to investigate to what extent these influence degree performance. They may also partly explain the residual variation at the institution level that has been noted. Our main focus in this report, however, is to see if they put the ethnicity main effects further into context.

Broecke and Nicholls (2007) used a broad indicator of whether the university was research intensive by using a Russell Group indicator. We refine this a little by defining type with three dummies relative to a reference category of Others (non-university institutions). The dummies are 'New in 1992 and post-1992 Universities', 'Russell Group Universities' and 'Other Old Non-Russell Universities'³. Model ME9 results (in Table A1c of Appendix 1) show that the net effects of the three university types are similar and have higher degree performances than non-university institutions. However, this lower performance for non-university institutions is not significant statistically. Once control has been exercised for the wide variety of student intake characteristics in the model, there are no great discernable differences between the groups of institutions. Also, their introduction leads to no changes in the net effects of any of the other variables, including those of ethnicity.

A group of institutional level contextual variables are then introduced in ME10. The institution mean and standard deviation of UCAS score for students in the sample are indicators of both level and the variability of intake. The standard deviation measure has often been found useful in educational effectiveness studies as an indicator of how mixed an intake is with regard to ability. As broad indicators relating to ethnicity and gender make-up of institutions, we also include institutional level proportion of females and proportion of non-

³ For some purposes in later analyses in this report we use just the Russell Group indicator. This facilitates comparability with Broecke and Nicholls' report (2007).

White students. All these effects are substantial and statistically significant. The socio-economic profile of institutions is also reflected by the mean of the normalised IMD score across students in an institution, although there is no discernible effect of this variable. The combined effect of these variables is to reduce the institution level variance by 32%, from 0.019 to 0.013. The pattern of other individual student level variable main effects, including ones related to ethnicity, are unaffected by the introduction of these contextual variables.

As part of our exploratory investigations we also merged in other Lower Super Output Area measures of the neighbourhood circumstances of the students. We experimented with the specific measures one at a time to investigate their potential for contextualising the specific effects we were interested in. The variables were also introduced in aggregate form as means at the institutional level. Table A2 of Appendix 2 introduces in turn the Income Deprivation Affecting Children Index (IDACI), Income Deprivation Affecting Older People Index (IDAOP1) and then several specific component domains of the IMD: income; employment; health, deprivation and disability; education, skills and training; barriers to housing and services; crime and disorder; and living environment. Nothing much of great interest emerges to add to or amplify the overall IMD score. The scores are all standardised, with the effects mostly of the order of -0.01 to -0.03, and although significantly different from zero they have little impact. The contextual institutional means of corresponding variables also have very small effects, but are also not significant statistically. For present purposes, the most important feature is that the patterns of other effects in the model, including those of ethnicity, remain entirely unchanged throughout this set of models.

We commented above on the effect of neighbourhood proportion with a degree, which although small was significant. Table A3 of Appendix 3 has models that trial some other relevant potential neighbourhood level variables: neighbourhood proportion of young people not staying on for further education beyond school leaving age; and the ethnicity characteristics measured by proportion in the neighbourhood from BME groups. These census measures proxy each other to some extent, so in some senses the proportion with a degree is adequate to capture effects of this variety of area characteristics.

2.3 Models exploring interactions with ethnicity

The previous section has conducted a very thorough exploration of the main effects affecting degree performance and analysed their interrelationships. As a starting point for our investigation of interactions we need a fairly full model, but one where the main effects of interest have stabilised. We have seen that the ethnicity and gender effects have been barely changed under the investigation of different higher level contextual variables, although we want to include these in a starting model where they are sources of marginal influence. We decided, therefore, that a basic model as a starting point from which to develop exploration of interactions would include the main IMD score only and the full range of institutional level variables considered. This is the 'With IMD' model, with full results in Table A2a in Appendix 2. It is essentially

Model ME8 with proportion of graduates in neighbourhood omitted, but including just a Russell Group Indicator and the group of institutional level contextual variables as in ME10. The summary of relevant main gender and ethnicity effects for this model is given in the 'With IMD' column of Table 4; although in examining this table and other summary tables in this section we must implicitly recognise the range of other covariates also included in the models.

Starting from this basic main effects model we examine groups of interactions one at a time. This strategy will indicate areas where there may be potential effects which we want to include in a final model. It will also act as a pointer to areas of interest that might be investigated in depth in the future. As such the results are also indicative only of areas of potential concern. At this stage, unless we identify specific interactions for incorporation into an eventual combined model, we are in danger of over-parameterisation if we include them all. Results will become unstable as the confounded group of effect combinations become based on too few observations in the sample. Complex interdependencies between covariates in the model may also mean that sets of revealed pairwise interactions may become intertwined with each other in a final full explanatory model. Their interesting potential may then be hidden.

We should at this stage also express our clear views right at the outset on one real issue. Many reports are content to focus on statistically significant results and are less orientated towards the substantive size of effects. Although we will comment on statistical significance in this report, we will also indicate areas of effect that, while not significant in this sense, may nonetheless be evidence of potential interesting issues. In our exploratory model results there are many substantial interaction effects that do not achieve significance. Often the reason for this is the imprecision of the results because of smallish numbers in particular combinations of ethnic groups and categories of the variable we are interacting with (degrees of freedom are small!). In these cases we will comment on such results, since they will stimulate interest that might be pursued in future, more intensive research. It would thus be unwise to dismiss entirely effects that are not statistically significant as there may be potential in some.

Following the pattern we will adopt for the rest of this section, we first use models with the more refined version of ethnicity with 13 categories, and 12 dummy variables with White as the reference category. Full model results for the summaries in this section are found in Appendix 4. Alongside this, however, we will also consider summaries when we group ethnicity into four broad groups: Black; Asian; and Other, relative to White as the reference group (Appendix 5 contains full sets of model results). The broad grouping has the advantage of producing more precise estimates of effects due to larger number of cases involved. Thus statistical significance of effects is easier to establish. The disadvantage is that interesting contrasts of effects within these broad groups are hidden, and this may be where the real interest lies. Much previous research on ethnicity and education has established the importance of these finer distinctions.

2.3.1 Gender and ethnicity interactions

Table 4 summarises the relevant main ethnic, gender and ethnicity by gender interactions from the full model results including just this set of interactions. From the fine ethnic breakdown the only interactions with gender that are statistically significant are the *Other ethnic* and *Pakistani* groups, with the latter achieving significance at the 5% level only. The size of the Pakistani*female effect is -0.088. We might recall what this means with regard to the standardised scale of the response variable. From the table, since the ethnic reference group is White, the gender effect result for female means that White females have an estimated positive differential effect of 0.131 standard deviations of achievement over White males. The interaction effect means that for the Pakistani group this differential between genders is much reduced to (0.131-0.088=) 0.043. The gender gap for Pakistani students is thus smaller than for White students. The interaction effect can also be viewed in an alternative way. Pakistani males are -0.095 lower than White males. This ethnic difference is larger at (-0.095-0.088=) -0.183 for females. Among females the gap between the Pakistani and White groups is greater than among males. Given the sizes of the average gender and Pakistani effects, this estimated interaction term is quite substantial.

Table 4: Evaluating interactions between ethnicity and gender on degree outcomes

	With IMD Model		With ethnicity and gender interactions		Interactions with broad ethnic groupings	
Fixed effects	Estimate	Std error	Estimate	Std error	Estimate	Std error
Intercept	0.035		0.034		0.034	
Female	0.127	(0.007)***	0.131	(0.0007)**	0.129	(0.0007)**
Other White	-0.076	(0.027)**	-0.019	(0.042)		
Black Caribbean	-0.252	(0.035)***	-0.276	(0.065)***		
Black African	-0.291	(0.029)***	-0.308	(0.046)***		
Other Black ethnic group	-0.157	(0.075)***	-0.256	(0.125)*		
Indian	-0.148	(0.015)***	-0.130	(0.023)***		
Pakistani	-0.149	(0.023)***	-0.095	(0.035)**		
Bangladeshi	-0.151	(0.037)***	-0.102	(0.058)		
Chinese	-0.277	(0.028)***	-0.322	(0.040)***		
Other Asian ethnic group	-0.151	(0.030)***	-0.116	(0.044)**		
Mixed ethnic	-0.052	(0.022)***	-0.055	(0.033)		
Other ethnic group	-0.099	(0.040)***	0.106	(0.065)		
Unknown/Refused ethnic group	-0.097	(0.029)**	-0.147	(0.039)***	-0.147	(0.039)***
Black					-0.294	(0.036)***
Asian					-0.147	(0.012)***
Other					-0.073	(0.016)***
Interactions of gender and ethnicity						
Other White*female			-0.100	(0.055)		
Black Caribbean*female			0.032	(0.077)		
Black African*female			0.028	(0.057)		
Other Black ethnic group*female			0.151	(0.156)		
Indian*female			-0.030	(0.029)		
Pakistani*female			-0.088	(0.044)*		
Bangladeshi*female			-0.081	(0.074)		
Chinese*female			0.088	(0.054)		

Other Asian ethnic group*female			-0.065	(0.059)		
Mixed ethnic*female			0.005	(0.044)		
Other ethnic group*female			-0.322	(0.081)***		
Unknown/Refused ethnic group*female			0.104	(0.056)		
Black*female					0.043	(0.044)
Asian*female					-0.029	(0.021)
Other*female					-0.010	(0.032)

Key: standard errors in parentheses; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

There are possibly other interesting interactions with gender effects among Asian groups, which although not significantly different from zero statistically are as large as or larger than the significant Pakistani one. The interaction term between *female* and *Bangladeshi* is not much smaller than that of the Pakistani group. The *Chinese*female* term at 0.088 is similar in magnitude, but in the opposite direction. Thus if this estimated term were operative, the advantage of Chinese females over Chinese males would (at 0.219) be even wider than the gender gap among White students.

It should be noted that when only broad ethnic groups are considered (last column of Table 4) all interaction terms are small and not significant statistically. The opposite sign of the *Chinese*female* interaction term has clearly balanced out the other negative interaction terms in the Asian groups when all are combined together.

2.3.2 Ability at entrance and ethnicity: interactions between ethnic groups and UCAS tariff score

Table 5 summarises sets of interaction effects from distinct full models; each model specifies single sets of interactions used one at a time, and results are given in full in the tables in Appendix 4 and 5.

The first set of rows in Table 5 are summary interaction effects from a model in which the full ethnic categorisation is interacted with UCAS score revealing a substantial and highly significant *Indian*UCAS score* term of 0.068. The full results show the UCAS linear term for White students to be 0.371, so this increase in the entrance qualification effect for the Indian group is not insubstantial. What it means is that the gap in achievement between two Indian students with differing UCAS scores is much wider than the gap between two White students with comparable scores. Alternatively, it may be said that any gap between Indian and White students in net achievement at given levels of prior qualification narrows as that level of qualifications increases, and may even reverse for very high achievers. Beyond standardised UCAS scores of two, for instance, the interaction term of $2*0.068 = 0.137$ counteracts the negative marginal Indian effect of -0.135, and Indian students will do better than their White counterparts.

Although there are no other statistically significant effects for other ethnic group interactions with UCAS tariff score, they are mostly positive for the main Asian and Black groups. Although the evidence is not conclusive and far from

clear, there is a suggestion of a phenomenon that might be worthy of deeper investigation. A suitable indicative research hypothesis, which might be more fully investigated on more extensive data, is that of differential progress in higher education between BME groups and White students. The negative gap between them may be much higher at lower levels of entrance qualifications, but this gap narrows as entrance qualifications increase, and can possibly reverse at very high levels of entrance qualifications. Very able students from BME groups may not be as disadvantaged as their less able colleagues from the same ethnic groups.

The interactions when broad ethnic groups are considered are again small and statistically not significant. Similar comments as for gender by ethnicity interactions apply; the grouping of negative and positive interaction may balance out.

2.3.3 Does whether a student is mature or not change effects of ethnicity? Interactions of ethnicity with aged 22 or over.

Around 90% of the students in this sample are in the first two age groups: either aged 21, or under 21. The cases are thinly spread over the older age groups. Thus to avoid small cells in investigating whether age moderated ethnic effects we formed a new binary indicator 'aged 22+', which might be labelled mature student, and entered this in interactions with ethnic groups. From the summary results in Table 5 it seems that the moderating effects of maturity are quite considerable and statistically significant for all the specific BME groups. They are all negative, which this implies that the net gap in achievement between various BME groups and White students is much wider for mature students than it is for those who are in the traditional age groups in higher education. This widening effect is evidently largest for the Bangladeshi group, closely followed by the Chinese group. We can also interpret the interaction effects in an alternative way. In general among White students, mature students have a higher net performance (aged 22 or over has a positive net effect of 0.404). The negative interactions reduce this mature student advantage considerably for BME groups, and in the case of the Bangladeshi and Chinese groups are sufficient to reverse it. For these two particular BME groups, the younger students have higher net achievements than their mature counterparts. Using the estimated values this maturity disadvantage for Bangladeshi students (age 22 or over effect) is $(0.404 - 0.567 =) -0.163$, and for Chinese students is $(0.404 - 0.519 =) -0.115$.

Since these interaction effects of aged 22+ and ethnicity are all consistently negative and statistically significant, it is also not surprising that this pattern carries over when BME groups are aggregated into four broad groups.

2.3.4 Does whether a student lives at home or not change effects of ethnicity? Interactions of ethnicity with living at home

From the summary results in Table 5 it seems that moderating effects of living at home are positive and statistically significant for most of the main specific Asian groups. The size of the Chinese*living at home interaction effect,

although it does not quite achieve 5% significance, is not that much below the corresponding effect for Indian students. For all these Asian groups the interaction effects are positive, which implies that the net gap in achievement between various Asian groups and White students is narrower for those students living at home than for those who are not. Among White students the living at home effect is small and not statistically significant. It seems that for the Asian groups, by contrast, there is a definitive positive net advantage to those students living at home. The interaction for Black Caribbean students is negative at -0.105, but due to the imprecision of the estimate it is not statistically significant. There is, however, slight evidence worthy of further investigation that living at home is not advantageous to this group. By contrast there may be a slight advantage to Black African students staying at home.

The Asian*living at home interaction for the broad grouping is large and significant.

The corresponding Black*living at home interaction is very insubstantial and not statistically significant. This observation is again unsurprising given that the Black African and Black Caribbean effects go in opposite directions.

Table 5: Evaluating ethnicity interactions, summary of other interaction effects

	With full set of ethnic groupings interactions		Interactions with broad ethnic groupings	
	Estimate	Std error	Estimate	Std error
UCAS score interactions			0.034	
Other White*UCAS score	0.039	(0.026)		
Black Caribbean*UCAS score	0.024	(0.038)		
Black African*UCAS score	0.056	(0.031)		
Other Black ethnic group*UCAS score	-0.013	0.072		
Indian*UCAS score	0.068	(0.014)***		
Pakistani*UCAS score	0.040	(0.023)		
Bangladeshi*UCAS score	0.057	(0.038)		
Chinese*UCAS score	0.018	(0.025)		
Other Asian ethnic group*UCAS score	-0.011	(0.030)		
Mixed ethnic*UCAS score	0.016	(0.022)		
Other ethnic group*UCAS score	-0.011	(0.038)		
Unknown/Refused ethnic group*UCAS score	-0.045	(0.028)		
Black*UCAS score			0.035	(0.023)
Asian*UCAS score			0.039	(0.010)
Other*UCAS score			-0.006	(0.016)
Interaction with maturity (Aged 22 or over)				
Other White*Aged 22 or over	-0.080	(0.080)		
Black Caribbean*Aged 22 or over	-0.292	(0.101)**		
Black African*Aged 22 or over	-0.219	(0.076)**		
Other Black*Aged 22 or over	-0.195	0.203		
Indian*Aged 22 or over	-0.352	(0.065)***		
Pakistani*Aged 22 or over	-0.247	(0.076)**		
Bangladeshi*Aged 22 or over	-0.567	(0.1326)***		
Chinese*Aged 22 or over	-0.519	(0.092)***		
Other Asian ethnic group*Aged 22 or over	-0.222	(0.092)*		
Mixed ethnic*Aged 22 or over	-0.207	(0.075)**		
Other ethnic group*Aged 22 or over	-0.286	(0.116)*		
Unknown/Refused ethnic group*Aged 22 or over	-0.086	(0.083)		
Black*Aged 22 or over			-0.239	(0.013)***
Asian*Aged 22 or over			-0.0349	(0.039)**
Other*Aged 22 or over			-0.178	(0.051)***
Interaction with living at home				
Other White*Lives at home	-0.003	(0.066)		
Black Caribbean*Lives at home	-0.105	(0.072)		
Black African*Lives at home	0.090	(0.062)		
Other Black ethnic group*Lives at home	-0.133	(0.153)		
Indian*Lives at home	0.141	(0.030)***		
Pakistani*Lives at home	0.149	(0.044)***		
Bangladeshi*Lives at home	0.220	(0.074)**		
Chinese*Lives at home	0.120	(0.065)		
Other Asian ethnic group*Lives at home	0.067	(0.063)		
Mixed ethnic*Lives at home	0.001	(0.055)		
Other ethnic group*Lives at home	0.003	(0.080)		
Unknown/Refused ethnic group*Lives at home	-0.116	(0.076)		
Black*Lives at home	0.003	(0.046)		
Asian*Lives at home	0.146	(0.022)***		
Other*Lives at home	-0.029	(0.039)		
Interaction with neighbourhood IMD score				
Other White*IMD	0.045	(0.027)		
Black Caribbean*IMD	0.041	(0.041)		
Black African*IMD	0.063	(0.031)*		
Other Black ethnic group*IMD	0.017	(0.069)		
Indian*IMD	0.026	(0.015)		

Pakistani*IMD	0.034	(0.024)		
Bangladeshi*IMD	-0.005	(0.038)		
Chinese*IMD	-0.016	(0.026)		
Other Asian ethnic group*IMD	0.027	(0.029)		
Mixed ethnic*IMD	0.023	(0.021)		
Other ethnic group*IMD	0.047	(0.038)		
Unknown/Refused ethnic group*IMD	-0.011	(0.028)		
Black*IMD			0.045	(0.023)
Asian*IMD			0.021	(0.010)*
Other*IMD			0.016	(0.015)
Interaction with whether A-levels only				
Other White*A-levels only	0.023	(0.093)		
Black Caribbean*A-levels only	-0.025	(0.092)		
Black African*A-levels only	0.068	(0.074)		
Other Black ethnic group*A-levels only	0.127	(0.224)		
Indian*A-levels only	0.118	(0.041)**		
Pakistani*A-levels only	0.119	(0.055)*		
Bangladeshi*A-levels only	0.342	(0.100)***		
Chinese*A-levels only	0.019	(0.087)		
Other Asian ethnic group*A-levels only	0.056	(0.101)		
Mixed ethnic*A-levels only	0.041	(0.080)		
Other ethnic group*A-levels only	0.036	(0.108)		
Unknown/Refused ethnic group*A-levels only	-0.011	(0.097)		
			0.039	(0.057)
Black*A-levels only			0.114	(0.030)***
Asian*A-levels only			0.028	(0.054)
Other*A-levels only				

Key: standard errors in parentheses; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

2.3.5 Deprivation in neighbourhood circumstances and ethnicity: interactions between ethnic groups and IMD score

The interactions between ethnic dummies and neighbourhood IMD score summarised in Table 5 reveal a substantial and significant (at 5% level) *Black African*IMD score*_interaction term of 0.063. The full results coefficient for IMD for the White reference group is -0.019 implying a very small but still statistically significant expected negative net effect of deprived circumstances. There is thus some evidence that this controlled negative effect is ameliorated for the Black Caribbean group, and for that matter the Other White and other BME groups, except for the Bangladeshi and Chinese groups. For most of these groups an unexpected result is that the net relationship between achievement and IMD is indeed positive. However, these indications are not strong and only tentative. Much stronger evidence is required on these issues. When we group Asian students together the consistent evidence on this matter across specific groups, although not individually statistically significant, becomes a small but statistically significant effect for the group as a whole.

2.3.6 Does type of entrance qualification change effects of ethnicity? Interactions of ethnicity with whether a student had only GCSE Advanced Level at entry

There is evidence that net of all other controlled effects if students had only A-level entrance qualifications, as opposed to either vocational ones or a mix of vocational and A-level., then their achievements are a little higher. The marginal reference effect for the White reference group is 0.068, which is statistically significantly different from zero beyond the 0.1% level. Table 5

indicates that for the main Asian group the interactions are positive. They are also mostly quite large and significant. Thus here the advantage of pursuing A-levels is even larger than among White students. Alternatively the results may also be interpreted as indicating that the overall gap in achievement between the specific Asian groups and the White group is considerably reduced for the A-levels only students. For example, for A-levels only students the net gap between Bangladeshi and White groups is only 0.10 ($=-0.442+0.342$), compared to a sizeable 0.442 for students with either vocational qualifications or a mix. The evidence on the interactions for Black and other BME groups is more inconclusive.

We summarise our preliminary indications of interactions involving ethnicity in Table 6. We make a distinction between statistically significant results and those that may be important but are estimated imprecisely (and hence will not be statistically significant). This table does not include the more complicated issue of interactions of ethnicity with subject group of study, which we consider in the next section.

Table 6: Summary of relevant interactions involving ethnicity

Significant from zero statistically at 5% level or beyond	Substantial but not significant statistically
<i>Pakistani*female</i>	<i>Bangladeshi*female</i>
<i>Other ethnic group*female</i>	<i>Chinese*female</i>
	<i>Other Black ethnic group*female</i>
<i>Indian*UCAS tariff score</i>	<i>Possibly all other specific Asian and Black groups*UCAS tariff score</i>
<i>Black Caribbean*Aged 22 or over</i>	<i>Other Black*Aged 22 or over</i>
<i>Black African*Aged 22 or over</i>	
<i>Indian*Aged 22 or over</i>	
<i>Pakistani*Aged 22 or over</i>	
<i>Bangladeshi*Aged 22 or over</i>	
<i>Chinese*Aged 22 or over</i>	
<i>Other Asian ethnic group*Aged 22 or over</i>	
<i>Mixed ethnic*Aged 22 or over</i>	
<i>Other ethnic group*Aged 22 or over</i>	
<i>Indian*Lives at home</i>	<i>Black Caribbean*Lives at home</i>
<i>Pakistani*Lives at home</i>	<i>Black African*Lives at home</i>
<i>Bangladeshi*Lives at home</i>	<i>Other Black ethnic group*Lives at home</i>
	<i>Mixed ethnic*Lives at home</i>
<i>Black African*IMD</i>	<i>Other White*IMD</i>
	<i>Black Caribbean*IMD</i>
	<i>Indian*IMD</i>
	<i>Pakistani*IMD</i>
	<i>Other ethnic group*IMD</i>
<i>Indian*A-levels only</i>	<i>Black African*A-levels only</i>
<i>Pakistani*A-levels only</i>	
<i>Bangladeshi*A-levels only</i>	

2.4 The possible moderating influence of subject area on ethnicity effects

The subject area of study in the sample dataset is represented by a 19 category variable. We are interested in whether the BME group effects vary over subject areas, i.e. whether they are larger in some areas than others. The study of such interaction effects is potentially somewhat problematic in the exploratory modelling we have under investigation, since there are (19*13=) 247 possible combinations of ethnic and subject group categories, with 216 associated dummy variables. Some groups will inevitably be very small, and indeed many are entirely empty. With so many parameters and small numbers instability will ensue, and unless effects are particularly strong any evidence for such subject differentials in ethnic effects will be weak. The potentiality for suggesting interacting effects capable of further exploration is thus somewhat limited. We did undertake analyses using the base model above and adding the set of interacting dummies. There was no clear pattern to be seen and almost all interaction terms were statistically not significant. The significant ones (Chinese*Law, Bangladeshi*Mathematical Sciences, Bangladeshi*Engineering, Pakistani*Architecture, Indian*Computer Sciences) were few and possibly due to being fairly precisely estimated from larger numbers rather than implying large substantial effects.

We also conducted exploratory interaction analyses using a coarser subject group classification, combined with both the fine and coarse (four group) ethnicity variable. Nowhere in this situation did we find results with statistical significance emerging, so their contribution to evidence about subject differentials is quite restricted. We approach the possible relation of differential subject influence on ethnic gaps from a slightly different angle in the later sections of this report. There we consider the final sets of statistical models using the degree grade ordered category response.

2.5 Models exploring interactions with gender

Table 7 summarises the set of interaction terms involving gender considering one interacting variable at a time. They are abstracted from the full model results of Table A6 in Appendix 6. Since gender is a binary variable represented by a female indicator, fewer terms are involved and the set of interaction effects are somewhat easier to summarise. A full exploration of gender and ethnicity interactions has also been discussed in a previous section. There are indications of statistically significant negative interaction terms of female*living at home and female*IMD score. In the case of living at home, it seems that the advantage that females have over males is much smaller for living at home students than for those not living at home. It also seems that living at home conveys an advantage to males, but is disadvantageous for females. The negative effect of IMD for males is also even greater for females. This also means that the advantage that females have over males narrows as the IMD score increases. The negative interaction of female*aged 22+ is relatively substantial, although not

statistically significant due to small numbers involved. It may, however, be worthy of investigation in future research. There is also a significant positive interaction term for female*A-levels only, so that the advantage females have over males in general is even larger among A-levels only students. Alternatively this can be interpreted as the A-levels only advantage, being also relatively larger for females than it is for males.

Table 7 also shows the evidence for subject differentials in gender effects, which were not as problematic to examine as those for ethnicity. Some of these are quite substantial. The overall female advantage seems to be widened even further for Biological, Mathematical and Physical Sciences and Business Studies, but narrows for Language, Historical and Philosophical Studies, and Creative Arts and Design. Again we approach the possible relation of differential subject influence on gender gaps from a slightly different angle in our consideration of final sets of statistical models in later sections of report. The summary of potential interactions involving gender emerging from the initial exploration to this point is given in Table 8.

Table 7: Evaluating gender interactions, summary of other interaction effects

	Estimate	Std error
UCAS score		
Female*UCAS score	0.010	(0.006)
Maturity		
Female*aged 22 or over	-0.025	(0.023)
Living at home		
Female*living at home	-0.082	(0.016)***
IMD score		
Female*IMD score	-0.014	(0.006)*
A-levels only		
Female*A-levels only	0.071	(0.021)***
Subject		
Female*Medicine & dentistry	-0.046	(0.086)
Female*Subjects allied to medicine	0.076	(0.036)*
Female*Biological sciences	0.115	(0.024)***
Female*Veterinary science	-0.243	(0.253)
Female*Agriculture & related subjects	0.064	(0.090)
Female*Physical sciences	0.194	(0.032)***
Female*Mathematical sciences	0.178	(0.048)***
Female*Computer science	-0.049	(0.044)
Female*Engineering & technology	0.066	(0.056)
Female*Architecture, building & planning	-0.084	(0.058)
Female*Law	-0.011	(0.030)
Female*Business & administrative studies	0.098	(0.027)***
Female*Mass communications & documentation	-0.052	(0.035)
Female*Languages	-0.145	(0.032)***
Female*Historical and philosophical studies	-0.057	(0.027)*
Female*Creative arts & design	-0.134	(0.025)***
Female*Education	0.016	(0.059)
Female*Combined	0.058	(0.091)

Key: standard errors in parentheses; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table 8: Summary of relevant interactions involving gender

Significant from zero statistically at 5% level or beyond	Substantial but not significant statistically
<i>Female*living at home</i>	<i>Female*aged 22 or over</i>
<i>Female*IMD score</i>	
<i>Female*A-levels only</i>	
<i>Female*Subjects allied to medicine</i>	<i>Female*Veterinary science</i>
<i>Female*Biological sciences</i>	
<i>Female*Physical sciences</i>	
<i>Female*Mathematical sciences</i>	
<i>Female*Business & administrative studies</i>	
<i>Female*Languages</i>	
<i>Female*Historical and philosophical studies</i>	
<i>Female*Creative arts & design</i>	

2.6 Separate models for groups of institutions

As part of our exploration of whether institution moderated (interacted with) ethnicity and gender effects, we trialled fitting separate points score models for groups of institutions that broadly differed on ethnicity or gender intake. A more appropriate way of handling institutional interactions through random effects at the institutional level in the multilevel analyses is properly considered in Section 4.

Table A7a in Appendix 7 fits fairly full multilevel models separately to three groups of institutions according ethnicity in the following way:

- (1) low: 40 institutions with lowest percentage of non-White students
- (2) medium: 40 institutions with percentage of non-White students in middle of the range
- (3) high: 40 institutions with highest percentage of non-White students.

There were no gender differences between these three models. Examination of the detailed results reveals some interesting and possibly surprising differences in the main net ethnic group effects (relative to White). The Black Caribbean students performed better than their White counterparts in institutions where the percentage of non-White students was low, but not in other groups. The net disadvantage of Pakistani and Chinese students seems to be slightly lower in groups of institutions having lower percentages of non-White students.

Table A7b in Appendix 7 also divides institutions into two groups of 60 according to the percentage of students who are female. There is a slightly smaller net female advantage in institutions where females are more prevalent. In this group most of the main ethnic groups also seem more disadvantaged than in the former group.

3. Exploring the data: Clarifying the role of institution, subject area and demographic background in explaining minority ethnic and gender-related differences

3.1 Introduction and description of sample data

The aim of this section is a further exploratory examination of the data, with a specific interest in preparing the dataset for the final set of analytical models. These models will treat the response variable as a set of ordered categories in the same way as Broecke and Nicholls (2007). Developing these final predictive models will also be informed by earlier work on the easier to handle points score models of Section 2. Indications of potential interactions are provided by these initial step by step explorations.

The dataset contains a large number of multi-categorical predictors for studying progress in higher education. Since these are represented by large numbers of dummy variable effects, care must be exercised in the feasibility of including many sets of interactions in combination. If too many are included there is a danger of instability, too many parameters, imprecise estimation and obscuring potentially important explanatory effects. The danger is making the data carry more weight than it can bear. Some exploratory analysis is needed to avoid problems of imbalance and lack of complete overlap in the distribution of background (control) variables when considering comparability between groups of primary interest. This might also lead to a smaller number of predictors. Imbalance and lack of complete overlap force us to rely more heavily on model specification and less on direct support from the data.

Factors of primary interest relate to differences in attainment in higher education according to prior attainment (measured by the UCAS tariff score and type of qualifications), by ethnicity and gender across different institutions. Further interest also lies on how these effects are possibly modified by (interact with) subject area, institution and student demographic background (measured by age, disability, living at home and area level deprivation). Some basic descriptive investigations of relationships between these factors now form a pre-cursor to how they should be treated as covariates in the ultimate models.

3.2 Prior qualifications and demographics

3.2.1 Prior attainment according to gender and age

The graphs in Figures 1 and 2 below illustrate in various ways the distribution of the prior attainments scores (standardised UCAS) for sub-groups of the sample defined by various combinations of the factors, type of entrance

qualifications and gender. These are formed from smoothing kernel density procedures available in the software Stata.

There are clear differences in prior attainment (UCAS tariff score) between groups of the three different types of qualifications in the 21 and under age group (Figure 1), and these are not due to gender differences. These differences are less apparent among older students.

Also there are clear differences in the distribution of UCAS tariff scores between different age groups among students with A-levels only and mixed type of qualifications, and these are also not related to gender. Differences in prior ability between the age groups are less apparent among the group with vocational qualifications only. Evidence of bimodality of UCAS scores in the older group with vocational qualifications might be due to different university paths followed by this group. Whatever the reason, it may mean that for some groups a monotonic (possibly linear) age and prior attainment relationship may distort the outcome models where prior attainment is the major covariate but age is also included as a predictor.

Figure 1: Distribution of UCAS tariff score by type of entrance qualification; analysed by gender and age subgroups

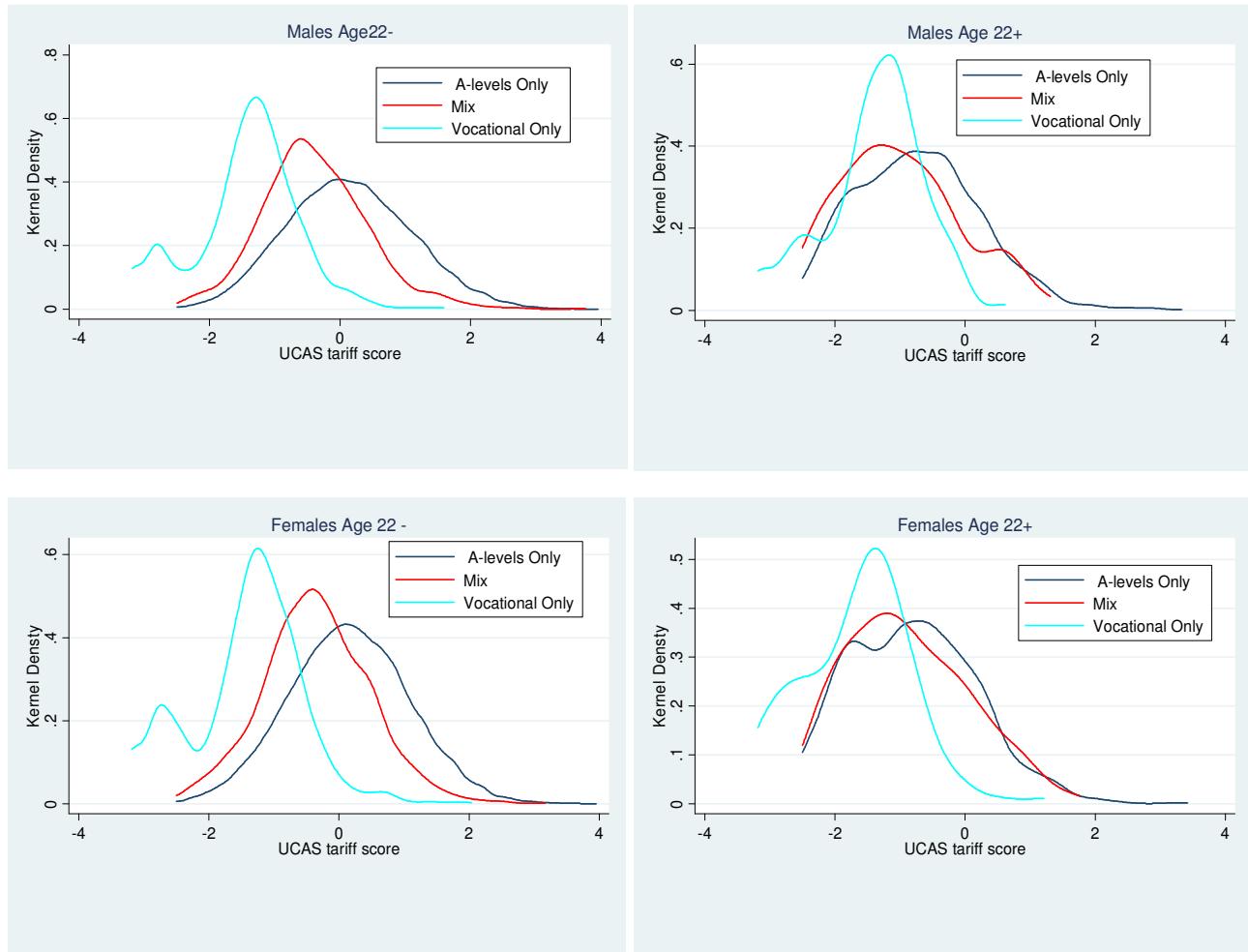
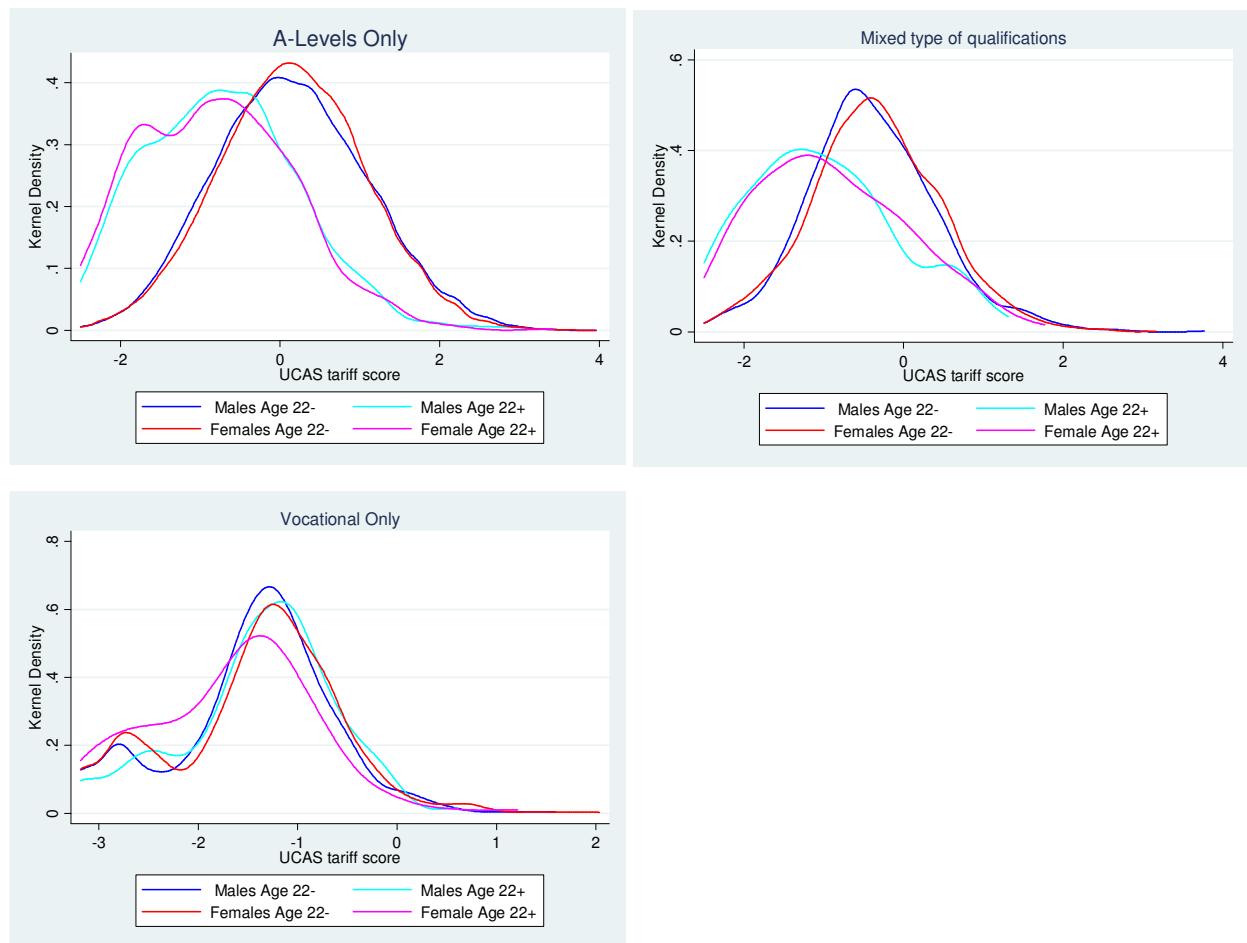


Figure 2: Distribution of UCAS tariff score by gender and maturity of student; analysed by type of entrance qualification subgroups



3.2.2 Disability, living at home and deprivation

Figure 3: Distribution of UCAS score and disability

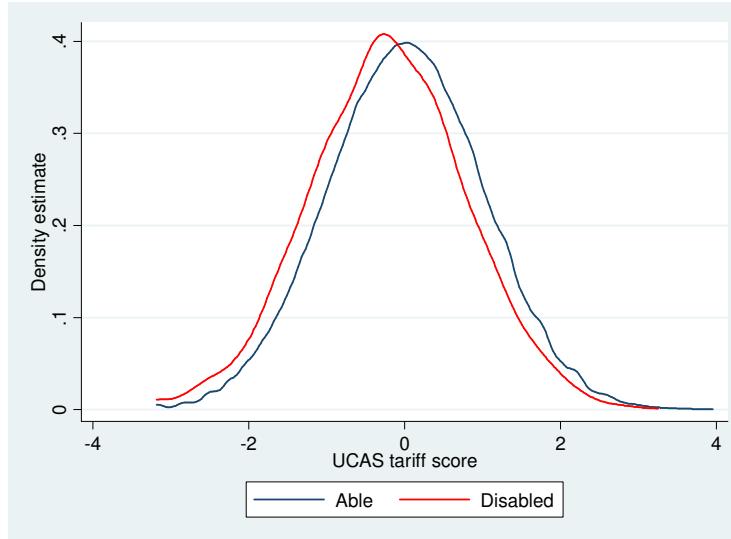
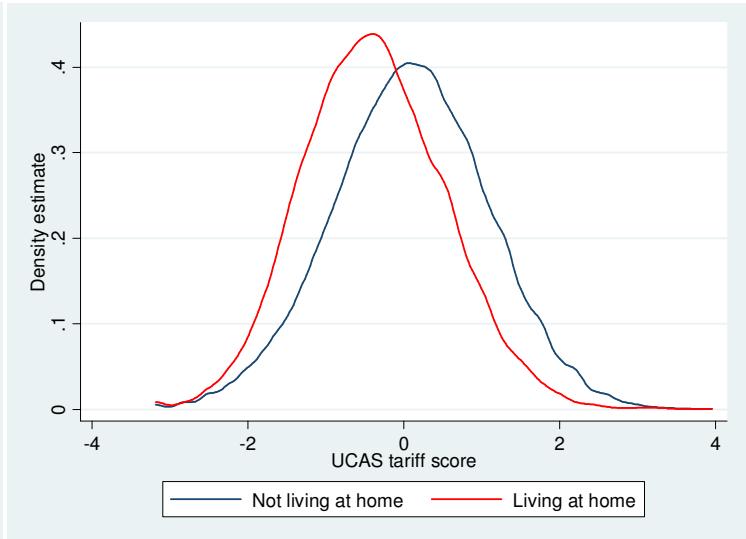
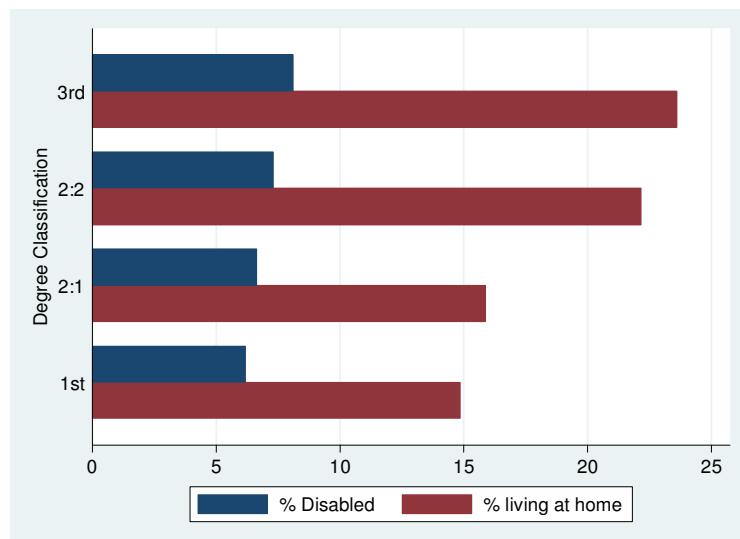


Figure 4: Distribution of UCAS score and living at home



Disabled students (a small but important 7% of the sample) are less likely to be living at home. 18% of students without a disability live at home compared to 14% of disabled students. Disabled students have slightly lower prior attainment, while students living at home have clearly lower prior attainment (see Figures 3 and 4). The same is true for their attainment in HE. There are some small differences in the percentage of students awarded each class of degree who are disabled, with slightly more than expected being awarded the lowest degrees (Figure 5). However, Figure 5 also shows that the incidence of those living at home is much higher than overall in the lower degree classes, with the reverse being true for the higher degree classes.

Figure 5: Degree class, living at home and disability



Disabled students seem to come from slightly less deprived areas, while the homes of students living at home are in considerably more deprived areas than those not living at home (see Figures 6 and 7).

Figure 6: Distribution of IMD score disability

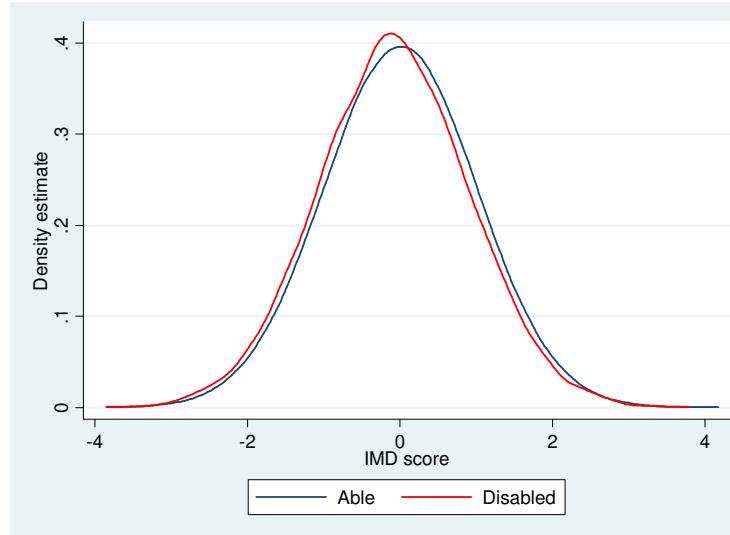
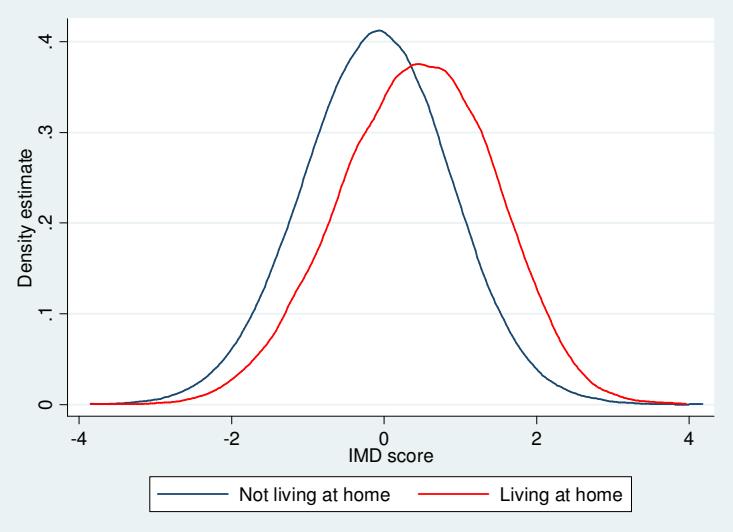


Figure 7: Distribution of IMD and score and living at home

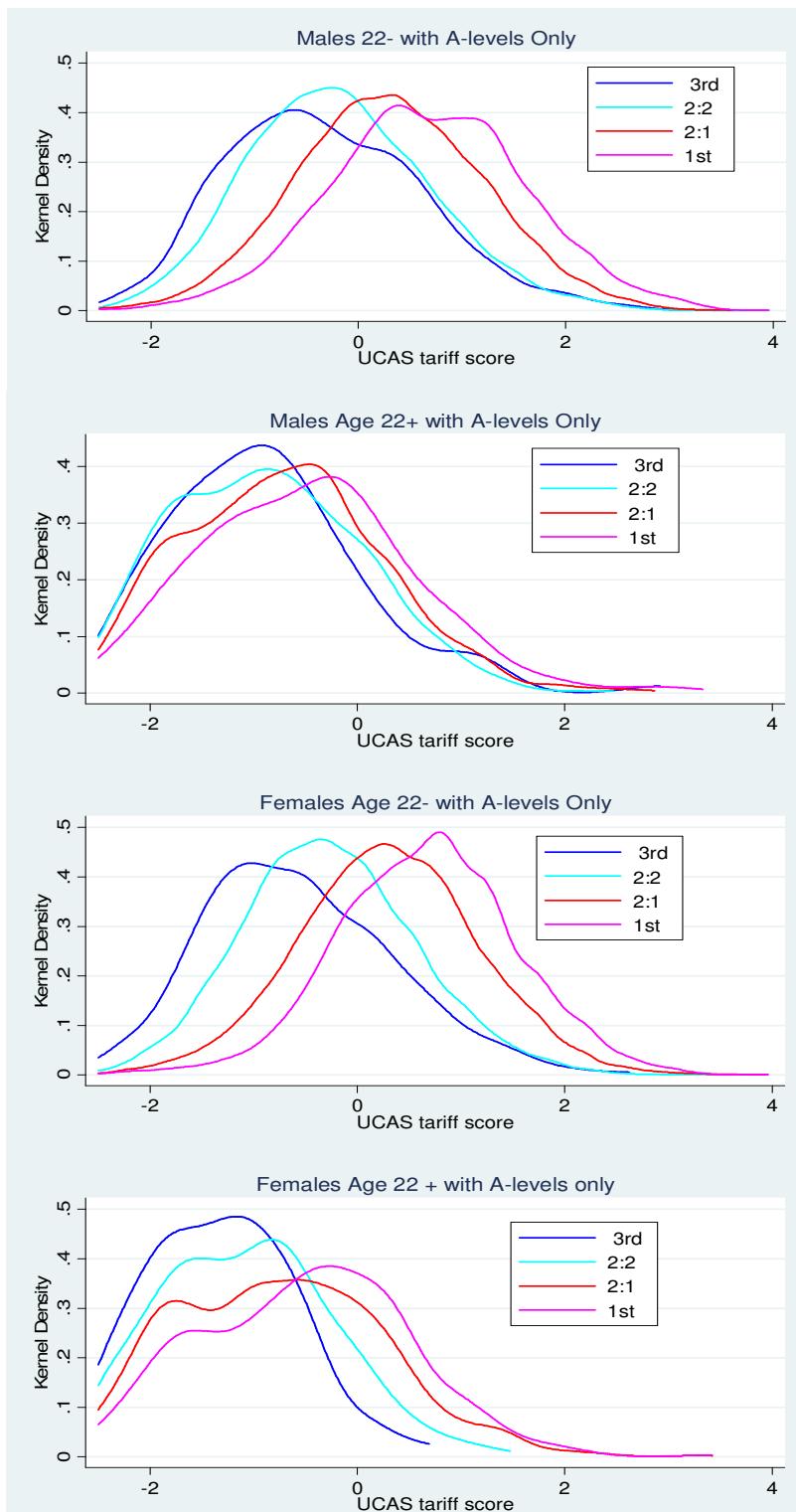


3.3 Progress in higher education and demographics

3.3.1 Age, gender and type of qualifications

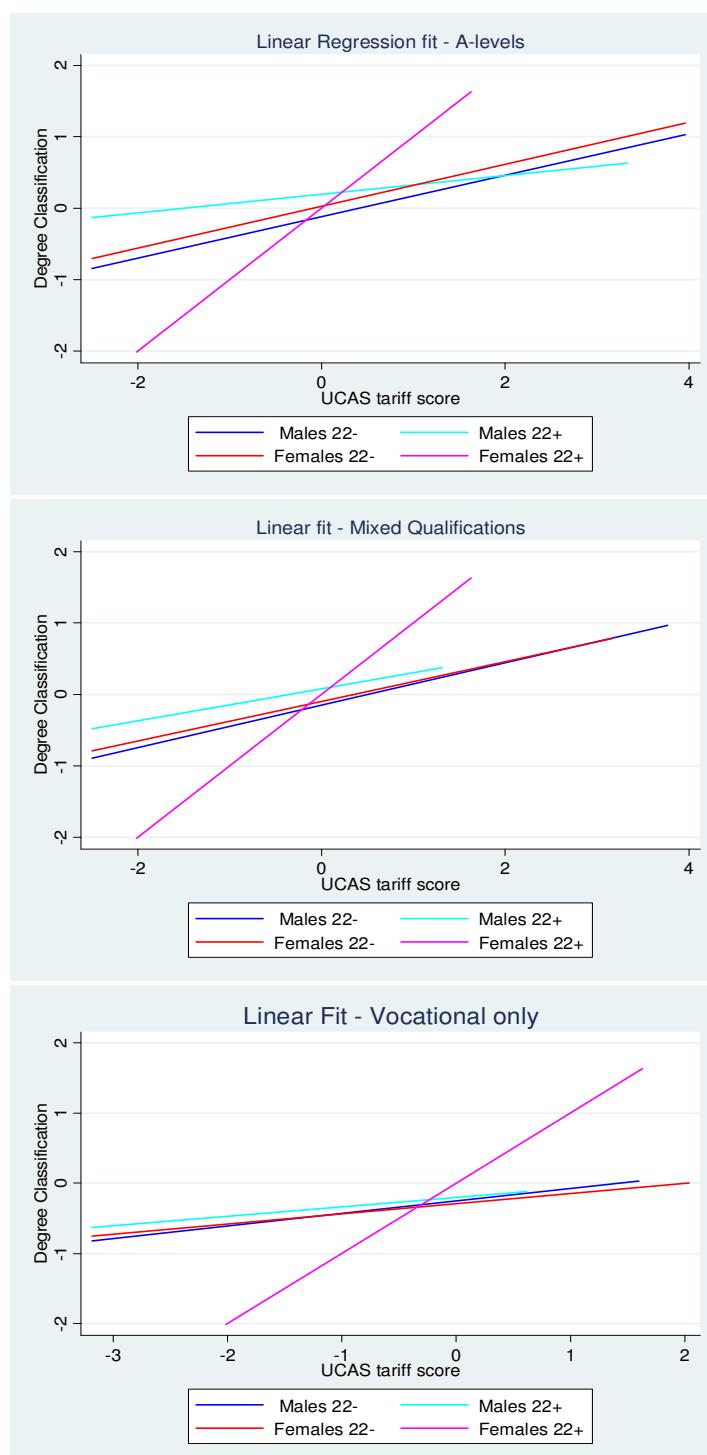
Figure 8, below, shows the pattern of the distribution of prior qualifications (specifically for the A-levels only students: 91% of the sample) for each degree class by each of the age/gender sub-groups. The effect of prior qualifications on degree performance seems more marked for the younger students.

Figure 8: Distribution of UCAS scores of students entering with A-levels only for each degree class outcome by gender and whether aged 22+ or not



Rough linear fits are also performed relating the standardised normal score for degree class (as used in Section 2 explorations) to UCAS tariff score for each of the four gender/age groups. Separate graphs are given for each type of entrance qualification in Figure 9. There appear to be similar relationships for the two male groups: older and younger. Younger females are also similar in pattern to these two groups. In each case it seems that the effect (slope) of UCAS tariff score on the degree performance outcome is similar for three main groups, but an interaction is present as the slope for mature females is much steeper. Older females have a steeper UCAS score outcome relationship. These patterns also seem to be similar across the three graphs of qualifications type.

Figure 9: Linear fits of degree class score to UCAS tariff score



3.3.2 Disability, living at home and deprivation

The disabled group make less progress from entry to degree outcome in higher education as indicated by their shallower slope in Figure 10. Those living at home progress more than those who do not (Figure 11). Thus interactions of living at home and prior attainment, and of disability and prior attainment are indicated below, and should possibly be considered for model trialling.

Figure 10: Progress and disability

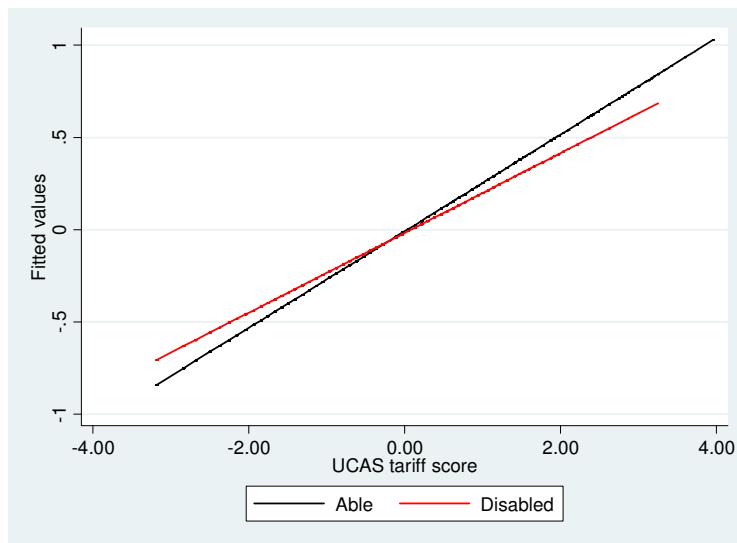
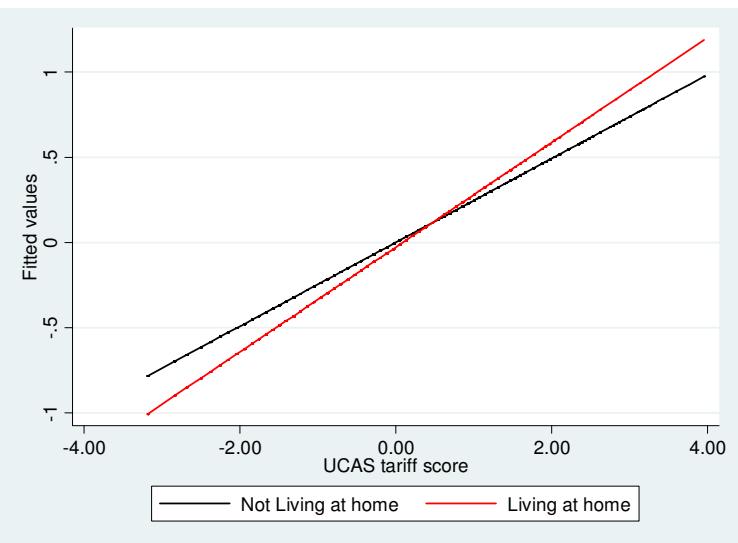
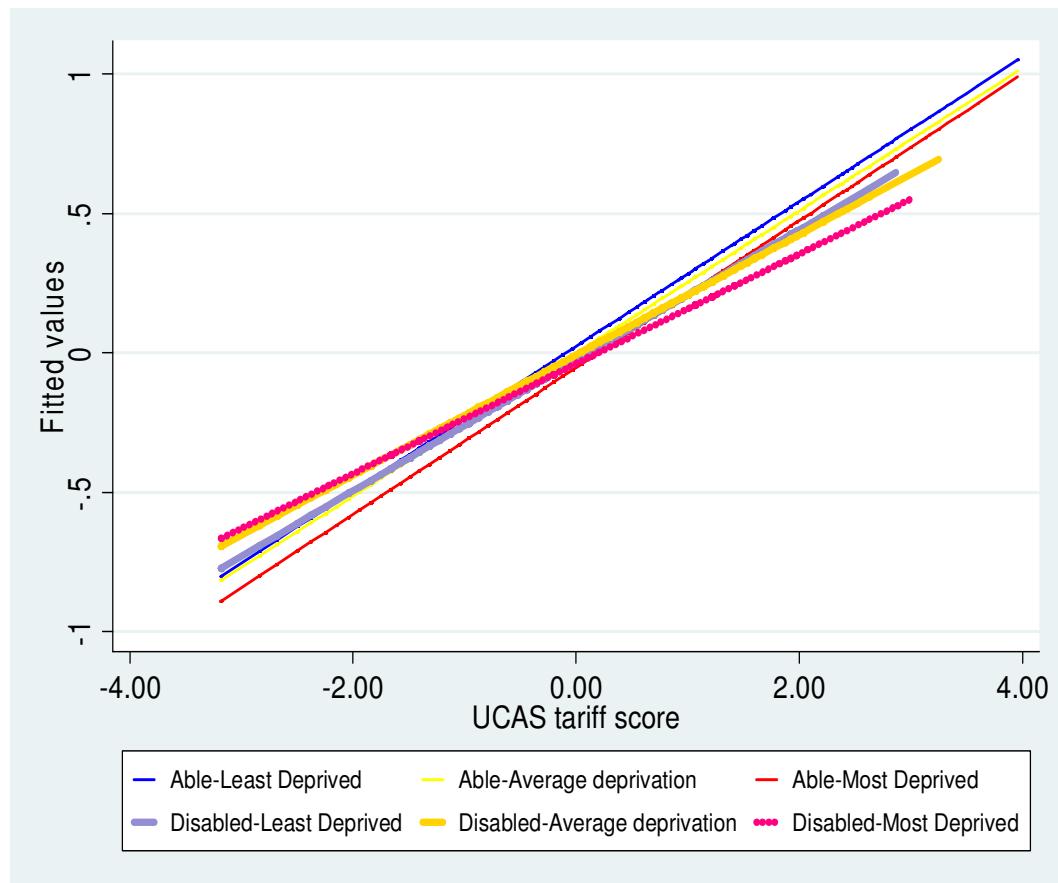


Figure 11: Progress and living at home



The sample of students is then divided up into three groups according to their origin in least deprived, average deprivation and most deprived residence area on the basis of quartiles on IMD score; the average group having values between the lower and the upper quartiles. This facilitates the rough linear fitting of progress to degree outcome lines for six combinations of disability and deprivation as in Figure 12 below. Differences in progress between students without a disability and disabled students are enhanced (i.e. slower progress with deprivation). Thus there is some evidence of interaction of these variables. A similar investigation was carried out with living at home, but no interactions are apparent with regard to living at home that are not captured by the main effects.

Figure 12: Linear fit of normal scored degree outcome by disability and deprivation group



3.4 Subject area according to prior and higher education attainment outcomes

Figure 13: Percentage distribution of sample over subject groups

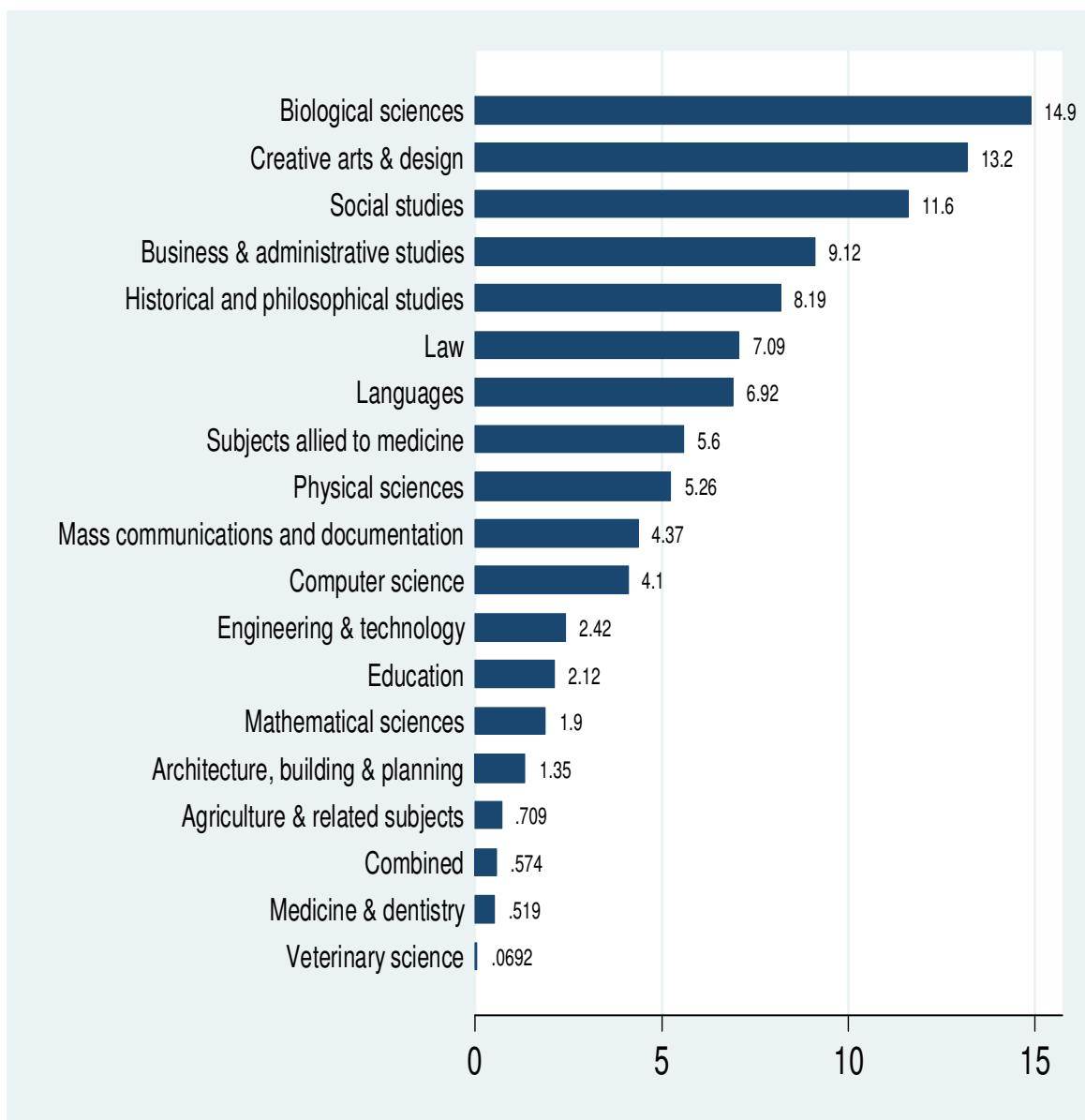


Figure 13 shows the relative sizes of the number of students in each of the 19 subject groups in the sample. They range from some fairly large groups, with Biological Sciences comprising 15% of the sample, down to very small subject groups with less than 1% of the sample, such as Veterinary Science, and Medicine and Dentistry. Full interactions of such small groups with ethnicity are likely to prove problematic in modelling.

Figure 14 plots the distribution density of intake scores for the various subject groups. Medicine and Veterinary Science stand apart as having a very high scoring intake; Mathematical Sciences attract the next highest intake scores,

followed by Law, Historical and Philosophical Studies, and Languages. Education, Engineering Studies, Agriculture and Business attract the lowest intake scores, followed by Creative Arts and Design, Mass Communications, and Computer Science. The most frequently occurring subjects in this sample are those attracting average to low intake scores, with Law, Historical and Philosophical Studies, and Languages being the exceptions.

Figure 14: Prior qualifications and subject group

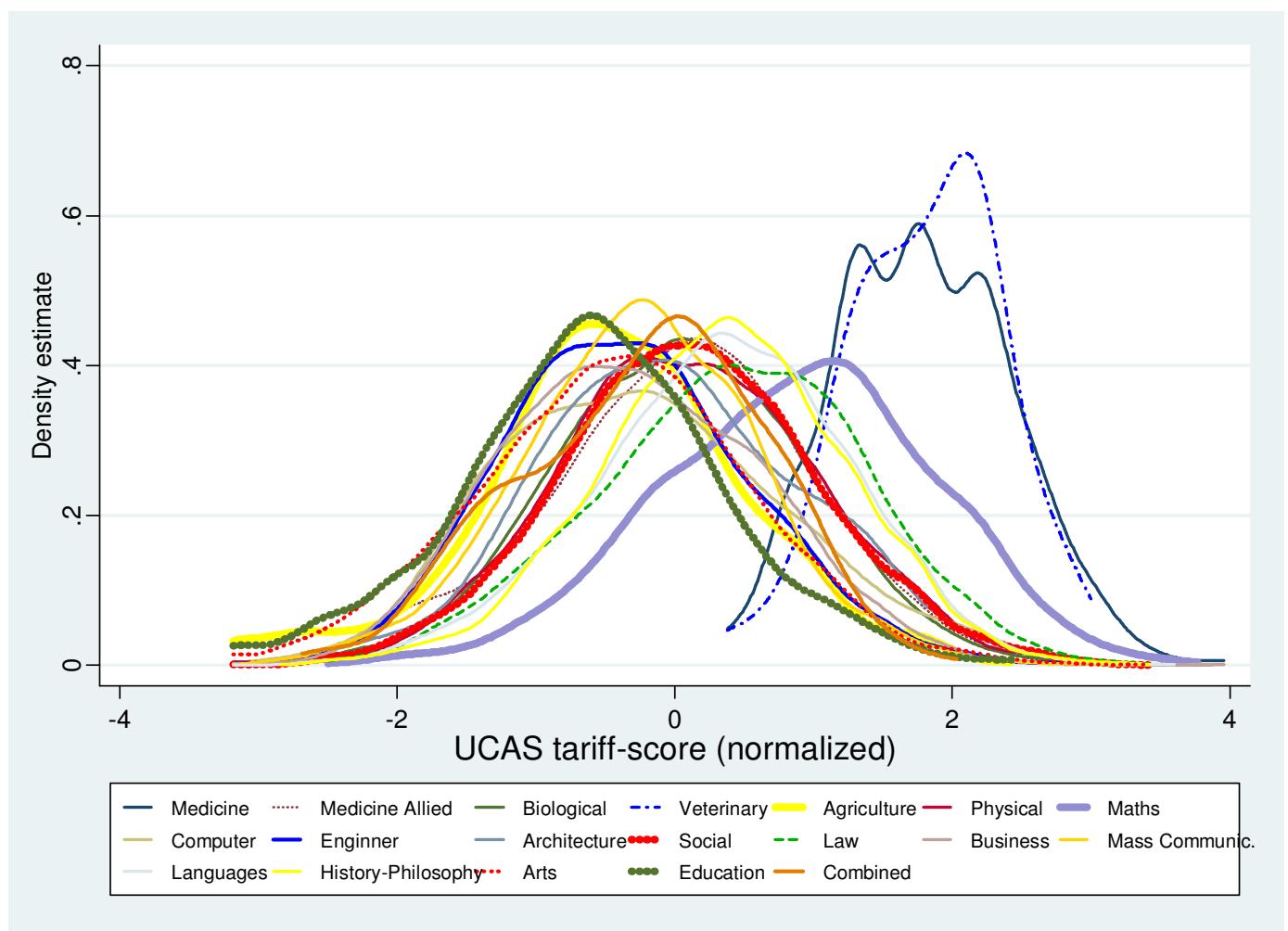


Table 9: The outcome distribution for the various subject groups ordered by percentage getting 2.1 degrees and above

Degree subject ranked according to proportion getting 2:1	Degree classification (normal score)				Intake ability group
	-2.01	-0.84	0.32	1.63	
Medicine & dentistry	1 0.29	39 11.30	241 69.86	64 18.55	345 100.00
Historical and phil	88 1.62	1,183 21.75	3,532 64.94	636 11.69	5,439 100.00
Languages	74 1.61	963 20.95	2,958 64.35	602 13.10	4,597 100.00
Veterinary science	1 2.17	11 23.91	28 60.87	6 13.04	46 100.00
Law	125 2.65	1,562 33.16	2,812 59.70	211 4.48	4,710 100.00
Mass communications	58 2.00	905 31.20	1,726 59.50	212 7.31	2,901 100.00
Combined	10 2.62	124 32.55	218 57.22	29 7.61	381 100.00
Social studies	237 3.07	2,501 32.43	4,306 55.83	669 8.67	7,713 100.00
Biological sciences	381 3.85	3,046 30.79	5,441 55.00	1,025 10.36	9,893 100.00
Creative arts & design	391 4.46	2,653 30.28	4,650 53.08	1,067 12.18	8,761 100.00
Subjects allied to med	131 3.52	1,197 32.17	1,964 52.78	429 11.53	3,721 100.00
Business & admin	381 6.29	2,324 38.36	2,915 48.11	439 7.25	6,059 100.00
Physical sciences	301 8.62	1,175 33.66	1,645 47.12	370 10.60	3,491 100.00
Architecture, building	51 5.69	343 38.28	418 46.65	84 9.38	896 100.00
Education	81 5.74	617 43.76	644 45.67	68 4.82	1,410 100.00
Agriculture & related	35 7.43	176 37.37	211 44.80	49 10.40	471 100.00
Computer science	260 9.54	928 34.06	1,114 40.88	423 15.52	2,725 100.00
Engineering & tech	170 10.56	659 40.93	603 37.45	178 11.06	1,610 100.00
Mathematical sciences	160 12.68	340 26.94	447 35.42	315 24.96	1,262 100.00
Total	2,936 4.42	20,746 31.23	35,873 54.00	6,876 10.35	66,431 100.00

Table 9 tabulates the outcome distribution for the various subject groups and orders them by percentage getting 2.1 degrees and above. On the right hand side is a rough indicator of their position on intake UCAS score level (labelled Highest, High, Average, Low and Lowest). It may be seen that there is considerable variation in higher education achievement that is not consonant with ranking by prior attainment. We can contrast Mathematical Sciences with Law, for example, both with a high intake, but with Mathematical Sciences having lower degree performance in general. There seems then to be an interaction between prior attainment and subject in their effects on achievement. As regards absolute numbers in the subject groups there is reasonable coverage. However, it might be problematic to fully model these interactions because of low counts at either end of the attainment range, e.g. Medicine, Mass Communications, Combined, Architecture, Agriculture and Education.

Table 10 shows the type of prior qualification by subject groups as relative numbers in each of the categories: A-levels only; mix of A-level and vocational qualifications; and vocational qualifications only. Although overall there is a heavy concentration on A-levels only, there is quite a disparate mix of types over the subject groups. The lowest and some of the average intake subjects have above average type of qualification mix (e.g. Business, Computer Science, Creative Arts and Design, Education, Engineering and Mass Communications).

Table 10: Type of qualification and subject ordered by percentage of A-levels only students

Degree subject	A-levels only	Mix	Vocational	Total	Intake ability group
Veterinary science	46	0	0	46	← Highest
	100.00	0.00	0.00	100.00	
Medicine & dentistry	344	1	0	345	← Highest
	99.71	0.29	0.00	100.00	
Mathematical sciences	1,238	23	1	1,262	← High
	98.10	1.82	0.08	100.00	
Physical sciences	3,374	100	17	3,491	← Average
	96.65	2.86	0.49	100.00	
Historical and phil	5,254	172	13	5,439	← High
	96.60	3.16	0.24	100.00	
Languages	4,416	176	5	4,597	← High
	96.06	3.83	0.11	100.00	
Law	4,492	179	39	4,710	← High
	95.37	3.80	0.83	100.00	
Biological sciences	9,402	367	124	9,893	← Average
	95.04	3.71	1.25	100.00	
Social studies	7,241	385	87	7,713	← Average
	93.88	4.99	1.13	100.00	
Combined	357	14	10	381	← Average
	93.70	3.67	2.62	100.00	
Subjects allied to med	3,444	184	93	3,721	← Average
	92.56	4.94	2.50	100.00	
Architecture, building	823	57	16	896	← Average
	91.85	6.36	1.79	100.00	
Agriculture & related	421	28	22	471	← Lowest
	89.38	5.94	4.67	100.00	
Mass communications	2,585	225	91	2,901	← Low
	89.11	7.76	3.14	100.00	
Engineering & tech	1,433	106	71	1,610	← Lowest
	89.01	6.58	4.41	100.00	
Education	1,200	133	77	1,410	← Lowest
	85.11	9.43	5.46	100.00	
Creative arts & design	7,256	971	534	8,761	← Low
	82.82	11.08	6.10	100.00	
Computer science	2,185	242	298	2,725	← Low
	80.18	8.88	10.94	100.00	
Business & admin	4,790	722	547	6,059	← Lowest
	79.06	11.92	9.03	100.00	
Total	60,301	4,085	2,045	66,431	
	90.77	6.15	3.08	100.00	

Figure 15: Linear fit of normalised degree result score to UCAS tariff score by subject group

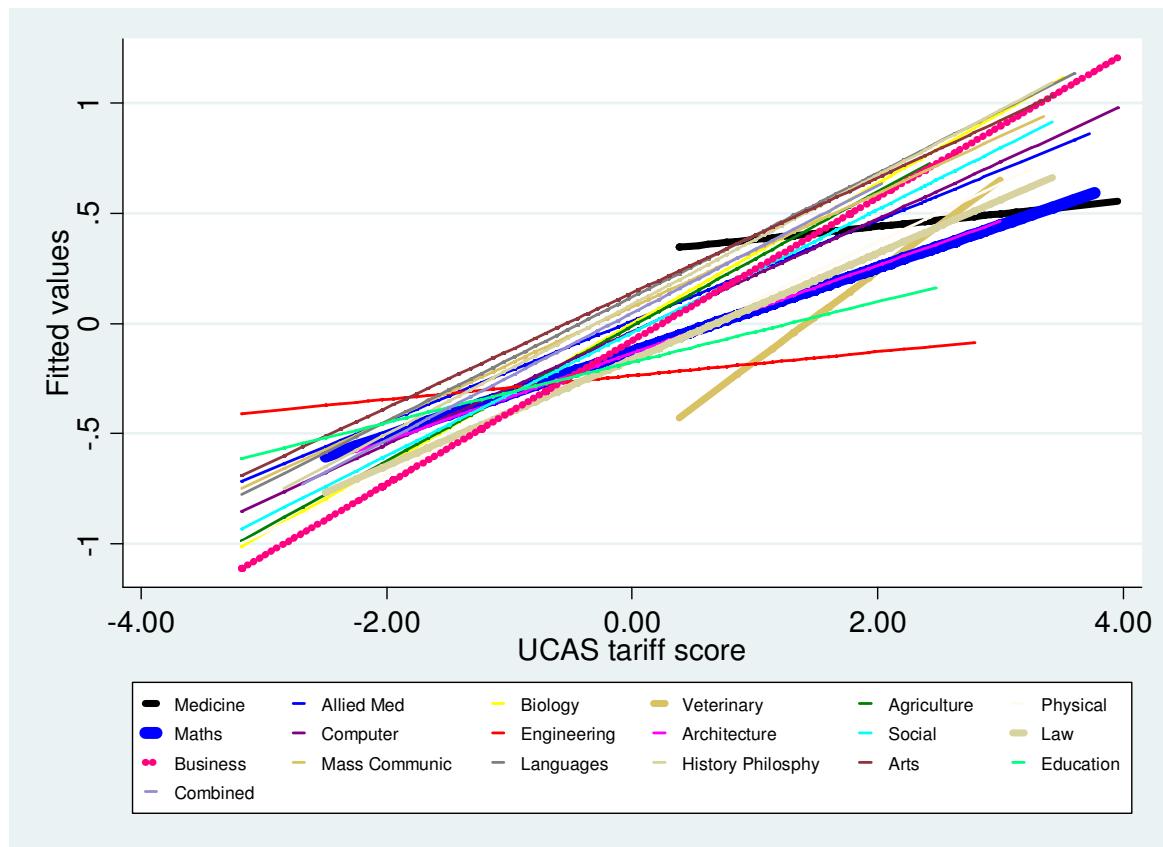


Figure 15 fits the linear relationship between the degree outcome and prior attainment for the separate subject groups. Although progress patterns are similar across many subjects, some lines are flatter meaning there is evidence of some differential progress, and hence possible interaction between subject group and UCAS score in the effect on degree achievement.

3.5 The demographics of subject area of study in higher education as evidenced in this sample

3.5.1 Subject area by gender, age and ethnicity

Figure 16: Subject area and gender

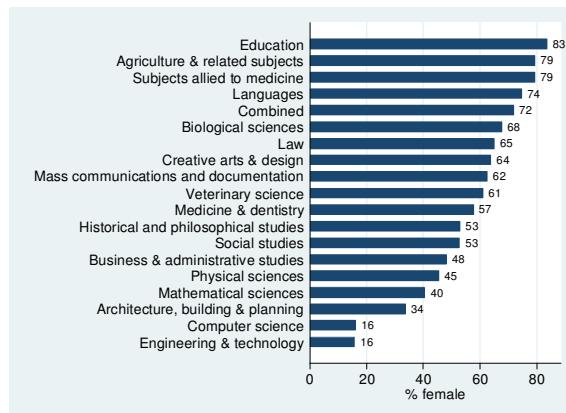


Figure 17: Subject area and maturity

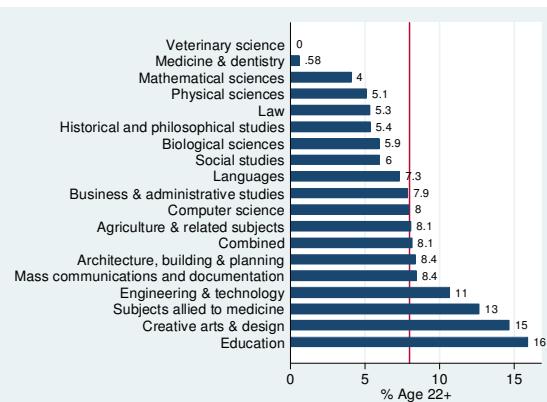
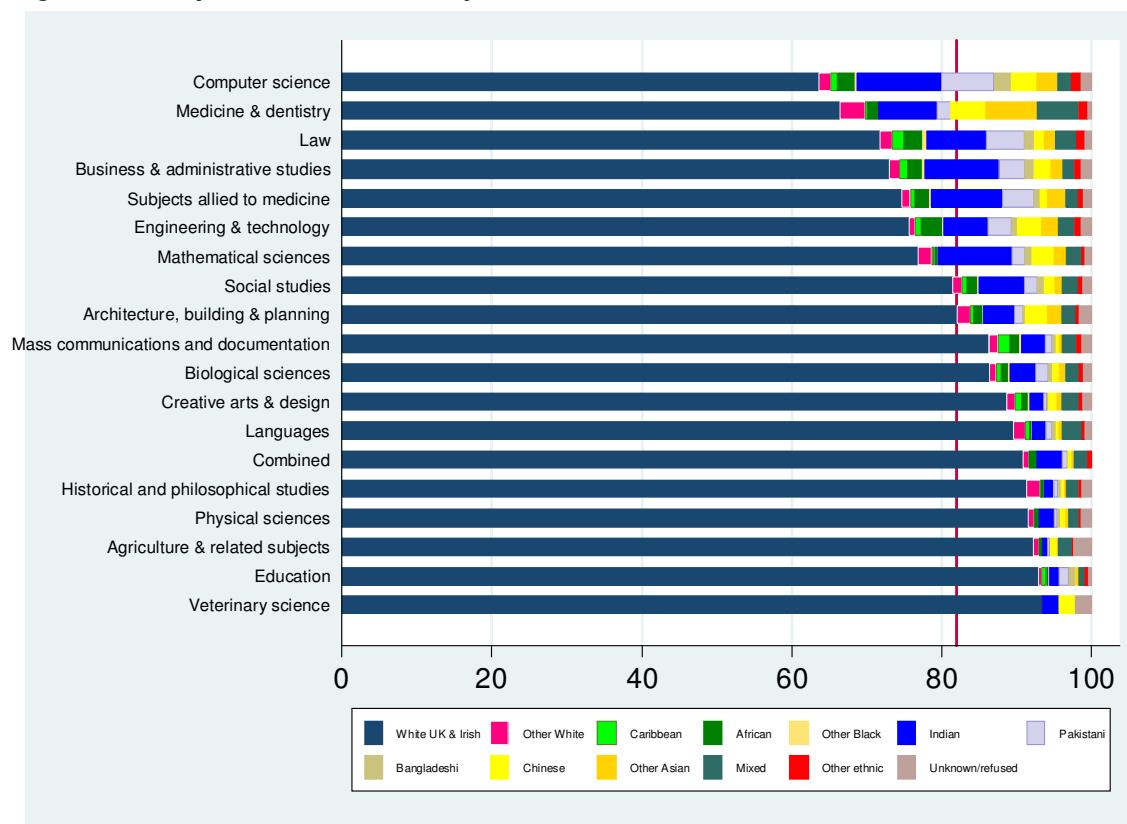


Figure 18: Subject area and ethnicity



Subjects attracting the lowest intakes generally have the oldest students. For example, Figure 17 shows the percentage in each subject group over the age of 22. This is highest for Education, Creative Arts and Design, and Engineering and Technology, and lowest for Veterinary Science, Medicine and Mathematical Sciences. Education also has the highest percentage of

females (see Figure 16). As seen from Figure 16, the gender make-up although quite variable is, however, not largely related to the intake achievement level of subjects. From Figure 18 it is seen that the ethnic mix of subjects is quite varied with Computer Science, Medicine and Law having relatively high proportions from BME groups. Some BME group and subject combinations will have small numbers, and there are a large number of combinations. This makes the study of interactions of subject area and ethnicity quite difficult, except perhaps for some combinations with Indian and Chinese. We explore the limited possibilities for these in the models of the next section.

3.5.2 Subject area, deprivation, disability and living at home

From the IMD distribution density estimates of Figure 19, we see that there are no major differences in groups of students on this measure of deprivation being attracted to certain subjects. Computer Science, which has the most diverse ethnic mix (see Figure 18), seems to attract students from somewhat more deprived backgrounds. Medicine and related subjects seem to attract students from somewhat less deprived backgrounds, despite the high ethnic mix attracted to the subjects. We saw above that Medicine also attracts higher prior attainment and younger students.

Figure 19: Distribution of IMD score by subject

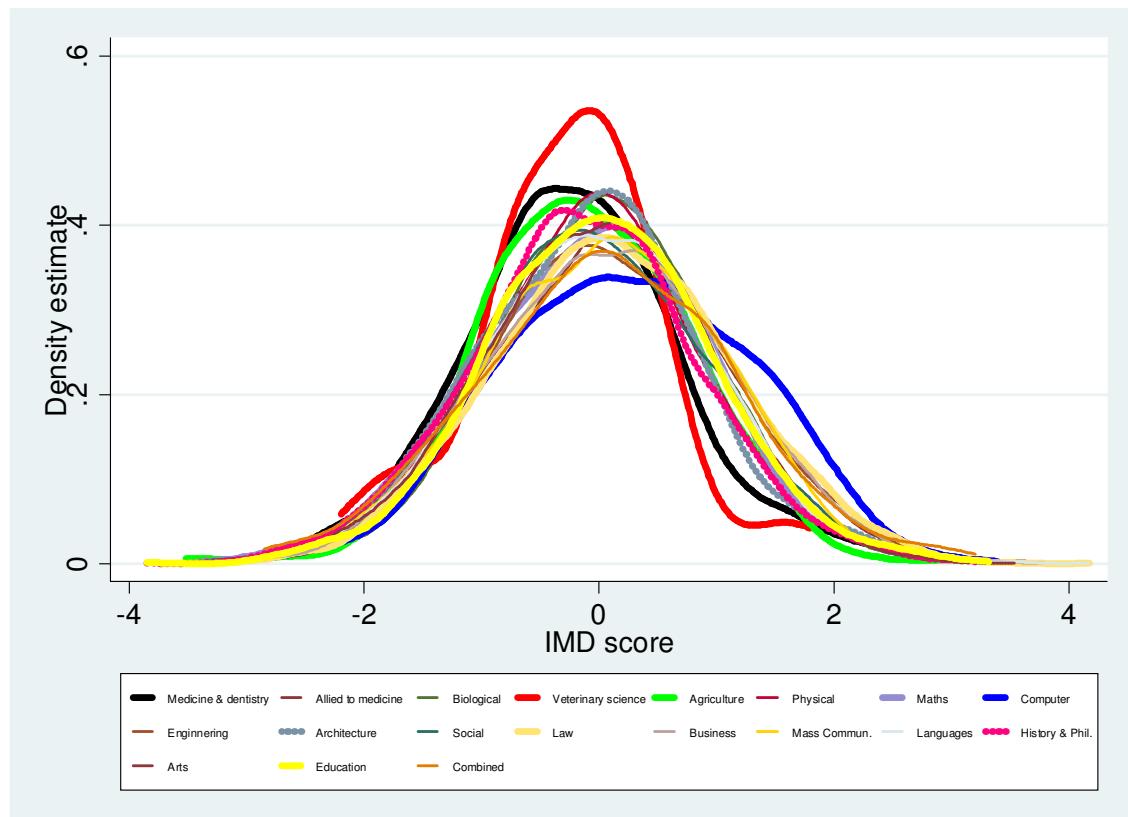
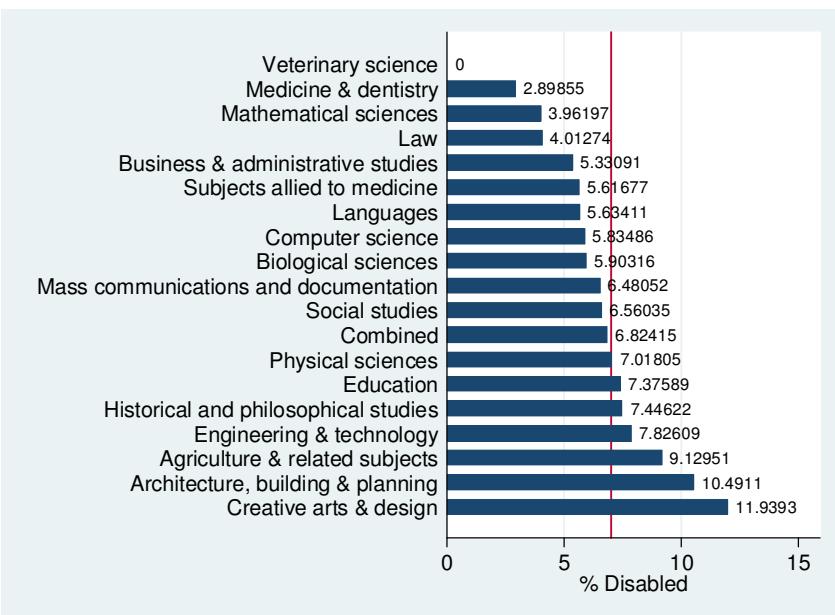
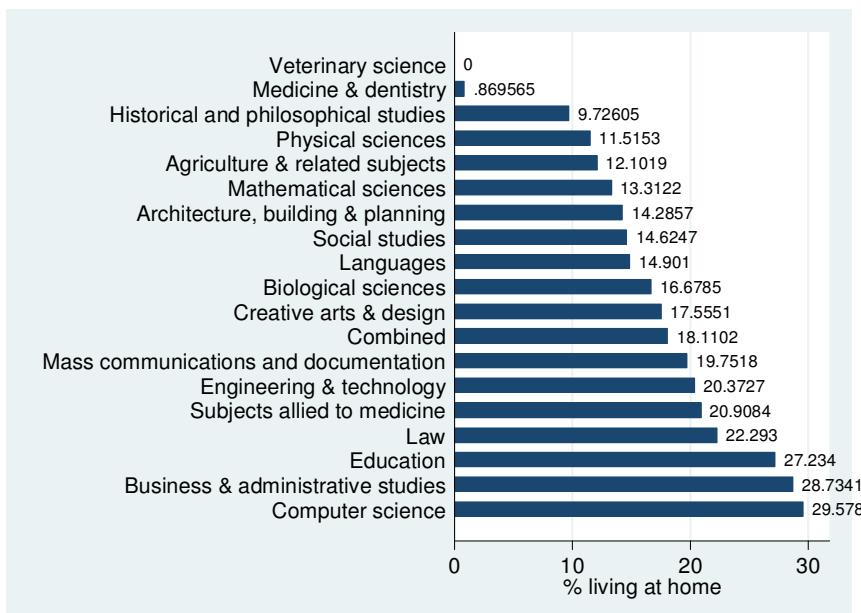


Figure 20: Percentage disabled, by subject



From Figure 20 it is seen that Veterinary Science, Medicine, Law and Mathematical Sciences are the subjects with the lowest proportion of disabled students (7% in total). There are relatively higher numbers in Creative Arts, Architecture and Agriculture. The proportion of students who live at home (12% overall in the sample) is much higher among students studying Education, Law, Computer Science and Business (see Figure 21).

Figure 21: Percentage living at home, by subject



3.6 The demographics of ethnicity in our sample

3.6.1 Ethnicity, gender and age

Females represent 58% of the overall sample. Figure 22 shows the proportion of females in the various BME groups. It is seen that females are dominating among students with any type of Black ethnic background. Figure 23 shows the proportions aged 22+ for different ethnic groups; most BME groups are more likely to be much older than the reference group of White UK and Irish, with the exception of Indian and Bangladeshi groups, who are younger.

Figure 22: Proportion female, by ethnicity

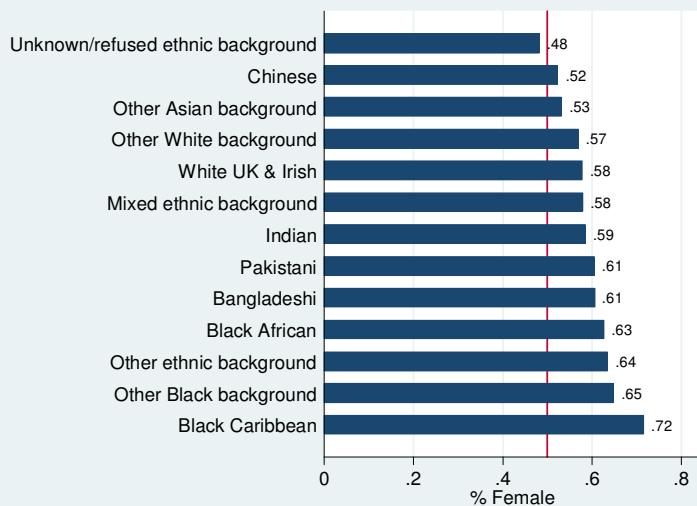
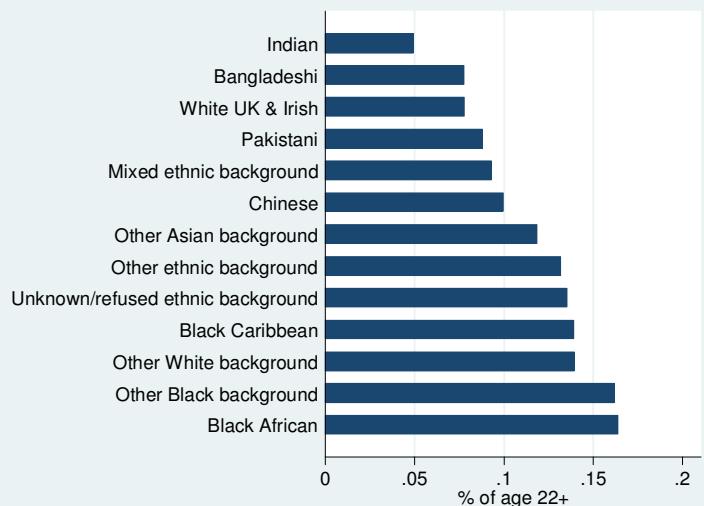
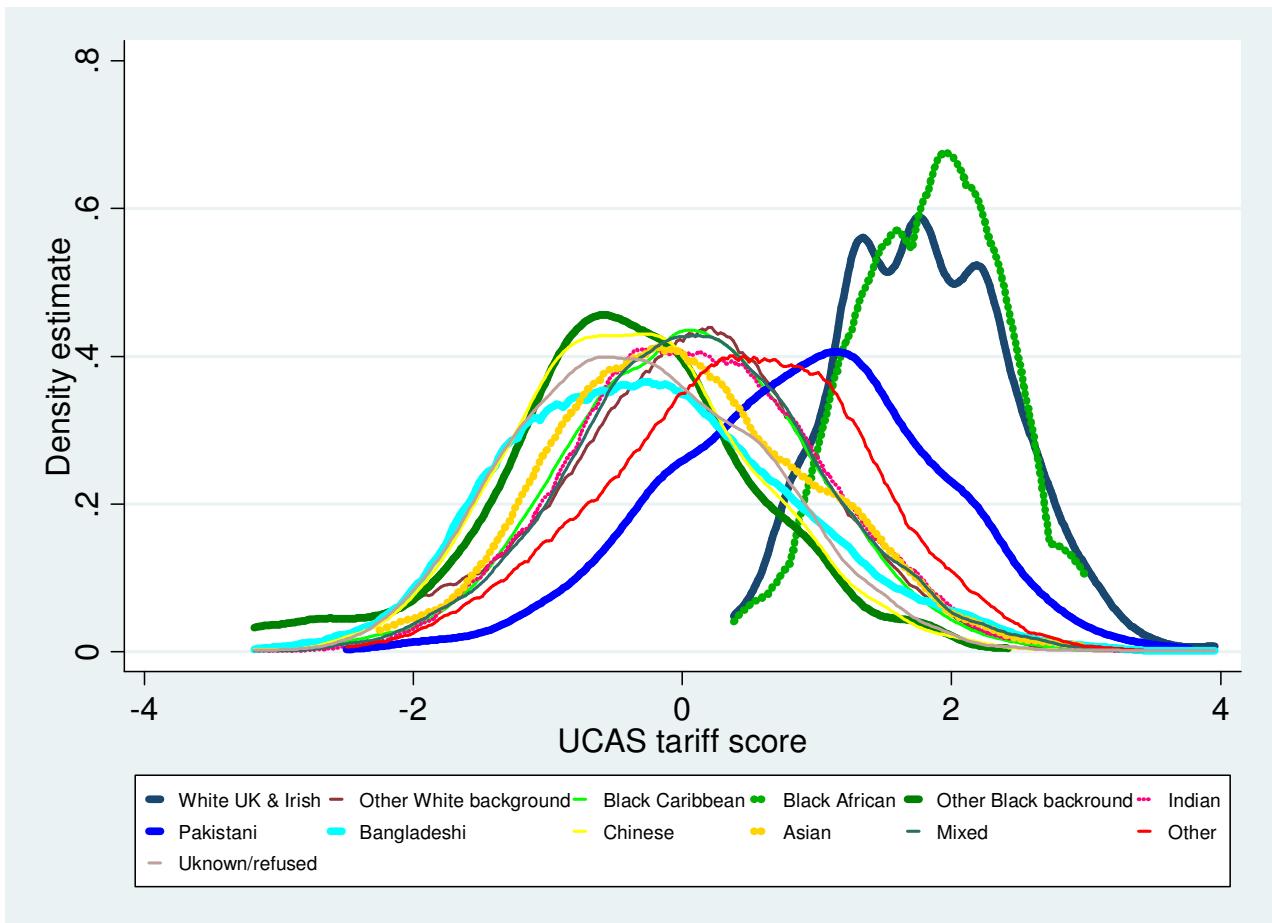


Figure 23: Proportion mature, by ethnicity



3.6.2 Ethnicity and prior attainment

Figure 24: Distribution of UCAS score by ethnicity



The prior attainment composition of the different groups of Black ethnic backgrounds is very variable. The groups with the highest prior attainment are White UK and Irish, Black African and Pakistani. These groups stand out in the UCAS score distributions by ethnicity in Figure 24. The ethnic groups with the lowest prior attainment are the Other Black backgrounds, Chinese and Bangladeshi.

Table 11 below shows distributions over type of prior qualifications categories for ethnic categories, ordered again by percentage of students having A-levels only. Some indication is also given on the right of the level of prior attainment of the groups. The White, Mixed, Other Asian and Unknown backgrounds have the highest proportion of students with A-levels (more than 90%), while all other ethnic groups have an above average proportion of students with vocational and mixed-type of qualifications (more than 4% and 6% respectively).

Table 11: Type of qualification and ethnicity ordered by percentage of A-levels only

Ethnic group	A-levels only	Mix	Vocational	Total	Level of prior attainment
Mixed	1,226	77	30	1,333	<- Average
	91.97	5.78	2.25	100.00	
White UK & Irish	50,405	3,277	1,299	54,981	<- Highest
	91.68	5.96	2.36	100.00	
Unknown/Refused	709	34	39	782	<- Average
	90.66	4.35	4.99	100.00	
Other White	758	46	33	837	<- Average
	90.56	5.50	3.94	100.00	
Other Asian	642	39	29	710	<- Average
	90.42	5.49	4.08	100.00	
Chinese	749	62	32	843	<- Lowest
	88.85	7.35	3.80	100.00	
Other Black background	97	7	7	111	<- Lowest
	87.39	6.31	6.31	100.00	
Indian	2,768	242	239	3,249	<- High
	85.20	7.45	7.36	100.00	
Other	346	39	24	409	<- Average
	84.60	9.54	5.87	100.00	
Bangladeshi	403	35	39	477	<- Lowest
	84.49	7.34	8.18	100.00	
Black Caribbean	429	42	46	517	<- Average
	82.98	8.12	8.90	100.00	
Black African	672	60	79	811	<- Highest
	82.86	7.40	9.74	100.00	
Pakistani	1,097	125	149	1,371	<- High
	80.01	9.12	10.87	100.00	
Total	60,301	4,085	2,045	66,431	
	90.77	6.15	3.08	100.00	

Figure 25: Class of degree and ethnicity (proportions in each degree class)

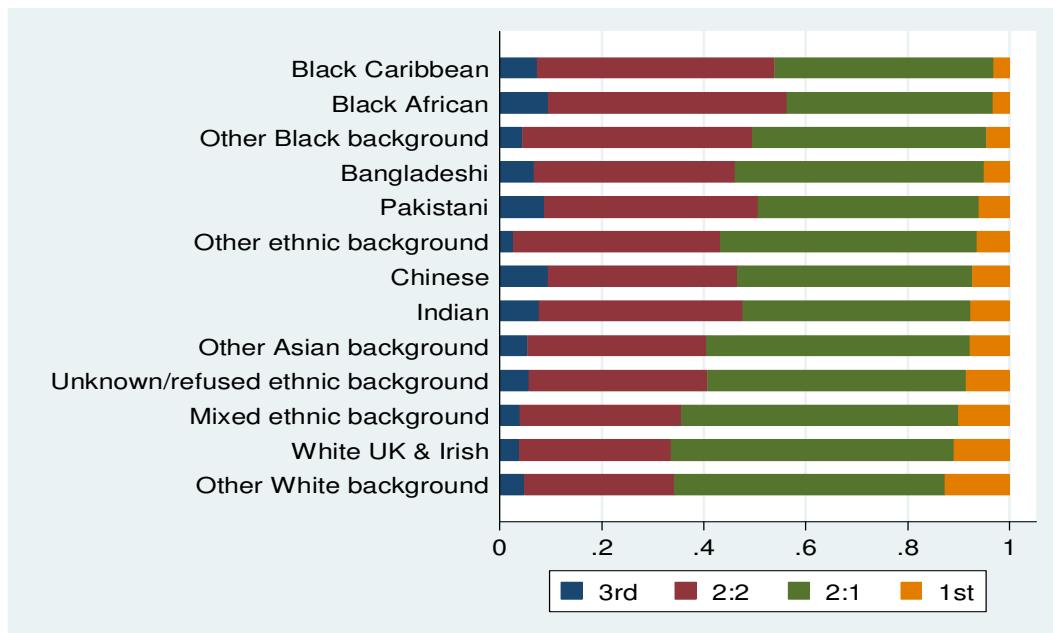


Figure 25 and Table 12 also show how our target response of degree outcome varies marginally over the ethnicity groups. They are bald indications of how the raw degree class response varies over ethnic groups before any control is exercised. It parallels the uncontrolled probabilities in Figure 3 of Broecke and Nicholls (2007, p17), although they had fewer BME groups.

Table 12: Degree class and ethnicity

Ethnic group	Degree classification (normal score)					Total
	-2.01	-0.84	0.32	1.63		
White UK & Irish	2,142	16,349	30,464	6,026		54,981
	3.90	29.74	55.41	10.96		100.00
Other White	41	245	445	106		837
	4.90	29.27	53.17	12.66		100.00
Black Caribbean	38	241	222	16		517
	7.35	46.62	42.94	3.09		100.00
Black African	77	380	328	26		811
	9.49	46.86	40.44	3.21		100.00
Other Black background	5	50	51	5		111
	4.50	45.05	45.95	4.50		100.00
Indian	253	1,295	1,452	249		3,249
	7.79	39.86	44.69	7.66		100.00
Pakistani	120	574	595	82		1,371
	8.75	41.87	43.40	5.98		100.00
Bangladeshi	32	188	233	24		477
	6.71	39.41	48.85	5.03		100.00
Chinese	80	313	389	61		843
	9.49	37.13	46.14	7.24		100.00
Other Asian	39	249	367	55		710
	5.49	35.07	51.69	7.75		100.00
Mixed	53	422	725	133		1,333
	3.98	31.66	54.39	9.98		100.00
Other	11	166	206	26		409
	2.69	40.59	50.37	6.36		100.00
Unknown/refused	45	274	396	67		782
	5.75	35.04	50.64	8.57		100.00
Total	2,936	20,746	35,873	6,876		66,431
	4.42	31.23	54.00	10.35		100.00

3.6.3 Ethnicity and progress

Figure 26: Linear fit of degree class score and UCAS score for different ethnic groups

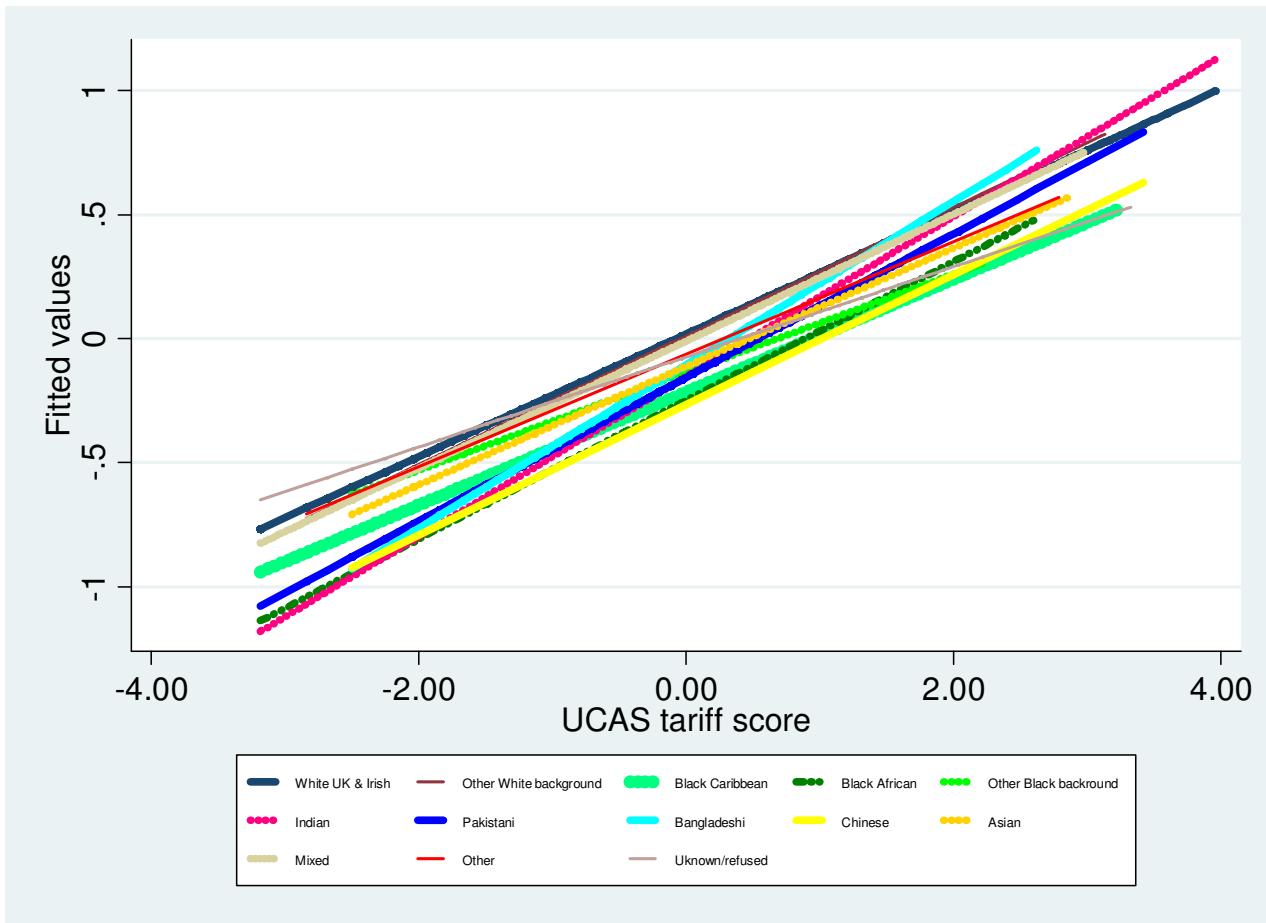
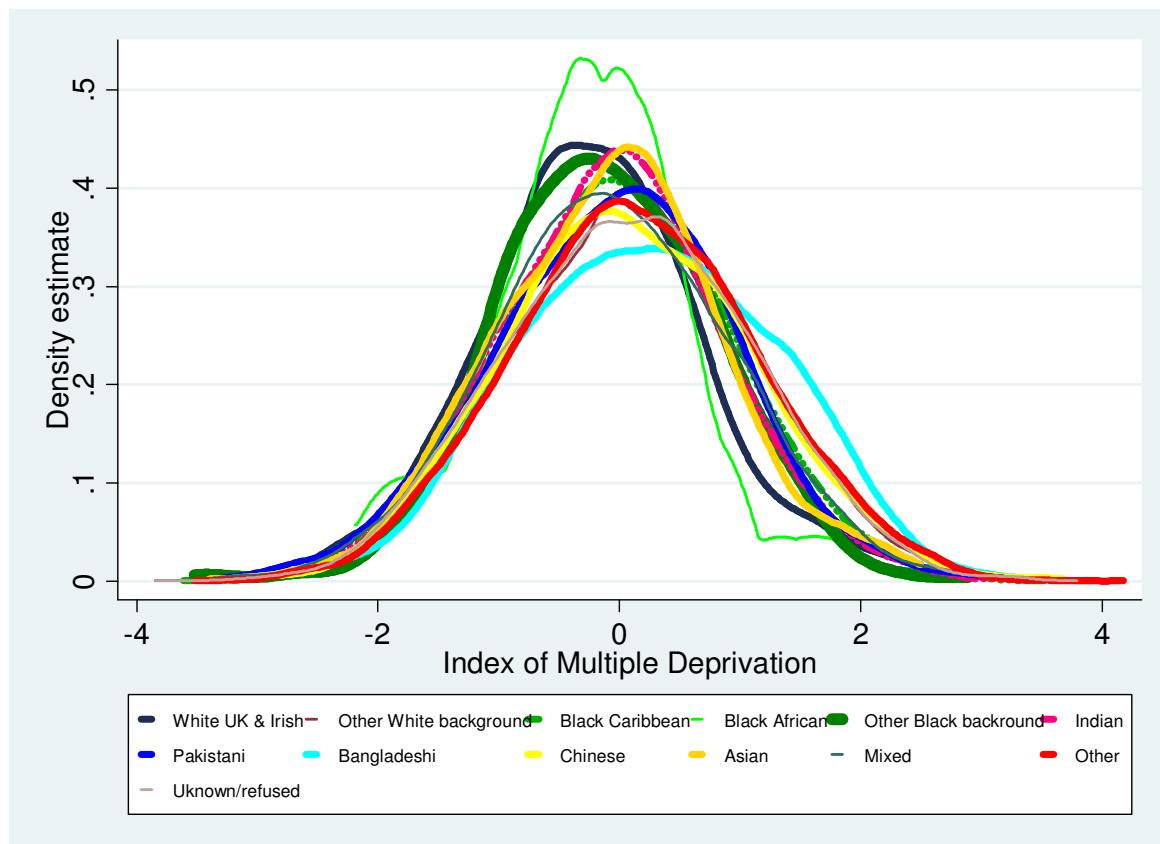


Figure 26 is a rough linear fit and an indication of overall interactions of prior attainment with ethnicity on degree outcome (differential progress). It shows that the Indian group (with the steepest slope: the red line), followed closely by the Pakistani and Bangladeshi groups, is making the most progress compared to the White UK and Irish group (the black line). The Other Black group (with shallow slopes: the bright green line) is making the least progress, with the other Asian groups being in between (the yellow lines). These patterns were also picked out in the model trials of Section 1. There is quite a lot of variability in progress among the groups from Black backgrounds. There is evidence that interactions of ethnicity with prior attainment need to be considered carefully in ultimate modelling.

3.6.4 Ethnicity and deprivation

Ethnic differences associated with deprivation are not really apparent in our sample. White UK and Irish, Black African and Other Black groups seem to have slightly lower deprivation in the sample as measured by the IMD score (see Figure 27). These differences are in agreement with ethnic differences associated with prior attainment.

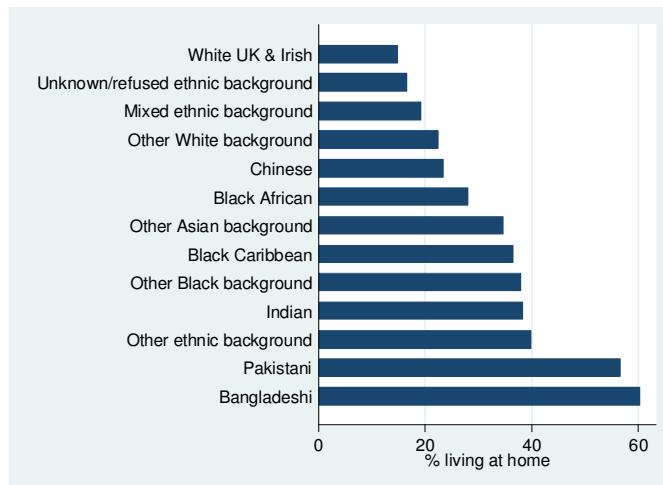
Figure 27: Distribution of IMD score by ethnicity



3.6.5 Ethnicity and living at home

There is a distinct pattern in the proportion of students living at home (who have the lowest prior attainment and come from the most deprived areas) according to ethnicity, with more than 50% of the Pakistani and Bangladeshi students living at home compared with less than 20% of the students from White backgrounds.

Figure 28: Ethnicity and living at home



3.7 Institutional composition by subject areas offered, ethnicity and demographics

3.7.1 Institutional composition of subject areas

Only one institution in our filtered sample has representatives from the full set of 17 subject areas of degree (the maximum number of subjects offered by an institution in the sample). Largely because of the artefact of filtering (meaning the sample is restricted to three-year degree courses), only one institution, the University of Cambridge, has Veterinary Science; 3.4% of that University's participating students. For similar reasons there are Medicine students in only three institutions in this sample (the Universities of Oxford and Cambridge, and St George's Hospital Medical School)⁴. Other pertinent information on the number of institutions (out of a total possible of 120) in the sample that have students in each of the subject areas is given in Figure 29.

Figure 29: Number of institutions offering a subject

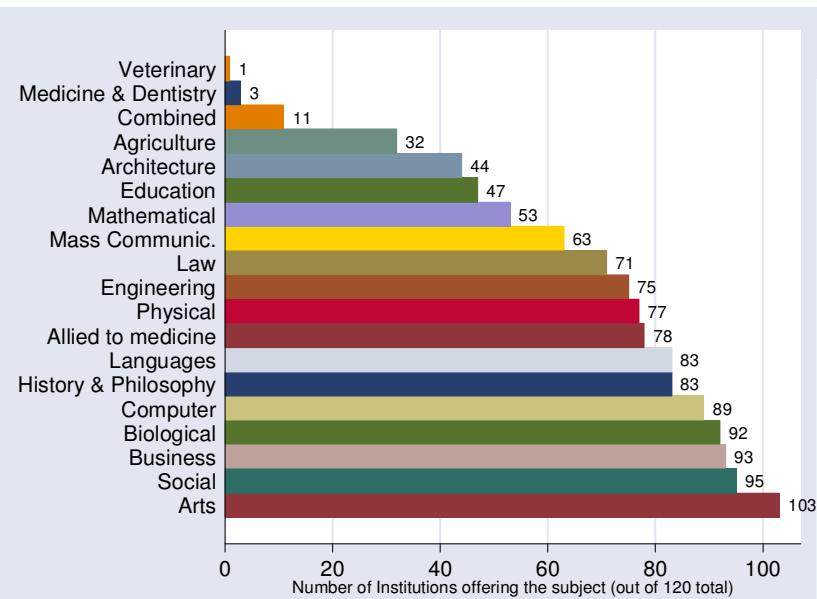


Figure 30: Number of subjects and institutions

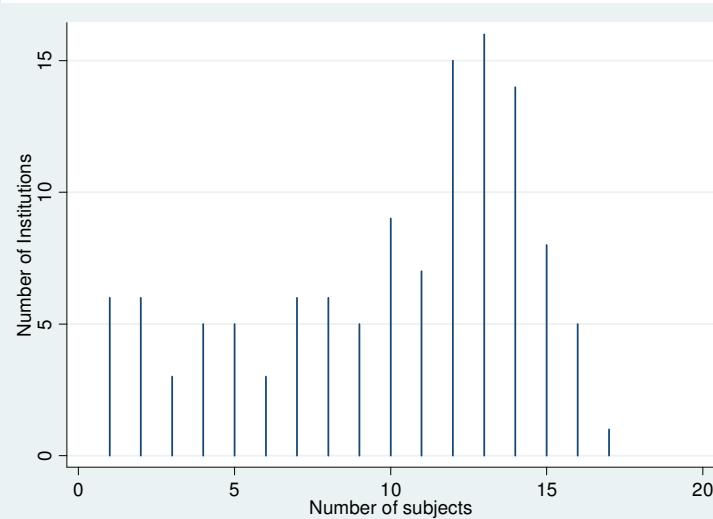


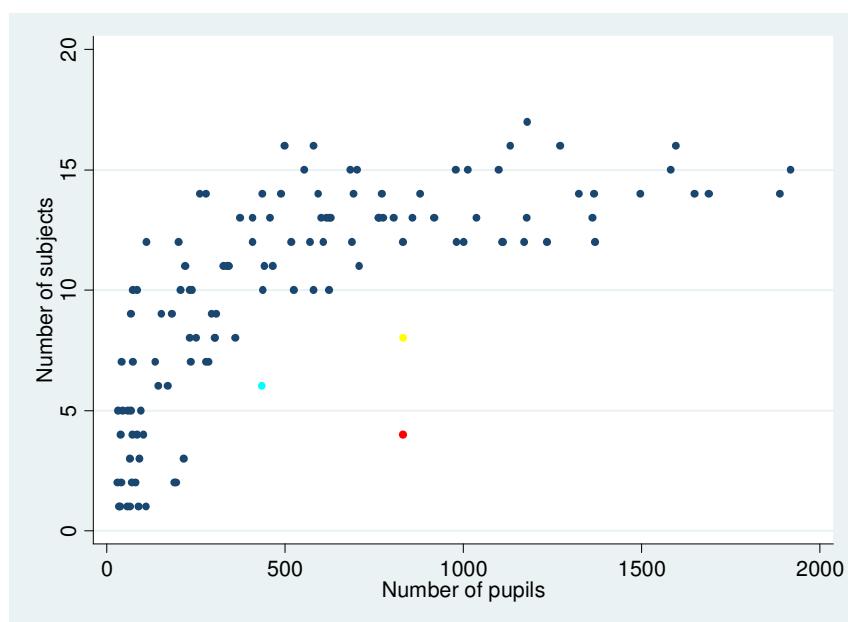
Figure 30 shows the distribution of the number of subjects per institution represented. There are 6 with only one subject (Creative Arts). These institutions are essentially specialist with relatively small numbers (see below).

	Number of students
Central School of Speech and Drama	35
Dartington College of Arts	37
Ravensbourne College of Design and Communication	58
Rose Bruford College	89
Wimbledon School of Art	64
Norwich School of Art and Design	110

⁴ Although the numbers in these subjects are artefacts of the sample, our sample is directly comparable to that of Broecke and Nicholls (2007).

The proportion of students pursuing a subject depends, of course, on the number of subjects offered and the size of the university, or the number of its students participating in this sample. Figure 31 plots the size of institutions as regards number of students (in the sample) and the number of subjects offered (in the sample). We see that institutions participating in this sample with more than 1000 students will necessarily have a high subject mix, but institutions with a small number of students have quite a variable subject mix. (Note the three outliers: red = University of the Arts, London; yellow = University of Oxford; and blue = London School of Economics and Political Science, which are again special cases for a variety of reasons).

Figure 31: Number of students by number of subjects offered (120 institutions)



In any attempt to disentangle subject and institution effects on our outcomes, these complexities of imbalance must be addressed in some way. Thus in order to summarise the most important features of the subject area composition of each institution, we now consider only those subjects in each institution with considerable weight in a particular sense. We restrict the number of ‘weighty’ subjects that dominate in each institution (the number of subjects of choice) to be those subjects with proportions greater than those that would be expected for the number of students and subjects offered by that institution. The pattern for the number of subjects per institution restricted in this sense is outlined in Table 13, below.

Table 13: Number subjects of ‘weight’ in institutions

Number of subjects (*)	Freq.	Per cent	Cum.
1	25	20.83	20.83
2	10	8.33	29.17
3	12	10.00	39.17
4	20	16.67	55.83
5	22	18.33	74.17
6	21	17.50	91.67
7	7	5.83	97.50
8	3	2.50	100.00
Total	120	100.00	

Note:

(*) denotes the number of subjects of choice in each university i.e. the number of subjects with proportions greater than those that would be expected for the number of students and subjects offered by its university.

We note then from this table, that if we look at the subject area composition of the dominating ‘weighty’ subjects for each institution there are only ten with high subject mix (seven to eight subjects). 92% of the institutions in our sample have a significant (relatively to their size) number of students in no more than six subjects, and 21% of them are largely dominated by a single subject area.

3.7.2 Single ‘weighty’ subject institutions

It is instructive to consider these single-subject institutions as in Table 14 below. Many of these are artefacts of the sample (e.g. University of Edinburgh with only a few students emerging with three-year degree courses out of the normal four-year Scottish degrees), so we should re-iterate that our main purpose here is in-depth investigation of the sample as a guide to feasible modelling. We are not attempting stylised facts about institution and subject in general. Table 14 shows the main subject represented, the percentage of the institution’s students in that subject, and the total number of subjects in the institution. Figure 32 shows the second percentage concentration of all students in the sample for the institution in this major subject and the subject in a diagrammatic way. The colours are for different subjects and are labelled on their first use in the diagram.

Table 14: Institutions with ‘weight’ in only one subject

(1)	(2)	(3)	(4)	(5)	(6)
1.	St George's Hospital Medical School	Allied to medicine	62	2	71
32.	University of Keele	Allied to medicine	79	4	84
109.	University of Edinburgh	Biological	42	5	45
111.	University of Wales, Bangor	Biological	65	11	338
113.	Writtle College	Agriculture	80	3	64

300.	Royal Agricultural College	Business	75	2	40
301.	Birmingham College of Food, Tourism and Creative Studies	Business	85	2	81
391.	University of Wales, Lampeter	History & Philosophy	75	5	32
445.	Cumbria Institute of the Arts	Arts	60	3	92
446.	North-East Wales Institute of Higher Education	Arts	61	7	41

447.	Swansea Institute of Higher Education	Arts	75	9	67
448.	University of the Arts, London	Arts	77	4	831
449.	Surrey Institute of Art and Design, University College	Arts	84	3	215
450.	University of Wales, Newport	Arts	86	7	73
451.	Arts Institute at Bournemouth	Arts	94	2	190

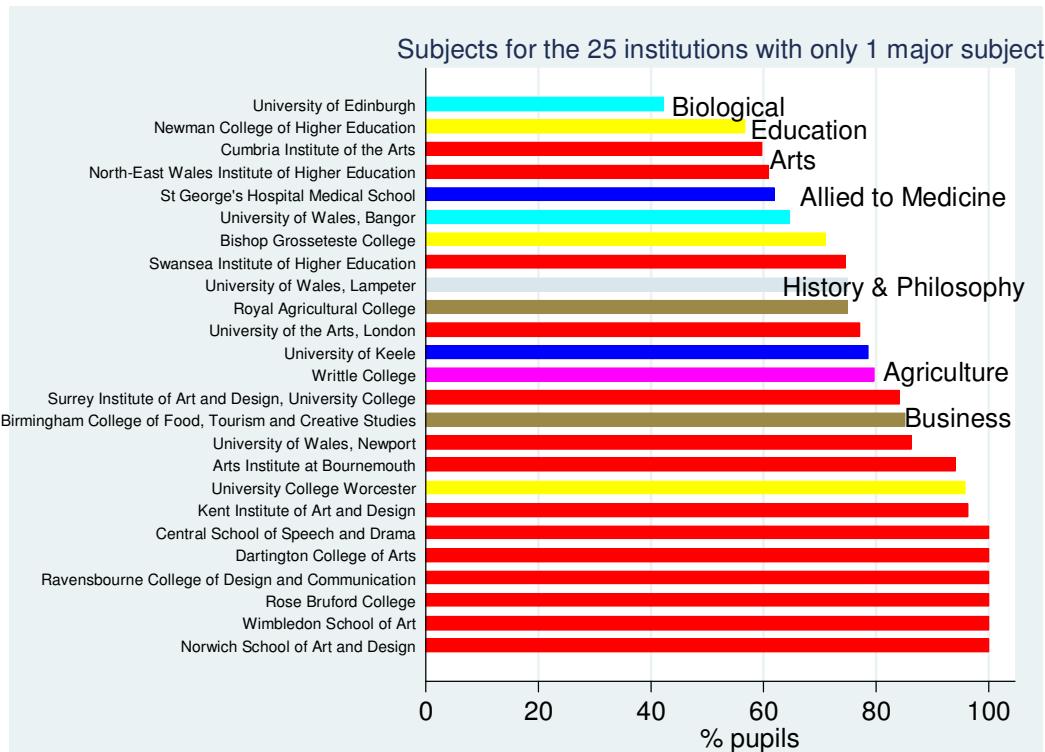
452.	Kent Institute of Art and Design	Arts	96	2	194
453.	Norwich School of Art and Design	Arts	100	1	110
454.	Rose Bruford College	Arts	100	1	89
455.	Central School of Speech and Drama	Arts	100	1	35
456.	Dartington College of Arts	Arts	100	1	37

457.	Wimbledon School of Art	Arts	100	1	64
458.	Ravensbourne College of Design and Communication	Arts	100	1	58
467.	Newman College of Higher Education	Education	57	2	30
468.	Bishop Grosseteste College	Education	71	4	38
469.	University College Worcester	Education	96	4	72

Column key

- (1) Institution code
- (2) Institution
- (3) The dominating subject
- (4) Percentage of institution’s students doing the subject
- (5) Total number of subjects
- (6) Number of students in the institution

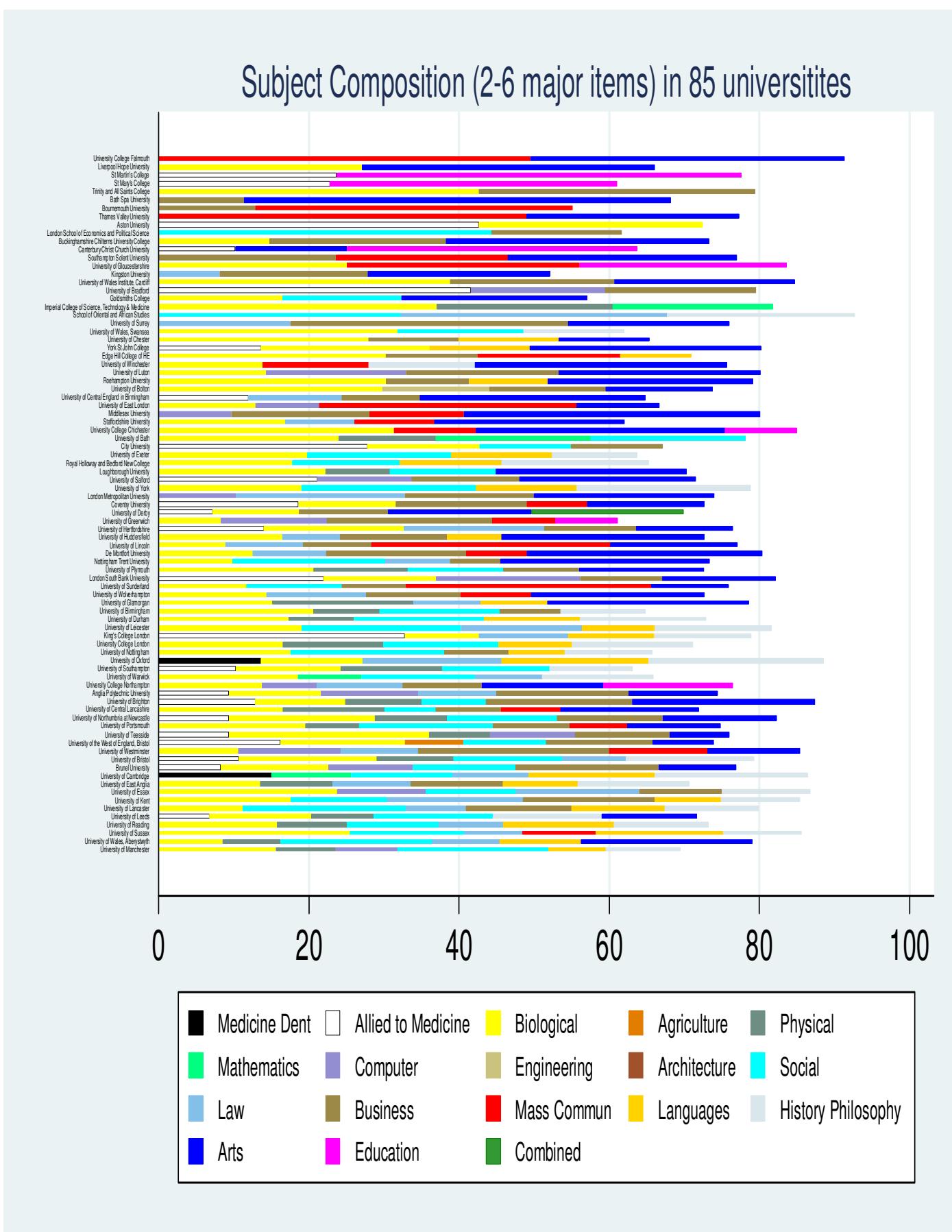
Figure 32: The 25 institutions with a single dominant subject, the major subject and percentage of students pursuing it



3.7.3 Institutions with two to six major dominant subjects

Figure 33, below, shows the subject area composition of the 85 institutions with two to six major subject areas sorted according to the number of different subjects: at the top are those with two different subject areas, and at the bottom are institutions with six. The major subjects, with only one exception, cover on average 70% of the institutions' subject area composition even for those with few major subjects. Biological Sciences are present across the spectrum with significant proportions, followed more patchily by Creative Arts. Social Studies, Historical and Philosophical Studies, and Law are present with significant proportions; Languages and Computer Sciences to a much lesser extent among institutions with a higher subject mix. These are usually the large university institutions. The presence of the rest of the subjects is very patchy across institutions with regard to both clustering with other subjects and size relevant to subject mix, with the exception of Education, which appears in significant proportions among institutions with a low subject mix.

Figure 33: Subject composition of 85 institutions with two to six major subjects



3.7.4 Institutions with seven to eight major dominant subjects

Figure 34, which is clearer, shows the corresponding subject area composition for the ten institutions that have seven or eight major subjects. The most common subject group across these ten relatively diverse bodies is Biological Sciences, followed by Social Sciences, Law, Business, Historical and Philosophical Studies, and Languages.

The complex patterns of relationships and balance between institutions and subject areas unravelled in an exploratory way in this section make for some difficulty in trying to disentangle what may be subject differentials in ethnic and gender effects in our sample and what may be institutional. It is difficult to see how anything other than very broad patterns may be unravelled. We adopt some pragmatic iterative approaches in fitting final models in Section 4.

Figure 34: Subject composition over major subjects in ten institutions with more than seven to eight major subject areas in the sample

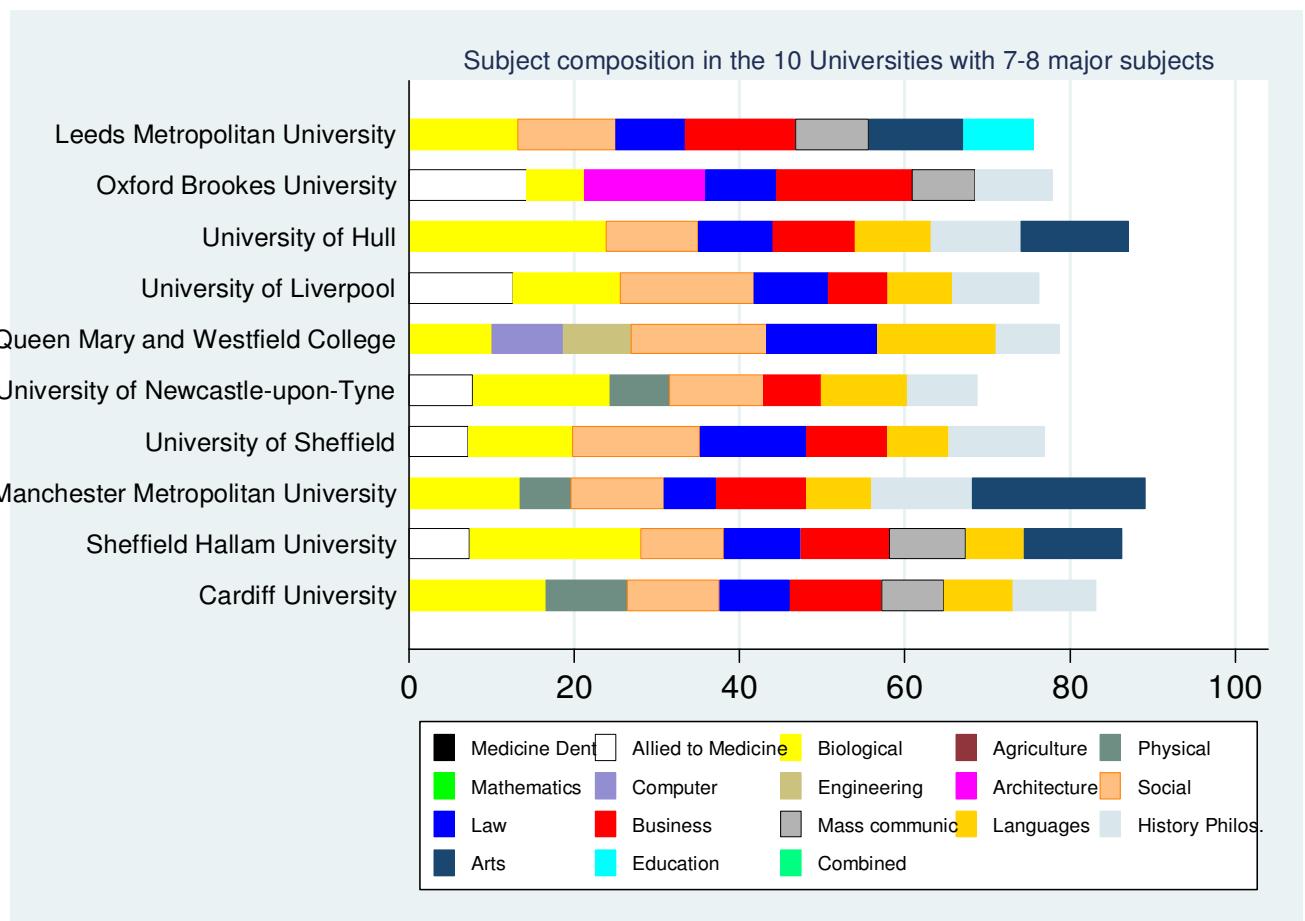
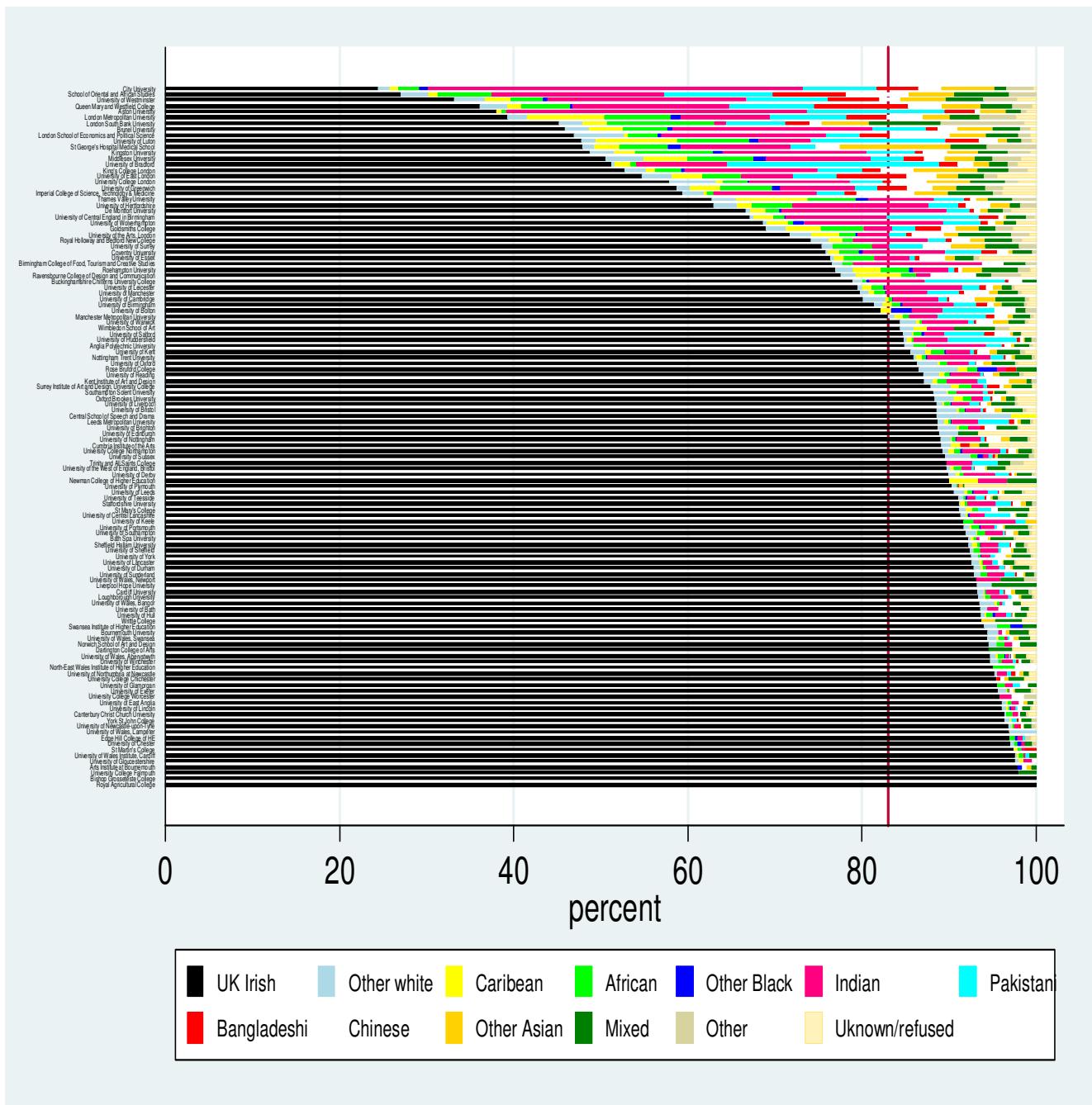


Figure 35: Distribution over ethnic categories for each institution ordered by percentage White British or Irish (the red vertical line denotes the overall percentage of White UK or Irish in the sample)



3.7.5 Institutional composition of ethnicity

Figure 35 indicates that a third ($n=40$) of the institutions in this sample have above average proportion of non-White UK and Irish ethnic minorities. Bishop Grosseteste College and Royal Agricultural College have no BME students at all. There are 71 institutions that have representatives across most of the ethnic minority spectrum. Thirty-three have representatives from all, another 16 all but Other Black, and the rest with no representatives from only one or two BME groups.

Figure 36: Number of institutions with representatives in the sample from each ethnic group

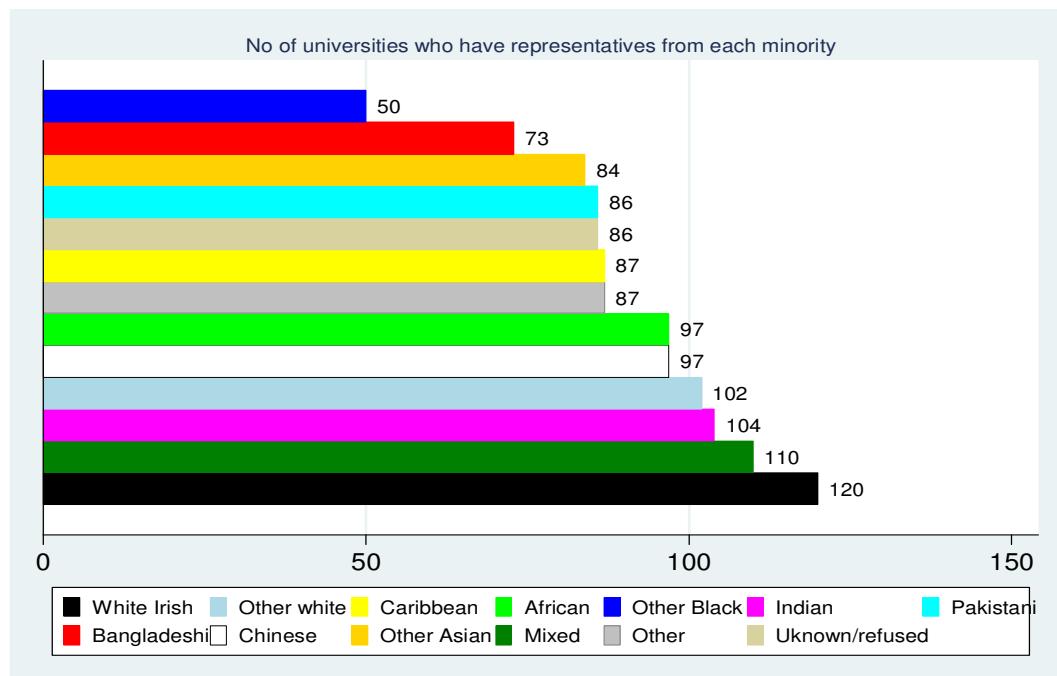


Table 15: Ethnicity composition of the study sample

Ethnic group	Freq.	Per cent
White UK & Irish	54,981	82.76
Indian	3,249	4.89
Pakistani	1,371	2.06
Mixed ethnic background	1,333	2.01
Chinese	843	1.27
Other White background	837	1.26
Black African	811	1.22
Unknown/Refused ethnic background	782	1.18
Other Asian background	710	1.07
Black Caribbean	517	0.78
Bangladeshi	477	0.72
Other ethnic background	409	0.62
Other Black background	111	0.17
Total	66,431	100.00

The pattern is seen in another useful and informative way in Figure 36, which shows for each ethnic category the number of institutions out of 120 who have representatives of that group. For comparison, the overall distribution across ethnicity categories is shown in Table 15. Some numbers in ethnic categories indicated are thus sparse and seen against Figure 36 will be thinly spread across a large number of institutions. Thus the identification of particular institutional differentials in ethnic effects on achievement is likely to be somewhat problematic. Allowing ethnic dummy effects to vary across the institutional level in multilevel models will thus run into some problems. This is taken into account in the later iterative model development.

3.7.6 Institutional composition regarding deprivation and relation to other intake characteristics

Figure 37 shows the pattern of student representation in three broad categories of their area IMD score for each institution. The categories are delineated by thresholds at the lower and upper quartile of IMD over the whole sample, and are labelled privileged, average and deprived. The distribution of the percentages in each group is also represented as a box plot in Figure 38. There are 12 institutions in which the proportion of students with average IMD score is less than 40%. For these institutions, the proportion of privileged is on average 13%, while the percentage of deprived is 50% on average. We might consider this a group of institutions with shrunken middle class in favour of deprived, and term it a *deprived institutional group*.

In the rest of the institutions (with more than 40% of students in the average IMD group), the average proportion of privileged and deprived is similar (24% on average). A minority of these universities will exceed 25% of deprived students (48% of all universities exceed 25% deprived) and we will term these a *low middle group*. Thus a significant proportion (a little less than half: 57) of universities have considerable social class mix; the remaining 63 we will call privileged. A useful deprivation compositional variable emerges for classifying the 120 institutions; 63 are privileged, 45 are low middle and 12 are deprived.

Figure 37: Institutional patterns of IMD score. Percentage of students in each of ranges: privileged = upper quartile of sample range of IMD scores; average = scores between upper and lower quartile; deprived = below lower quartile

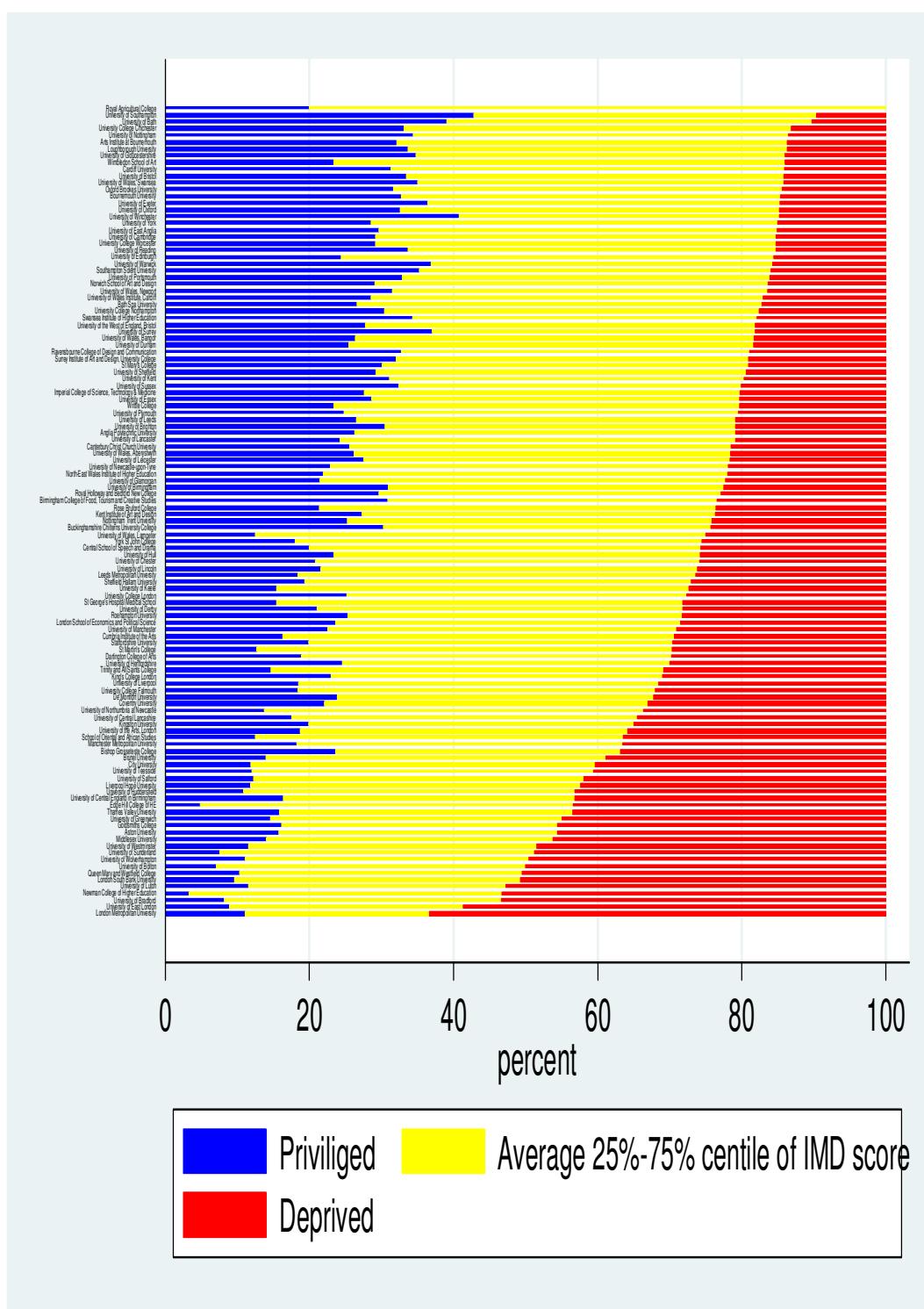
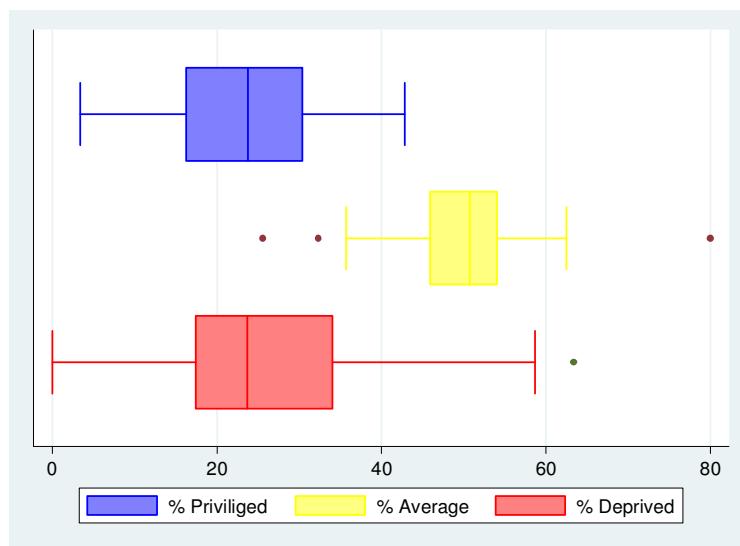


Figure 38: Boxplots for percentage privileged, percentage average deprivation, and percentage deprived (for 120 institutions)



The relation of ethnic composition and deprivation at institutional level suggests that selection at institutional level might be operating. Table 16 cross-classifies the 120 institutions according to this deprivation composition variable and whether the percentage from the non-White UK and Irish ethnic group was low or high, according to the previously defined threshold of whether the percentage was above or below the sample average. Among universities that have privileged intake according to this classification, only 16% have high non-White UK and Irish composition, compared to 42% and 92% for universities drawing their intakes from low middle and deprived neighbourhoods, respectively.

Table 16: Deprivation composition of institutions by percentage White UK or Irish

Deprivation composition	Below average % of non-White UK or Irish students	Above average % of non-White UK or Irish students	Totals
Privileged	53 (84%)	10(16%)	63 (100%)
Low Middle	26 (58%)	19 (42%)	45 (100%)
Deprived	1 (8%)	11 (92%)	12 (100%)
Total	80 (67%)	40 (33%)	120 (100%)

3.7.7 Institutional deprivation composition and subject prevalence

Of the 25 universities that concentrate predominantly on one subject, only one draws from the deprived intake class, eight from the low middle category and 16 from the privileged group.

3.7.8 Institutional deprivation composition and type

Russell group universities draw their intakes predominantly from privileged neighbourhoods (13 out of 18), but their ethnic composition can be diverse as seen previously.

4. The final models

4.1 Modelling strategy

The provenance of the models discussed in this section and the rationale for their organisation was discussed in Section 1.3.

4.2 Final models using normalise points scores for degree outcomes

In Table 16(a), models (A) to (D) broadly formalise the similar model development prior to introducing interactions that we followed in the trialling of models in Section 2, but in a scheme more directed to connecting with the final interaction models we wish to introduce at this stage. They accord with the model building, development and selection strategy outlined in the previous section. Starting from the base model (A) with ethnicity effects only, model (B) then adds the most important predictor, prior attainment, as a fourth-degree polynomial, and type of prior attainment. In model (C) we add subject area, which is closely related to prior attainment (see density plots of prior attainment according to subject area presented in Section 3). Model (D) then includes certain important demographic characteristics of students that we have used in previous sections and are available in the data, including the area indicator of IMD score that was found most useful in Section 1. During this process we note, as in Section 1, reductions in net effects of being in various BME groups, but all are still quite prevalent and quite significant statistically. Also the clear net effect of gender is established. Even after control for prior ability, subject and relevant personal characteristics (including ethnicity), females seem to perform at a relatively higher level.

Models (E) and (F) of Table 16(b) now further account for a multitude of possible contributory moderating patterns using a range of fixed covariate interactions informed by our explorations outlined in Sections 2 and 3. Model (F) differs from Model (E) in that it has rationalised the groupings for the ethnicity categorisation when interacting them with other covariates in the light of previous explorations. Finally Model (G) of Table 16(c), additionally introduces certain compositional effects of institutions that have been explored in earlier sections (proportion non-White; proportion female; mean IMD score; and a Russell Group indicator) and also includes a full exploration of interactions of individual characteristics with institutions through random slopes at the institutional level. Even after all this control, main ethnic-related gaps in higher education attainment remain and most are also significant statistically. The largest net main effects in the final fully controlled model are for Black Caribbean and Black African groups, closely followed by Chinese. The net main gaps from White are similar for Indian, Pakistani and Bangladeshi students, and are of the order of 0.2 standard deviations in the degree outcome.

4.2.1 The role of interactions with ethnicity

One of the main foci of this report was to use a fully specified model to investigate the extent to which ethnicity effects were moderated by other characteristics of students; the desire is to investigate interactions. We have explored many of them one at a time in our trials in Section 1. Now they are contextualised by reference to the full model.

From sizes of interaction terms in models (E), (F) and the Final Model, there is evidence that some of the BME group differentials in degree achievement vary somewhat according to gender, prior attainment, age, deprivation and institution attended. We consider each of these in turn and defer consideration of subject group until some related issues have been addressed.

Ethnicity and gender: The only statistically significant term is the female interaction with Pakistani or Pakistani/Bangladeshi when groupings are rationalised (on its own the Bangladeshi*female term in model (E) is relatively large, but not significant due to imprecision). It is negative here so that the negative marginal main ethnic effect for the reference gender males is even wider for females. Most other Asian groups have effects that are similarly negative, but are a bit smaller and not statistically significant. The interaction effects between female and various Black ethnic groups are by contrast positive, which means that any advantage females have over males is stronger for these groups. However, the effects are relatively small and not statistically significant.

Prior attainment: Higher prior attainment generally reduces the gap between all BME groups and the White reference group in the final models; the interaction effect of all known ethnic group dummies with the UCAS tariff score is positive. Since UCAS is a standardised score around a mean of zero this suggests that for students with comparable high ability (and hence positive scores) the gaps for various BME groups are narrowed. However, for students of below average ability the interactions are with negative scores, and the gap may be wider. This effect is particularly strong for Other White, Indian and Bangladeshi groups, where the effects are statistically significant in model (G). This also implies that although there are net raw achievement deficits, in fact given their starting points students from these backgrounds will make more progress. This is an important feature that may have been hidden by a concentration on overall raw outcomes.

Social deprivation: Two forms of this interaction effect are used in the models. In model (E) the full set of BME groups is used. However, many groups are really too small for any precise inference, so in model (F) and the Final Model some interactions use dummy variables for the coarser rationalised groupings. The White groups are combined together as the new reference category. All three Black groups are combined into a single Black group; Pakistani and Bangladeshi are combined, as are Chinese and Other Asians into a new Other Asian category. This re-grouping has little effect on our interpretations of interactions between IMD score and ethnicity, almost all of which are positive. The two small negative ones in the full model (E) are negligible.

There is some evidence that for most BME groups there is a real impact of the social deprivation of the student's background on ethnic differences. However, it seems in this case that for students from comparable areas of high deprivation, the gap between BME groups and their White peers narrows and possibly even reverses. For students from areas of low deprivation the gap may be widened. The general conclusion is that relative to White students, the performance of students from BME groups depends on the level of deprivation of areas they come from, with students from areas of low deprivation being more advantaged. These effects are consistent across all the ethnic groups, but are only statistically significant for Indian students and the combined Black group.

Effect of maturity: Ethnicity related gaps in performance relative to the White reference group are much wider for more mature students. All interactions of BME groups with the aged 22 or over dummy variable are negative, and most interactions for specific BME groups are highly significant statistically. Thus there appears a much greater net disadvantage of BME groups over the White reference group in achieving good degree results for mature students than there is for younger ones. Put another way the net advantage that seems to accrue for mature students is much weaker for students from BME backgrounds.

Institutional variation in ethnicity effects: For reasons given previously and that are evident in the detailed data exploration in Section 3, it is difficult due to data limitations to incorporate as level 2 random effects the institutional variation in detailed specific BME group effects. In our trials in Section 2 we investigated possible institution differences by classifying them into broad groups by various criteria and examining the ethnic parameter estimates from models fitted separately on the groups of institutions. None of this evidence was convincing for specific groups (use of gender and non-White make-up was illustrated), but did point to a more general institutional effect on the overall difference between BME groups in general and White students. So in the random part of our final model (G) we just fit a term for general non-White to White groups difference to vary over the level 2 institutions. Relative to other sources of institutional variation, the variance was quite high and significant. This suggests that there is considerable variability between institutions in the size of the advantage accruing to White students over their various non-White counterparts.

The ethnic gaps in attainment are also smaller in institutions with higher intakes i.e. prior attainment (from the random effect variance and covariances, a 0.53 positive correlation of non-White effect with prior attainment can be calculated). This could also explain the significantly large contextual net effect (0.373) on achievement of the proportion of non-White students in an institution. This positive effect is not necessarily interpretable in itself. It could serve as a proxy for an underlying variable related to differential impact of ethnicity in entering more selective (i.e. selecting their intakes) universities. The positive effect may be explained if, as a consequence of selection, we only observe the best performers from the ethnic minorities who manage to enter the more selective institutions. This is supported by the following

observations. The proportion non-White contextual effect is actually counterbalanced by interaction with the Russell Group indicator, suggesting that an increase in the proportion of non-White students is associated with better outcomes more often in Russell Group universities. Here Indian students, who have among the highest level of prior attainment, maintain their student share in this group of universities with an average of 4.5% (see Section 3 exploratory analyses).

4.2.2 The role of interactions with gender

There is evidence that gender differentials in HE attainment vary significantly according to prior attainment, age, qualification mix, subject area and institution. For some situations it seems that there is a female advantage, and in other cases not so. The range of covariates that moderate gender effects are quite varied, and it is thus unduly simplistic to take as a stylised fact the net female advantage overall, as evidenced in model (D), before important interactions are introduced.

Subject group: From an examination of the interactions of gender with subject group in the models (E) and (F) and the Final Model, it should be apparent that gender gaps are quite variable across subjects. It should be noted that the Final Model coefficients are not directly comparable since a different base reference subject group is used. However, the relative differences between the coefficients across models are consistent and allow some tentative generalisations. Females seem to be more advantaged relative to males among the sciences, Engineering and related subjects, and Computer Science (the reference main effect), and less so or even reversed in subjects such as Social Studies, Law, Business Studies, Languages, Historical and Philosophical Studies, and Creative Arts and Design.

Prior attainment and progress: From the combined age group and gender interactions with UCAS tariff score we see that older male students (22+) progress less well than younger males, and also slightly less well than females aged 22+. However, young females progress better than any of the other comparable groups. For students of comparable entrance level, the younger females group will achieve most. The reverse is the case for both males and females aged 22 and over, who make less progress on a comparable basis than the younger females and also the younger males. Gender group differentials are also modified according to qualification mix. More specifically, any female advantage in HE outcomes reduces significantly among those with vocational qualifications.

Institutional variation in gender effects: Gender gaps vary significantly across institutions as evidenced by the significant female dummy variance term across institutions. Thus net differences between the genders for any interacting sub-groups will also depend upon the particular institutions in which the students are studying.

4.2.3 The role of subject area

From the evidence discussed above and seen in the various flavours of models (E), (F) and (G), there is evidence that subject group differentials vary according to gender. By the same token, the gender differences will also vary according to different subject of study.

There is also evidence from the sometimes large and significant interaction terms with UCAS score that subject differentials vary according to prior attainment. Thus progress from a given starting point is widely variable between subjects. From the final model results we can compute the linear term in the UCAS relationship for different subjects (in order): Engineering and Technology (0.1232); Medicine (0.184); Architecture (0.253), Mathematical Sciences (0.259); Law (0.281); Computer Science (0.285 – the reference value); Physical Sciences (0.307); Education (0.307); Subjects Allied to Medicine (0.312); Mass Communications (0.316); Social Studies (0.333); Combined (0.344); Creative Arts and Design (0.348); Historical and Philosophical Studies (0.351); Languages (0.352); Biological Sciences (0.363); Business Studies (0.365); Agriculture (0.383); and Veterinary Science (0.578).

4.2.4 Ethnicity and subject group

It proved infeasible for reasons explained in previous sections to fit full sets of ethnicity by subject group interactions, although selected ones using the rationalised BME groupings are presented as part of the Final Model results. Thus due to data limitations⁵ only selected interactions were fitted and are discussed below.

The pattern of these fitted interaction effects are very varied, but hardly any are statistically significant. However, many are in fact quite substantial indicating some real variability among subjects between various BME groups

⁵ **Data limitations relating to subject interactions with ethnicity:** Ethnic minorities are spread very thinly across subjects in combination with the unbalanced subject uptake in the sample. Subjects with the highest proportion of ethnic minorities are not among the most popular in this sample, e.g. Computer Science has the highest proportion non-White followed by Medicine, Law, Business Studies and Subjects Allied to Medicine. The actual proportions of students taking these subjects up in the sample are only: 4%, 0.5% (from 3 universities), 7%, 9%, and 6% respectively. These patterns are considered in the exploratory work in Section 3.

More specifically, Medicine and Dentistry, Veterinary Science, Architecture, Agriculture, Mathematical Sciences, Education and Combined were grouped together and classified as Other in the interactions with ethnicity in the Final Model.

This was because:

- a) more than half of the universities did not contribute to data on these subjects
- b) the proportion of non-White students was much smaller, with a large number of ethnic minorities completely missing or being represented by very small numbers within a subject area.

It also proved necessary to use the rationalised ethnic groupings.

and the White reference category. There is considerable detail demonstrating that the ethnicity effects may be narrowed or widened according to different subject groups. For many subject groups the ethnic differences become quite narrow. Some are sufficient to convert a particular BME disadvantage into an apparently ethnic advantage. The significant positive interaction term between Pakistani/Bangladeshi groups and Engineering (0.277) is larger than the negative term for the reference group, and thus in this subject Pakistani/Bangladeshi students may have an advantage over their White counterparts. Broadly the same may be said for Pakistani/Bangladeshi students in Law, where again the positive interaction term is significant. Again, Indian students may have higher net performance in Creative Arts and Design than their White counterparts. A very large significant negative interaction term is that for Black students and Physical Sciences, where the disadvantage for Black students is even wider than that for other subject groups. (Note that HE attainment is significantly lower in Physical Sciences than in some other subjects.)

It was also infeasible due to data limitations and structure to incorporate subject differentials across institutions by level 2 random effects. *These terms might have been otherwise desirable.* Only one university offers 17 subjects (the maximum number of subjects offered by a university in the sample). Veterinary Science is only offered by one university (University of Cambridge), with only 3.4% of its participating students studying it. Medicine is offered by only three universities in this sample. Subject areas are spread too thinly across institutions to allow any significant interactions with institutions to emerge.

We might also have included *subject interactions with age*. This again was infeasible since the smallish number of older students is concentrated in Creative Arts and Design, and Education, resulting in very small numbers, or indeed empty cells, when studying interactions of subject with age.

Tables 16(a) to (c): Final continuous model results (using MlwiN iterative generalised least squares)

Table 16(a): Models (A) to (D)

Model (A) is the base model with ethnicity effects only; (B) adds in prior qualification controls; (C) introduces further variables relevant to prior qualifications, i.e. subject group dummies relative to Creative Arts and Design; and (D) adds in certain demographic characteristics including gender.

	(A)		(B)		(C)		(D)	
Fixed parameters	Estimate	Std error						
Intercept	-0.016		0.0486		0.166		0.063	
UCAS tariff score			0.3232	0.006***	0.322	0.0059***	0.338	0.006***
UCAS tariff score (squared)			-0.0051	0.005	0.000	0.0049	-0.013	0.005*
UCAS tariff score (cubed)			-0.0249	0.001***	-0.023	0.0014***	-0.022	0.001***
UCAS tariff score (quadrupled)			0.0034	0.001***	0.003	0.0007**	0.004	0.001***
Mix of A-levels and vocational qualifications			-0.0929	0.014***	-0.101	0.0136***	-0.092	0.013***
Vocational qualifications only			-0.1828	0.020***	-0.184	0.0199***	-0.158	0.020***
Ethnicity (Reference group: White UK & Irish)								
Other White	-0.089	0.0289***	-0.056	0.028	-0.052	0.0279	-0.066	0.028*
Black Caribbean	-0.382	0.0368***	-0.280	0.036***	-0.259	0.0356***	-0.258	0.035***
Black African	-0.458	0.0296***	-0.331	0.029***	-0.293	0.0287***	-0.300	0.029***
Other Black ethnic group	-0.279	0.0787***	-0.199	0.076*	-0.161	0.0758*	-0.166	0.075*
Indian	-0.296	0.0157***	-0.223	0.015***	-0.185	0.0153***	-0.163	0.015***
Pakistani	-0.332	0.0231***	-0.225	0.023***	-0.179	0.0225***	-0.160	0.023***
Bangladeshi	-0.326	0.0386***	-0.233	0.038***	-0.197	0.0373***	-0.169	0.037***
Chinese	-0.348	0.0286***	-0.316	0.028***	-0.286	0.0279***	-0.288	0.028***
Other Asian ethnic group	-0.259	0.0316***	-0.193	0.031***	-0.161	0.0306***	-0.164	0.030***
Mixed ethnic	-0.095	0.0230***	-0.062	0.022*	-0.058	0.0221***	-0.053	0.022*
Other ethnic group	-0.209	0.0412***	-0.136	0.040**	-0.111	0.0398***	-0.113	0.039*
Unknown/Refused ethnic group	-0.135	0.0299***	-0.081	0.029*	-0.079	0.0288**	-0.082	0.029*
Subjects (Reference group: Creative arts & design)								
Medicine & dentistry					-0.212	0.0480***	-0.207	0.048***
Subjects allied to medicine					-0.127	0.0169***	-0.159	0.017***
Biological sciences					-0.123	0.0128***	-0.121	0.013***
Veterinary science					-0.532	0.1199***	-0.529	0.119***
Agriculture & related subjects					-0.140	0.0395**	-0.144	0.039***
Physical sciences					-0.299	0.0169***	-0.269	0.017***
Mathematical sciences					-0.321	0.0252***	-0.292	0.025***
Computer science					-0.134	0.0184***	-0.066	0.019***
Engineering & technology					-0.284	0.0221***	-0.223	0.022***
Architecture, building & planning					-0.268	0.0288***	-0.228	0.029***
Social studies					-0.162	0.0137***	-0.145	0.014***
Law					-0.303	0.0156***	-0.299	0.015***
Business & administrative studies					-0.182	0.0141***	-0.154	0.014***
Mass communications & documentation					-0.048	0.0180	-0.040	0.018*
Languages					-0.035	0.0156	-0.051	0.016***
Historical & philosophical studies					-0.060	0.0150	-0.044	0.015*
Education					-0.198	0.0251***	-0.224	0.025***
Combined					-0.141	0.0441**	-0.140	0.044***
Demographic variables								
Female							0.125	0.007***
Aged 22 or over							0.350	0.012***
Lives at home full-time							-0.008	0.009*
Disabled							-0.039	0.012***
Neighbourhood level IMD score							-0.014	0.003***
Random part across institutions								
Cons	0.0474	0.0065	0.0267	0.00041	0.0221	0.0032	0.020	0.003

Key: standard errors in parentheses; $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table 16(b): Models (E) and (F)

Model (E) adds in certain explored interactions; (F) is similar to (E), but rationalises ethnicity groupings for some interaction terms.

	(E)		(F)	
Fixed parameters	Estimate	Std error	Estimate	Std error
Intercept	0.153		0.1531	
UCAS tariff score	0.353	0.0110***	0.3535	0.0110***
UCAS tariff score (squared)	-0.0213	0.0051***	-0.0214	0.0051****
UCAS tariff score (cubed)	-0.0214	0.0016***	-0.0215	0.0016***
UCAS tariff score (quadrupled)	0.0050	0.0008***	0.0050	0.0008***
Mix of A-levels and vocational qualifications	-0.0620	0.0215*	-0.0611	0.0215*
Vocational qualifications only	0.0159	0.0455	0.0158	0.0455
Ethnicity (Reference group: White UK & Irish)				
Other White	-0.0284	0.044	-0.0720	0.0276*
Black Caribbean	-0.2883	0.080**	-0.2993	0.0571***
Black African	-0.3249	0.059***	-0.3228	0.0500***
Other Black ethnic group	-0.2241	0.146	-0.1777	0.0920
Indian	-0.1297	0.024***	-0.1319	0.0243***
Pakistani	-0.0972	0.044*	-0.0864	0.0402*
Bangladeshi	-0.0412	0.080	-0.0888	0.0536
Chinese	-0.2675	0.043***	-0.2479	0.0370***
Other Asian ethnic group	-0.0874	0.048	-0.1161	0.0392*
Mixed ethnic	-0.0383	0.035	-0.0398	0.0345
Other ethnic group	0.1053	0.069	-0.0693	0.0519
Unknown/Refused ethnic group	-0.1234	0.041**	-0.0527	0.0375
Subjects (Reference group: Creative arts & design)				
Medicine & dentistry	-0.0715	0.1423	-0.0532	0.1423
Subjects allied to medicine	-0.3164	0.0330***	-0.3120	0.0330***
Biological sciences	-0.2832	0.0210***	-0.2828	0.0210***
Veterinary science	-0.9092	0.4348*	-0.9135	0.4349*
Agriculture & related subjects	-0.2432	0.0854*	-0.2437	0.0855*
Physical sciences	-0.4420	0.0241**	-0.4422	0.0241***
Mathematical sciences	-0.4215	0.0392***	-0.4209	0.0392***
Computer science	-0.1674	0.0232***	-0.1657	0.0232***
Engineering & technology	-0.3997	0.0276***	-0.3987	0.0276***
Architecture, building & planning	-0.2997	0.0362***	-0.2999	0.0362***
Social studies	-0.2411	0.0208***	-0.2410	0.0208***
Law	-0.3575	0.0261***	-0.3553	0.0261***
Business & administrative studies	-0.2856	0.0213***	-0.2851	0.0213***
Mass communications & documentation	-0.0993	0.0291**	-0.0989	0.0291**
Languages	-0.0374	0.0285	-0.0364	0.0285
Historical & philosophical studies	-0.1138	0.0228***	-0.1131	0.0228***
Education	-0.3384	0.0556***	-0.3378	0.0556***
Combined	-0.2779	0.0799**	-0.2767	0.0800**
Demographic variables				
Female	-0.0036	0.0184	-0.0040	0.0183
Aged 22 or over	0.3265	0.0157***	0.3256	0.0155***
Lives at home full-time	-0.0081	0.0089	-0.0078	0.0090
Disabled	-0.0414	0.0125**	-0.0412	0.0125**
Neighbourhood level IMD score	-0.0145	0.0053*	-0.0129	0.0053*
Gender by ethnicity interactions				
Other White*female	-0.0884	0.0554		
Black Caribbean*female	0.0311	0.0775		
Black African*female	0.0102	0.0586		
Other Black ethnic group*female	0.1380	0.1597		
Indian*female	-0.0433	0.0297		
Pakistani*female	-0.1052	0.0454*		

Bangladeshi*female	-0.0884	0.0750		
Chinese*female	0.0707	0.0550		
Other Asian ethnic group*female	-0.0993	0.0601		
Mixed ethnic*female	0.0025	0.0442		
Other ethnic group*female	-0.3395	0.0816***		
Unknown/Refused ethnic group*female	0.1071	0.0568		
<i>Rationalised interactions</i>				
Black*female		0.0306	0.0456	
Indian*female		-0.0403	0.0297	
Pakistani/Bangladeshi*female		-0.0985	0.0396*	
Other Asian*female		-0.0058	0.0410	
Mixed ethnic*female		0.0047	0.0442	
Other ethnic*female		-0.0321	0.0468	
<i>Other interactions involving gender</i>				
UCAS tariff score*male aged 22+ (Reference group: Males aged 22-)	-0.0969	0.0164***	-0.0976	0.0164***
UCAS tariff score*females aged 22-	0.0215	0.0077*	0.0212	0.0077*
UCAS tariff score*female aged 22+	-0.0838	0.0149***	-0.0841	0.0149***
IMD score*female	-0.0120	0.0065	-0.0131	0.0065*
Mix of A-levels and vocational qualifications*female	-0.0503	0.0262	-0.0517	0.0263
Vocational qualifications only*female	-0.0910	0.0377*	-0.0916	0.0377*
Medicine & dentistry*female	0.1552	0.0890	0.1426	0.0890
Subjects allied to medicine*female	0.2122	0.0369***	0.2072	0.0369***
Biological sciences*female	0.2339	0.0248***	0.2333	0.0248***
Veterinary science*female	-0.0718	0.2381	-0.0683	0.2381
Agriculture & related subjects*female	0.1647	0.0918	0.1662	0.0918
Physical sciences*female	0.3151	0.0323***	0.3161	0.0323***
Mathematical sciences*female	0.3325	0.0494***	0.3313	0.0494***
Computer science*female	0.1069	0.0456*	0.1021	0.04568
Engineering & technology*female	0.2129	0.0567**	0.2121	0.0567**
Architecture, building & planning*female	0.0633	0.0587	0.0626	0.0587
Social studies*female	0.1342	0.0257***	0.1337	0.0257***
Law*female	0.1138	0.0308**	0.1104	0.0308**
Business & administrative studies*female	0.2378	0.0271***	0.2374	0.0271***
Mass communications & documentation*female	0.0731	0.0350*	0.0723	0.0350*
Languages*female	-0.0206	0.0324	-0.0219	0.0325
Historical & philosophical studies*female	0.0743	0.0283*	0.0734	0.0283*
Education*female	0.1264	0.0593*	0.1246	0.0593*
Combined*female	0.2016	0.0914*	0.2005	0.0914*
<i>Other interactions involving ethnicity</i>				
UCAS tariff score*Other White	0.0516	0.0278	0.0492	0.0262
UCAS tariff score*Black Caribbean	0.0006	0.0393	0.0053	0.0387
UCAS tariff score*Black African	0.0557	0.0331	0.0505	0.0326
UCAS tariff score*Other Black ethnic group	-0.0053	0.0760	0.0028	0.0726
UCAS tariff score*Indian	0.0642	0.0151***	0.0642	0.0151***
UCAS tariff score*Pakistani	0.0391	0.0238	0.0345	0.0237
UCAS tariff score*Bangladeshi	0.0555	0.0390	0.0679	0.0385
UCAS tariff score*Chinese	0.0081	0.0258	0.0190	0.0254
UCAS tariff score*Other Asian ethnic group	0.0012	0.0313	-0.0119	0.0306
UCAS tariff score*Mixed ethnic	0.0138	0.0232	0.0137	0.0232
UCAS tariff score*Other ethnic group	0.0102	0.0402	-0.0031	0.0388
UCAS tariff score*Unknown/Refused ethnic group	-0.0572	0.0291	-0.0626	0.0287*
Aged 22+*Other White	-0.0240	0.0838		
Aged 22+*Black Caribbean	-0.3250	0.1033**		
Aged 22+*Black African	-0.2471	0.0784**		
Aged 22+*Other Black ethnic group	-0.2183	0.2098		
Aged 22+*Indian	-0.3341	0.0664***		
Aged 22+*Pakistani	-0.2727	0.0774**		
Aged 22+*Bangladeshi	-0.5293	0.1363**		

Aged 22+*Chinese	-0.5018	0.0941***		
Aged 22+*Other Asian ethnic group	-0.2386	0.0948*		
Aged 22+*Mixed ethnic	-0.2043	0.07718*		
Aged 22+*Other ethnic group	-0.3285	0.1179*		
Aged 22+*Unknown/Refused ethnic group	-0.1415	0.0867		
<i>Rationalised interactions</i>				
Aged 22+*Black		-0.2692	0.0607***	
Aged 22+*Indian		-0.3337	0.0664***	
Aged 22+*Pakistani/Bangladeshi		-0.3317	0.0677***	
Aged 22+*Other Asian		-0.3698	0.0675***	
Aged 22+*Mixed ethnic		-0.2034	0.0771*	
Aged 22+*Other ethnic		-0.1971	0.0704*	
IMD score*Other White	0.0516	0.0278		
IMD score*Black Caribbean	0.0537	0.0409		
IMD score*Black African	0.0723	0.0318*		
IMD score*Other Black ethnic group	0.0132	0.0702		
IMD score*Indian	0.0423	0.0156*		
IMD score*Pakistani	0.0415	0.0240		
IMD score*Bangladeshi	-0.0012	0.0386		
IMD score*Chinese	-0.0008	0.0261		
IMD score*Other Asian ethnic group	0.0293	0.0295		
IMD score*Mixed ethnic	0.0340	0.0211		
IMD score*Other ethnic group	0.0819	0.0398*		
IMD score*Unknown/Refused ethnic group	-0.0253	0.0283		
<i>Rationalised interactions</i>				
IMD score*Black		0.0590	0.0238*	
IMD score*Indian		0.0414	0.0156*	
IMD score*Pakistani/Bangladeshi		0.0294	0.0205	
IMD score*Other Asian		0.0125	0.0197	
IMD score*Mixed ethnic		0.0331	0.0211	
IMD score*Other ethnic		0.0064	0.0232	
Background interaction				
UCAS tariff score*disabled	-0.0170	0.0122	-0.0166	0.0122
IMD score*disabled	0.0220	0.0122	0.0215	0.0122
UCAS tariff score*Mix of A-levels and vocational	0.0007	0.0153	0.0010	0.0153
UCAS tariff score*Vocational qualifications only	0.0779	0.0281*	0.0782	0.0281*
UCAS tariff score*Medicine & dentistry	-0.1687	0.0708*	-0.1732	0.0708*
UCAS tariff score*Subjects allied to medicine	-0.0340	0.0163*	-0.0344	0.0164*
UCAS tariff score*Biological sciences	0.0135	0.0126	0.0134	0.0126
UCAS tariff score*Veterinary science	0.2033	0.2141	0.2040	0.2141
UCAS tariff score*Agriculture & related subjects	0.0332	0.0392	0.0325	0.0392
UCAS tariff score*Physical sciences	-0.0365	0.0172*	-0.0362	0.0172*
UCAS tariff score*Mathematical sciences	-0.0812	0.0250**	-0.0814	0.0250**
UCAS tariff score*Computer science	-0.0528	0.0175**	-0.0534	0.0175**
UCAS tariff score*Engineering & technology	-0.2330	0.0241***	-0.2338	0.0241***
UCAS tariff score*Architecture, building & planning	-0.0981	0.0292**	-0.0989	0.0292**
UCAS tariff score*Social studies	-0.0167	0.0135	-0.0164	0.0135
UCAS tariff score*Law	-0.0738	0.0154***	-0.0739	0.0154***
UCAS tariff score*Business & administrative studies	0.0126	0.0142	0.0128	0.0142
UCAS tariff score*Mass communications & documentation	-0.0360	0.0194	-0.0354	0.0194
UCAS tariff score*Languages	0.0011	0.0159	0.0008	0.0159
UCAS tariff score*Historical & philosophical studies	-0.0005	0.0154	-0.0004	0.0154
UCAS tariff score*Education	-0.0633	0.0242*	-0.0639	0.0242*
UCAS tariff score*Combined	0.0048	0.0487	0.0052	0.0487
Random part across institutions				
<i>Variances</i>				
Intercept	0.0193	0.0032	0.0192	0.004

Key: standard errors in parentheses; $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table 16(c): The Final Continuous Response Model (G)

Model (G) further introduces some institution-level contextual variables, such as the Russell Group indicator, proportion non-White students, proportion female and institutional aggregate mean IMD score. It explores interactions between these variables and the cross-level interaction of gender with proportion non-White.

The random part is further elaborated in order to study random slopes that represent interactions between institutions and certain individual level predictors, including a broad non-White ethnic indicator.

In this table the reference category for subject area is changed to Computer Science because it has the highest proportion of non-White students, and it works better when working with interactions with ethnicity.

Fixed parameters	Estimate	Std error
Intercept	0.207	
UCAS tariff score	0.285	0.0192***
UCAS tariff score (squared)	-0.015	0.0059*
UCAS tariff score (cubed)	-0.019	0.0018***
UCAS tariff score (quadrupled)	0.005	0.0008***
Mix of A-levels and vocational qualifications	-0.080	0.0266*
Vocational qualifications only	0.014	0.0523
Ethnicity		
Other White	-0.059	0.0297
Black Caribbean	-0.345	0.1015**
Black African	-0.365	0.0969**
Other Black ethnic group	-0.242	0.1255
Indian	-0.202	0.0533**
Pakistani	-0.210	0.0637***
Bangladeshi	-0.199	0.0737*
Chinese	-0.308	0.0687***
Other Asian ethnic group	-0.184	0.0707*
Mixed ethnic	0.050	0.1155
Other ethnic group	-0.075	0.1038
Unknown/Refused ethnic group	-0.077	0.1003
Subjects (Reference group: Computer Science)		
Medicine & dentistry	0.044	0.1471
Subjects allied to medicine	-0.188	0.0366***
Biological sciences	-0.138	0.0244***
Veterinary science	-0.852	0.4400
Agriculture & related subjects	-0.086	0.0867
Physical sciences	-0.289	0.0268***
Mathematical sciences	-0.268	0.0416**
Engineering & technology	-0.245	0.0310***
Architecture, building & planning	-0.163	0.0393***
Social studies	-0.089	0.0247**
Law	-0.239	0.0294***
Business & administrative studies	-0.152	0.0250***
Mass communications & documentation	0.025	0.0329
Languages	0.101	0.0309**
Historical & philosophical studies	0.026	0.0259
Creative arts & design	0.134	0.0256**
Education	-0.190	0.0581**
Combined	-0.161	0.0817
Demographic variables		
Female	0.109	0.0448*
Aged 22 or over	0.327	0.0217***
Lives at home full-time	-0.011	0.0089

Disabled	-0.042	0.0124**
Neighbourhood level IMD score	-0.020	0.0037***
Gender by ethnicity interactions		
<i>Rationalised interactions</i>		
Black*female	0.026	0.0480
Indian*female	-0.051	0.0330
Pakistani/Bangladeshi.*female	-0.106	0.0423*
Other Asian*female	-0.055	0.0436
Mixed ethnic*female	0.037	0.0464
Other ethnic*female	-0.040	0.0498
Other interactions involving gender		
UCAS tariff score*male aged 22+ (Reference group: Males aged 22+)	-0.088	0.0171***
UCAS tariff score*females aged 22-	0.028	0.0089**
UCAS tariff score*female aged 22+	-0.077	0.0157***
IMD score*female	-0.012	0.007
Mix of A-levels and vocational qualifications*female	-0.036	0.0264
Vocational qualifications only*female	-0.092	0.0383*
Medicine & dentistry*female	0.122	0.1018
Subjects allied to medicine*female	0.114	0.0537*
Biological sciences*female	0.097	0.0468*
Veterinary science*female	-0.118	0.2413
Agriculture & related subjects*female	0.023	0.1007
Physical sciences*female	0.179	0.0515**
Mathematical sciences*female	0.200	0.0624**
Engineering & technology*female	0.090	0.0695
Architecture, building & planning*female	-0.058	0.0702
Social studies*female	-0.008	0.0468
Law*female	-0.013	0.0492
Business & administrative studies*female	0.113	0.0463*
Mass communications & documentation*female	-0.040	0.0532
Languages*female	-0.149	0.0502*
Historical & philosophical studies*female	-0.051	0.0488
Creative arts and design*female	-0.115	0.0467*
Education*female	0.019	0.0727
Combined*female	0.098	0.1019
Other interactions involving ethnicity		
UCAS tariff score*Other White	0.075	0.0272*
UCAS tariff score*Black Caribbean	0.017	0.0401
UCAS tariff score*Black African	0.059	0.0340
UCAS tariff score*Other Black ethnic group	0.010	0.0744
UCAS tariff score*Indian	0.086	0.0171***
UCAS tariff score*Pakistani	0.048	0.0257
UCAS tariff score*Bangladeshi	0.089	0.0404*
UCAS tariff score*Chinese	0.049	0.0276
UCAS tariff score*Other Asian ethnic group	0.027	0.0327
UCAS tariff score*Mixed ethnic	0.035	0.0255
UCAS tariff score*Other ethnic group	0.021	0.0404
UCAS tariff score*Unknown/Refused ethnic group	-0.062	0.0306*
<i>Rationalised interactions</i>		
Aged 22+*Black	-0.269	0.0628***
Aged 22+*Indian	-0.349	0.0675***
Aged 22+*Pakistani/Bangladeshi	-0.311	0.0693***
Aged 22+*Other Asian	-0.376	0.0686***
Aged 22+*Mixed ethnic	-0.201	0.0778*
Aged 22+*Other ethnic	-0.214	0.0718*
IMD score*Black	0.049	0.0240*
IMD score*Indian	0.039	0.0158*
IMD score*Pakistani/Bangladeshi	0.023	0.0211

IMD score*Other Asian	0.013	0.0196
IMD score*Mixed ethnic	0.041	0.0217
IMD score*Other ethnic	0.009	0.0234
Selected interactions of coarse ethnic groups with subject group		
Black*Biological sciences	0.051	0.1067
Indian*Biological sciences	0.090	0.0688
Pakistani/Bangladeshi*Biological sciences	0.182	0.0788*
Other Asian*Biological sciences	0.217	0.0912*
Mixed ethnic*Biological sciences	-0.165	0.1305
Other ethnic*Biological sciences	0.019	0.1163
Black*Business & administrative studies	0.110	0.1048
Indian*Business & administrative studies	0.113	0.0619
Pakistani/Bangladeshi*Business & administrative studies	0.210	0.0743*
Other Asian*Business & administrative studies	0.147	0.0839
Mixed ethnic*Business & administrative studies	-0.090	0.1401
Other ethnic*Business & administrative studies	-0.039	0.1187
Black*Creative arts & design	-0.023	0.1061
Indian*Creative arts & design	0.224	0.0819*
Pakistani/Bangladeshi*Creative arts & design	-0.106	0.1138
Other Asian*Creative arts & design	0.173	0.0960
Mixed ethnic*Creative arts & design	-0.161	0.1298
Other ethnic*Creative arts & design	0.036	0.1182
Black*Engineering & technology	0.015	0.1346
Indian*Engineering & technology	-0.057	0.0972
Pakistani/Bangladeshi*Engineering & technology	0.277	0.1161*
Other Asian*Engineering & technology	-0.026	0.1082
Mixed*Engineering & technology	-0.096	0.1763
Other*Engineering & technology	-0.149	0.1640
Black*Historical & philosophical studies	-0.064	0.1685
Indian*Historical & philosophical studies	0.023	0.1081
Pakistani/Bangladeshi*Historical & philosophical studies	0.003	0.1233
Other Asian*Historical & philosophical studies	-0.001	0.1428
Mixed ethnic*Historical & philosophical studies	-0.081	0.1436
Other ethnic*Historical & philosophical studies	0.121	0.1271
Black*Languages	0.189	0.1492
Indian*Languages	0.136	0.1016
Pakistani/Bangladeshi*Languages	0.122	0.1172
Other Asian*Languages	0.205	0.1481
Mixed ethnic*Languages	-0.242	0.1387
Other ethnic*Languages	0.153	0.1448
Black*Law	0.146	0.1054
Indian*Law	0.135	0.0685
Pakistani/Bangladeshi*Law	0.227	0.0758*
Other Asian*Law	0.278	0.0986*
Mixed ethnic*Law	-0.057	0.1372
Other ethnic*Law	-0.019	0.1278
Black*Mass communications and documentation	0.066	0.1223
Indian*Mass communications and documentation	0.177	0.0994
Pakistani/Bangladeshi*Mass communications and documentation	0.247	0.1351
Other Asian*Mass communications and documentation	0.393	0.1807
Mixed ethnic*Mass communications and documentation	-0.073	0.1552*
Other ethnic*Mass communications and documentation	-0.029	0.1423
Black*Other	0.067	0.1424
Indian*Other	0.054	0.0767
Pakistani/Bangladeshi*Other	0.113	0.1025
Other Asian*Other	0.008	0.0944
Mixed ethnic*Other	0.097	0.1442
Other ethnic*Other	0.114	0.1350
Black*Physical sciences	-0.439	0.1781*
Indian*Physical sciences	0.011	0.1085
Pakistani/Bangladeshi*Physical sciences	0.312	0.1549
Other Asian*Physical sciences	-0.303	0.1439
Mixed ethnic*Physical sciences	-0.116	0.1598
Other ethnic*Physical sciences	0.227	0.1427
Black*Social studies	0.112	0.1083
Indian*Social studies	0.118	0.0644

Pakistani/Bangladeshi*Social studies	0.110	0.0795
Other Asian*Social studies	-0.004	0.0877
Mixed ethnic*Social studies	-0.065	0.1319
Other ethnic*Social studies	-0.033	0.1172
Black*Subjects allied to medicine	0.054	0.1199
Indian*Subjects allied to medicine	0.012	0.0701
Pakistani/Bangladeshi*Subjects allied to medicine	0.017	0.0834
Other Asian*Subjects allied to medicine	0.129	0.1017
Mixed ethnic*Subjects allied to medicine	-0.142	0.1557
Other ethnic*Subjects allied to medicine	0.026	0.1392
Background interaction		
UCAS tariff score*disabled	-0.015	0.0123
IMD score*disabled	0.023	0.0121
UCAS tariff score*Mix of A-levels and vocational	-0.013	0.0168
UCAS tariff score*Vocational qualifications only	0.070	0.0291*
UCAS tariff score*Medicine & dentistry	-0.101	0.0728
UCAS tariff score*Subjects allied to medicine	0.027	0.0212
UCAS tariff score*Biological sciences	0.078	0.0179***
UCAS tariff score*Veterinary science	0.293	0.2161
UCAS tariff score*Agriculture & related subjects	0.098	0.0424*
UCAS tariff score*Physical sciences	0.022	0.0211
UCAS tariff score*Mathematical sciences	-0.026	0.0274
UCAS tariff score*Engineering & technology	-0.162	0.0267***
UCAS tariff score*Architecture, building & planning	-0.032	0.0318
UCAS tariff score*Social studies	0.048	0.0181*
UCAS tariff score*Law	-0.004	0.0198
UCAS tariff score*Business & administrative studies	0.080	0.0189***
UCAS tariff score*Mass communications & documentation	0.031	0.0241
UCAS tariff score*Languages	0.067	0.0206**
UCAS tariff score*Historical & philosophical studies	0.066	0.0198**
UCAS tariff score*Creative arts & design	0.063	0.0183**
UCAS tariff score*Education	0.022	0.0297
UCAS tariff score*Combined	0.059	0.0523
Institutional variables and interactions		
Institutional Russell Group indicator	0.084	0.0520
Institution level mean UCAS tariff score	-0.068	0.0356
Institution level std. dev. of UCAS tariff score	-0.257	0.1023*
Institution mean IMD score	-0.007	0.0589
Institution level proportion of females	-0.498	0.1760*
Institution level proportion non-White	0.373	0.1183**
<i>Institution-level interactions</i>		
Russell Group*proportion non-White	0.692	0.5855
Institutional proportion female*proportion non-White	0.473	0.2004*
<i>Cross-level interaction</i>		
Female*institutional proportion non-White	-0.149	0.0691*
Random part across institutions		
<i>Variances (all significant)</i>		
Intercept	0.029	0.0059
UCAS tariff score	0.004	0.0009
Mix of A-levels and vocational qualifications	0.017	0.0062
Vocational qualifications only	0.031	0.0109
Female	0.010	0.0026
Aged 22+	0.018	0.0056
Non-White	0.008	0.0028
<i>Covariances (Correlations)</i>		
Intercept/UCAS tariff score	-0.002 (-0.186)	0.0020
Intercept/Mix of A-levels and vocational qualifications	-0.003 (-0.135)	0.0047
Intercept/Vocational qualifications only	0.000 (0.012)	0.0060
Intercept/Fe male	-0.010 (-0.587)	0.0033
Intercept/Aged 22 +	-0.008 (-0.351)	0.0044
Intercept/Non-White	-0.002 (-0.132)	0.0031

UCAS tariff score/Mix of A-levels and vocational qualifications	-0.001 (-0.122)	0.0018
UCAS tariff score/Vocational qualifications only	0.002 (0.180)	0.0027
UCAS tariff score/Female	0.000 (0.002)	0.0011
UCAS tariff score/Aged 22+	0.002 (0.236)	0.0017
UCAS tariff score/Non-White	0.003 (0.530)	0.0012
Mix of A-levels and vocational qualifications/Vocational qualifications only	0.010 (0.436)	0.0062
Mix of A-levels and vocational qualifications/Female	0.001 (0.077)	0.0027
Mix of A-levels and vocational qualifications/Aged 22+	-0.004 (-0.229)	0.0040
Mix of A-levels and vocational qualifications/Non-White	-0.001 (-0.086)	0.0030
Vocational qualifications only/Female	-0.006 (-0.341)	0.0037
Vocational qualifications only/Aged 22+	-0.001 (-0.042)	0.0051
Vocational qualifications only/Non-White	0.005 (0.317)	0.0037
Female/Aged 22+	0.004 (0.298)	0.0027
Female/Non-White	0.000 (0.056)	0.0019
Aged 22+/Non-White	0.000 (0.004)	0.0028
Individual student level variance		
Intercept	0.609	0.0034

Key: standard errors in parentheses; $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

4.3 The final models: using ordered category response for degree class⁶

4.3.1 Aspects of the ordinal model requiring further clarification: subject group as a covariate

It proved difficult to cope computationally with all the 17 subject area dummies in these models, mainly for various reasons previously discussed, as they are more complex to estimate. Thus in order to cope, and informed by the previous data exploration of Section 3 and subject area interactions with ethnicity, gender and prior attainment in previous modelling, we have grouped subject areas further into five groups. The rationale behind the grouping is according to levels of prior attainment and whether a subject belongs to a rough science/non-science divide. The coarser groupings we use are as follows:

Science (S): This combines Biological, Physical and Mathematical Sciences, and consists of students with generally average to high prior attainment.

New Combined (NC): This includes the previous Combined group and the mainly medical related subjects: Medicine and Dentistry; Subjects Allied to Medicine; Veterinary Science; and Agricultural subjects. Veterinary Science, Agriculture and old Combined have very low proportions of BME group students, while Medicine and Subjects Allied to Medicine are groups with the highest proportion of BME students. This New Combined group is dominated by students in Subjects Allied to Medicine and has the lowest proportion of females. Again this broad grouping has average to high levels of prior attainment.

Technology (T): This includes Computer Science, Engineering and Technology, Architecture, Business and Mass Communications. This group is dominated by students in Business and has low to average prior attainment.

Creative Arts/Education and Social Studies (CEAS): This includes Social Studies, Education, and Creative Arts and Design. This group has the highest proportion of females. It generally has average to low prior attainment.

Law/Languages/History/Philosophy (LLHP): This group generally has average levels of prior achievement.

Table 17 cross-tabulates the number of students involved in the old and new subject groupings.

⁶ As discussed in Section 1, interpretation of effects in logit models for ordered categories and how they are exponentiated to give the corresponding multiplicative odds ratio effects as displayed in our tables of results may be found in any basic econometrics text, although Greene's *Econometric Analysis* (as cited in Section 1) is as good as any.

Table 17: Original subject group by redefined subject group

Degree subject	Coarse subject groupings					LLHP	Total
	NC	S	T	CEAS			
Medicine & dentistry	345	0	0	0	0	0	345
Subjects allied to med	3,721	0	0	0	0	0	3,721
Biological sciences	0	9,893	0	0	0	0	9,893
Veterinary science	46	0	0	0	0	0	46
Agriculture & related	471	0	0	0	0	0	471
Physical sciences	0	3,491	0	0	0	0	3,491
Mathematical sciences	0	1,262	0	0	0	0	1,262
Computer science	0	0	2,725	0	0	0	2,725
Engineering & tech	0	0	1,610	0	0	0	1,610
Architecture & building	0	0	896	0	0	0	896
Social studies	0	0	0	7,713	0	0	7,713
Law	0	0	0	0	4,710	4,710	4,710
Business & admin	0	0	6,059	0	0	0	6,059
Mass communications	0	0	2,901	0	0	0	2,901
Languages	0	0	0	0	4,597	4,597	4,597
Historical & phil	0	0	0	0	5,439	5,439	5,439
Creative arts & design	0	0	0	8,761	0	0	8,761
Education	0	0	0	1,410	0	0	1,410
Combined	381	0	0	0	0	0	381
Total	4,964	14,646	14,191	17,884	14,746	14,746	66,431

4.3.2 Main effects

Since we have interaction effects present in the models of this section, it must be stressed again that the net main effects of covariates usually only relate to reference groups, and are capable of being moderated by other contingent conditions when the covariates are involved in important interaction effects. This is of particular importance when we come to consider our factors of main interest, ethnicity and gender.

The model results in Table 18 unsurprisingly broadly correspond to the continuous points models of Section 4.2, except that they are now interpreted as regards odds ratios. However, using the logit model with certain effects made non-proportional means that the actual parameter estimates (multiplicative effects on odds) are now directly comparable with the previous work of Broecke and Nicholls (2007).

Table 18: The ordered category response multilevel model (with non-proportional odds for certain characteristics)

Notes: In this table the cumulative distribution over the degree classes is denoted as follows:

A = 3rd or Pass; B = 2.2 or below; and C = 2.1 or below.

For covariates where non-proportional odds are allowed there will be three estimates for A, B and C as above. The rest of the effects are fitted as proportional odds.

Fixed parameters	Estimate	Std error	Odds Ratio	95% Confidence Interval	
Threshold parameter A	-3.163	0.1382			
Threshold parameter B	-0.710	0.1329			
Threshold parameter C	1.846	0.1358			
UCAS tariff score	-0.709	0.0295***	2.0316	1.9194	2.1576
Mix of A-levels and vocational qualifications	0.253	0.0524***	0.7769	0.7012	0.8633
Vocational qualifications only	0.551	0.1034***	0.5765	0.4752	0.7096
Ethnicity (different odds across degree scale)					
A & B: Other White	0.218	0.0810*	0.8040	0.6880	0.9474
A & B: Black Caribbean	0.699	0.1949**	0.4969	0.3322	0.7175
A & B: Black African	0.769	0.1860***	0.4633	0.3185	0.6703
A & B: Other Black ethnic group	0.477	0.2812	0.6206	0.3628	1.0768
A & B: Indian	0.296	0.1063*	0.7437	0.6041	0.9139
A & B: Pakistani	-0.031	0.1575	1.0314	0.7695	1.4106
A & B: Bangladeshi	-0.148	0.1922	1.1592	0.8114	1.7092
A & B: Chinese	0.419	0.1408*	0.6579	0.5026	0.8685
A & B: Other Asian ethnic group	0.101	0.1509	0.9042	0.6723	1.2165
A & B: Mixed ethnic	0.148	0.1460	0.8628	0.6590	1.1630
A & B: Other ethnic group	-0.001	0.1839	1.0012	0.6970	1.4391
A & B: Unknown/Refused ethnic group	-0.053	0.1538	1.0543	0.7757	1.4106
C: Other White	0.007	0.1205	0.9929	0.7788	1.2536
C: Black Caribbean	1.123	0.3112**	0.3253	0.1726	0.5863
C: Black African	1.088	0.2669***	0.3369	0.1977	0.5678
C: Other Black ethnic group	0.821	0.5172	0.4398	0.1456	1.1275
C: Indian	0.193	0.1247	0.8248	0.6427	1.0544
C: Pakistani	-0.055	0.1826	1.0568	0.7423	1.5098
C: Bangladeshi	0.280	0.2641	0.7556	0.4493	1.2624
C: Chinese	0.382	0.1841*	0.6824	0.4738	0.9812
C: Other Asian ethnic group	0.189	0.1952	0.8279	0.5633	1.2092
C: Mixed ethnic	0.146	0.1705	0.8639	0.6231	1.2177
C: Other ethnic group	0.246	0.2502	0.7822	0.4752	1.2461
C: Unknown/Refused ethnic group	-0.141	0.1904	1.1510	0.7937	1.6770
Subjects (Reference group: Science) (different odds across degree scale)					
A: New Combined	-0.376	0.1034*	1.4560	1.1865	1.7860
A: Technology	-0.334	0.0576***	1.3967	1.2486	1.5667
A: Creative Arts/Education/Social Studies	-0.772	0.0610***	2.1632	1.9213	2.4498
A: Law/Languages/History/Philosophy	-1.185	0.0775***	3.2707	2.7899	3.7924
B: New Combined	-0.084	0.0685	1.0876	0.9531	1.2423
B: Technology	-0.236	0.0364***	1.2668	1.1747	1.3566
B: Creative Arts/Education/Social Studies	-0.478	0.0359***	1.6125	1.5008	1.7246
B: Law/Languages/History/Philosophy	-0.555	0.0386***	1.7418	1.6096	1.8739
C: New Combined	0.016	0.0792	0.9842	0.8462	1.1584
C: Technology	-0.154	0.0512**	1.1668	1.0544	1.2879
C: Creative Arts/Education/Social Studies	-0.217	0.0466***	1.2422	1.1343	1.3621

C: Law/Languages/History/Philosophy	0.205	0.0520**	0.8155	0.7379	0.9003
Demographic variables					
A: Female	-0.996	0.0596***	2.7069	2.4013	3.0374
B: Female	-0.662	0.0461***	1.9383	1.7700	2.1149
C: Female	-0.243	0.0421***	1.2758	1.1806	1.3882
Aged 22 or over (proportional odds)	-0.810	0.0555***	2.2488	2.0178	2.5068
Lives at home full-time (proportional odds)	0.063	0.0230*	0.9388	0.8967	0.9831
Disabled (proportional odds)	0.097	0.0310**	0.9079	0.8547	0.9656
Neighbourhood level IMD score	0.0483	0.0094***	0.9529	0.9361	0.9704
Gender by ethnicity interactions (proportional odds)					
<i>Rationalised interactions</i>					
Black*female	-0.032	0.1231	1.0324	0.8122	1.3205
Indian*female	0.133	0.0774	0.8758	0.7543	1.0222
Pakistani/Bangladeshi*female	0.310	0.1062*	0.7333	0.5945	0.8985
Other Asian*female	0.139	0.1022	0.8700	0.7103	1.0629
Mixed ethnic*female	-0.037	0.1140	1.0382	0.8278	1.2853
Other ethnic*female	0.202	0.1197	0.8170	0.6512	1.0315
Other interactions involving gender (proportional odds)					
UCAS tariff score*male aged 22+ (Reference group: Males aged 22-)	0.310	0.042***	0.7336	0.6737	0.7985
UCAS tariff score*females aged 22-	-0.062	0.0194**	1.0646	1.0253	1.1052
UCAS tariff score*females aged 22+	0.241	0.0406***	0.7862	0.7240	0.8513
IMD score*female					
New Combined*Female	0.150	0.0736*	0.8610	0.7416	0.9960
Technology*Female	0.194	0.0494**	0.8235	0.7498	0.9085
Creative Arts/Education/Social Studies*Female	0.401	0.0440***	0.6695	0.6145	0.7305
Law/Languages/History/Philosophy*Female	0.482	0.0482***	0.6171	0.5638	0.6825
Other interactions involving ethnicity (proportional odds)					
UCAS tariff score*Other White	-0.163	0.0727*	1.1769	1.0192	1.3580
UCAS tariff score*Black Caribbean	-0.050	0.1064	1.0511	0.8564	1.2982
UCAS tariff score*Black African	-0.166	0.0868	1.1802	0.9940	1.3993
UCAS tariff score*Other Black ethnic group	0.053	0.1935	0.9487	0.6557	1.3951
UCAS tariff score*Indian	-0.194	0.0430***	1.2141	1.1163	1.3192
UCAS tariff score*Pakistani	-0.135	0.0659*	1.1447	1.0070	1.3034
UCAS tariff score*Bangladeshi	-0.310	0.1077*	1.3637	1.1074	1.6871
UCAS tariff score*Chinese	-0.058	0.0698	1.0594	0.9259	1.2141
UCAS tariff score*Other Asian ethnic group	0.044	0.0852	0.9575	0.8146	1.1354
UCAS tariff score*Mixed ethnic	-0.094	0.0669	1.0983	0.9637	1.2523
UCAS tariff score*Other ethnic group	-0.029	0.1080	1.0296	0.8294	1.2649
UCAS tariff score*Unknown/Refused ethnic group	0.136	0.0763	0.8729	0.7535	1.0151
<i>Rationalised interactions(proportional odds)</i>					
Aged 22+*Black	0.7280	0.1547***	0.4829	0.3574	0.6590
Aged 22+*Indian	0.9246	0.1653***	0.3967	0.2891	0.5521
Aged 22+*Pakistani/Bangladeshi	0.8493	0.1788***	0.4277	0.3030	0.6157
Aged 22+*Other Asian	0.9495	0.1754***	0.3869	0.2674	0.5417
Aged 22+*Mixed ethnic	0.5803	0.2058*	0.5597	0.3742	0.8311
Aged 22+*Other ethnic	0.5294	0.1803*	0.5890	0.4173	0.8496
IMD score*Black	-0.115	0.0612	1.1213	0.9930	1.2611
IMD score*Indian	-0.103	0.0405*	1.1087	1.0222	1.1984
IMD score*Pakistani/Bangladeshi	-0.055	0.0537	1.0561	0.9531	1.1782
IMD score*Other Asian	-0.015	0.0510	1.0152	0.9176	1.1241
IMD score*Mixed ethnic	-0.090	0.0551	1.0946	0.9802	1.2238
IMD score*Other ethnic	-0.015	0.0574	1.0147	0.9076	1.1366
<i>Selected interactions of coarse ethnic groups with broader subject groupings (proportional odds)</i>					
Black*New Combined	-0.0885	0.2387	1.0925	0.6845	1.7577
Indian*New Combined	0.2336	0.1329	0.7917	0.6053	1.0263

Pakistani/Bangladeshi*New Combined	0.4670	0.1895*	0.6269	0.4352	0.9103
Other Asian*New Combined	-0.0030	0.1999	1.0030	0.6744	1.4785
Mixed ethnic*New Combined	-0.2194	0.2488	1.2453	0.7581	2.0462
Other ethnic*New Combined	-0.0578	0.2485	1.0595	0.6453	1.7350
Black*Technology	-0.0737	0.1688	1.0765	0.7827	1.5038
Indian*Technology	0.0317	0.1060	0.9688	0.7898	1.1841
Pakistani/Bangladeshi*Technology	0.1575	0.1452	0.8543	0.6357	1.1185
Other Asian*Technology	0.2143	0.1483	0.8071	0.5993	1.0747
Mixed ethnic*Technology	-0.1538	0.1770	1.1663	0.8204	1.6389
Other ethnic*Technology	0.2292	0.1745	0.7952	0.5724	1.1309
Black*Creative Arts/Education/Social Studies	0.0438	0.1789	0.9571	0.6744	1.3458
Indian*Creative Arts/Education/Social Studies	-0.0280	0.1147	1.0284	0.8179	1.2789
Pakistani/Bangladeshi*Creative Arts/Education/Social Studies	0.4518	0.1659*	0.6365	0.4589	0.8816
Other Asian*Creative Arts/Education/Social Studies	0.1835	0.1624	0.8324	0.6053	1.1286
Mixed ethnic*Creative Arts/Education/Social Studies	-0.0115	0.1608	1.0116	0.7386	1.3979
Other ethnic*Creative Arts/Education/Social Studies	0.2266	0.1697	0.7972	0.5741	1.1129
Black*Law/Languages/History/Philosophy	0.1238	0.1826	0.8836	0.6151	1.2561
Indian*Law/Languages/History/Philosophy	0.2324	0.1196	0.7926	0.6294	1.0010
Pakistani/Bangladeshi*Law/Languages/History/Philosophy	0.4058	0.1551*	0.6664	0.4877	0.9039
Other Asian*Law/Languages/History/Philosophy	0.0703	0.1884	0.9321	0.6544	1.3703
Mixed ethnic*Law/Languages/History/Philosophy	0.1336	0.1689	0.8749	0.6307	1.2251
Other ethnic*Law/Languages/History/Philosophy	0.0586	0.1878	0.9430	0.6570	1.3689
Background interaction (proportional odds)					
UCAS tariff score*Disabled	0.0561	0.0312	0.9455	0.8878	1.0020
UCAS tariff score*IMD score	0.0068	0.0085	0.9932	0.9763	1.0101
UCAS tariff score*Mix of A-levels and vocational	0.0606	0.0420	0.9412	0.8676	1.0212
UCAS tariff score*Vocational qualifications only	0.3304	0.0593***	0.7186	0.6427	0.8098
UCAS tariff score>New Combined	0.048	0.0354	0.9536	0.8905	1.0202
UCAS tariff score*Technology	0.035	0.0270	0.9654	0.9158	1.0182
UCAS tariff score*Creative Arts/Education/Social Studies	0.007	0.0256	0.9935	0.9436	1.0429
UCAS tariff score*Law/Languages/History/Philosophy	-0.111	0.0280*	1.1178	1.0565	1.1794
Institutional variables and interactions					
Institutional Russell Group indicator	-0.2525	0.1473	1.2872	0.9003	1.6372
Institution level mean UCAS tariff score	0.1894	0.1151	0.8275	0.6873	1.0534
Institution level std. dev. of UCAS tariff score	0.6949	0.1723***	0.4991	0.3883	0.6825
Institution mean IMD score	-0.0694	0.1769	1.0719	0.7680	1.5746
Institution level proportion of females	1.5660	0.5319*	0.2089	0.0690	0.5305
Institution level proportion of non-White	-0.7257	0.2813*	2.0662	1.1241	3.4281
Institution-level interactions					
Institutional proportion female* Russell Group	-1.6390	1.6010	5.1500	0.2471	112.3928
Cross-level interaction					
Female student*institutional proportion non-White	0.1734	0.1356	0.8408	0.6402	1.0887
Non-White student*institutional proportion female	-1.3330	0.5247*	3.7924	1.3621	10.5276
Interactions with Institutions: Random effects across institutions					
<i>Variances (all quite significant)</i>					
A: Threshold	0.4517	0.1173			
B & C: Thresholds	0.2484	0.0721			
UCAS tariff score	0.0371	0.0076			
A-levels only	0.1071	0.0386			
Female at A & B thresholds	0.0794	0.0169			
Aged 22+	0.1280	0.0385			
Non-White	0.0430	0.0154			
<i>Covariances (Correlations)</i>					
A: Threshold/B & C: Thresholds	0.2413 (0.7200)	0.0829*			
A: Threshold/UCAS tariff score	-0.0006 (-0.0045)	0.0195			

B & C: Thresholds/UCAS tariff score	0.0255 (0.2660)	0.0158			
A: Threshold/Female at A & B	0.0057 (0.0030)	0.0302			
B & C: Thresholds/Female at A & B	-0.0131 (-0.0930)	0.0243			
A: Threshold/Aged 22+	-0.0321 (-0.1340)	0.0415			
B & C: Thresholds/Aged 22+	-0.0726 (-0.0471)	0.0366			
A: Threshold/A-levels only	-0.1050 (-0.478)	0.0592			
B & C: Thresholds/A-levels only	-0.0887 (-0.5440)	0.0470			
A: Threshold/Non-White	-0.0233 (-0.1670)	0.0288			
B & C: Thresholds/Non-White	-0.0166 (-0.0168)	0.0214			
UCAS Tariff score/A-levels only	0.0043 (0.0682)	0.0124			
UCAS Tariff score/Female at A & B	0.0001 (0.0010)	0.0079			
UCAS Tariff score/Aged 22+	0.0204 (0.2960)	0.0136			
UCAS Tariff score/Non-White	0.0176 (0.4400)	0.0084*			
A-levels only/Female at A & B	-0.0210 (-0.228)	0.0192			
A-levels only/Aged 22+	0.0123 (0.1050)	0.0281			
A-levels only/Non-White	0.0054 (0.0791)	0.0163			
Female at A & B/Aged 22+	0.0181 (-.1800)	0.0176			
Female at A & B/Non-White	-0.0161 (-0.2760)	0.0124			
Aged 22+/Non-White	-0.0158 (-0.2130)	0.0187			

Key: standard errors in parentheses; $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Although full and comprehensive details may be found in Table 18, a summary of the main features expressed in this new framework are as follows:

- A standard deviation increase in prior attainment doubles the chances of getting a better outcome. The odds ratio of 2.03 in the table means a multiplicative effect on the odds of getting a degree above a certain threshold for a change of one unit in the scale of the covariate. Since the odds are taken as proportional for this covariate, this doubling of odds occurs at all thresholds.
- Students with mixed or vocational qualifications are significantly less likely to attain better outcomes – relatively to those with A-levels; their odds are reduced by 23% and 42% respectively.
- Older students are over twice as likely to attain better outcomes as younger ones.
- Disability reduces the odds of better outcomes at all thresholds by 9%.

- Students living at home have slightly, but statistically significantly, worse odds of performing well than those not living at home.
- There is a 5% reduction in odds of achieving above certain levels for a standard deviation increase in the individual IMD deprivation score of the student's area of residence. (Odds are multiplied by 0.9529 for a unit increase in IMD score.)

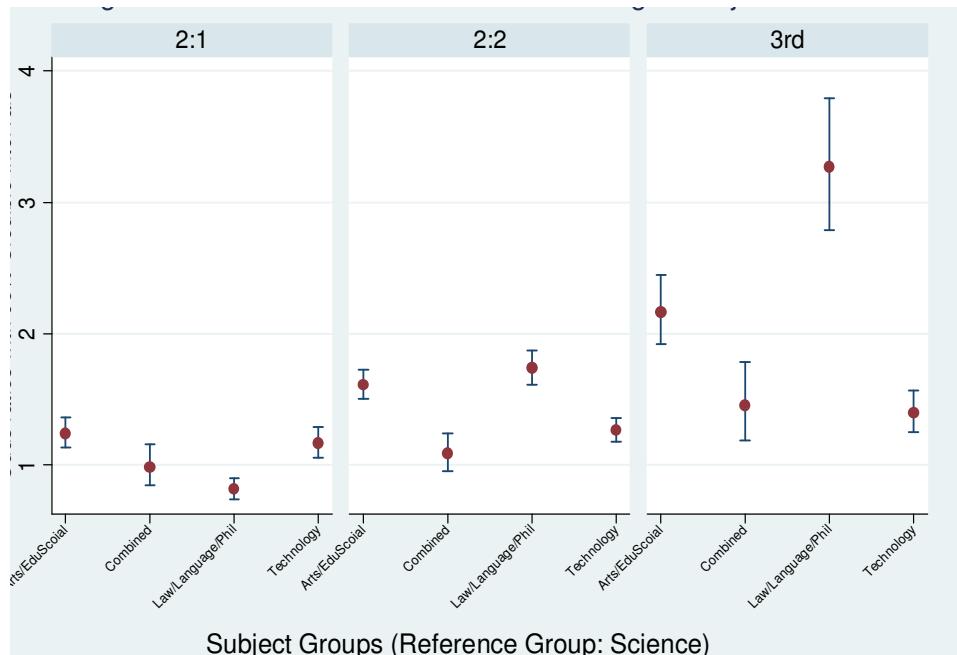
All the above marginal net effects apply across the scale of higher education attainment, since they are governed by proportional odds. Another way of thinking of this is that they just shift the cumulative probability distribution function of degree attainment right or left along an underlying scale, by amounts indicated by the corresponding parameter estimates.

There are also significant main effect differences in attainment according to gender, ethnicity and subject area. The effect of these factors is different in nature from those above in that they have been fitted using proportional odds; as part of the model building process they were found to have differential effects across the attainment thresholds. We deal with subject effects first then return to our factors of main interest, gender and ethnicity. Thus the multiplicative net effects of studying a Technology subject rather than the Science reference group, for example, on odds of getting above a certain class of degree differ according to the class under consideration. With the proportional odds above, this effect remained constant.

4.3.3 Subject area

There is considerable evidence that overall differences in higher education achievement due to subject are not just on average levels of attainment, as might be evidenced if the odds were proportional. The odds of getting a first-class degree, represented by the odds against the C threshold (i.e. against a 2.1 or below) in the table, are slightly larger for the T and CEAS groups than for the Science group (by 17% and 24% respectively), but marginally smaller for the NC and LLHP groups. These odds characteristics are shown in Figure 39, which shows the odds ratio effects of getting certain classes of degree or better. At the lower end of the scale it seems that the chances of avoiding a third-class degree are considerably enhanced for all groups compared to Science. The odds of getting better than a third, for instance, for the LLHP group is over three times that of students in the Science group, and about twice that of the CEAS group. The patterns suggest that except for high-flying first candidates it is more difficult to get a good degree in Science (net of other factors). It seems most difficult to get a first-class degree in the LLHP group, but on the other hand this group has a better chance of getting above a 2.1.

Figure 39: Net odds ratios of getting a certain degree classification or above and 95% credible intervals, by subject groups



It is worth noting that the negative contextual effect of institution-level average prior attainment on the outcome is not any more significant since we have accounted for differences in scale relating to subject areas; these scaling differences seem to relate to the ability and motivation (prior attainment) of students drawn to specific subjects.

The subject area differences also vary according to prior attainment, ethnicity and gender. We comment on the last two below in connection with the discussion on gender and ethnicity. However, *prior attainment* seems to be significantly more important for students who study in the LLHP group compared to Sciences, as evidenced by the multiplicative effect on the slope of UCAS score greater than unity for this group. Thus progress is higher for that LLHP group than for the reference Science group. A better UCAS score by a standard deviation increases the chances of better outcomes (across) the scale by an additional 11% over the effect in Science (UCAS*LLHP odds ratio is 1.1178). The reverse is true for the NC, T, and CEAS groups.

4.3.4 The role of ethnicity

Main effects: Significant main effect ethnic differences in achievement in higher education remain after accounting for all the number of control covariates and interactions, and taking scaling into consideration through some non-proportional odds. However, since most of the interactions we consider involve BME groups in one form or another, the consideration of main effects in isolation is somewhat

uncontextualised; because of the interaction effects considered they relate only to relevant characteristics of the reference group (male, young, Science, at averages of intake and IMD scores). For this reference group in general the odds of getting a good degree are a considerably smaller overall for the various Black groups and the Chinese group; these effects, due to a degree of non-proportional odds, vary according to degree threshold defining ‘good’. Thus the chance of getting a very good degree compared to White students is larger than lower down the degree scale; for example, the odds of Black Caribbean students in the reference group getting better than a third or better than a 2.2 are about 50% of those of White students (odds ratio in table is 0.4969). The odds of getting a first are, by contrast, about 30% of those of White students. The effects for various other Asian groups are somewhat smaller at all thresholds. However, for this reference group, Pakistani students have odds ratios slightly larger than unity.

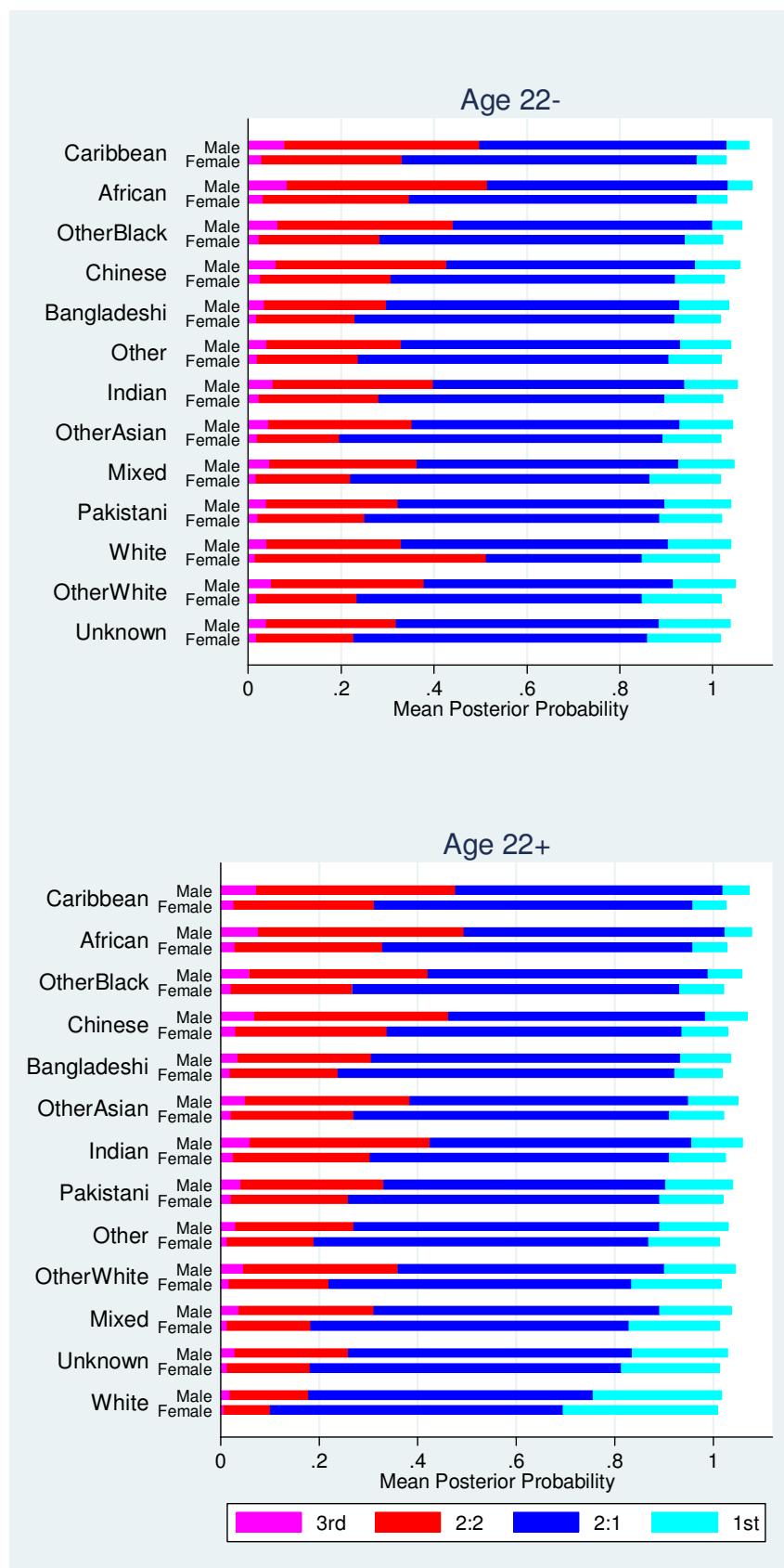
As with the continuous points model, the ordered category model confirms similar patterns of evidence of interactions indicating that ethnic group differentials are modified according to *gender, age, prior attainment, deprivation, age, subject group and institution*.

Ethnicity and gender: As with the continuous points model the only statistically significant term is the female interaction with the Pakistani/Bangladeshi grouping, and again this indicates that the ethnic effect is wider for females than for males. The odds for Pakistani/Bangladeshi males relative to White males are further reduced by a factor of 0.7333. The other Asian groups have a similar pattern, but as with the continuous model the reduction effects are a bit smaller and not statistically significant. The interaction effects between female and the combined Black and Mixed ethnic groups are, by contrast, in the other direction, although they are really quite small and not statistically significant. For these groups it seems that ethnic effects are not greatly moderated by gender.

Age: As with the continuous points model, the indications from the interaction odds ratio of the rationalised ethnic groups and the ‘aged 22+’ dummy indicate that ethnicity related gaps are larger among older students. The estimates of the interaction multiplicative odds ratios in the fitted model are between approximately 0.4 and 0.6, and are all significant.

Some of the combined effects of age, gender and ethnicity interactions are displayed in Figure 40, which displays the expected degree distribution (fitted probabilities) according to age group, gender and ethnic group. The pattern is evaluated for the Science reference group, A-levels only qualifications, not living at home, not disabled and at the sample means of intake UCAS and IMD deprivation scores.

Figure 40: Fitted probabilities of degree classes according to ethnicity, gender and age.
Reference group of students is the Science group, not living at home, not disabled at mean prior UCAS achievement and mean IMD scores



From the model results in Table 18 it is seen, and as we have noted previously, prior attainment is more important among most BME groups than it is for White students and reduces ethnic gaps. These gaps decline with increasing levels of UCAS score. Thus multiplicative odds ratios for the interactions of UCAS score with ethnic dummies are almost all greater than unity for the main specific BME groups, although not all are statistically significant. These indicate that, in general, BME groups appear to make more progress, despite the fact that their prior achievements and raw degree performance may be lower. The higher the prior achievement, the smaller the gaps between various BME groups and the White reference group. These results, of course, confirm the broad patterns we observed for the continuous points model, but with regard to odds of degree classes at various levels. This progress effect is particularly marked for Bangladeshi, Indian and Black African students, where an increase of a standard deviation unit of a UCAS score increases the odds of a better outcome relative to White students by 36%, 21% and 18% respectively (multiplicative odds ratios are 1.36, 1.21 and 1.18).

Deprivation: There appear to be effects that weaken gaps between all rationalised BME groups and the reference White group as students' IMD identification increases, in the sense that all interaction odds against getting lower classes of degree ratio multipliers are greater than unity; however, this is only statistically significant for Indian students. The achievement outcomes for Indian students get closer to those of their White UK and Irish peers when they come from more deprived areas.

Subject groups and ethnicity: Acknowledging the simplifications that had to be made in rationalising both subject and ethnicity classifications to make the combinations less than thin and hence estimable, the only statistically significant effects found relate to the Pakistani/Bangladeshi group. These interactions relate to comparisons with Science of the New Combined, CEAS and LLHP groups with a reduction in odds of getting a degree above any class threshold of around 35%. There is a slightly smaller non-significant reduction of 15% for the T group in interaction with the Pakistani/Bangladeshi group. The impression is that Pakistani/Bangladeshi students fare better in Science than they do in other subject areas. The other results for our ordered model add little to the knowledge we gained from the continuous points model. There are suggestions that Indian students perform similarly in CEAS to Science, and that, like the Pakistani/Bangladeshi group, they have higher achievements in Science than other subject areas, although all these effects are not statistically significant. There are also non-significant indications that the Black group have lower achievements in Science than they do for other groups, except LLHP. Similar patterns are observed for the Mixed ethnic group.

Cross-level interaction of non-White students with institutional proportion female: There seems to be an important differential effect in that for non-White students there is reduced disadvantage as the proportion of females in the institution rise (odds ratios change by a factor of 3.8). The ethnic gaps will be lower for students in institutions with relatively large numbers of females.

Institutional variation and ethnicity: Overall at the institution level, a higher percentage of non-White students seems beneficial for students attending, even net of all the complex controls that have gone into the model. The odds ratio in the table for this variable of 2.0662 translates into approximately an 8% increase in the chances of getting a good degree for a 10 point change in percentage of non-White students. Since there is a cross-level interaction with gender, this figure relates to males. The odds are still favourable to females, but on applying the interaction multiplier reduce to 1.71 meaning that this effect is weaker among females.

For reasons explained previously, only a general term for variation of the non-White effect across institutions was fitted in this model. Complex random effects even for rationalised ethnic groupings are infeasible. As with the continuous points model, this was quite substantial indicating that there may be considerable variation across institutions in the net difference between White and BME groups. We also note in this model a marked positive correlation across institutions between this non-White gap and UCAS score effect differences (correlation 0.44). This suggests that institutions with a better record of progressing students (higher effect of prior achievement) also have the largest non-White to White differential.

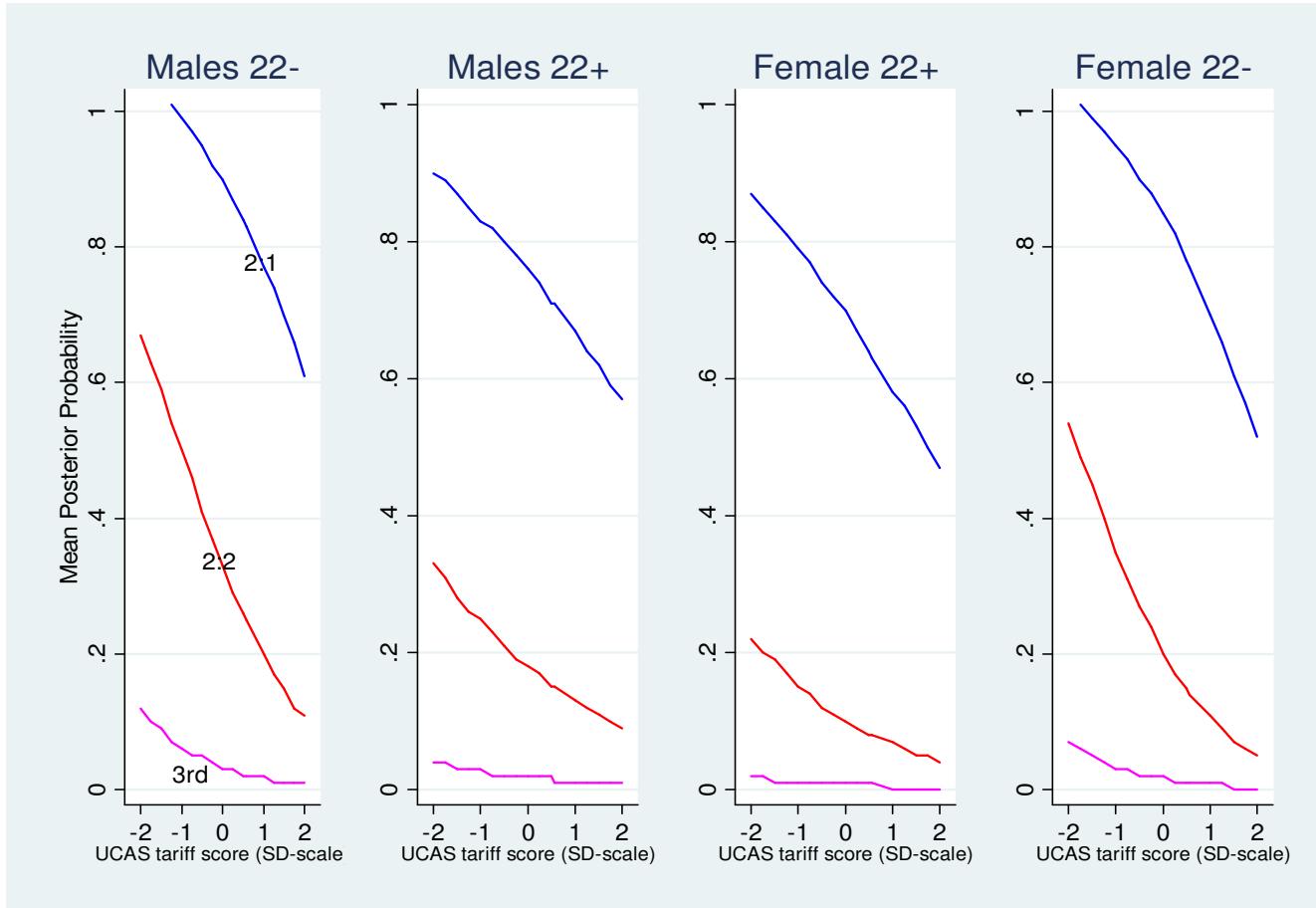
4.3.5 Gender

Main effect: Significant marginal overall gender effects on achievement remain after accounting for all the demographic factors and interactions, allowing variation of effects across institutions and using the ordered scale. However, since many interactions with the female dummy are involved, the main effect female net advantage over males relates to relevant characteristics of the reference group (White, younger, Science at zero, mean UCAS and IMD scores). This seems to be highest at the bottom of the degree scale, with the effect for this reference group on odds relative to males of avoiding a third being 2.7 times higher. Females also have an advantage over males in getting firsts, but the odds gap is now narrower and only 20% higher than males.

Prior attainment: From the combined age group and gender interactions with UCAS tariff score, we see similar patterns as observed for the continuous points scores. Younger females have the highest prior qualifications effect, followed by younger males, followed by mature females and then mature males. For students of comparable entrance level, the younger females group will achieve most. The reverse is the case for both males and females aged 22 and over, who make less progress on a comparable basis than the younger females and also the younger males.

The pattern of progress is shown in Figure 41, which shows the relationship of the predicted probability of getting below certain classes of degree at levels of UCAS score for each of the age by gender groupings. The probabilities are evaluated for the same reference group of Science, White, not living at home, not disabled, at mean prior achievement and mean IMD score.

Figure 41: Predicted cumulative probabilities of getting below certain degree classes as a function UCAS tariff score, age group and gender. The reference group is Science, White, not living at home, not disabled, at mean prior achievement and mean IMD score.



Deprivation: As in the continuous model, the effect of coming from a more deprived area is more pronounced for females than for males. At high levels of deprivation it may be sufficient to overturn the overall advantage that females seem to have.

Subject area and gender: The gender-related effect is also modified by the subjects of study, and there are interactions that are quite statistically significant between the female dummy and the coarse subject dummies. Females seem to perform at not as high a standard in the NC, T, CAES and LLHP groups, as they do in Science. (All the relative odds ratios in Table 18 are less than 1, by factors ranging between 14% and 39%.) The lowest performances relative to males are in the last two groups, which are in fact female dominated subject areas. The suggestion here is that females do better in Science when they choose it, even though the prevalence of female students in Science is much lower.

Institutional variation in gender effects: Overall, there are effects of the proportion of females in institutions on achievements of students. Since we have a cross-level interaction of this variable with student being non-White, the effect varies according to the ethnicity of students. The odds ratio for the reference group (White) of this variable in Table 18 is 0.2089. On calculation if the percentage of females is 10% higher in one institution, the odds of White students of getting a good degree reduce by about 15%. However, this effect of institutional gender make-up changes dramatically among non-White students. The interaction odds ratio is 3.7924, so the odds ratio effect of the proportion of females is now 0.80; for non-White students the impact of this institutional variable in lowering degree achievements is much reduced.

If we examine the results for the variance of random effects at level 2, we see that there is considerable variation in the individual gender effect over institutions, but only at the higher degree class thresholds. There is no female at C threshold institutional random effect in the tables of results since the variance is negligible. A common effect over institutions at the other two thresholds seemed to fit well, so there is significant institutional variation in the effect of gender on getting degrees that are no worse than a 2.1.

There also seem to be negative correlations across institutions, whereby in institutions where the gender effect is smaller, then the effects of age, whether a student did A-levels and being non-White are larger. These effects, although noticeable as regards the size of correlations, all arise from covariances that are not statistically significant.

4.3.6 Background interactions with prior attainment and progress

The gradient of the prior attainment UCAS score, which governs how students progress and is the major determinant of degree performance, is modified quite a bit by type of qualification in addition to the interactions with subject, age, gender and ethnicity considered above. There is no significant interaction with the mix of qualifications, but the interaction with vocational qualifications is quite substantial and statistically significant. The impact of better UCAS scores on performance seems much smaller for vocational qualifications than it does for the reference group A-levels only (interaction odds ratio is 0.72).

The interactions of UCAS score with the living at home and disabled dummies are inconsequential and statistically not significant.

4.3.7 Other institutional effects

We have commented above on the range of institutional fixed effects and random effect variation that were important in degree performance insofar as they related to our factors of major interest, ethnicity, gender and subject. However, there are a number of other institutional factors and random effects that have been built into our final ordered response model and are worthy of mention:

- The Russell Group universities (an indicator of research intensiveness) did seem to have better performance and also interacted with the proportion females indicator, but neither of these effects proved statistically significant.
- The random effects for thresholds B and C were fitted as common. It will be seen that there is significant variation between institutions in degree performance above certain thresholds even after the complex set of adjusting controls have been fitted. The proportion above and below the third-class threshold is, as seen from the A threshold variance, considerably more variable across institutions than that of higher degree classes, although even at those thresholds it is still substantial.
- There is significant variance in the UCAS tariff effect when this is allowed to vary across institutions, and this indicates that the progress made by students is highly variable and dependent quite heavily on where they study. The prior attainment effect is also negatively correlated with variation in the proportions getting less than a 2.1 and less than a 2.2 (thresholds B and C). The suggestion here is that net of everything else, institutions awarding on average a higher set of better degrees are also those institutions where progress adjusted for intake is more advanced.
- There are significant variations across institutions in the age effect. It also seems that this different age effect for institutions is associated negatively with proportions below third-class degree level (the A threshold). This correlation effect, however, is not significant.
- The model has fitted only one random effect for type of qualification. This is labelled 'A-levels only', which is the reference category for the type dummies. This is a model device only, and it can be interpreted as implying that we take the difference between the qualification mix and vocational effects as constant across institutions, meaning that there is only one random effect that can just as well be applied to the reference category A-levels only. This effect is quite variable across institutions, and again is firmly negatively associated with the variation in institutions in net overall degree performance (correlations of -0.48 and -0.54). The gap for A-level only students will be higher in institutions with overall lower degree performances.

5 Analysis of the National Student Survey 2006 data

5.1 Introduction

In this section we turn to the multilevel analysis of particular responses in the data from the 2006 National Student Survey (NSS). In particular we focus on ethnic and gender differences that have been noted in full reports on the satisfaction scales by Surridge (2006). As with the degree outcomes of the previous sections, we are concerned with exploring how these effects are mediated and/or moderated by a wide range of other factors. The modelling framework and strategy follows closely those of earlier sections.

We focus on five of the available 22 survey questions that are in the group ‘Assessment and Feedback’. In rating these statements, students are asked to use a five-point rating scale: definitely disagree; mostly disagree; neither agree nor disagree; mostly agree; and definitely agree.

The questions used were:

- Q5 The criteria used in marking have been made clear in advance
- Q6 Assessment arrangements and marking have been fair
- Q7 Feedback on my work has been prompt
- Q8 I have received detailed comments on my work
- Q9 Feedback on my work has helped me clarify things I did not understand

The questions are all about marking and feedback aspects of the way in which students’ work is assessed during their degree. The response in the main analysis is a total score defined as the sum of the separate scores across the five questions. This response was then normalised and hence had mean zero and standard deviation unity over the analysed sample. Effects, then, are on the scale of the response variable standard deviation in a similar way to the points scored degree outcome of earlier sections.

5.2 The analysis sample

The original sample of the NSS 2006 provided to us, consists of 278,296 students in 137 institutions. For similar reasons to restrictions we imposed on the sample for student progress data, and to make it comparable both to this work and that of Broecke and Nicholls (2007), we likewise deleted certain cases by filter. Filters were applied in the following way:

- first degree students only
- zero or missing UCAS tariff score cases were dropped

- only students whose prior entrance qualifications were ‘any combinations of GCE ‘A’/SCE ‘Higher’ and GNVQ/GSVQ or NVQ/SVQ at level 3’ were kept
- restricted to cases where reported year of study was two, three and four
- full-time or full-time sandwich students only
- UK domiciled only
- ‘silly ages’ were dropped.

This reduced the sample to 139,703 student cases in 137 institutions. The sample is then restricted to the 83,151 students from 137 institutions that gave valid answers to questions five to nine. The full file contained information on students who did not respond to the survey; this is approximately 40% of cases. In addition a few students were dropped with item non-response to one or more of the five questions. Such cases were minimal. Listwise deleting observations that had missing values on variables to be used in analysis reduced the sample to 66,596 in 125 institutions. To avoid outlying institutions in the multilevel analysis, we dropped cases for six institutions with less than 30 students on the file. This gave us an estimation sample of 66,837 students in 119 institutions.

5.3 Exploration of data: descriptive summary statistics

Separate scores for questions five to nine

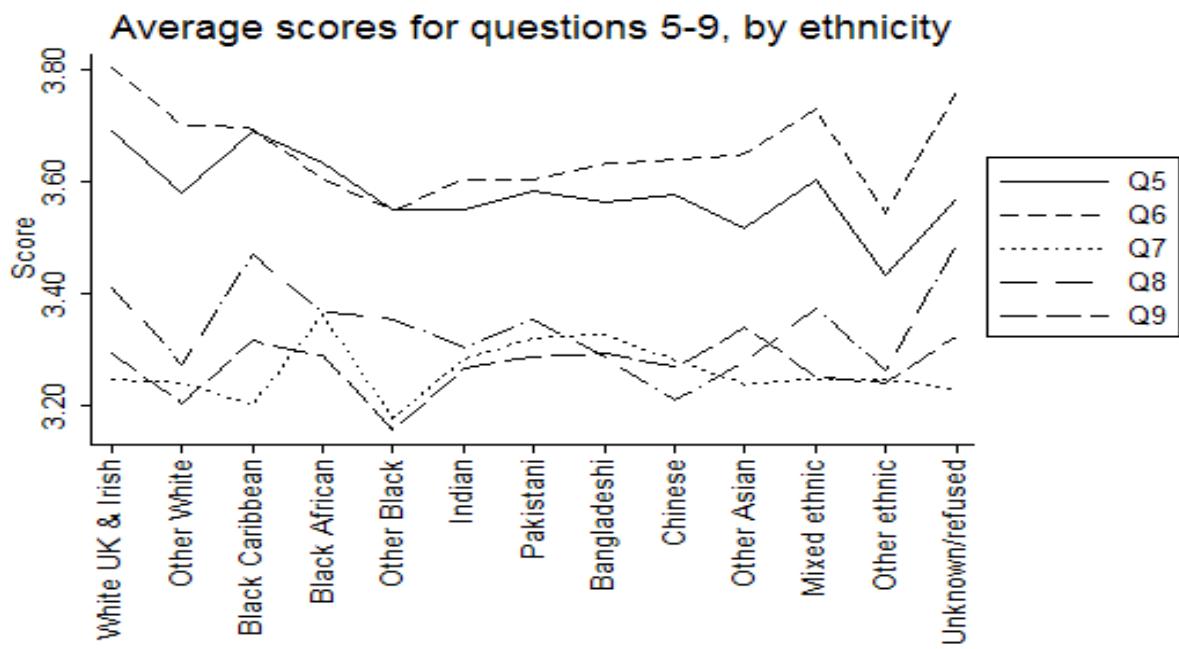
Table 19 gives the distribution of students’ responses for each of the five questions. The response to each question is measured on a Likert scale whose values range from 1 (definitely disagree) to 5 (definitely agree). The modal response to each question was 4 (mostly agree). Students tended to answer slightly more positively to questions five and six than seven, eight and nine.

Table 19: Distribution of response for questions five to nine

Score	Question					Total
	5	6	7	8	9	
Definitely disagree	4.51	2.87	8.53	7.27	7.30	6.10
Mostly disagree	13.75	8.91	20.53	18.39	19.72	16.26
Neither agree nor disagree	15.41	16.66	20.78	17.92	23.34	18.82
Mostly agree	42.77	50.79	37.66	40.16	36.03	41.48
Definitely agree	23.55	20.77	12.50	16.26	13.61	17.34
Total	100.00	100.00	100.00	100.00	100.00	100.00

Figure 43 plots the average response to each question across the ethnic groups. All ethnic groups answered more positively for questions concerning the clarity and fairness of the assessment procedure (Q5 and Q6) than they did for the questions concerning feedback about their work (Q7 to Q9). The figure also indicates that White UK and Irish students tended to answer more positively than most other ethnic groups, while the Other Black and Other ethnic groups tended to give the least positive responses.

Figure 43: Average scores for questions five to nine, by ethnicity



Total score across questions five to nine

The total score is the sum across the five separate questions (Q5 to Q9). Since each individual question can range from 1 to 5 points, the total score can range from 5 to 25 points. The distribution of the total score is shown in Figure 44. For the analysis, this variable is converted into a normal score, the distribution of which is shown in Figure 45.

Figure 44: Distribution of total score

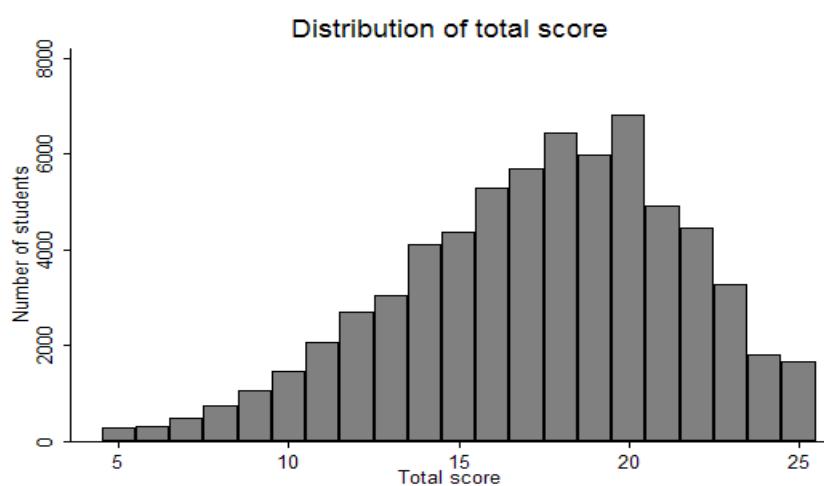


Figure 45: Distribution of total score (normalised)

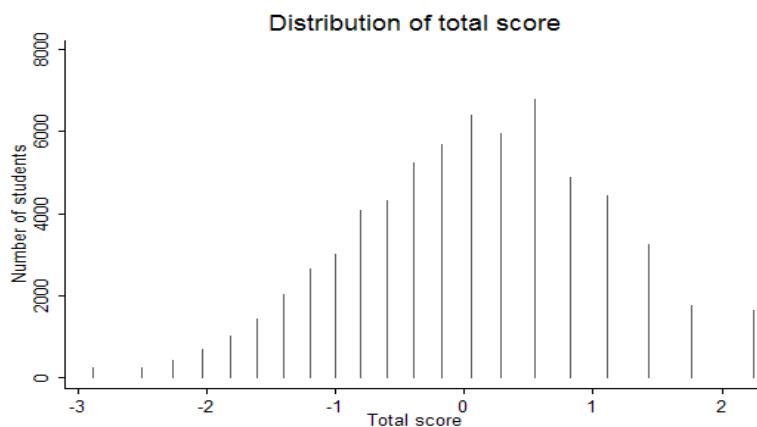
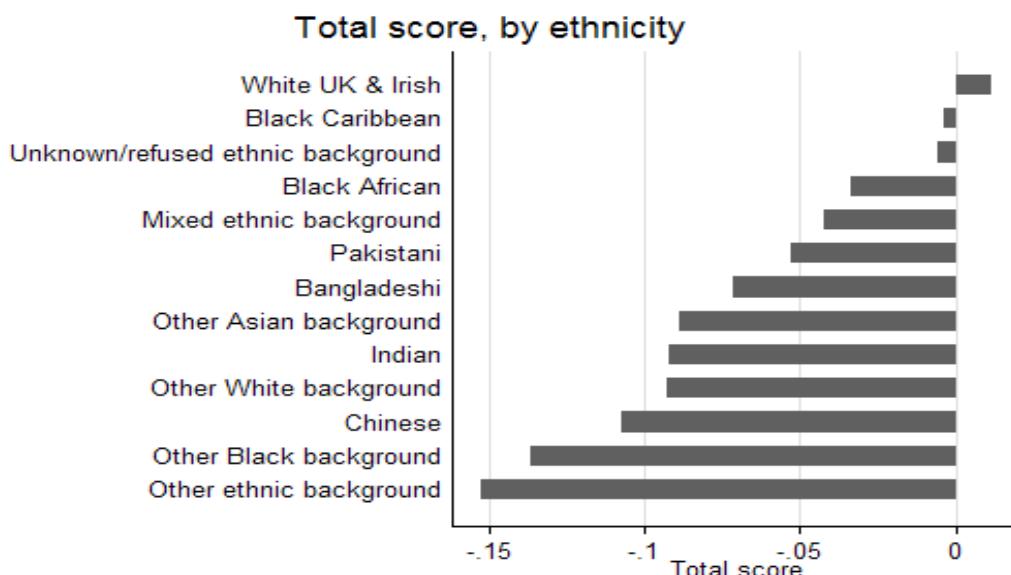


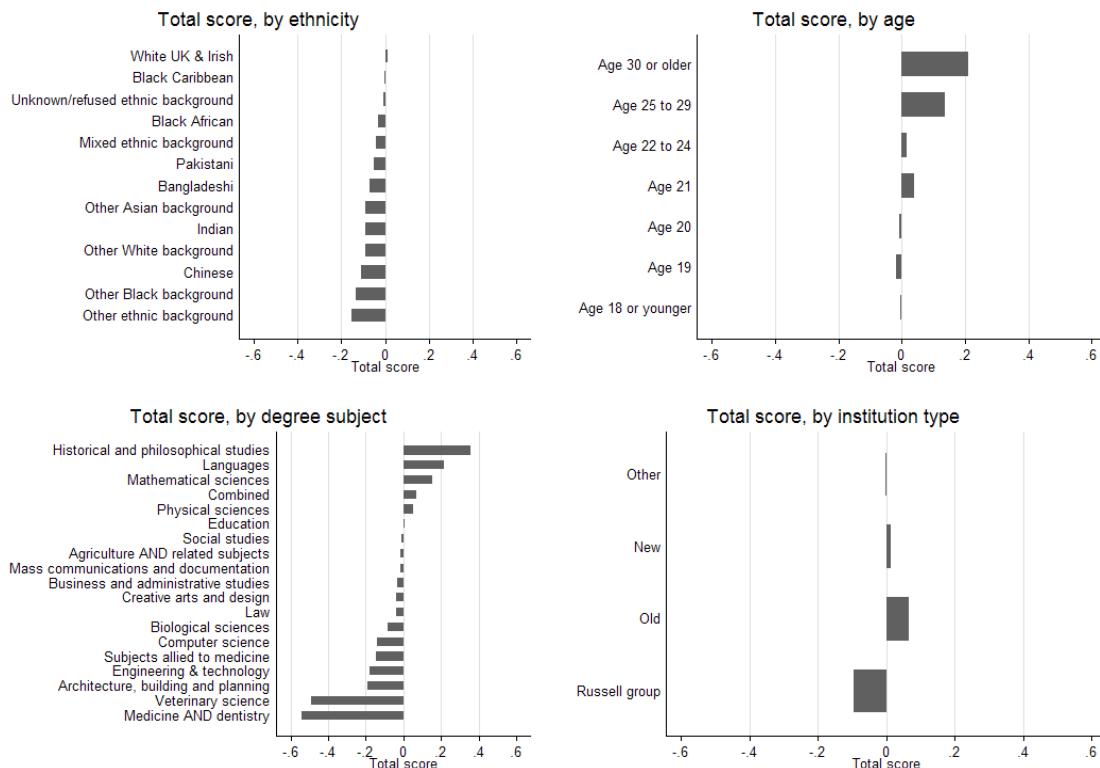
Figure 46 shows the raw ethnic differences in the normalised total score. Chinese, Other Black and Other ethnic groups all score on average over 0.1 of a standard deviation less than the White UK and Irish group.

Figure 46: Total score, by ethnicity



Before proceeding to the models of total score, it is helpful first to consider how the magnitude of these ethnic differences compare to differences across other variables, such as student's age and subject studied; doing this will help guide our model selection criteria. Figures 47(a) to (d) show the magnitude of ethnic differences to be of similar importance to those of age differences and differences between institution types. However, they are small compared to differences across degree subjects. There is almost a 1 standard deviation difference in the total score between the highest and lowest scoring degree subjects. The Russell Group research-intensive universities also score lowest on the scale.

Figures 47(a) to (d): Total score, by ethnicity, age, subject and institution type



5.4 Results from multilevel analyses

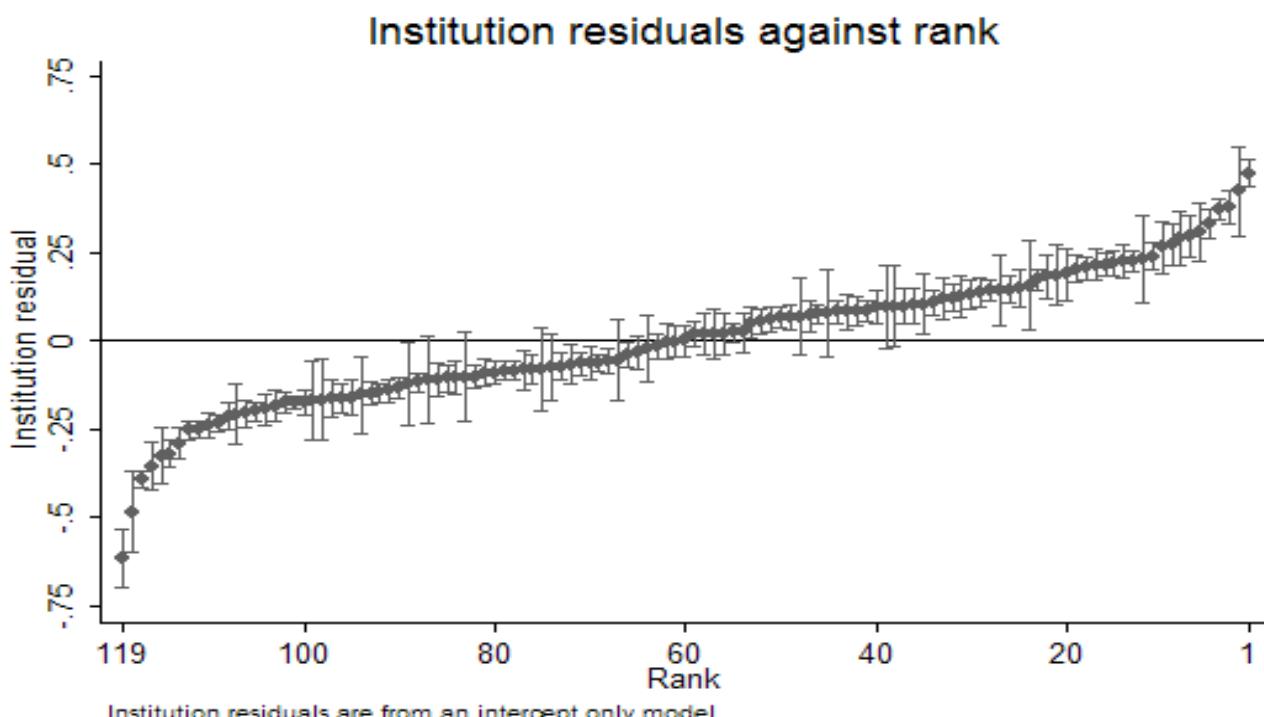
5.4.1 Basic models for total score: Table 20

Table 20 presents the results from a series of two-level variance components models that attempt to ‘explain away’ the raw ethnic differences in student’s scores. The table explores the main effects for a standard set of students and institution-level controls.

Model (1) in Table 20 decomposes the raw variation in the total score into the part that is attributable to institutions and the part that is attributable to students. The variance partition coefficient shows that just 0.041 (or 4.1%) of the raw variation lies between institutions. This suggests that, from one institution to the next, although there are some differences in levels of response the major source of variation is between students, and that within any given institution students are relatively variable. Put another way, students’ responses are relatively homogenous across institutions, but are relatively heterogeneous within institutions. Figure 48 is a ‘caterpillar’ plot of institutions’ ‘raw effects’ against their rank order. This plots the estimated residuals of institutions from the basic variance components model and surrounds them with 95% confidence intervals. Many institutions are significantly different from the average institution (few institution effects overlap with the zero line). The institution raw outcome effects are estimated quite precisely since we have

ensured over 30 students in each institution, and the number of students in some are very large. The magnitude of the institution effects is then fairly substantial. A number have effects more than 0.2 of a standard deviation greater or smaller than the average institution.

Figure 48: Institution residuals against rank



Model (2) in Table 20 adds in the binary indicators of the ethnic groups (White UK and Irish is again the omitted, or reference, category). This model gives the raw ethnic differences in students' responses. All ethnic groups answer less positively than White UK and Irish students, but only six out of 12 minority groups answer significantly less positively. Of these, just Other White, Chinese and Other ethnic group students are found to score 0.1 of a standard deviation or less than White UK and Irish students.

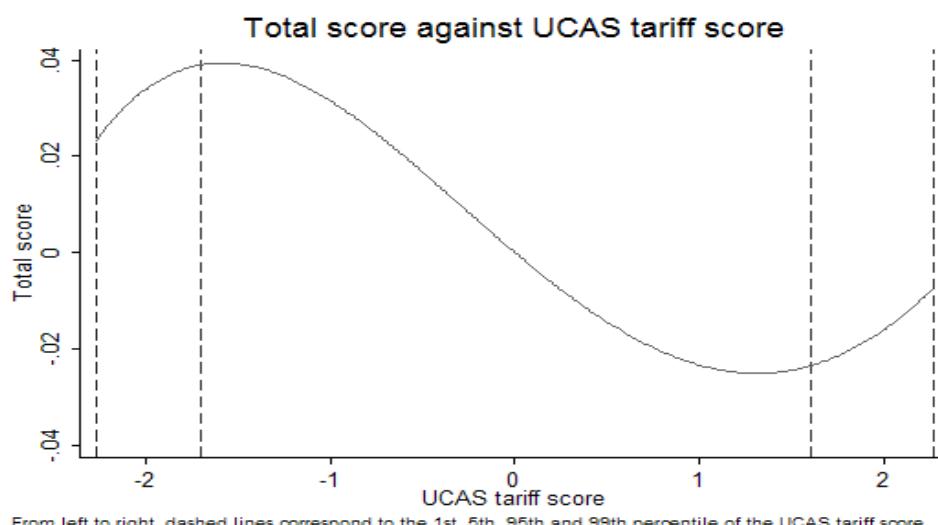
To see whether these ethnic differences can be 'explained' by differences in other student characteristics, we begin to add a range of covariates to the model. Model (3) adds in indicators of gender, age category (reference category is 18 or younger), living at home, disability and degree subject (reference category is Social Studies) and normalised neighbourhood IMD score. The results suggest that female students rate their experience slightly less positively, although not significantly less, than males. Similarly disabled students are less positive than those without a disability. Older students are found to score more highly, although significant differences are only present when comparing the very oldest students to the youngest. Students who live in their family home score slightly higher, as do those from more deprived neighbourhoods. There are significant and sizable differences between students

studying different subjects. Students studying Historical and Philosophical Studies rated their experiences the highest, while those studying Veterinary Science, and Medicine and Dentistry rated their experiences the lowest. There is almost a 1 standard deviation differential between the experiences of these two extreme groups of students. Adding these control covariates so as to adjust ethnicity effects leaves only four ethnic groups that respond significantly less positively to the questions than White students: Other White; Indian; Pakistani; and Other ethnic group. However, some of the other ethnic group effects are comparable in the adjusted effect size, although not statistically significant (due to smaller numbers and consequently less precision in estimates).

Model (4) in Table 20 controls for students' prior performance by adding their UCAS tariff score to the model. This is usually the main determinant of student performance. A cubic relationship is required to adequately model the relationship between UCAS prior performance score and the total score. This marginal relationship is illustrated in Figure 49. For the most part, there is a negative association between UCAS and total score, which is linear in all but the tails of the A-level score distribution. The higher the student's prior academic performance, the less satisfied they are with the assessment process at degree level. However, the decrease in total score as we move from the fifth to the 95th percentile of A-level score is only 0.064 of a standard deviation.

One important feature of this new progress model must be stressed. Controlling for A-level score mildly magnifies the difference between White students and all other ethnic groups, as can be seen by comparing the ethnic group effects across models (3) and (4). This can happen when the control variable is related in opposite directions to the outcome and the effects of interest, and is a mild example of what is often known as a 'suppression' effect.

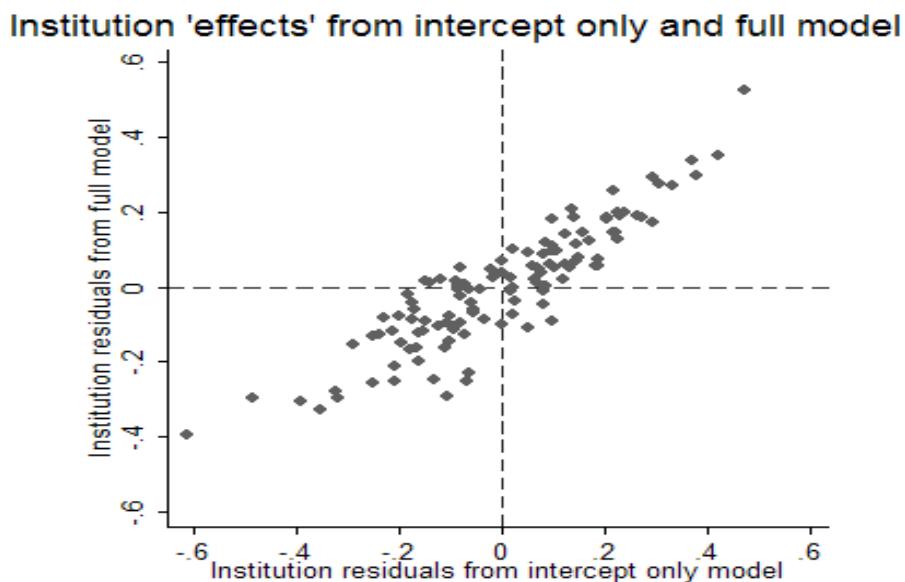
Figure 49: Total score against UCAS tariff score



Model (5) adds in some characteristics of the students' institution or aggregates of its student composition: its size; its type (Old, New or Other, relative to Russell Group as reference); the mean UCAS tariff score; proportion females; proportion non-White; and mean IMD score. These institutional level 2 explanatory variables reduce the between institution residual variance slightly from 0.035 to 0.019. The size of the institution (in 000s) was found to have a significant negative effect. However, net of this no significant differences were found between different types of institution, nor were any relationships found between the institutional compositional variables and total score. Controlling for the institution variables slightly dampens the differences between White students and students from other ethnic groups.

The full set of predictors as far as Model (5) explains away approximately 25% of the variation between institutions, but just 3% of the differences between students within institutions. This suggests that, although we are partially able to explain why students respond more positively in some institutions than others, we are so far unable to explain why students respond differently within institutions. There is considerable heterogeneity among students, which may be due to important but unobserved factors. Figure 50 plots the institution effects from the intercept only model with those from model (5). The graph shows that the rank ordering of students' responses across institutions is fairly similar whether we look at raw differences or those adjusted for student and institution characteristics.

Figure 50: Institution effects from intercept only and full model



5.4.2 Exploration of gender interaction terms: Table 21

Table 21 extends the analysis in Table 20 to explore potential interactions between gender and other student characteristics. These interactions are introduced separately and one at a time since they may suggest patterns that could be adapted

to a final model, or indicate where further investigation might be required. We make no attempt with this data to try and fit a final predictive model.

Model (6) in Table 21 is the same as model (5) in the previous table, and is included to ease comparison with the subsequent models.

Interaction of ethnicity and gender: Model (7) interacts female with ethnic group interactions. This allows us to examine whether the pattern of ethnic differences in students' responses is the same for males and females. Put another way, is the gender gap in the total score constant across ethnic groups. The model shows that only the gender gap for Indian students is significantly different from the gender gap for White students. Whereas White females score 0.016 of a standard deviation less than males, Indian females score 0.064 of a standard deviation more than Indian males. A Chi-squared test finds that the inclusion of the interaction terms marginally improve the fit of the model at the 5% level of significance ($\text{chi}^2(12) = 21.08$, $p\text{-value} = 0.0491$). There are some interaction effects that, although not statistically significant, are larger in magnitude than this statistically significant Indian one. They may be worthy of further investigation since with this data they are estimated imprecisely. Thus the estimates for Black Caribbean females indicate that they may score up to 0.142 more than Black Caribbean males. The Other Black, Bangladeshi, Black African, Mixed ethnic and Chinese groups are the reverse. The positive differential of males over females for White students is even higher for these groups.

Interaction of UCAS and gender: Model (8) interacts female with the UCAS tariff score. The negative association between A-level points and the total score is significantly stronger for female students compared to male students. Higher ability female students will be considerably more dissatisfied than their male counterparts.

Interaction of age and gender: Model (9) interacts female with a binary indicator of whether a student is aged 20 or above. Although the main effect for being aged 20 or over is not statistically significant, the gender gap in the total score is found to be significantly lower for these students than those aged 18 or 19.

Interaction of living at home and gender: Model (10) interacts female with whether the student lives at home. The gender gap in students' responses for those who live at home is not significantly different statistically from those that live away from home. In size it is also relatively inconsequential at 0.029.

Level of deprivation and gender: Model (11) interacts gender with the level of deprivation in their home neighbourhood, but finds no significant differences. It is also substantively of little consequence.

All gender interactions: Model (12) includes the full set of interactions explored in models (7) to (11). When all interactions are included it barely affects the general conclusions we reach above.

5.4.3 Exploration of ethnicity interaction terms with four broad ethnic categories: Table 22

Table 22 extends the analysis in Table 21 to explore potential interactions between the ethnicity and student variables. For simplicity the ethnic groups are collapsed into a coarse four category classification: White; Black; Asian; and Other. Interactions terms for the finer 13 category classification of ethnicity are presented later, in Table 23. The variables that are interacted with ethnic groups are the same as those employed in Table 20.

Model (13) is similar to the last model in Table 21 before interactions are introduced, except that it uses the coarser four category classification of ethnicity. The model shows students from Black, Asian and Other ethnic groups to all respond less positively than White students, even after controlling for other student and institution-level characteristics. (This is unsurprising since it is simply grouping together effects that were all previously quite significant.)

Gender and broad ethnicity: Model (14) interacts this broad ethnicity variable with female. The main effect of female is -0.017, indicating that White females respond slightly less positively than White males all else being equal. The interaction terms for Black and Asian students are approximately 0.05, indicating that Black and Asian females respond more positively than their male counterparts. These differences are not significant.

Age and broad ethnicity: Model (15) interacts ethnicity with the indicator of being aged 20 or over. The main effect is positive, although not significant, indicating that more mature White students respond more positively than younger White students. This differential is larger in magnitude particularly for Black students, although this result is not significant at the 5% level.

UCAS tariff score and broad ethnicity: Model (16) interacts ethnicity with UCAS tariff score, but finds no differences across the ethnic groups in the effect of prior ability at entrance on satisfaction.

Living at home and broad ethnicity: Model (17) interacts ethnicity with whether the student lives at home or not. The main effect is positive and significant, indicating that White students who live at home respond more positively about the assessment process than their counterparts living away from home, although statistically significant this effect is small. Relative to White students, the effect of living at home is significantly less for Black students. So much so that it is Black students who live away from home that actually respond more positively, not those Black students who live with their family. The differential effects for Asian and Other ethnic groups suggest that there may be slightly stronger positive effects for living at home for these groups than for White students. However, the differences are not statistically significant.

Level of deprivation and broad ethnicity: Model (18) interacts ethnicity with the level of deprivation in the students' home neighbourhood. There are slight ethnic differences in the slight positive association between neighbourhood deprivation and total score; however, the evidence is unconvincing.

All broad ethnicity interactions:

Model (19) includes the full set of interactions explored in models (14) to (18). No broad conclusions from the study of separate interactions are disturbed.

5.4.4 Exploration of ethnicity interaction terms with the full 13 ethnic categories:
Table 23

Table 23 repeats the form of analysis in Table 22 to explore potential interactions between all ethnic categories and the other student variables. However, we now use the full fine set of ethnic categories. The relative advantages and disadvantages of using a fine classification rather than a broad one have been discussed in earlier sections of this report.

Model (20) is the same as the last model in Table 22 and is included to ease comparison with the subsequent models. Model (21) is also the same as model (7) interacting ethnicity with gender, but is included here again for comparative purposes.

Model (22), which interacts ethnicity with the indicator of being aged 20 or over, finds only the Other Asian group to respond significantly more positively if they are more mature. There are some similar effects indicated for the various Black groups, but as is usual with these groups their overall size means these effects are estimated imprecisely and are consequently not statistically significant.

UCAS tariff score and ethnicity: Model (23), which interacts ethnicity with A-level score, finds no significant differences across the ethnic groups. Relative to the UCAS linear term for the main reference White group of -0.031, some of the differences for other ethnic groups seem quite substantial. For instance, using the estimates the linear term would be small and negative at -0.025 for Other White; -0.072 for Black Caribbean; -0.009 for Black African; -0.057 for Indian; -0.022 for Pakistani; -0.046 for Bangladeshi; -0.048 for Chinese; -0.021 for Other Asian and also Mixed ethnic; and -0.052 for Other ethnic. For the Other Black group it would be small and positive at 0.050. There is insufficient evidence in the sample, however, to make these differences statistically discernable.

Living at home and ethnicity: Model (24) interacts ethnicity with whether the student lives at home or not. Relative to White students, Black African students are found to respond significantly less positively if they live at home, while those from a Mixed ethnic background are found to respond significantly more positively. The magnitude of these effects are fairly sizeable, both in excess of 0.15 standard deviations. The

Black Caribbean and Other Black effects are also relatively quite large, but do not reach significance.

Level of deprivation and ethnicity: Model (25) interacts ethnicity with the level of deprivation in the students' home neighbourhood. Few ethnic differences are found in the slight positive association between neighbourhood deprivation and total score. No interactions are significant, but given the main reference group IMD coefficient of 0.014, similar remarks may be made about differential impact of IMD as were made for the UCAS score coefficient discussed above.

All interactions with ethnicity: Model (26) includes the full set of interactions explored in models (21) to (25). No new or novel conclusions emerge from this exercise.

5.4.5 Interactions of gender and ethnicity effects with subject group

The investigation of differential gender and ethnicity effects across subjects is as problematic with this dataset as it was for the progress data (see Section 2.5). It is for this reason that we have left the consideration of possible interaction with subject effects to this stage.

Ethnicity and subject: We did trial a full set of interacting dummies for the 19 subject groups and 13 ethnic categories. We do not give full results here. Most of the 216 dummy combinations were naturally not statistically significant being based on very small numbers, so little about subject differentials in ethnic effects can be inferred from this exercise.

There are, however, significant negative interactions between the Black African dummy indicator variable and those for Business, Education, Historical and Philosophical Studies, Mathematical Sciences, Law, and Creative Arts and Design. These may be broadly termed non-Science; the suggestion is that this ethnic group of students were more satisfied if they happened to be doing more scientific subjects or Social Studies. Indian, Pakistani, Bangladeshi and Chinese designations exhibited significant positive interactions with Medicine, suggesting this group of Asian students were more satisfied if they were in Medical Schools than elsewhere. Indian and Chinese dummy indicators had significant negative interactions with Mathematical Sciences. Indian and Pakistani groups had significant positive interactions with Education, and the Pakistani group also with Computer Science.

When we combined ethnic groups into four broad groups nothing further of interest was revealed. Significant interactions were found only for the following: the Black group with Mathematical Sciences and Law; the Asian group with Medicine and Education. A variety of interactions with the umbrella Other ethnic group now proved statistically not significant. For the rest, the suggestion is that in this broad ethnic grouping some balancing out of effects working in opposite directions has occurred.

Gender and subject: The only statistically discernable subject differentials for gender effects seem to be for Computer Science, Mass Communications, and Creative Arts and Design. These were positive and large enough to indicate females were more satisfied than males in these groups, whereas differences for other groups were not statistically discernable.

5.4.6 Institutional impacts

We investigated institutional differentials by two broad means:

- (a) fitting separate models for broad groupings of institutions defined on relevant characteristics, e.g. proportion of female students
- (b) allowing the gender effect and a term for non-White aggregate BME effect to vary as a random coefficient at level 2 of institution in the multilevel model.
(This was all that proved feasible at this stage. Future development work may consider a more complex model involving variation for specific ethnic groups. However, due to thin spreading across institutions, the success of such modelling will require care in trialling various model specifications and larger scale data.)

Institutions divided into three groups on the basis of proportion of non-White students (low, medium and high): Table 24

Table 24 re-estimates model (5) from Table 20 on three subsets of the sample: institutions with low, medium and high proportions of non-White students. These three groups are defined simply as being in the bottom, middle or top third of institutions according to the percentage of non-White students they have in the sample.

The pattern of the ethnicity effects from these models is reproduced below:

Ethnic group (relative to White)	Institutions non-White %		
	Low	Medium	High
Other White	-0.066	-0.149**	-0.077
Black Caribbean	0.185	0.013	-0.039
Black African	0.270	0.079	-0.065
Other Black ethnic group	0.134	-0.232	-0.135
Indian	-0.130	-0.106**	-0.055*
Pakistani	-0.105	-0.165**	-0.026
Bangladeshi	0.256	0.077	-0.111*
Chinese	-0.100	-0.044	-0.066
Other Asian ethnic group	-0.223	-0.079	-0.041
Mixed ethnic	-0.101	-0.023	-0.065
Other ethnic group	-0.293	-0.162	-0.123
Unknown/Refused ethnic group	-0.014	-0.040	0.001

Key: standard errors in parentheses; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

The main patterns that may be discerned are discussed below. As a caveat, it should be stressed that perhaps these results should not be over-interpreted. For instance, there may be other crucial unobserved institutional variables closely connected to

satisfaction levels that are related to the groupings. However, each model has controlled for a variety of broad institutional indicators within the groups.

The following may be noted:

- For various Black groups and the Bangladeshi group, there is a marked decline in difference in total scores across the groups relative to White students. In institutions with a low percentage of non-White students, these students seem more satisfied than the reference White groups, but this reverses for the institutions with a high percentage of non-White students. Clearly Black or Bangladeshi students are less satisfied in institutions where there are relatively fewer White students. The reasons for this curious peer group effect are obscure, but it may be, for instance, that pastoral care in institutions is inversely related to the proportion of non-White students.
- The pattern for Indian, Chinese, Other Asian and Other ethnic groups seems, if anything, to be the reverse. They are less satisfied than White students in all three groups, but the distance between these groups declines as the percentage of non-White students increases.

Institutions divided into two groups on the basis of proportion of female students (below average and above average): Table 25

Table 25 re-estimates model (5) from Table 20 on two subsets of the sample: institutions with below or above average proportion of female students. Similar caveats to those expressed for Table 24 apply. The controlled gender effect, although small for students overall, seems slightly to decrease for the high percentage female group. Females seem more dissatisfied than males in institutions where they are fewer in number, although these effects are small and not statistically discernable. There seems little in the way of discernable differences in ethnicity effects between these two groups of institutions.

Institutions divided into four groups on the basis of classification (Russell Group; Old pre-1992 universities; New post-1992 universities; Other non-university institutions): Table 26

Table 26 re-estimates model (5) from Table 20 on four subsets of the sample: elite Russell Group universities; other Old pre-1992 universities; New post-1992 universities; and Other non-university institutions. The pattern of the ethnicity and gender effects from these models are reproduced below. Similar caveats to those expressed for Table 25 apply.

	Russell	Old	New	Other
Ethnic group (relative to White)	-0.127*	-0.086	-0.098	-0.148
Black Caribbean	0.139	-0.189	-0.032	0.142
Black African	0.044	-0.020	-0.036	-0.125
Other Black ethnic group	-0.104	-0.176	-0.212*	0.449
Indian	-0.073	-0.095**	-0.090**	0.085
Pakistani	0.030	-0.082	-0.079*	-0.545**
Bangladeshi	0.135	-0.169*	-0.080	-0.260
Chinese	-0.076	-0.038	-0.106	0.035
Other Asian ethnic group	-0.159*	-0.012	-0.063	0.081
Mixed ethnic	-0.016	-0.083	-0.060	-0.033
Other ethnic group	-0.125	-0.155	-0.156*	-0.194
Unknown/Refused ethnic group	0.071	-0.084	-0.020	-0.025
Gender				
Female	-0.063***	-0.000	0.025	-0.046

Key: standard errors in parentheses; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Females appear less satisfied with assessment and feedback than males in both elite universities and non-university institutions. However, for Russell Group institutions Black African, Black Caribbean, Pakistani and Bangladeshi students seem more satisfied than White students, but less so in other groups of institutions. The exception is Black Caribbean students, who are also more satisfied in Other non-university institutions. The gap between Pakistani and White students is much larger for Other non-university institutions than it is elsewhere. The reverse seems to be true for Indian, Chinese and Other Asian groups, as in Other non-university institutions they seem to be more satisfied than White students.

Allowing the gender effect and a term for non-White aggregate BME effect to vary as a random coefficient at the institutional level: Table 27

Table 27 shows basic model results for total score with random coefficients on non-White and female.

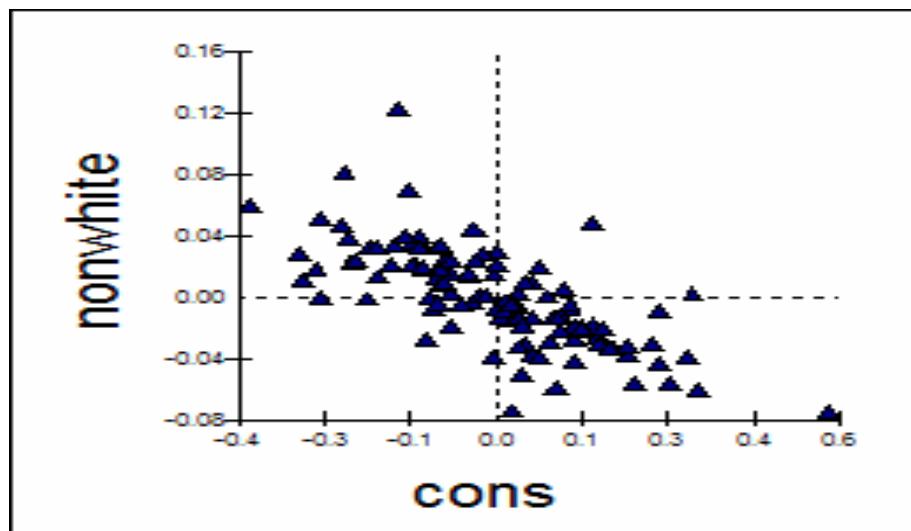
Model (27A) is the same as the last model (5) in Table 20, and is included to ease comparison with the subsequent models. The reason for the slight difference in parameter estimates between this model and that reported in Table 1, is that here we estimate the model in the MLwiN statistical package, whereas before we estimated it in Stata. Two different estimation procedures are used.

Model (27B) allows a random institution effect for whether or not students are non-White. This improves the deviance by 8 points for a loss of 2 degrees of freedom ($p = 0.018$). Thus the variation on the difference between White and BME groups varies significantly over institutions.

Figure 51 plots the random institution effects for the non-White term against those for the intercept. The scatter plot shows a strong negative correlation of -0.44. This

suggests that institutions that score above average for White students tend to be the ones that have the biggest White/non-White divergence of opinions. It may be instructive in future work to identify groups of institutions that are quite high and quite low on these effects in order to investigate more deeply the characteristics they possess. Apart from the broad characteristics discussed above in connection with groupings of institutions, there is nothing in names in a ranking of institutions on these factors to indicate what these characteristics might be.

Figure 51: Plot of estimated non-White and intercept residual institution effects



Model (27C) additionally allows a random institution effect for whether or not students are female. This greatly improves the deviance by 35 for a loss of a further 3 degrees of freedom ($p < 0.001$). This suggests gender effects are highly variable across institutions. The correlation matrix associated with the level 2 random effects variance covariance matrix is given below. The matrix shows all three random effects to be negatively correlated. Institutions that score above average for White males tend to have bigger gender differences in opinion with White female students scoring less highly, and bigger ethnic differences with non-White males scoring less highly. Institutions with bigger gender differences, on the other hand, tend to have smaller ethnic differences and vice versa.

Correlation between effects for Model (27C) in Table 27

	Intercept	Female	Non-White
Intercept	1.00		
Female	-0.139	1.00	
Non-White	-0.351	-0.329	1

Table 20: Basic models for total score

	(1)	(2)	(3)	(4)	(5)	
Fixed Part						
Intercept	0.023	(0.019)	0.037 (0.019)	0.043 (0.022)*	0.039 (0.022)	0.056 (0.062)
Other White	-0.107 (0.032)***	-0.105 (0.032)**	-0.105 (0.041)	-0.106 (0.041)	-0.105 (0.041)	(0.032)**
Black Caribbean	-0.003 (0.041)	-0.015 (0.041)	-0.015 (0.032)	-0.022 (0.033)	-0.022 (0.033)	(0.041)
Black African	-0.038 (0.079)	-0.013 (0.078)	-0.013 (0.078)	-0.021 (0.078)	-0.021 (0.078)	(0.033)
Other Black ethnic group	-0.126 (0.018)***	-0.143 (0.018)***	-0.143 (0.018)***	-0.150 (0.018)***	-0.147 (0.018)***	(0.078)
Indian	-0.093 (0.027)*	-0.073 (0.028)*	-0.073 (0.028)*	-0.079 (0.028)*	-0.077 (0.028)*	(0.019)***
Pakistani	-0.064 (0.045)	-0.063 (0.045)	-0.063 (0.045)	-0.070 (0.045)	-0.067 (0.045)	(0.028)*
Bangladeshi	-0.056 (0.036)**	-0.076 (0.036)	-0.076 (0.036)	-0.085 (0.036)*	-0.081 (0.036)	(0.045)
Chinese	-0.106 (0.039)*	-0.067 (0.039)	-0.067 (0.039)	-0.070 (0.039)	-0.068 (0.039)	(0.036)
Other Asian ethnic group	-0.091 (0.026)	-0.059 (0.026)	-0.059 (0.026)	-0.064 (0.026)*	-0.061 (0.026)*	(0.039)
Mixed ethnic	-0.051 (0.050)**	-0.051 (0.050)**	-0.051 (0.050)**	-0.053 (0.050)**	-0.051 (0.050)**	(0.026)*
Other ethnic group	-0.164 (0.032)	-0.151 (0.032)	-0.151 (0.032)	-0.155 (0.032)	-0.152 (0.032)	(0.050)**
Unknown/Refused ethnic group	-0.001 (0.032)	-0.010 (0.032)	-0.010 (0.032)	-0.015 (0.032)	-0.014 (0.032)	(0.032)
Female		-0.012 (0.008)	-0.012 (0.008)	-0.010 (0.008)	-0.010 (0.008)	(0.008)
Age 19		-0.012 (0.009)	-0.012 (0.009)	-0.015 (0.009)	-0.014 (0.009)	(0.009)
Age 20		-0.007 (0.016)	-0.007 (0.016)	-0.013 (0.017)	-0.013 (0.017)	(0.017)
Age 21		0.035 (0.030)	0.035 (0.030)	0.026 (0.030)	0.027 (0.030)	(0.030)
Age 22 to 24		0.019 (0.029)	0.019 (0.029)	0.008 (0.030)	0.008 (0.030)	(0.030)
Age 25 to 29		0.105 (0.044)*	0.105 (0.044)*	0.091 (0.044)*	0.091 (0.044)*	(0.044)*
Age 30 or older		0.160 (0.036)***	0.160 (0.036)***	0.143 (0.037)***	0.144 (0.037)***	(0.037)***
Lives at home full-time		0.086 (0.010)***	0.086 (0.010)***	0.084 (0.010)***	0.085 (0.010)***	(0.010)***
Neighbourhood level IMD score		0.016 (0.004)***	0.016 (0.004)***	0.015 (0.004)***	0.015 (0.004)***	(0.004)***
Disabled		-0.026 (0.015)	-0.026 (0.015)	-0.029 (0.015)*	-0.029 (0.015)*	(0.015)*
Medicine & dentistry		-0.543 (0.053)***	-0.543 (0.053)***	-0.535 (0.053)***	-0.535 (0.053)***	(0.053)***
Subjects allied to medicine		-0.147 (0.023)***	-0.147 (0.023)***	-0.145 (0.023)***	-0.145 (0.023)***	(0.023)***
Biological sciences		-0.108 (0.014)***	-0.108 (0.014)***	-0.106 (0.014)***	-0.107 (0.014)***	(0.014)***
Veterinary science		-0.332 (0.086)***	-0.332 (0.086)***	-0.324 (0.086)***	-0.341 (0.086)***	(0.086)***
Agriculture & related subjects		-0.036 (0.046)	-0.036 (0.046)	-0.040 (0.046)	-0.045 (0.046)	(0.046)
Physical sciences		0.061 (0.018)***	0.061 (0.018)***	0.060 (0.018)**	0.060 (0.018)**	(0.018)**
Mathematical sciences		0.175 (0.027)***	0.175 (0.027)***	0.179 (0.027)***	0.178 (0.027)***	(0.027)***
Computer science		-0.156 (0.021)***	-0.156 (0.021)***	-0.159 (0.021)***	-0.159 (0.021)***	(0.021)***
Engineering & technology		-0.154 (0.022)***	-0.154 (0.022)***	-0.156 (0.022)***	-0.156 (0.022)***	(0.022)***
Architecture, building & planning		-0.158 (0.033)***	-0.158 (0.033)***	-0.159 (0.033)***	-0.158 (0.033)***	(0.033)***
Law		-0.055 (0.019)**	-0.055 (0.019)**	-0.048 (0.019)*	-0.047 (0.019)*	(0.019)*
Business & administrative studies		-0.042 (0.016)*	-0.042 (0.016)*	-0.042 (0.016)*	-0.042 (0.016)*	(0.016)*
Mass communications & documentation		-0.042 (0.021)*	-0.042 (0.021)*	-0.039 (0.021)	-0.040 (0.021)	(0.021)
Languages		0.203 (0.017)***	0.203 (0.017)***	0.207 (0.017)***	0.206 (0.017)***	(0.017)***
Historical & philosophical studies		0.349 (0.018)***	0.349 (0.018)***	0.352 (0.018)***	0.351 (0.018)***	(0.018)***
Creative arts & design		-0.063 (0.017)***	-0.063 (0.017)***	-0.059 (0.017)***	-0.061 (0.017)***	(0.017)***
Education		-0.050 (0.026)	-0.050 (0.026)	-0.052 (0.026)	-0.054 (0.026)	(0.027)*
Combined		-0.067 (0.058)	-0.067 (0.058)	-0.067 (0.058)	-0.067 (0.058)	(0.058)
UCAS tariff score				-0.032 (0.007)***	-0.031 (0.007)***	(0.007)***
UCAS tariff score (squared)				0.001 (0.003)	0.001 (0.003)	(0.003)
UCAS tariff score (cubed)				0.005 (0.002)**	0.005 (0.002)**	(0.002)**
Institution size ('000s)					-0.014 (0.004)***	(0.004)***
Old institution					-0.033 (0.069)	(0.069)
New institution					0.014 (0.088)	(0.088)
Other institution					-0.096 (0.092)	(0.092)
Institution level mean UCAS tariff score					0.023 (0.055)	(0.055)
Institution level proportion of females					-0.060 (0.206)	(0.206)

Institution level proportion of non-White								-0.226	(0.119)	
Institution mean IMD score								0.038	(0.070)	
Level 2: Institution										
Intercept	0.040	(0.006)***	0.039	(0.006)***	0.035	(0.005)***	0.035	(0.005)***	0.029	(0.004)***
Level 1: Student										
Intercept	0.940	(0.005)***	0.939	(0.005)***	0.919	(0.005)***	0.919	(0.005)***	0.919	(0.005)***
Log-likelihood	-	92935.4	-	92905.0	-	92186.0	-	92176.1	-	92167.4
Variance partition coefficient (VPC)	0.041	0.040		0.037		0.036		0.031		
Number of institutions	119	119		119		119		119		119
Number of students	66837	66837		66837		66837		66837		66837

Key: standard errors in parentheses; $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table 21: Exploration of gender interaction terms

	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Fixed Part							
Intercept	0.056 (0.062)	0.059 (0.062)	0.052 (0.062)	0.056 (0.062)	0.059 (0.063)	0.056 (0.062)	0.056 (0.062)
Other White	-0.105 (0.032)**	-0.071 (0.050)	-0.104 (0.032)**	-0.104 (0.032)**	-0.104 (0.032)**	-0.104 (0.032)**	-0.068 (0.050)
Black Caribbean	-0.019 (0.041)	-0.137 (0.082)	-0.023 (0.041)	-0.023 (0.041)	-0.020 (0.041)	-0.020 (0.041)	-0.126 (0.082)
Black African	-0.018 (0.033)	-0.045 (0.053)	-0.018 (0.033)	-0.022 (0.033)	-0.018 (0.033)	-0.018 (0.033)	-0.032 (0.053)
Other Black ethnic group	-0.147 (0.078)	0.073 (0.150)	-0.151 (0.078)	-0.149 (0.078)	-0.148 (0.078)	-0.148 (0.078)	0.086 (0.150)
Indian	-0.077 (0.019)***	-0.126 (0.028)***	-0.078 (0.019)***	-0.077 (0.019)***	-0.077 (0.019)***	-0.076 (0.019)***	-0.124 (0.029)***
Pakistani	-0.067 (0.028)*	-0.095 (0.043)*	-0.067 (0.028)*	-0.070 (0.028)*	-0.067 (0.028)*	-0.067 (0.028)*	-0.089 (0.044)*
Bangladeshi	-0.081 (0.045)	0.014 (0.069)	-0.081 (0.045)	-0.082 (0.045)	-0.082 (0.045)	-0.081 (0.045)	0.022 (0.069)
Chinese	-0.068 (0.036)	-0.086 (0.055)	-0.067 (0.036)	-0.069 (0.036)	-0.068 (0.036)	-0.068 (0.036)	-0.089 (0.055)
Other Asian ethnic group	-0.061 (0.039)	-0.100 (0.058)	-0.062 (0.039)	-0.063 (0.039)	-0.061 (0.039)	-0.061 (0.039)	-0.098 (0.058)
Mixed ethnic	-0.051 (0.026)*	-0.025 (0.043)	-0.051 (0.026)*	-0.054 (0.026)*	-0.051 (0.026)*	-0.051 (0.026)*	-0.025 (0.043)
Other ethnic group	-0.152 (0.050)**	-0.266 (0.080)***	-0.152 (0.050)**	-0.154 (0.050)**	-0.152 (0.050)**	-0.152 (0.050)**	-0.259 (0.080)**
Unknown/Refused ethnic group	-0.014 (0.032)	-0.020 (0.045)	-0.013 (0.032)	-0.013 (0.032)	-0.013 (0.032)	-0.014 (0.032)	-0.012 (0.045)
Female	-0.010 (0.008)	-0.016 (0.009)	-0.010 (0.008)	-0.019 (0.009)*	-0.016 (0.009)	-0.010 (0.008)	-0.023 (0.010)*
Age 19	-0.014 (0.009)	-0.014 (0.009)	-0.014 (0.009)		-0.014 (0.009)	-0.014 (0.009)	
Age 20	-0.013 (0.017)	-0.013 (0.017)	-0.012 (0.017)		-0.013 (0.017)	-0.013 (0.017)	
Age 21	0.027 (0.030)	0.027 (0.030)	0.027 (0.030)		0.027 (0.030)	0.027 (0.030)	
Age 22 to 24	0.008 (0.030)	0.008 (0.030)	0.008 (0.030)		0.009 (0.030)	0.008 (0.030)	
Age 25 to 29	0.091 (0.044)*	0.092 (0.044)*	0.090 (0.044)*		0.091 (0.044)*	0.091 (0.044)*	
Age 30 or older	0.144 (0.037)***	0.144 (0.037)***	0.135 (0.037)***		0.144 (0.037)***	0.144 (0.037)***	
Lives at home full-time	0.085 (0.010)***	0.085 (0.010)***	0.084 (0.010)***	0.083 (0.010)***	0.066 (0.016)***	0.085 (0.010)***	0.075 (0.016)***
Neighbourhood level IMD score	0.015 (0.004)***	0.015 (0.004)***	0.015 (0.004)***	0.016 (0.004)***	0.015 (0.004)***	0.013 (0.006)*	0.019 (0.006)**
Disabled	-0.029 (0.015)*	-0.030 (0.015)*	-0.029 (0.015)*	-0.031 (0.015)*	-0.030 (0.015)*	-0.030 (0.015)*	-0.031 (0.015)*
Medicine & dentistry	-0.535 (0.053)***	-0.533 (0.053)***	-0.532 (0.053)***	-0.534 (0.053)***	-0.535 (0.053)***	-0.535 (0.053)***	-0.529 (0.053)***
Subjects allied to medicine	-0.145 (0.023)***	-0.146 (0.023)***	-0.142 (0.023)***	-0.144 (0.023)***	-0.144 (0.023)***	-0.145 (0.023)***	-0.143 (0.023)***
Biological sciences	-0.107 (0.014)***	-0.107 (0.014)***	-0.104 (0.014)***	-0.106 (0.014)***	-0.107 (0.014)***	-0.107 (0.014)***	-0.103 (0.014)***
Veterinary science	-0.341 (0.086)***	-0.340 (0.086)***	-0.335 (0.086)***	-0.343 (0.086)***	-0.340 (0.086)***	-0.340 (0.086)***	-0.337 (0.086)***
Agriculture & related subjects	-0.045 (0.046)	-0.044 (0.046)	-0.044 (0.046)	-0.043 (0.046)	-0.045 (0.046)	-0.045 (0.046)	-0.041 (0.046)
Physical sciences	0.060 (0.018)**	0.059 (0.018)**	0.061 (0.018)***	0.060 (0.018)**	0.060 (0.018)**	0.060 (0.018)**	0.061 (0.018)**
Mathematical sciences	0.178 (0.027)***	0.179 (0.027)***	0.179 (0.027)***	0.181 (0.027)***	0.179 (0.027)***	0.178 (0.027)***	0.181 (0.027)***
Computer science	-0.159 (0.021)***	-0.158 (0.021)***	-0.153 (0.021)***	-0.159 (0.021)***	-0.157 (0.021)***	-0.159 (0.021)***	-0.152 (0.021)***
Engineering & technology	-0.156 (0.022)***	-0.156 (0.022)***	-0.154 (0.022)***	-0.157 (0.022)***	-0.155 (0.022)***	-0.156 (0.022)***	-0.155 (0.022)***
Architecture, building & planning	-0.158 (0.033)***	-0.159 (0.033)***	-0.154 (0.033)***	-0.157 (0.033)***	-0.158 (0.033)***	-0.158 (0.033)***	-0.154 (0.033)***
Law	-0.047 (0.019)*	-0.048 (0.019)*	-0.045 (0.019)*	-0.046 (0.019)*	-0.047 (0.019)*	-0.048 (0.019)*	-0.044 (0.019)*
Business & administrative studies	-0.042 (0.016)*	-0.042 (0.016)**	-0.040 (0.016)*	-0.043 (0.016)**	-0.042 (0.016)*	-0.042 (0.016)*	-0.041 (0.016)*
Mass communications & documentation	-0.040 (0.021)	-0.040 (0.021)	-0.038 (0.021)	-0.040 (0.021)	-0.040 (0.021)	-0.040 (0.021)	-0.039 (0.021)
Languages	0.206 (0.017)***	0.207 (0.017)***	0.209 (0.017)***	0.208 (0.017)***	0.206 (0.017)***	0.206 (0.017)***	0.211 (0.017)***
Historical & philosophical studies	0.351 (0.018)***	0.351 (0.018)***	0.353 (0.018)***	0.353 (0.018)***	0.351 (0.018)***	0.351 (0.018)***	0.355 (0.018)***
Creative arts & design	-0.061 (0.017)***	-0.061 (0.017)***	-0.059 (0.017)***	-0.063 (0.017)***	-0.060 (0.017)***	-0.061 (0.017)***	-0.061 (0.017)***
Education	-0.054 (0.027)*	-0.053 (0.027)*	-0.057 (0.027)*	-0.052 (0.027)	-0.055 (0.027)*	-0.054 (0.027)*	-0.054 (0.027)*
Combined	-0.067 (0.058)	-0.067 (0.058)	-0.065 (0.058)	-0.068 (0.058)	-0.067 (0.058)	-0.067 (0.058)	-0.066 (0.058)
UCAS tariff score	-0.031 (0.007)***	-0.031 (0.007)***	-0.011 (0.009)	-0.032 (0.007)***	-0.031 (0.007)***	-0.031 (0.007)***	-0.014 (0.009)
UCAS tariff score (squared)	0.001 (0.003)	0.001 (0.003)	0.001 (0.003)	0.003 (0.003)	0.001 (0.003)	0.001 (0.003)	0.003 (0.003)
UCAS tariff score (cubed)	0.005 (0.002)**	0.005 (0.002)**	0.005 (0.002)**	0.004 (0.002)**	0.005 (0.002)**	0.005 (0.002)**	0.004 (0.002)**
Institution size ('000s)	-0.014 (0.004)***						
Old institution	-0.033 (0.069)	-0.033 (0.069)	-0.030 (0.069)	-0.032 (0.069)	-0.032 (0.069)	-0.033 (0.069)	-0.029 (0.069)
New institution	0.014 (0.088)	0.014 (0.088)	0.015 (0.088)	0.013 (0.088)	0.014 (0.088)	0.014 (0.088)	0.014 (0.088)
Other institution	-0.096 (0.092)	-0.097 (0.092)	-0.093 (0.092)	-0.097 (0.092)	-0.096 (0.092)	-0.096 (0.092)	-0.095 (0.091)
	0.023 (0.055)	0.023 (0.054)	0.022 (0.055)	0.023 (0.054)	0.023 (0.055)	0.023 (0.055)	0.023 (0.054)

Institution level mean UCAS tariff score														
Institution level proportion of females	-0.060	(0.206)	-0.060	(0.206)	-0.060	(0.206)	-0.055	(0.206)	-0.059	(0.206)	-0.059	(0.206)	-0.056	(0.206)
Institution level proportion of non-White	-0.226	(0.119)	-0.226	(0.119)	-0.226	(0.119)	-0.228	(0.119)	-0.225	(0.119)	-0.225	(0.119)	-0.229	(0.119)
Institution mean IMD score	0.038	(0.070)	0.038	(0.070)	0.038	(0.070)	0.041	(0.070)	0.038	(0.070)	0.038	(0.070)	0.041	(0.070)
Female*Other White			-0.057	(0.065)									-0.059	(0.065)
Female*Black Caribbean			0.158	(0.094)									0.135	(0.094)
Female*Black African			0.043	(0.065)									0.017	(0.066)
Female*Other Black ethnic group			-0.299	(0.175)									-0.325	(0.176)
Female*Indian			0.080	(0.035)*									0.074	(0.036)*
Female*Pakistani			0.045	(0.054)									0.030	(0.055)
Female*Bangladeshi			-0.163	(0.089)									-0.179	(0.090)*
Female*Chinese			0.030	(0.071)									0.033	(0.071)
Female*Other Asian ethnic group			0.069	(0.077)									0.060	(0.077)
Female*Mixed ethnic			-0.040	(0.054)									-0.044	(0.054)
Female*Other ethnic group			0.186	(0.102)									0.171	(0.102)
Female*Unknown/Refused ethnic group			0.011	(0.062)									-0.001	(0.062)
Female*UCAS tariff score					-0.034	(0.008)***							-0.029	(0.008)***
Aged 20 or over							-0.032	(0.019)					-0.021	(0.019)
Female*Aged 20 or over							0.091	(0.024)***					0.071	(0.025)**
Female*Lives at home full-time									0.029	(0.019)			0.011	(0.020)
Female*Neighbourhood level IMD score											0.004	(0.008)	-0.005	(0.008)
Level 2: Institution														
Intercept	0.029	(0.004)***	0.029	(0.004)***	0.029	(0.004)***	0.029	(0.004)***	0.029	(0.004)***	0.029	(0.004)***	0.029	(0.004)***
Level 1: Student														
Intercept	0.919	(0.005)***	0.919	(0.005)***	0.919	(0.005)***	0.919	(0.005)***	0.919	(0.005)***	0.919	(0.005)***	0.919	(0.005)***
Log-likelihood													-92153.5	
	92167.4		92156.9		92157.5		92171.2		92166.3		92167.3			
Variance partition coefficient (VPC)	0.031		0.031		0.031		0.031		0.031		0.031		0.031	
Number of institutions	119		119		119		119		119		119		119	
Number of students	66837		66837		66837		66837		66837		66837		66837	

Key: standard errors in parentheses; $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table 22: Exploration of ethnicity interaction terms (four categories)

	(13)	(14)	(15)	(16)	(17)	(18)	(19)	
Fixed Part								
Intercept	0.054 (0.063)	0.058 (0.063)	0.049 (0.063)	0.054 (0.063)	0.054 (0.063)	0.054 (0.062)	0.054 (0.063)	0.053 (0.062)
Black	-0.025 (0.025)	-0.055 (0.043)	-0.042 (0.028)	-0.020 (0.031)	0.015 (0.030)	-0.041 (0.039)	-0.056 (0.055)	
Asian	-0.067 (0.014)***	-0.097 (0.021)***	-0.066 (0.015)***	-0.071 (0.015)***	-0.072 (0.018)***	-0.067 (0.016)***	-0.105 (0.024)***	
Other ethnic group	-0.049 (0.019)*	-0.052 (0.030)	-0.053 (0.021)**	-0.047 (0.019)*	-0.062 (0.022)**	-0.050 (0.019)*	-0.074 (0.032)*	
Female	-0.011 (0.008)	-0.017 (0.009)	-0.012 (0.008)	-0.011 (0.008)	-0.011 (0.008)	-0.011 (0.008)	-0.011 (0.008)	-0.016 (0.009)
Age 19	-0.014 (0.009)	-0.014 (0.009)		-0.014 (0.009)	-0.014 (0.009)	-0.014 (0.009)	-0.014 (0.009)	
Age 20	-0.014 (0.017)	-0.013 (0.017)		-0.014 (0.017)	-0.014 (0.017)	-0.014 (0.017)	-0.014 (0.017)	
Age 21	0.027 (0.030)	0.027 (0.030)		0.027 (0.030)	0.026 (0.030)	0.027 (0.030)		
Age 22 to 24	0.009 (0.030)	0.009 (0.030)		0.009 (0.030)	0.008 (0.030)	0.009 (0.030)		
Age 25 to 29	0.092 (0.044)*	0.092 (0.044)*		0.093 (0.044)*	0.092 (0.044)*	0.092 (0.044)*		
Age 30 or older	0.144 (0.037)***	0.144 (0.037)***		0.146 (0.037)***	0.144 (0.037)***	0.144 (0.037)***		
Lives at home full-time	0.084 (0.010)***	0.084 (0.010)***	0.083 (0.010)***	0.084 (0.010)***	0.084 (0.012)***	0.084 (0.010)***	0.082 (0.012)***	
Neighbourhood level IMD score	0.015 (0.004)***	0.015 (0.004)***	0.015 (0.004)***	0.014 (0.004)***	0.014 (0.004)***	0.014 (0.004)***	0.015 (0.004)**	
Disabled	-0.030 (0.015)*	-0.030 (0.015)*	-0.028 (0.015)	-0.029 (0.015)*	-0.030 (0.015)*	-0.030 (0.015)*	-0.031 (0.015)*	
Medicine & dentistry	-0.537 (0.053)***	-0.536 (0.053)***	-0.543 (0.053)***	-0.535 (0.053)***	-0.536 (0.053)***	-0.537 (0.053)***	-0.532 (0.053)***	
Subjects allied to medicine	-0.145 (0.023)***	-0.146 (0.023)***	-0.145 (0.023)***	-0.144 (0.023)***	-0.145 (0.023)***	-0.145 (0.023)***	-0.144 (0.023)***	
Biological sciences	-0.106 (0.014)***	-0.106 (0.014)***	-0.108 (0.014)***	-0.107 (0.014)***	-0.106 (0.014)***	-0.106 (0.014)***	-0.106 (0.014)***	
Veterinary science	-0.339 (0.086)***	-0.338 (0.086)***	-0.346 (0.086)***	-0.340 (0.086)***	-0.339 (0.086)***	-0.339 (0.086)***	-0.338 (0.086)***	
Agriculture & related subjects	-0.044 (0.046)	-0.044 (0.046)	-0.040 (0.046)	-0.044 (0.046)	-0.044 (0.046)	-0.044 (0.046)	-0.044 (0.046)	-0.042 (0.046)
Physical sciences	0.061 (0.018)***	0.061 (0.018)***	0.063 (0.018)***	0.061 (0.018)***	0.061 (0.018)***	0.061 (0.018)***	0.062 (0.018)***	
Mathematical sciences	0.179 (0.027)***	0.180 (0.027)***	0.179 (0.027)***	0.179 (0.027)***	0.179 (0.027)***	0.179 (0.027)***	0.184 (0.027)***	
Computer science	-0.159 (0.021)***	-0.157 (0.021)***	-0.158 (0.021)***	-0.160 (0.021)***	-0.159 (0.021)***	-0.159 (0.021)***	-0.157 (0.021)***	
Engineering & technology	-0.155 (0.022)***	-0.155 (0.022)***	-0.154 (0.022)***	-0.155 (0.022)***	-0.155 (0.022)***	-0.155 (0.022)***	-0.155 (0.022)***	
Architecture, building & planning	-0.158 (0.033)***	-0.159 (0.033)***	-0.157 (0.033)***	-0.158 (0.033)***	-0.158 (0.033)***	-0.158 (0.033)***	-0.158 (0.033)***	
Law	-0.047 (0.019)*	-0.048 (0.019)*	-0.053 (0.019)**	-0.047 (0.019)*	-0.048 (0.019)*	-0.047 (0.019)*	-0.047 (0.019)*	-0.047 (0.019)*
Business & administrative studies	-0.042 (0.016)*	-0.042 (0.016)*	-0.043 (0.016)**	-0.042 (0.016)**	-0.042 (0.016)*	-0.042 (0.016)*	-0.042 (0.016)*	-0.042 (0.016)**
Mass communications & documentation	-0.040 (0.021)	-0.040 (0.021)	-0.045 (0.021)*	-0.040 (0.021)	-0.040 (0.021)	-0.040 (0.021)	-0.040 (0.021)	-0.040 (0.021)
Languages	0.206 (0.017)***	0.207 (0.017)***	0.204 (0.017)***	0.206 (0.017)***	0.207 (0.017)***	0.207 (0.017)***	0.209 (0.017)***	
Historical & philosophical studies	0.352 (0.018)***	0.352 (0.018)***	0.352 (0.018)***	0.352 (0.018)***	0.352 (0.018)***	0.352 (0.018)***	0.354 (0.018)***	
Creative arts & design	-0.060 (0.017)***	-0.060 (0.017)***	-0.067 (0.017)***	-0.060 (0.017)***	-0.060 (0.017)***	-0.060 (0.017)***	-0.062 (0.017)***	
Education	-0.053 (0.027)*	-0.051 (0.027)	-0.047 (0.027)	-0.052 (0.027)*	-0.052 (0.027)*	-0.052 (0.027)*	-0.047 (0.027)	
Combined	-0.067 (0.058)	-0.067 (0.058)	-0.068 (0.058)	-0.066 (0.058)	-0.066 (0.058)	-0.066 (0.058)	-0.067 (0.058)	
UCAS tariff score	-0.031 (0.007)***	-0.031 (0.007)***		-0.031 (0.007)***	-0.031 (0.007)***	-0.031 (0.007)***	-0.032 (0.007)***	
UCAS tariff score (squared)	0.001 (0.003)	0.001 (0.003)	0.003 (0.003)	0.001 (0.003)	0.001 (0.003)	0.001 (0.003)	0.003 (0.003)	
UCAS tariff score (cubed)	0.005 (0.002)**	0.005 (0.002)**	-0.001 (0.001)	0.005 (0.002)**	0.005 (0.002)**	0.005 (0.002)**	0.004 (0.002)**	
Institution size ('000s)	-0.014 (0.004)***							
Old institution	-0.032 (0.069)	-0.033 (0.069)	-0.031 (0.069)	-0.033 (0.069)	-0.033 (0.069)	-0.033 (0.069)	-0.032 (0.069)	-0.032 (0.069)
New institution	0.012 (0.088)	0.012 (0.088)	0.015 (0.088)	0.013 (0.088)	0.012 (0.088)	0.012 (0.088)	0.010 (0.088)	
Other institution	-0.098 (0.092)	-0.099 (0.092)	-0.097 (0.092)	-0.098 (0.092)	-0.098 (0.092)	-0.098 (0.092)	-0.101 (0.092)	
Institution level mean UCAS tariff score	0.022 (0.055)	0.021 (0.055)	0.007 (0.055)	0.022 (0.055)	0.022 (0.055)	0.022 (0.055)	0.022 (0.055)	
Institution level proportion of females	-0.060 (0.206)	-0.058 (0.206)	-0.049 (0.207)	-0.061 (0.206)	-0.059 (0.206)	-0.060 (0.206)	-0.052 (0.206)	
Institution level proportion of non-White	-0.240 (0.119)*	-0.241 (0.119)*	-0.251 (0.120)*	-0.240 (0.119)*	-0.241 (0.119)*	-0.242 (0.119)*	-0.245 (0.119)*	
Institution mean IMD score	0.041 (0.070)	0.041 (0.070)	0.043 (0.070)	0.040 (0.070)	0.041 (0.070)	0.041 (0.070)	0.043 (0.070)	
Black*female		0.046 (0.051)					0.050 (0.051)	
Asian*female		0.049 (0.026)					0.050 (0.026)	
Other*female		0.006 (0.038)					0.004 (0.038)	
Aged 20 or over			0.018 (0.014)				0.011 (0.014)	
Black*Aged 20 or over			0.114 (0.061)				0.121 (0.063)	
Asian*Aged 20 or over			0.022 (0.044)				0.025 (0.044)	
Other*Aged 20 or over			0.045 (0.053)				0.061 (0.054)	

Black*UCAS score					0.006	(0.027)					0.019	(0.028)	
Asian*UCAS score					-0.013	(0.013)					-0.007	(0.014)	
Other*UCAS score					0.009	(0.019)					0.021	(0.020)	
Black*Lives at home							-0.119	(0.052)*			-0.121	(0.052)*	
Asian*Lives at home							0.011	(0.027)			0.007	(0.028)	
Other*Lives at home							0.054	(0.044)			0.062	(0.045)	
Black*IMD									0.017	(0.029)	0.023	(0.029)	
Asian*IMD									0.002	(0.013)	-0.003	(0.013)	
Other*IMD									0.006	(0.018)	0.001	(0.019)	
Level 2: Institution													
Intercept	0.029	(0.004)***	0.029	(0.004)***	0.029	(0.004)***	0.029	(0.004)***	0.029	(0.004)***	0.029	(0.004)***	
Level 1: Student													
Intercept	0.919	(0.005)***	0.919	(0.005)***	0.920	(0.005)***	0.919	(0.005)***	0.919	(0.005)***	0.919	(0.005)***	
Log-likelihood					-	-	-	-	-	-	-	-	
	92176.9		92174.8		92195.3		92176.2		92173.1		92176.6		92178.4
Variance partition coefficient (VPC)	0.031		0.031		0.031		0.031		0.031		0.031		0.031
Number of institutions	119		119		119		119		119		119		119
Number of students	66837		66837		66837		66837		66837		66837		66837

Key: standard errors in parentheses; $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table 23: Exploration of ethnicity interaction terms (13 categories)

	(20)	(21)	(22)	(23)	(24)	(25)	(26)	
Fixed Part								
Intercept	0.056	(0.062)	0.059	(0.062)	0.050	(0.063)	0.056	(0.062)
Other White	-0.105	(0.032)**	-0.071	(0.050)	-0.094	(0.035)**	-0.105	(0.032)**
Black Caribbean	-0.019	(0.041)	-0.137	(0.082)	-0.030	(0.045)	-0.047	(0.053)
Black African	-0.018	(0.033)	-0.045	(0.053)	-0.039	(0.036)	-0.003	(0.040)
Other Black ethnic group	-0.147	(0.078)	0.073	(0.150)	-0.165	(0.087)	-0.092	(0.098)
Indian	-0.077	(0.019)***	-0.126	(0.028)***	-0.068	(0.019)***	-0.083	(0.019)***
Pakistani	-0.067	(0.028)*	-0.095	(0.043)*	-0.067	(0.029)*	-0.062	(0.032)
Bangladeshi	-0.081	(0.045)	0.014	(0.069)	-0.082	(0.048)	-0.090	(0.054)
Chinese	-0.068	(0.036)	-0.086	(0.055)	-0.066	(0.037)	-0.066	(0.036)
Other Asian ethnic group	-0.061	(0.039)	-0.100	(0.058)	-0.089	(0.042)*	-0.060	(0.039)
Mixed ethnic	-0.051	(0.026)*	-0.025	(0.043)	-0.059	(0.028)*	-0.051	(0.026)
Other ethnic group	-0.152	(0.050)**	-0.266	(0.080)***	-0.125	(0.055)*	-0.158	(0.053)**
Unknown/Refused ethnic group	-0.014	(0.032)	-0.020	(0.045)	-0.025	(0.035)	-0.009	(0.033)
Female	-0.010	(0.008)	-0.016	(0.009)	-0.011	(0.008)	-0.010	(0.008)
Age 19	-0.014	(0.009)	-0.014	(0.009)			-0.015	(0.009)
Age 20	-0.013	(0.017)	-0.013	(0.017)			-0.012	(0.017)
Age 21	0.027	(0.030)	0.027	(0.030)			0.027	(0.030)
Age 22 to 24	0.008	(0.030)	0.008	(0.030)			0.009	(0.030)
Age 25 to 29	0.091	(0.044)*	0.092	(0.044)*			0.093	(0.044)*
Age 30 or older	0.144	(0.037)***	0.144	(0.037)***			0.146	(0.037)***
Lives at home full-time	0.085	(0.010)***	0.085	(0.010)***	0.084	(0.010)***	0.085	(0.010)***
Neighbourhood level IMD score	0.015	(0.004)***	0.015	(0.004)***	0.016	(0.004)***	0.015	(0.004)***
Disabled	-0.029	(0.015)*	-0.030	(0.015)*	-0.028	(0.015)	-0.029	(0.015)*
Medicine & dentistry	-0.535	(0.053)***	-0.533	(0.053)***	-0.541	(0.053)***	-0.534	(0.053)***
Subjects allied to medicine	-0.145	(0.023)***	-0.146	(0.023)***	-0.144	(0.023)***	-0.144	(0.023)***
Biological sciences	-0.107	(0.014)***	-0.107	(0.014)***	-0.108	(0.014)***	-0.107	(0.014)***
Veterinary science	-0.341	(0.086)***	-0.340	(0.086)***	-0.348	(0.086)***	-0.341	(0.086)***
Agriculture & related subjects	-0.045	(0.046)	-0.044	(0.046)	-0.040	(0.046)	-0.045	(0.046)
Physical sciences	0.060	(0.018)**	0.059	(0.018)**	0.062	(0.018)***	0.060	(0.018)**
Mathematical sciences	0.178	(0.027)***	0.179	(0.027)***	0.178	(0.027)***	0.179	(0.027)***
Computer science	-0.159	(0.021)***	-0.158	(0.021)***	-0.158	(0.021)***	-0.160	(0.021)***
Engineering & technology	-0.156	(0.022)***	-0.156	(0.022)***	-0.155	(0.022)***	-0.156	(0.022)***
Architecture, building & planning	-0.158	(0.033)***	-0.159	(0.033)***	-0.158	(0.033)***	-0.158	(0.033)***
Law	-0.047	(0.019)*	-0.048	(0.019)*	-0.054	(0.019)**	-0.047	(0.019)**
Business & administrative studies	-0.042	(0.016)*	-0.042	(0.016)**	-0.043	(0.016)**	-0.042	(0.016)**
Mass communications & documentation	-0.040	(0.021)	-0.040	(0.021)	-0.045	(0.021)*	-0.040	(0.021)
Languages	0.206	(0.017)***	0.207	(0.017)***	0.204	(0.017)***	0.206	(0.017)***
Historical & philosophical studies	0.351	(0.018)***	0.351	(0.018)***	0.351	(0.018)***	0.350	(0.018)***
Creative arts & design	-0.061	(0.017)***	-0.061	(0.017)***	-0.068	(0.017)***	-0.061	(0.017)***
Education	-0.054	(0.027)*	-0.053	(0.027)*	-0.049	(0.027)	-0.054	(0.027)*
Combined	-0.067	(0.058)	-0.067	(0.058)	-0.068	(0.058)	-0.068	(0.058)
UCAS tariff score	-0.031	(0.007)***	-0.031	(0.007)***			-0.031	(0.008)***
UCAS tariff score (squared)	0.001	(0.003)	0.001	(0.003)	0.003	(0.003)	0.001	(0.003)
UCAS tariff score (cubed)	0.005	(0.002)**	0.005	(0.002)**	-0.001	(0.001)	0.005	(0.002)**
Institution size ('000s)	-0.014	(0.004)***	-0.014	(0.004)***	-0.014	(0.004)***	-0.014	(0.004)***
Old institution	-0.033	(0.069)	-0.033	(0.069)	-0.031	(0.069)	-0.033	(0.069)
New institution	0.014	(0.088)	0.014	(0.088)	0.016	(0.088)	0.015	(0.088)
Other institution	-0.096	(0.092)	-0.097	(0.092)	-0.095	(0.092)	-0.096	(0.092)
Institution level mean UCAS tariff	0.023	(0.055)	0.023	(0.054)	0.008	(0.055)	0.024	(0.055)

score															
Institution level proportion of females	-0.060	(0.206)	-0.060	(0.206)	-0.051	(0.207)	-0.061	(0.206)	-0.058	(0.206)	-0.060	(0.206)	-0.054	(0.206)	
Institution level proportion of non-White	-0.226	(0.119)	-0.226	(0.119)	-0.237	(0.119)*	-0.225	(0.119)	-0.229	(0.119)	-0.228	(0.119)	-0.232	(0.119)	
Institution mean IMD score	0.038	(0.070)	0.038	(0.070)	0.041	(0.070)	0.038	(0.070)	0.039	(0.070)	0.039	(0.070)	0.041	(0.070)	
Other White*female		-0.057	(0.065)										-0.049	(0.065)	
Black Caribbean*female		0.158	(0.094)										0.148	(0.095)	
Black African*female		0.043	(0.065)										0.044	(0.066)	
Other Black ethnic group*female		-0.299	(0.175)										-0.304	(0.181)	
Indian*female		0.080	(0.035)*										0.077	(0.035)*	
Pakistani*female		0.045	(0.054)										0.046	(0.054)	
Bangladeshi*female		-0.163	(0.089)										-0.144	(0.090)	
Chinese*female		0.030	(0.071)										0.028	(0.071)	
Other Asian ethnic group*female		0.069	(0.077)										0.066	(0.077)	
Mixed ethnic*female		-0.040	(0.054)										-0.050	(0.054)	
Other ethnic group*female		0.186	(0.102)										0.180	(0.103)	
Unknown/Refused ethnic group*female		0.011	(0.062)										0.014	(0.063)	
Aged 20 or over				0.020	(0.014)								0.013	(0.014)	
Other White*Aged 20 or over				-0.046	(0.082)								-0.044	(0.087)	
Black Caribbean*Aged 20 or over				0.096	(0.111)								0.068	(0.115)	
Black African*Aged 20 or over				0.119	(0.078)								0.134	(0.080)	
Other Black ethnic group*Aged 20 or over				0.113	(0.198)								0.194	(0.219)	
Indian*Aged 20 or over				-0.073	(0.070)								-0.076	(0.071)	
Pakistani*Aged 20 or over				0.032	(0.080)								0.048	(0.082)	
Bangladeshi*Aged 20 or over				0.058	(0.142)								0.019	(0.146)	
Chinese*Aged 20 or over				-0.005	(0.124)								0.002	(0.124)	
Other Asian ethnic group*Aged 20 or over				0.219	(0.109)*								0.253	(0.113)*	
Mixed ethnic *Aged 20 or over				0.062	(0.076)								0.074	(0.079)	
Other ethnic group*Aged 20 or over				-0.151	(0.131)								-0.142	(0.139)	
Unknown/Refused ethnic group*Aged 20 or over				0.095	(0.083)								0.112	(0.087)	
Other White*UCAS score						0.006	(0.028)						0.010	(0.030)	
Black Caribbean*UCAS score						-0.041	(0.047)						-0.032	(0.049)	
Black African*UCAS score						0.022	(0.035)						0.032	(0.036)	
Other Black ethnic group*UCAS score						0.081	(0.090)						0.134	(0.098)	
Indian*UCAS score						-0.026	(0.019)						-0.021	(0.019)	
Pakistani*UCAS score						0.009	(0.029)						0.017	(0.030)	
Bangladeshi*UCAS score						-0.015	(0.048)						-0.009	(0.050)	
Chinese*UCAS score						-0.017	(0.032)						-0.017	(0.033)	
Other Asian ethnic group*UCAS score						0.010	(0.038)						0.033	(0.040)	
Mixed ethnic*UCAS score						0.010	(0.026)						0.037	(0.027)	
Other ethnic group*UCAS score						-0.021	(0.050)						-0.035	(0.054)	
Unknown/Refused ethnic group*UCAS score						0.018	(0.032)						0.028	(0.034)	
Other White*Lives at home								0.071	(0.075)				0.052	(0.077)	
Black Caribbean*Lives at home								-0.124	(0.083)				-0.142	(0.084)	
Black African*Lives at home								-0.182	(0.071)*				-0.181	(0.072)*	
Other Black ethnic group*Lives at								0.229	(0.163)				0.331	(0.171)	

home														
Indian*Lives at home								0.024	(0.036)			0.011	(0.037)	
Pakistani*Lives at home								0.013	(0.055)			0.019	(0.056)	
Bangladeshi*Lives at home								-0.148	(0.095)			-0.140	(0.097)	
Chinese*Lives at home								0.045	(0.081)			0.053	(0.084)	
Other Asian ethnic group*Lives at home								0.016	(0.079)			0.047	(0.081)	
Mixed ethnic*Lives at home								0.164	(0.062)**			0.176	(0.064)**	
Other ethnic group*Lives at home								0.014	(0.101)			-0.021	(0.108)	
Unknown/Refused ethnic group*Lives at home								-0.045	(0.076)			-0.039	(0.077)	
Other White*IMD										0.044	(0.033)	0.043	(0.034)	
Black Caribbean*IMD										0.043	(0.049)	0.042	(0.051)	
Black African*IMD										0.003	(0.039)	0.016	(0.040)	
Other Black ethnic group*IMD										-0.011	(0.086)	-0.020	(0.090)	
Indian*IMD										0.019	(0.018)	0.013	(0.019)	
Pakistani*IMD										-0.001	(0.030)	-0.001	(0.030)	
Bangladeshi*IMD										0.003	(0.049)	0.018	(0.050)	
Chinese*IMD										-0.030	(0.032)	-0.037	(0.033)	
Other Asian ethnic group*IMD										-0.028	(0.038)	-0.033	(0.040)	
Mixed ethnic*IMD										0.020	(0.025)	0.011	(0.026)	
Other ethnic group*IMD										0.002	(0.048)	0.000	(0.051)	
Unknown/Refused ethnic group*IMD										0.004	(0.030)	0.005	(0.031)	
Level 2: Institution														
Intercept	0.029	(0.004)***	0.029	(0.004)***	0.029	(0.004)***	0.029	(0.004)***	0.029	(0.004)***	0.029	(0.004)***	0.029	(0.004)***
Level 1: Student														
Intercept	0.919	(0.005)***	0.919	(0.005)***	0.919	(0.005)***	0.919	(0.005)***	0.919	(0.005)***	0.919	(0.005)***	0.918	(0.005)***
Log-likelihood	-		-		-		-		-		-		-	
	92167.4		92156.9		92181.7		92164.8		92155.8		92164.6		92143.2	
Variance partition coefficient (VPC)	0.031		0.031		0.031		0.031		0.031		0.031		0.031	
Number of institutions	119		119		119		119		119		119		119	
Number of students	66837		66837		66837		66837		66837		66837		66837	

Key: standard errors in parentheses; $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table 24: Basic model for total score estimated on sample split by proportion of non-White students (low, medium and high)

	Low % non-White	Medium % non-White	High % non-White	
Fixed Part				
Intercept	0.184 (0.318)	0.125 (0.151)	0.055 (0.089)	
Other White	-0.066 (0.086)	-0.149 (0.050)**	-0.077 (0.048)	
Black Caribbean	0.185 (0.172)	0.013 (0.091)	-0.039 (0.050)	
Black African	0.270 (0.150)	0.079 (0.062)	-0.065 (0.041)	
Other Black ethnic group	0.134 (0.256)	-0.232 (0.143)	-0.135 (0.101)	
Indian	-0.130 (0.083)	-0.106 (0.034)**	-0.055 (0.024)*	
Pakistani	-0.105 (0.167)	-0.165 (0.056)**	-0.026 (0.035)	
Bangladeshi	0.256 (0.240)	0.077 (0.120)	-0.111 (0.052)*	
Chinese	-0.100 (0.122)	-0.044 (0.057)	-0.066 (0.049)	
Other Asian ethnic group	-0.223 (0.162)	-0.079 (0.076)	-0.041 (0.048)	
Mixed ethnic	-0.101 (0.074)	-0.023 (0.039)	-0.065 (0.040)	
Other ethnic group	-0.293 (0.200)	-0.162 (0.094)	-0.123 (0.063)	
Unknown/Refused ethnic group	-0.014 (0.085)	-0.040 (0.048)	0.001 (0.049)	
Female	0.011 (0.017)	-0.015 (0.012)	-0.025 (0.015)	
Age 19	0.004 (0.018)	-0.024 (0.012)	-0.014 (0.016)	
Age 20	-0.010 (0.035)	-0.026 (0.025)	-0.002 (0.029)	
Age 21	0.068 (0.062)	-0.017 (0.047)	0.050 (0.049)	
Age 22 to 24	0.013 (0.062)	-0.041 (0.046)	0.048 (0.049)	
Age 25 to 29	0.024 (0.090)	-0.063 (0.071)	0.275 (0.073)***	
Age 30 or older	0.078 (0.070)	0.163 (0.059)**	0.156 (0.066)*	
Lives at home full-time	0.081 (0.026)**	0.109 (0.016)***	0.066 (0.016)***	
Neighbourhood level IMD score	0.005 (0.008)	0.018 (0.006)**	0.022 (0.008)**	
Disabled	-0.052 (0.028)	-0.018 (0.022)	-0.026 (0.029)	
Medicine & dentistry	-0.172 (0.069)*	-0.136 (0.032)***	-0.138 (0.039)***	
Subjects allied to medicine	-0.183 (0.029)***	-0.070 (0.020)***	-0.111 (0.027)***	
Biological sciences	-0.005 (0.076)	-0.100 (0.061)	-0.030 (0.077)	
Veterinary science	0.098 (0.037)**	0.050 (0.026)	0.032 (0.038)	
Agriculture & related subjects	0.143 (0.060)*	0.205 (0.038)***	0.153 (0.048)**	
Physical sciences	-0.233 (0.046)***	-0.099 (0.032)**	-0.182 (0.034)***	
Mathematical sciences	-0.146 (0.060)*	-0.117 (0.030)***	-0.222 (0.040)***	
Computer science	-0.077 (0.100)	-0.219 (0.040)***	0.013 (0.068)	
Engineering & technology	-0.073 (0.045)	-0.123 (0.026)***	0.084 (0.033)*	
Architecture, building & planning	-0.012 (0.034)	-0.057 (0.024)*	-0.050 (0.030)	
Law	-0.159 (0.040)***	0.051 (0.031)	-0.065 (0.042)	
Business & administrative studies	0.132 (0.033)***	0.249 (0.025)***	0.197 (0.032)***	
Mass communications & documentation	0.373 (0.035)***	0.382 (0.026)***	0.249 (0.036)***	
Languages	-0.214 (0.033)***	-0.015 (0.025)	-0.002 (0.032)	
Historical & philosophical studies	-0.150 (0.043)***	-0.004 (0.042)	-0.027 (0.060)	
Creative arts & design	-0.322 (0.206)	-0.035 (0.062)	0.100 (0.347)	
UCAS tariff score	-0.029 (0.015)*	-0.033 (0.011)**	-0.031 (0.014)*	
UCAS tariff score (squared)	0.014 (0.006)*	0.002 (0.004)	-0.009 (0.005)	
UCAS tariff score (cubed)	0.004 (0.003)	0.004 (0.002)	0.006 (0.003)	
Institution size ('000s)	-0.010 (0.009)	-0.023 (0.009)**	-0.019 (0.005)***	
Old institution	0.036 (0.185)	-0.045 (0.121)	0.011 (0.100)	
New institution	0.101 (0.194)	0.055 (0.172)	0.155 (0.145)	
Other institution	0.109 (0.211)	-0.159 (0.218)	-0.181 (0.112)	
Institution level mean UCAS tariff score	-0.007 (0.096)	0.080 (0.110)	0.151 (0.102)	
Institution level proportion of females	0.069 (0.285)	-0.568 (0.590)	0.244 (0.287)	
Institution level proportion of non-White	1.522 (2.154)	0.612 (1.271)	-0.340 (0.187)	
Institution mean IMD score	-0.095 (0.109)	0.260 (0.130)*	0.089 (0.126)	

s1			-0.474	(0.064)***	-0.650	(0.095)***
s4			-0.289	(0.093)**	-0.452	(0.312)
<hr/>						
Level 2: Institution Intercept	0.022	(0.007)***	0.037	(0.009)***	0.015	(0.004)***
<hr/>						
Level 1: Student Intercept	0.910	(0.010)***	0.896	(0.007)***	0.952	(0.009)***
<hr/>						
Log-likelihood	-22118.1		-41733.0		-28184.4	
Variance partition coefficient (VPC)	0.024		0.040		0.015	
Number of institutions	40		40		39	
Number of students	16097		30553		20187	

Key: standard errors in parentheses; $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table 25: Basic model for total score estimated on sample split by proportion of female students (below average and above average)

	Below average % female	Above average % female	
Fixed Part			
Intercept	0.028 (0.081)	0.105 (0.119)	
Other White	-0.084 (0.039)*	-0.150 (0.055)**	
Black Caribbean	-0.021 (0.061)	-0.026 (0.056)	
Black African	-0.007 (0.042)	-0.037 (0.052)	
Other Black ethnic group	-0.320 (0.114)**	-0.002 (0.107)	
Indian	-0.077 (0.024)**	-0.076 (0.029)**	
Pakistani	-0.081 (0.038)*	-0.051 (0.041)	
Bangladeshi	-0.040 (0.062)	-0.137 (0.066)*	
Chinese	-0.052 (0.042)	-0.117 (0.067)	
Other Asian ethnic group	-0.101 (0.046)*	0.027 (0.071)	
Mixed ethnic	-0.042 (0.034)	-0.060 (0.041)	
Other ethnic group	-0.104 (0.067)	-0.211 (0.076)**	
Unknown/Refused ethnic group	-0.032 (0.044)	-0.003 (0.046)	
Female	-0.016 (0.010)	0.001 (0.013)	
Age 19	-0.036 (0.011)**	0.018 (0.014)	
Age 20	0.008 (0.023)	-0.033 (0.024)	
Age 21	0.070 (0.043)	-0.008 (0.042)	
Age 22 to 24	0.010 (0.043)	0.010 (0.040)	
Age 25 to 29	0.149 (0.067)*	0.055 (0.059)	
Age 30 or older	0.011 (0.056)	0.249 (0.050)***	
Lives at home full-time	0.099 (0.015)***	0.073 (0.015)***	
Neighbourhood level IMD score	0.010 (0.005)	0.024 (0.006)***	
Disabled	-0.005 (0.019)	-0.063 (0.023)**	
Medicine & dentistry	-0.476 (0.063)***	-0.675 (0.097)***	
Subjects allied to medicine	-0.111 (0.028)***	-0.226 (0.043)***	
Biological sciences	-0.138 (0.018)***	-0.073 (0.024)**	
Veterinary science	-0.257 (0.107)*	-0.444 (0.146)**	
Agriculture & related subjects	0.032 (0.061)	-0.156 (0.071)*	
Physical sciences	0.082 (0.022)***	0.001 (0.035)	
Mathematical sciences	0.158 (0.030)***	0.250 (0.057)***	
Computer science	-0.154 (0.026)***	-0.175 (0.035)***	
Engineering & technology	-0.162 (0.026)***	-0.121 (0.046)**	
Architecture, building & planning	-0.214 (0.041)***	-0.066 (0.054)	
Law	-0.020 (0.023)	-0.098 (0.031)**	
Business & administrative studies	0.003 (0.021)	-0.109 (0.026)***	
Mass communications & documentation	0.022 (0.033)	-0.090 (0.030)**	
Languages	0.221 (0.021)***	0.178 (0.029)***	
Historical & philosophical studies	0.386 (0.021)***	0.264 (0.034)***	
Creative arts & design	-0.061 (0.024)*	-0.076 (0.026)**	
Education	0.119 (0.054)*	-0.122 (0.033)***	
Combined	-0.070 (0.083)	-0.077 (0.083)	
UCAS tariff score	-0.026 (0.010)**	-0.037 (0.011)**	
UCAS tariff score (squared)	0.000 (0.004)	-0.003 (0.005)	
UCAS tariff score (cubed)	0.005 (0.002)*	0.004 (0.003)	
Institution size ('000s)	-0.019 (0.007)**	-0.011 (0.005)*	
Old institution	0.013 (0.082)	-0.104 (0.130)	
New institution	0.119 (0.113)	-0.110 (0.141)	
Other institution	-0.028 (0.132)	-0.112 (0.141)	

Institution level mean UCAS tariff score	0.153	(0.071)*	-0.194	(0.082)*
Institution level proportion of females	0.694	(0.439)	-0.310	(0.398)
Institution level proportion of non-White	-0.198	(0.175)	-0.279	(0.145)
Institution mean IMD score	0.098	(0.114)	-0.039	(0.079)
Level 2: Institution Intercept	0.027	(0.006)***	0.020	(0.005)***
Level 1: Student Intercept	0.920	(0.006)***	0.913	(0.008)***
Log-likelihood	-55413.4		-36674.3	
Variance partition coefficient (VPC)	0.028		0.022	
Number of institutions	60		59	
Number of students	40177		26660	

Key: standard errors in parentheses; $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table 26: Basic model for total score estimated on sample split by institution type (Russell Group, Old, New and Other)

	Russell	Old	New	Other
Fixed Part				
Intercept	-0.093 (0.108)	0.053 (0.057)	-0.008 (0.088)	-0.016 (0.219)
Other White	-0.127 (0.056)*	-0.086 (0.064)	-0.098 (0.052)	-0.148 (0.138)
Black Caribbean	0.139 (0.120)	-0.189 (0.102)	-0.032 (0.051)	0.142 (0.159)
Black African	0.044 (0.077)	-0.020 (0.064)	-0.036 (0.045)	-0.125 (0.177)
Other Black ethnic group	-0.104 (0.208)	-0.176 (0.187)	-0.212 (0.098)*	0.449 (0.347)
Indian	-0.073 (0.038)	-0.095 (0.034)**	-0.090 (0.028)**	0.085 (0.100)
Pakistani	0.030 (0.065)	-0.082 (0.053)	-0.079 (0.039)*	-0.545 (0.168)**
Bangladeshi	0.135 (0.111)	-0.169 (0.083)*	-0.080 (0.066)	-0.260 (0.188)
Chinese	-0.076 (0.056)	-0.038 (0.075)	-0.106 (0.062)	0.035 (0.157)
Other Asian ethnic group	-0.159 (0.072)*	-0.012 (0.071)	-0.063 (0.063)	0.081 (0.181)
Mixed ethnic	-0.016 (0.047)	-0.083 (0.052)	-0.060 (0.042)	-0.033 (0.112)
Other ethnic group	-0.125 (0.110)	-0.155 (0.107)	-0.156 (0.072)*	-0.194 (0.170)
Unknown/Refused ethnic group	0.071 (0.060)	-0.084 (0.057)	-0.020 (0.050)	-0.025 (0.205)
Female	-0.063 (0.015)***	-0.000 (0.016)	0.025 (0.013)*	-0.046 (0.043)
Age 19	-0.059 (0.016)***	-0.000 (0.017)	0.000 (0.013)	0.045 (0.046)
Age 20	0.034 (0.037)	-0.005 (0.036)	-0.023 (0.023)	-0.042 (0.074)
Age 21	0.028 (0.082)	-0.058 (0.070)	0.029 (0.038)	0.240 (0.115)*
Age 22 to 24	-0.005 (0.075)	0.005 (0.067)	0.047 (0.039)	-0.205 (0.107)
Age 25 to 29	0.139 (0.119)	0.246 (0.104)*	0.046 (0.056)	-0.006 (0.169)
Age 30 or older	0.185 (0.111)	0.005 (0.088)	0.151 (0.047)**	0.288 (0.142)*
Lives at home full-time	0.132 (0.028)***	0.078 (0.022)***	0.075 (0.014)***	0.089 (0.045)*
Neighbourhood level IMD score	0.021 (0.008)**	0.011 (0.008)	0.015 (0.006)*	-0.014 (0.021)
Disabled	0.005 (0.031)	-0.019 (0.029)	-0.052 (0.022)*	-0.021 (0.059)
Medicine & dentistry	-0.510 (0.055)***	-0.249 (0.398)		
Subjects allied to medicine	-0.148 (0.035)***	-0.064 (0.049)	-0.184 (0.041)***	-0.089 (0.311)
Biological sciences	-0.010 (0.027)	-0.201 (0.025)***	-0.105 (0.024)***	-0.073 (0.117)
Veterinary science	-0.225 (0.107)*		-0.361 (0.267)	-0.658 (0.238)**
Agriculture & related subjects	0.104 (0.096)	0.101 (0.114)	-0.117 (0.068)	-0.387 (0.170)*
Physical sciences	0.070 (0.029)*	0.208 (0.033)***	-0.094 (0.035)**	-0.734 (0.194)***
Mathematical sciences	0.203 (0.040)***	0.159 (0.044)***	0.151 (0.070)*	0.127 (0.159)
Computer science	-0.039 (0.047)	-0.177 (0.037)***	-0.191 (0.031)***	-0.384 (0.179)*
Engineering & technology	-0.091 (0.034)**	-0.214 (0.046)***	-0.210 (0.039)***	0.247 (0.345)
Architecture, building & planning	-0.250 (0.057)***	-0.461 (0.120)***	-0.078 (0.044)	-0.328 (0.317)
Law	-0.065 (0.034)	-0.083 (0.035)*	-0.026 (0.030)	0.071 (0.151)
Business & administrative studies	-0.082 (0.037)*	0.013 (0.032)	-0.076 (0.025)**	0.021 (0.107)
Mass communications & documentation	0.250 (0.064)***	-0.084 (0.056)	-0.077 (0.028)**	-0.243 (0.113)*
Languages	0.238 (0.029)***	0.190 (0.029)***	0.192 (0.030)***	0.125 (0.115)
Historical & philosophical studies	0.375 (0.029)***	0.373 (0.031)***	0.312 (0.038)***	0.190 (0.109)
Creative arts & design	-0.110 (0.042)**	-0.030 (0.038)	-0.090 (0.025)***	-0.104 (0.105)
Education	0.177 (0.102)	-0.023 (0.083)	-0.100 (0.033)**	-0.174 (0.107)
Combined	0.023 (0.101)	-0.277 (0.158)	-0.067 (0.080)	
UCAS tariff score	-0.042 (0.016)**	-0.014 (0.014)	-0.032 (0.011)**	-0.052 (0.033)
UCAS tariff score (squared)	-0.006 (0.009)	0.009 (0.007)	-0.003 (0.007)	0.005 (0.012)
UCAS tariff score (cubed)	0.008 (0.004)*	0.004 (0.004)	0.003 (0.003)	0.003 (0.007)
Institution size ('000s)	-0.025 (0.009)**	-0.004 (0.016)	-0.009 (0.005)	-0.023 (0.024)
Institution level mean UCAS tariff score	0.457 (0.113)***	0.005 (0.115)	-0.118 (0.129)	0.037 (0.141)
Institution level proportion of females	2.207 (0.537)***	-0.076 (0.593)	0.038 (0.248)	-0.289 (0.509)
Institution level proportion of non-White	0.125 (0.352)	-0.394 (0.270)	-0.187 (0.172)	-0.734 (0.475)
Institution mean IMD score	0.107 (0.240)	0.207 (0.184)	-0.063 (0.067)	0.153 (0.245)

Level 2: Institution Intercept	0.016	(0.006)***	0.028	(0.008)***	0.015	(0.004)***	0.046	(0.023)***
Level 1: Student Intercept	0.905	(0.010)***	0.935	(0.010)***	0.905	(0.008)***	0.930	(0.025)***
Log-likelihood	-24460.4		-24724.5		-38895.9		-3891.7	
Variance partition coefficient (VPC)	0.017		0.029		0.017		0.047	
Number of institutions	16		27		54		22	
Number of students	17853		17817		28366		2801	

Key: standard errors in parentheses; $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table 27: Basic model of total score estimated with random coefficients for non-White and gender

	A		B		C	
Fixed Part						
Intercept	0.056	(0.062)	0.067	(0.062)	0.064	(0.061)
Other White	-0.105	(0.032)	-0.105	(0.032)	-0.106	(0.032)
Black Caribbean	-0.019	(0.041)	-0.020	(0.042)	-0.023	(0.042)
Black African	-0.018	(0.033)	-0.017	(0.034)	-0.015	(0.034)
Other Black ethnic group	-0.147	(0.078)	-0.149	(0.078)	-0.154	(0.078)
Indian	-0.077	(0.019)	-0.078	(0.020)	-0.080	(0.020)
Pakistani	-0.067	(0.028)	-0.068	(0.029)	-0.067	(0.029)
Bangladeshi	-0.081	(0.045)	-0.085	(0.046)	-0.086	(0.046)
Chinese	-0.068	(0.036)	-0.071	(0.036)	-0.072	(0.036)
Other Asian ethnic group	-0.061	(0.039)	-0.062	(0.039)	-0.063	(0.039)
Mixed ethnic	-0.051	(0.026)	-0.053	(0.027)	-0.055	(0.027)
Other ethnic group	-0.152	(0.050)	-0.151	(0.051)	-0.152	(0.051)
Unknown/Refused ethnic group	-0.014	(0.032)	-0.016	(0.033)	-0.016	(0.033)
Female	-0.010	(0.008)	-0.010	(0.008)	-0.006	(0.012)
Age 19	-0.014	(0.009)	-0.014	(0.009)	-0.014	(0.009)
Age 20	-0.013	(0.017)	-0.013	(0.017)	-0.012	(0.017)
Age 21	0.027	(0.030)	0.026	(0.030)	0.026	(0.030)
Age 22 to 24	0.008	(0.030)	0.009	(0.030)	0.009	(0.030)
Age 25 to 29	0.091	(0.044)	0.091	(0.044)	0.091	(0.044)
Age 30 or older	0.144	(0.037)	0.144	(0.037)	0.141	(0.037)
Lives at home full-time	0.085	(0.010)	0.085	(0.011)	0.086	(0.011)
Neighbourhood level IMD score	0.015	(0.004)	0.015	(0.004)	0.015	(0.004)
Disabled	-0.029	(0.015)	-0.030	(0.015)	-0.029	(0.015)
Medicine & dentistry	-0.535	(0.053)	-0.543	(0.053)	-0.540	(0.053)
Subjects allied to medicine	-0.145	(0.023)	-0.144	(0.023)	-0.141	(0.023)
Biological sciences	-0.107	(0.014)	-0.107	(0.014)	-0.105	(0.014)
Veterinary science	-0.341	(0.086)	-0.341	(0.086)	-0.336	(0.086)
Agriculture & related subjects	-0.045	(0.046)	-0.045	(0.046)	-0.044	(0.046)
Physical sciences	0.060	(0.018)	0.060	(0.018)	0.059	(0.018)
Mathematical sciences	0.178	(0.027)	0.178	(0.027)	0.179	(0.027)
Computer science	-0.159	(0.021)	-0.160	(0.021)	-0.154	(0.021)
Engineering & technology	-0.156	(0.022)	-0.157	(0.022)	-0.157	(0.022)
Architecture, building & planning	-0.158	(0.033)	-0.159	(0.033)	-0.155	(0.033)
Law	-0.047	(0.019)	-0.047	(0.019)	-0.045	(0.019)
Business & administrative studies	-0.042	(0.016)	-0.042	(0.016)	-0.040	(0.016)
Mass communications & documentation	-0.040	(0.021)	-0.041	(0.021)	-0.041	(0.021)
Languages	0.206	(0.017)	0.206	(0.017)	0.208	(0.017)
Historical & philosophical studies	0.351	(0.018)	0.351	(0.018)	0.352	(0.018)
Creative arts & design	-0.061	(0.017)	-0.061	(0.017)	-0.062	(0.017)
Education	-0.054	(0.027)	-0.055	(0.027)	-0.056	(0.027)
Combined	-0.067	(0.058)	-0.067	(0.058)	-0.071	(0.058)
UCAS tariff score	-0.031	(0.007)	-0.031	(0.007)	-0.032	(0.007)
UCAS tariff score (squared)	0.001	(0.003)	0.001	(0.003)	0.002	(0.003)
UCAS tariff score (cubed)	0.005	(0.002)	0.005	(0.002)	0.005	(0.002)
Institution size ('000s)	-0.014	(0.004)	-0.013	(0.004)	-0.013	(0.004)
Old institution	-0.033	(0.069)	-0.047	(0.068)	-0.048	(0.067)
New institution	0.014	(0.088)	0.000	(0.087)	0.000	(0.086)
Other institution	-0.096	(0.092)	-0.101	(0.090)	-0.099	(0.090)

Institution level mean UCAS tariff score	0.023 (0.054)	0.023 (0.054)	0.028 (0.054)
Institution level proportion of females	-0.060 (0.206)	-0.050 (0.205)	-0.042 (0.204)
Institution level proportion of non-White	-0.226 (0.119)	-0.236 (0.117)	-0.237 (0.116)
Institution mean IMD score	0.038 (0.070)	0.042 (0.069)	0.042 (0.069)
Level: institution			
cons/cons	0.029 (0.004)	0.030 (0.005)	0.030 (0.005)
non-White/cons		-0.005 (0.002)	-0.004 (0.002)
non-White/non-White		0.004 (0.002)	0.004 (0.002)
female/cons			-0.002 (0.002)
female/female			0.006 (0.002)
non-White/female			-0.002 (0.001)
Level: student			
cons/cons	0.919 (0.005)	0.919 (0.005)	0.917 (0.005)
-2*loglikelihood:	184335	184327	184291
Number of institutions	119	119	119
Number of students	66837	66837	66837

Key: standard errors in parentheses; $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

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Appendix 1: Basic main effects models of degree attainment and progress: continuous normalised response

Table A1a

	(ME1)	(ME2)	(ME3)			
Intercept	-0.066	-0.158	-0.109			
Female		0.154	(0.007)***	0.156	(0.006)***	
Age 21						
Age 22						
Age 23						
Age 24						
Age 25 to 29						
Age 30 or older				-0.089	(0.029)***	
Other White				-0.401	(0.037)***	
Black Caribbean				-0.465	(0.029)***	
Black African				-0.289	(0.078)***	
Other Black ethnic group				-0.296	(0.016)***	
Indian				-0.336	(0.023)***	
Pakistani				-0.328	(0.038)***	
Bangladeshi				-0.341	(0.029)***	
Chinese				-0.253	(0.031)***	
Other Asian ethnic group				-0.096	(0.023)***	
Mixed ethnic				-0.217	(0.041)***	
Other ethnic group				-0.121	(0.030)***	
Unknown/Refused ethnic group						
Lives at home full-time						
Disabled						
UCAS tariff score						
UCAS tariff score (squared)						
UCAS tariff score (cubed)						
UCAS tariff score (quadrupled)						
Between institution variance	0.044	(0.006)	0.046	(0.007)	0.050	(0.007)
Between student within institution variance	0.690	(0.004)	0.684	(0.004)	0.674	(0.004)
Deviance (-2*log likelihood)	3285307					
Akaike Information Criteria (AIC)	1642713					
Bayesian Information Criteria (BIC)	1642987					
Variance partition coefficient (VPC)	0.059					
Number of institutions	120					
Number of students	66431					

Key: standard errors in parentheses; $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table A1b

	(ME4)	(ME5)	(ME6)
Intercept	-	-	-0.126
	0.041	0.032	
Female	0.129 (0.006)***	- (0.006)**	0.131 (0.006)***
Age 21			0.228 (0.008)***
Age 22			0.314 (0.016)***
Age 23			0.342 (0.026)***
Age 24			0.506 (0.036)***
Age 25 to 29			0.610 (0.030)***
Age 30 or older			0.957 (0.032)***
Other White	- (0.028)*	- (0.028)*	-0.083 (0.028)**
	0.060	0.058	
Black Caribbean	- (0.036)***	- (0.036)***	-0.283 (0.035)***
	0.305	0.301	
Black African	- (0.029)***	- (0.029)***	-0.340 (0.028)***
	0.349	0.348	
Other Black ethnic group	- (0.076)***	- (0.076)***	-0.197 (0.075)**
	0.206	0.203	
Indian	- (0.015)***	- (0.015)***	-0.182 (0.015)***
	0.234	0.230	
Pakistani	- (0.022)***	- (0.023)***	-0.197 (0.022)***
	0.243	0.233	
Bangladeshi	- (0.037)***	- (0.037)***	-0.189 (0.037)***
	0.245	0.236	
Chinese	- (0.028)***	- (0.028)***	-0.300 (0.027)***
	0.317	0.316	
Other Asian ethnic group	- (0.031)***	- (0.031)***	-0.176 (0.030)***
	0.194	0.191	
Mixed ethnic	- (0.022)***	- (0.022)***	-0.061 (0.022)**
	0.064	0.064	
Other ethnic group	- (0.040)***	- (0.040)***	-0.123 (0.039)**
	0.150	0.146	
Unknown/Refused ethnic group	- (0.029)**	- (0.029)**	-0.100 (0.029)***
	0.072	0.073	
Lives at home full-time	- (0.009)**	- (0.009)**	-0.005 (0.009)
	0.037		
Disabled	- (0.012)	- (0.012)	-0.042 (0.012)***
	0.023		
UCAS tariff score	0.315 (0.006)***	0.314 (0.006)***	0.369 (0.006)***
UCAS tariff score (squared)	- (0.003)*	- (0.004)*	-0.007 (0.005)***
	0.004	0.004	
UCAS tariff score (cubed)	0.022 (0.001)***	0.021 (0.001)***	-0.022 (0.001)***
UCAS tariff score (quadrupled)	0.002 (0.001)***	0.002 (0.001)***	0.004 (0.001)***
Between institution variance	0.028 (0.004)	0.028 (0.004)	0.022 (0.003)***
Between student within institution variance	0.637 (0.003)	0.637 (0.004)	0.617 (0.003)***
Deviance (-2*log likelihood)			313433.1
Akaike Information Criteria (AIC)			156772.6
Bayesian Information Criteria (BIC)			157027.5
Variance partition coefficient (VPC)			0.034
Number of institutions	120	120	
Number of students	66431	66431	

Key: standard errors in parentheses; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table A1c

	(ME7)	(ME8)	(ME9)	(ME10)
Intercept	-0.142	(0.017)	-0.170	(0.019)
UCAS tariff score	0.370	(0.006)***	0.370	(0.006)***
UCAS tariff score (squared)	-0.018	(0.005)***	-0.017	(0.005)***
UCAS tariff score (cubed)	-0.022	(0.001)***	-0.022	(0.001)***
UCAS tariff score (quadrupled)	0.004	(0.001)***	0.004	(0.001)***
Female	0.126	(0.007)***	0.127	(0.007)***
Age 21	0.210	(0.008)***	0.207	(0.008)***
Age 22	0.299	(0.016)***	0.298	(0.016)***
Age 23	0.329	(0.026)***	0.329	(0.026)***
Age 24	0.496	(0.035)***	0.497	(0.035)***
Age 25 to 29	0.602	(0.030)***	0.603	(0.030)***
Age 30 or older	0.944	(0.032)***	0.945	(0.032)***
Other White	-0.079	(0.027)**	-0.081	(0.028)**
			0.081	
Black Caribbean	-0.262	(0.035)***	-0.254	(0.035)***
Black African	-0.304	(0.028)***	-0.295	(0.029)***
Other Black ethnic group	-0.166	(0.075)*	-0.161	(0.075)*
Indian	-0.152	(0.015)***	-0.146	(0.015)***
Pakistani	-0.159	(0.022)***	-0.148	(0.023)***
Bangladeshi	-0.165	(0.037)***	-0.151	(0.037)***
Chinese	-0.282	(0.027)***	-0.277	(0.028)***
Other Asian ethnic group	-0.154	(0.030)***	-0.153	(0.030)***
Mixed ethnic	-0.056	(0.022)*	-0.055	(0.022)*
Other ethnic group	-0.103	(0.039)**	-0.101	(0.039)**
Unknown/Refused ethnic group	-0.098	(0.028)***	-0.096	(0.028)***
Lives at home full-time	0.006	(0.009)	0.011	(0.009)
Disabled	-0.045	(0.012)***	-0.047	(0.012)***
Medicine & dentistry	-0.049	(0.047)	-0.050	(0.047)
Subjects allied to medicine	-0.025	(0.016)	-0.024	(0.016)
Biological sciences	0.029	(0.012)*	0.031	(0.012)*
Veterinary science	-0.372	(0.118)**	-0.371	(0.118)**
Agriculture & related subjects	0.014	(0.039)	0.014	(0.039)
Physical sciences	-0.110	(0.016)***	-0.107	(0.016)***
Mathematical sciences	-0.136	(0.024)***	-0.134	(0.024)***
Computer science	0.093	(0.018)***	0.095	(0.018)***
Engineering & technology	-0.067	(0.022)**	-0.066	(0.022)**
Architecture, building & planning	-0.075	(0.028)**	-0.075	(0.028)**
Law	-0.150	(0.015)***	-0.147	(0.015)***
Business & administrative studies	0.000	(0.014)	0.000	(0.014)
Mass communications & documentation	0.112	(0.018)***	0.112	(0.018)***
Languages	0.084	(0.015)***	0.085	(0.015)***
Historical & philosophical studies	0.099	(0.014)***	0.099	(0.014)***
Creative arts & design	0.115	(0.014)***	0.115	(0.014)***
Education	-0.080	(0.025)**	-0.079	(0.025)**
			0.077	
Combined	0.005	(0.043)	0.005	(0.043)
Mix of A-levels and vocational qualifications	-0.072	(0.013)***	-0.070	(0.013)***
Vocational qualifications only	-0.129	(0.020)***	-0.126	(0.020)***
Neighbourhood level IMD score			-0.010	(0.004)**
Neighbourhood level proportion of adults with a degree			0.108	(0.031)***
			0.107	(0.031)***
			0.105	(0.031)***

New institution		0.080	(0.042)					
Russell Group university		0.077	(0.046)	0.046	(0.044)			
Old institution		0.078	(0.041)					
Institution level mean UCAS tariff score				-0.079	(0.030)**			
Institution level std. dev. of UCAS tariff score				0.256	(0.089)**			
Institution level proportion of females					0.402	(0.151)**		
Institution level proportion of non-White					0.259	(0.083)**		
Institution mean IMD score					-0.006	(0.051)		
Between institution variance	0.019	(0.003)***	0.019	(0.003)***	0.018	(0.003)***	0.013	(0.002)***
Between student within institution variance	0.610	(0.003)***	0.610	(0.003)***	0.610	(0.003)***	0.610	(0.00)***
Deviance (-2*log likelihood)	312020.2		311956.4				311884.9	
Akaike Information Criteria (AIC)	156106.1		156078.2				156054.4	
Bayesian Information Criteria (BIC)	156543.1		156533.4				156564.3	
Variance partition coefficient (VPC)	0.030		0.030				0.021	
Number of institutions	120		120				120	
Number of students	66431		66431				66431	

Key: standard errors in parentheses; $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Appendix 2: Introducing neighbourhood level variables to the basic continuous variable models

Table A2a: Introducing specific indexes at the LSOA area level: Index of Multiple Deprivation (IMD); Income Deprivation Affecting Children Index (IDACI); and Income Deprivation Affecting Older People (IDAOPI)

	With IMD	With IDACI	With IDAOPI
Intercept	0.035 (0.074)	0.048 (0.074)	0.039 (0.073)
UCAS tariff score	0.371 (0.006)***	0.371 (0.006)***	0.371 (0.006)***
UCAS tariff score (squared)	-0.017 (0.005)***	-0.018 (0.005)***	-0.018 (0.005)***
UCAS tariff score (cubed)	-0.022 (0.001)***	-0.022 (0.001)***	-0.022 (0.001)***
UCAS tariff score (quadrupled)	0.004 (0.001)***	0.004 (0.001)***	0.004 (0.001)***
Female	0.127 (0.007)***	0.127 (0.007)***	0.127 (0.007)***
Age 21	0.209 (0.008)***	0.209 (0.008)***	0.209 (0.008)***
Age 22	0.301 (0.016)***	0.300 (0.016)***	0.300 (0.016)***
Age 23	0.331 (0.026)***	0.330 (0.026)***	0.331 (0.026)***
Age 24	0.500 (0.035)***	0.498 (0.035)***	0.498 (0.035)***
Age 25 to 29	0.607 (0.030)***	0.604 (0.030)***	0.605 (0.030)***
Age 30 or older	0.950 (0.032)***	0.947 (0.032)***	0.948 (0.032)***
Other White	-0.076 (0.027)**	-0.079 (0.027)**	-0.077 (0.027)**
Black Caribbean	-0.252 (0.035)***	-0.261 (0.035)***	-0.257 (0.035)***
Black African	-0.291 (0.029)***	-0.301 (0.029)***	-0.297 (0.029)***
Other Black ethnic group	-0.157 (0.075)*	-0.164 (0.075)*	-0.160 (0.075)*
Indian	-0.148 (0.015)***	-0.153 (0.015)***	-0.149 (0.015)***
Pakistani	-0.149 (0.023)***	-0.158 (0.023)***	-0.152 (0.023)***
Bangladeshi	-0.151 (0.037)***	-0.162 (0.037)***	-0.155 (0.037)***
Chinese	-0.277 (0.028)***	-0.281 (0.028)***	-0.279 (0.028)***
Other Asian ethnic group	-0.151 (0.030)***	-0.155 (0.030)***	-0.152 (0.030)***
Mixed ethnic	-0.052 (0.022)*	-0.055 (0.022)*	-0.054 (0.022)*
Other ethnic group	-0.099 (0.039)*	-0.104 (0.039)**	-0.102 (0.039)**
Unknown/Refused ethnic group	-0.097 (0.028)***	-0.098 (0.028)***	-0.098 (0.028)***
Lives at home full-time	0.008 (0.009)	0.005 (0.009)	0.006 (0.009)
Disabled	-0.045 (0.012)***	-0.044 (0.012)***	-0.044 (0.012)***
Medicine & dentistry	-0.044 (0.047)	-0.044 (0.047)	-0.045 (0.047)
Subjects allied to medicine	-0.025 (0.016)	-0.025 (0.016)	-0.025 (0.016)
Biological sciences	0.030 (0.012)*	0.029 (0.012)*	0.029 (0.012)*
Veterinary science	-0.369 (0.118)**	-0.370 (0.118)**	-0.369 (0.118)**
Agriculture & related subjects	0.014 (0.039)	0.016 (0.039)	0.014 (0.039)
Physical sciences	-0.109 (0.016)***	-0.109 (0.016)***	-0.109 (0.016)***
Mathematical sciences	-0.136 (0.024)***	-0.137 (0.024)***	-0.136 (0.024)***
Computer science	0.093 (0.018)***	0.093 (0.018)***	0.093 (0.018)***
Engineering & technology	-0.068 (0.022)**	-0.068 (0.022)**	-0.068 (0.022)**
Architecture, building & planning	-0.076 (0.028)**	-0.076 (0.028)**	-0.076 (0.028)**
Law	-0.149 (0.015)***	-0.150 (0.015)***	-0.150 (0.015)***
Business & administrative studies	-0.001 (0.014)	-0.001 (0.014)	-0.001 (0.014)
Mass communications & documentation	0.111 (0.018)***	0.111 (0.018)***	0.111 (0.018)***
Languages	0.086 (0.015)***	0.085 (0.015)***	0.085 (0.015)***
Historical & philosophical studies	0.100 (0.014)***	0.099 (0.014)***	0.100 (0.014)***
Creative arts & design	0.116 (0.014)***	0.117 (0.014)***	0.116 (0.014)***
Education	-0.070 (0.025)**	-0.070 (0.025)**	-0.070 (0.025)**
Combined	0.006 (0.043)	0.006 (0.043)	0.007 (0.043)
Mix of A-levels and vocational qualifications	-0.072 (0.013)***	-0.073 (0.013)***	-0.073 (0.013)***
Vocational qualifications only	-0.128 (0.020)***	-0.129 (0.020)***	-0.128 (0.020)***
Neighbourhood level IMD score	-0.015 (0.003)***		
Neighbourhood level IDACI score		-0.006 (0.003)	
Neighbourhood level IDAOPI score			-0.010 (0.003)**
Institution level Russell Group indicator	0.048 (0.044)	0.046 (0.044)	0.046 (0.044)
Institution level mean UCAS tariff score	-0.077 (0.030)**	-0.062 (0.033)	-0.074 (0.030)*
Institution level std. dev. of UCAS tariff score	-0.257 (0.089)**	-0.271 (0.090)**	-0.260 (0.089)**
Institution level proportion of females	-0.403 (0.151)**	-0.422 (0.151)**	-0.408 (0.152)**
Institution level proportion of non-White	0.267 (0.083)**	0.189 (0.125)	0.256 (0.109)*
Institution mean IMD score	-0.005 (0.051)		
Institution mean IDACI score		0.061 (0.088)	
Institution mean IDAOPI score			0.006 (0.069)
Between institution variance	0.013 (0.002)***	0.013 (0.002)***	0.013 (0.002)***
Between student within institution variance	0.610 (0.003)***	0.610 (0.003)***	0.610 (0.003)***
Deviance (-2*log likelihood)	311907.2	311940.3	311928.9
Akaike Information Criteria (AIC)	156063.6	156080.2	156074.4
Bayesian Information Criteria (BIC)	156564.3	156580.9	156575.2
Variance partition coefficient (VPC)	0.021	0.021	0.021
Number of institutions	120	120	120
Number of students	66431	66431	66431

Key: standard errors in parentheses; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table A2b: Introducing different dimensions of the Index of Multiple Deprivation: Income Domain (IMDI); Employment Domain (IMDE); and Health Deprivation and Disability Domain (IMDH)

	IMDI	IMDE	IMDH
Intercept	0.040 (0.074)	0.030 (0.073)	0.029 (0.073)
UCAS tariff score	0.371 (0.006)***	0.371 (0.006)***	0.371 (0.006)***
UCAS tariff score (squared)	-0.017 (0.005)***	-0.017 (0.005)***	-0.016 (0.005)***
UCAS tariff score (cubed)	-0.022 (0.001)***	-0.022 (0.001)***	-0.022 (0.001)***
UCAS tariff score (quadrupled)	0.004 (0.001)***	0.004 (0.001)***	0.004 (0.001)***
Female	0.127 (0.007)***	0.127 (0.007)***	0.127 (0.007)***
Age 21	0.209 (0.008)***	0.208 (0.008)***	0.207 (0.008)***
Age 22	0.300 (0.016)***	0.300 (0.016)***	0.300 (0.016)***
Age 23	0.330 (0.026)***	0.331 (0.026)***	0.331 (0.026)***
Age 24	0.498 (0.035)***	0.500 (0.035)***	0.502 (0.035)***
Age 25 to 29	0.605 (0.030)***	0.608 (0.030)***	0.611 (0.030)***
Age 30 or older	0.948 (0.032)***	0.951 (0.032)***	0.953 (0.032)***
Other White	-0.077 (0.027)**	-0.077 (0.027)**	-0.077 (0.027)**
Black Caribbean	-0.256 (0.035)***	-0.247 (0.035)***	-0.245 (0.035)***
Black African	-0.296 (0.029)***	-0.285 (0.028)***	-0.281 (0.028)***
Other Black ethnic group	-0.161 (0.075)*	-0.155 (0.075)*	-0.151 (0.074)*
Indian	-0.150 (0.015)***	-0.145 (0.015)***	-0.143 (0.015)***
Pakistani	-0.153 (0.023)***	-0.145 (0.022)***	-0.139 (0.022)***
Bangladeshi	-0.156 (0.037)***	-0.145 (0.037)***	-0.138 (0.037)***
Chinese	-0.279 (0.028)***	-0.275 (0.027)***	-0.272 (0.027)***
Other Asian ethnic group	-0.152 (0.030)***	-0.150 (0.030)***	-0.149 (0.030)***
Mixed ethnic	-0.054 (0.022)*	-0.051 (0.022)*	-0.050 (0.022)*
Other ethnic group	-0.102 (0.039)**	-0.099 (0.039)*	-0.097 (0.039)*
Unknown/Refused ethnic group	-0.098 (0.028)***	-0.096 (0.028)***	-0.096 (0.028)***
Lives at home full-time	0.006 (0.009)	0.010 (0.009)	0.012 (0.009)
Disabled	-0.045 (0.012)***	-0.046 (0.012)***	-0.046 (0.012)***
Medicine & dentistry	-0.045 (0.047)	-0.045 (0.047)	-0.044 (0.047)
Subjects allied to medicine	-0.025 (0.016)	-0.024 (0.016)	-0.024 (0.016)
Biological sciences	0.029 (0.012)*	0.030 (0.012)*	0.031 (0.012)*
Veterinary science	-0.370 (0.118)**	-0.368 (0.118)**	-0.368 (0.118)**
Agriculture & related subjects	0.014 (0.039)	0.012 (0.039)	0.011 (0.039)
Physical sciences	-0.109 (0.016)***	-0.108 (0.016)***	-0.107 (0.016)***
Mathematical sciences	-0.136 (0.024)***	-0.134 (0.024)***	-0.134 (0.024)***
Computer science	0.093 (0.018)***	0.094 (0.018)***	0.095 (0.018)***
Engineering & technology	-0.068 (0.022)**	-0.067 (0.022)**	-0.067 (0.022)**
Architecture, building & planning	-0.076 (0.028)**	-0.076 (0.028)**	-0.076 (0.028)**
Law	-0.150 (0.015)***	-0.148 (0.015)***	-0.147 (0.015)***
Business & administrative studies	-0.001 (0.014)	-0.001 (0.014)	-0.001 (0.014)
Mass communications & documentation	0.111 (0.018)***	0.111 (0.018)***	0.111 (0.018)***
Languages	0.085 (0.015)***	0.087 (0.015)***	0.087 (0.015)***
Historical & philosophical studies	0.100 (0.014)***	0.100 (0.014)***	0.100 (0.014)***
Creative arts & design	0.116 (0.014)***	0.117 (0.014)***	0.117 (0.014)***
Education	-0.070 (0.025)**	-0.069 (0.025)**	-0.069 (0.025)**
Combined	0.006 (0.043)	0.006 (0.043)	0.006 (0.043)
Mix of A-levels and vocational qualifications	-0.073 (0.013)***	-0.073 (0.013)***	-0.072 (0.013)***
Vocational qualifications only	-0.128 (0.020)***	-0.127 (0.020)***	-0.126 (0.020)***
Neighbourhood level IMD Income domain score (IMDI)	-0.010 (0.003)**		
Neighbourhood level IMD Employment domain score (IMDE)		-0.023 (0.003)***	
Neighbourhood level IMD Health deprivation and disability domain score (IMDH)			-0.029 (0.003)***
Institution level Russell Group indicator	0.046 (0.044)	0.049 (0.044)	0.050 (0.044)
Institution level mean UCAS tariff score	-0.073 (0.032)*	-0.082 (0.029)**	-0.082 (0.029)**
Institution level std. dev. of UCAS tariff score	-0.261 (0.090)**	-0.254 (0.089)**	-0.256 (0.088)**
Institution level proportion of females	-0.410 (0.152)**	-0.396 (0.150)**	-0.398 (0.149)**
Institution level proportion of non-White	0.250 (0.107)*	0.262 (0.069)***	0.253 (0.067)***
Institution mean IMD score			
Institution level mean IMD Income domain score	0.012 (0.074)		
Institution level mean IMD Employment domain score		-0.014 (0.038)	
Institution level mean IMD Health score			-0.008 (0.031)
Between institution variance	0.013 (0.002)***	0.013 (0.002)***	0.013 (0.002)***
Between student within institution variance	0.610 (0.003)***	0.610 (0.003)***	0.610 (0.003)***
Deviance (-2*log likelihood)	311928.9	311850.0	311803.1
Akaike Information Criteria (AIC)	156074.5	156035.0	156011.5
Bayesian Information Criteria (BIC)	156575.2	156535.7	156512.3
Variance partition coefficient (VPC)	0.021	0.021	0.021
Number of institutions	120	120	120
Number of students	66431	66431	66431

Key: standard errors in parentheses; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table A2c: Introducing further different dimensions of the Index of Multiple Deprivation: Education, Skills & Training Domain (IMDEST); Barriers to Housing and Services Domain (IMDBHS); Crime and Disorder Domain (IMDCD); and Living and Environment Domain (IMDLE)

	IMDEST	IMDBHS	IMDCD	IMDLE
Intercept	0.037 (0.074)	0.032 (0.072)	0.045 (0.073)	0.041 (0.073)
UCAS tariff score	0.371 (0.006)***	0.372 (0.006)***	0.371 (0.006)***	0.371 (0.006)***
UCAS tariff score (squared)	-0.017 (0.005)***	-0.017 (0.005)***	-0.018 (0.005)***	-0.018 (0.005)***
UCAS tariff score (cubed)	-0.022 (0.001)***	-0.022 (0.001)***	-0.022 (0.001)***	-0.022 (0.001)***
UCAS tariff score (quadrupled)	0.004 (0.001)***	0.004 (0.001)***	0.004 (0.001)***	0.004 (0.001)***
Female	0.127 (0.007)***	0.126 (0.007)***	0.126 (0.007)***	0.127 (0.007)***
Age 21	0.208 (0.008)***	0.208 (0.008)***	0.209 (0.008)***	0.210 (0.008)***
Age 22	0.299 (0.016)***	0.297 (0.016)***	0.300 (0.016)***	0.301 (0.016)***
Age 23	0.329 (0.026)***	0.327 (0.026)***	0.330 (0.026)***	0.331 (0.026)***
Age 24	0.498 (0.035)***	0.496 (0.035)***	0.498 (0.035)***	0.498 (0.035)***
Age 25 to 29	0.603 (0.030)***	0.602 (0.030)***	0.604 (0.030)***	0.605 (0.030)***
Age 30 or older	0.947 (0.032)***	0.944 (0.032)***	0.948 (0.032)***	0.948 (0.032)***
Other White	-0.081 (0.027)**	-0.084 (0.027)**	-0.077 (0.027)**	-0.077 (0.027)**
Black Caribbean	-0.261 (0.035)***	-0.273 (0.035)***	-0.260 (0.035)***	-0.261 (0.035)***
Black African	-0.302 (0.028)***	-0.319 (0.028)***	-0.301 (0.028)***	-0.302 (0.028)***
Other Black ethnic group	-0.165 (0.075)*	-0.176 (0.075)*	-0.163 (0.075)*	-0.164 (0.075)*
Indian	-0.153 (0.015)***	-0.158 (0.015)***	-0.151 (0.015)***	-0.152 (0.015)***
Pakistani	-0.156 (0.022)***	-0.165 (0.022)***	-0.157 (0.022)***	-0.156 (0.023)***
Bangladeshi	-0.161 (0.037)***	-0.178 (0.037)***	-0.163 (0.037)***	-0.163 (0.037)***
Chinese	-0.281 (0.027)***	-0.286 (0.027)***	-0.281 (0.027)***	-0.282 (0.027)***
Other Asian ethnic group	-0.156 (0.030)***	-0.162 (0.030)***	-0.154 (0.030)***	-0.154 (0.030)***
Mixed ethnic	-0.056 (0.022)*	-0.059 (0.022)**	-0.054 (0.022)*	-0.055 (0.022)*
Other ethnic group	-0.105 (0.039)**	-0.114 (0.039)**	-0.103 (0.039)**	-0.103 (0.039)**
Unknown/Refused ethnic group	-0.098 (0.028)***	-0.100 (0.028)***	-0.098 (0.028)***	-0.098 (0.028)***
Lives at home full-time	0.006 (0.009)	0.005 (0.009)	0.005 (0.009)	0.005 (0.009)
Disabled	-0.045 (0.012)***	-0.045 (0.012)***	-0.044 (0.012)***	-0.044 (0.012)***
Medicine & dentistry	-0.045 (0.047)	-0.045 (0.047)	-0.044 (0.047)	-0.045 (0.047)
Subjects allied to medicine	-0.025 (0.016)	-0.024 (0.016)	-0.025 (0.016)	-0.025 (0.016)
Biological sciences	0.030 (0.012)*	0.029 (0.012)*	0.029 (0.012)*	0.029 (0.012)*
Veterinary science	-0.370 (0.118)**	-0.373 (0.118)**	-0.372 (0.118)**	-0.370 (0.118)**
Agriculture & related subjects	0.014 (0.039)	0.010 (0.039)	0.015 (0.039)	0.015 (0.039)
Physical sciences	-0.108 (0.016)***	-0.110 (0.016)***	-0.110 (0.016)***	-0.110 (0.016)***
Mathematical sciences	-0.136 (0.024)***	-0.136 (0.024)***	-0.137 (0.024)***	-0.137 (0.024)***
Computer science	0.093 (0.018)***	0.093 (0.018)***	0.092 (0.018)***	0.092 (0.018)***
Engineering & technology	-0.067 (0.022)**	-0.068 (0.022)**	-0.068 (0.022)**	-0.068 (0.022)**
Architecture, building & planning	-0.076 (0.028)**	-0.077 (0.028)**	-0.076 (0.028)**	-0.076 (0.028)**
Law	-0.149 (0.015)***	-0.150 (0.015)***	-0.150 (0.015)***	-0.150 (0.015)***
Business & administrative studies	-0.001 (0.014)	-0.001 (0.014)	-0.001 (0.014)	-0.001 (0.014)
Mass communications & documentation	0.111 (0.018)***	0.111 (0.018)***	0.111 (0.018)***	0.111 (0.018)***
Languages	0.085 (0.015)***	0.085 (0.015)***	0.085 (0.015)***	0.085 (0.015)***
Historical & philosophical studies	0.099 (0.014)***	0.099 (0.014)***	0.099 (0.014)***	0.099 (0.014)***
Creative arts & design	0.116 (0.014)***	0.116 (0.014)***	0.117 (0.014)***	0.117 (0.014)***
Education	-0.069 (0.025)**	-0.070 (0.025)**	-0.070 (0.025)**	-0.070 (0.025)**
Combined	0.007 (0.043)	0.008 (0.043)	0.007 (0.043)	0.006 (0.043)
Mix of A-levels and vocational qualifications	-0.072 (0.013)***	-0.073 (0.013)***	-0.073 (0.013)***	-0.073 (0.013)***
Vocational qualifications only	-0.128 (0.020)***	-0.129 (0.020)***	-0.129 (0.020)***	-0.129 (0.020)***
Neighbourhood level IMD Education, Skills and Training domain score (IMDEST)	-0.010 (0.003)**			
Neighbourhood level IMD Barriers to Housing and Services domain score (IMDBHS)		0.013 (0.003)***		
Neighbourhood IMD Crime and Disorder domain score (IMDCD)			-0.008 (0.003)*	
Neighbourhood level IMD Environment domain score (IMDLE)				-0.007 (0.003)*
Institution level Russell Group indicator	0.045 (0.044)	0.047 (0.044)	0.043 (0.045)	0.046 (0.044)
Institution level mean UCAS tariff score	-0.077 (0.032)*	-0.078 (0.027)**	-0.067 (0.029)*	-0.073 (0.028)**
Institution level std. dev. of UCAS tariff score	-0.257 (0.090)**	-0.252 (0.088)**	-0.264 (0.089)**	-0.262 (0.089)**
Institution level proportion of females	-0.404 (0.152)**	-0.401 (0.148)**	-0.423 (0.151)**	-0.409 (0.151)**
Institution level proportion of non-White	0.260 (0.070)***	0.204 (0.077)**	0.203 (0.096)*	0.252 (0.097)**
Institution level mean IMD Education score (IMDEST)	-0.003 (0.061)			
Institution level mean IMD Housing score (IMDBHS)		0.049 (0.043)		
Institution level mean IMD Crime score (IMDCD)			0.052 (0.060)	
Institution level mean IMD Environment score (IMDLE)				0.010 (0.060)
Between institution variance	0.013 (0.002)***	0.013 (0.002)***	0.013 (0.002)***	0.013 (0.002)***
Between student within institution variance	0.610 (0.003)***	0.610 (0.003)***	0.610 (0.003)***	0.610 (0.003)***
Deviance (-2*log likelihood)	311927.6	311910.0	311934.4	311937.3
Akaike Information Criteria (AIC)	156073.8	156065.0	156077.2	156078.7
Bayesian Information Criteria (BIC)	156574.5	156565.7	156577.9	156579.4
Variance partition coefficient (VPC)	0.021	0.020	0.021	0.021
Number of institutions	120	120	120	120
Number of students	66431	66431	66431	66431

Key: standard errors in parentheses; $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Appendix 3: Introducing census neighbourhood level variables to the basic continuous variable models

Table A3: Two variants of a model exploring the effect of census neighbourhood level variables

	CN1	CN2
Intercept	-0.015 (0.076)	0.061 (0.074)
UCAS tariff score	0.372 (0.006)***	0.372 (0.006)***
UCAS tariff score (squared)	-0.017 (0.005)***	-0.016 (0.005)***
UCAS tariff score (cubed)	-0.022 (0.001)***	-0.022 (0.001)***
UCAS tariff score (quadrupled)	0.004 (0.001)***	0.004 (0.001)***
Female	0.127 (0.007)***	0.127 (0.007)***
Age 21	0.207 (0.008)***	0.208 (0.008)***
Age 22	0.298 (0.016)***	0.299 (0.016)***
Age 23	0.329 (0.026)***	0.329 (0.026)***
Age 24	0.497 (0.035)***	0.499 (0.035)***
Age 25 to 29	0.604 (0.030)***	0.605 (0.030)***
Age 30 or older	0.946 (0.032)***	0.948 (0.032)***
Other White	-0.090 (0.028)**	-0.089 (0.028)**
Black Caribbean	-0.275 (0.036)***	-0.272 (0.036)***
Black African	-0.317 (0.029)***	-0.313 (0.029)***
Other Black ethnic group	-0.179 (0.075)*	-0.177 (0.075)*
Indian	-0.171 (0.017)***	-0.169 (0.017)***
Pakistani	-0.174 (0.024)***	-0.173 (0.024)***
Bangladeshi	-0.178 (0.038)***	-0.175 (0.038)***
Chinese	-0.287 (0.028)***	-0.284 (0.028)***
Other Asian ethnic group	-0.172 (0.031)***	-0.169 (0.031)***
Mixed ethnic	-0.062 (0.022)**	-0.061 (0.022)**
Other ethnic group	-0.118 (0.039)**	-0.113 (0.039)**
Unknown/Refused ethnic group	-0.101 (0.028)***	-0.100 (0.028)***
Lives at home full-time	0.007 (0.009)	0.009 (0.009)
Disabled	-0.046 (0.012)***	-0.046 (0.012)***
Medicine & dentistry	-0.043 (0.047)	-0.042 (0.047)
Subjects allied to medicine	-0.023 (0.016)	-0.021 (0.016)
Biological sciences	0.031 (0.012)*	0.031 (0.012)*
Veterinary science	-0.368 (0.118)**	-0.367 (0.118)**
Agriculture & related subjects	0.015 (0.039)	0.016 (0.039)
Physical sciences	-0.106 (0.016)***	-0.106 (0.016)***
Mathematical sciences	-0.135 (0.024)***	-0.135 (0.024)***
Computer science	0.094 (0.018)***	0.094 (0.018)***
Engineering & technology	-0.066 (0.022)**	-0.065 (0.022)**
Architecture, building & planning	-0.076 (0.028)**	-0.075 (0.028)**
Law	-0.148 (0.015)***	-0.147 (0.015)***
Business & administrative studies	-0.001 (0.014)	-0.000 (0.014)
Mass communications & documentation	0.111 (0.018)***	0.111 (0.018)***
Languages	0.086 (0.015)***	0.086 (0.015)***
Historical & philosophical studies	0.099 (0.014)***	0.099 (0.014)***
Creative arts & design	0.117 (0.014)***	0.117 (0.014)***
Education	-0.069 (0.025)**	-0.070 (0.025)**
Combined	0.005 (0.043)	0.004 (0.043)
Mix of A-levels and vocational qualifications	-0.072 (0.013)***	-0.071 (0.013)***
Vocational qualifications only	-0.129 (0.020)***	-0.128 (0.020)***
Neighbourhood level IMD score	-0.017 (0.004)***	-0.015 (0.004)***
Neighbourhood level proportion non-White British	0.087 (0.026)***	0.088 (0.026)***
Neighbourhood level proportion of adults with a degree	0.074 (0.035)*	0.062 (0.034)
Neighbourhood level proportion of yps not staying in FE	0.038 (0.027)	
Institution level Russell Group indicator	0.046 (0.044)	
Institution level mean UCAS tariff score	-0.079 (0.030)**	-0.065 (0.022)**
Institution level std. dev. of UCAS tariff score	-0.256 (0.089)**	-0.302 (0.092)***
Institution level proportion of females	-0.406 (0.150)**	-0.457 (0.157)**
Institution level proportion of non-White	0.238 (0.083)**	
Institution mean IMD score	-0.000 (0.051)	
Between institution variance	0.013 (0.002)***	0.015 (0.002)***
Between student within institution variance	0.610 (0.003)***	0.610 (0.003)***
Deviance (-2*log likelihood)	311860.9	311891.9
Akaike Information Criteria (AIC)	156046.4	156053.9
Bayesian Information Criteria (BIC)	156574.5	156545.6
Variance partition coefficient (VPC)	0.021	0.024
Number of institutions	120	120
Number of students	66431	66431

Key: standard errors in parentheses; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Appendix 4: Exploring ethnicity interactions using the full ethnicity variable with 13 categories (12 dummies relative to White)

Table A4a

	(1) With IMD model (As in A2a) The Base	(2) Interaction: ethnicity and gender	(3) Interaction: ethnicity and UCAS score	(4) Interaction: ethnicity and Aged 22 or over
Intercept	0.035 (0.074)	0.034 (0.074)	0.033 (0.074)	0.086 (0.075)
UCAS tariff score	0.371 (0.006)***	0.370 (0.006)***	0.365 (0.006)***	0.339 (0.006)***
UCAS tariff score (squared)	-0.017 (0.005)***	-0.017 (0.005)***	-0.015 (0.005)**	-0.013 (0.005)**
UCAS tariff score (cubed)	-0.022 (0.001)***	-0.022 (0.001)***	-0.022 (0.001)***	-0.022 (0.001)***
UCAS tariff score (quadrupled)	0.004 (0.001)***	0.004 (0.001)***	0.004 (0.001)***	0.004 (0.001)***
Female	0.127 (0.007)***	0.131 (0.007)***	0.128 (0.007)***	0.125 (0.007)***
Age 21	0.209 (0.008)***	0.209 (0.008)***	0.210 (0.008)***	
Age 22	0.301 (0.016)***	0.301 (0.016)***	0.301 (0.016)***	
Age 23	0.331 (0.026)***	0.331 (0.026)***	0.331 (0.026)***	
Age 24	0.500 (0.035)***	0.500 (0.035)***	0.499 (0.035)***	
Age 25 to 29	0.607 (0.030)***	0.606 (0.030)***	0.603 (0.030)***	
Age 30 or older	0.950 (0.032)***	0.949 (0.032)***	0.944 (0.032)***	
Other White	-0.076 (0.027)**	-0.019 (0.042)	-0.079 (0.028)**	-0.059 (0.030)*
Black Caribbean	-0.252 (0.035)***	-0.276 (0.065)***	-0.244 (0.042)***	-0.224 (0.038)***
Black African	-0.291 (0.029)***	-0.308 (0.046)***	-0.266 (0.033)***	-0.272 (0.031)***
Other Black ethnic group	-0.157 (0.075)*	-0.256 (0.125)*	-0.170 (0.085)*	-0.140 (0.082)
Indian	-0.148 (0.015)***	-0.130 (0.023)***	-0.135 (0.015)***	-0.147 (0.016)***
Pakistani	-0.149 (0.023)***	-0.095 (0.035)**	-0.135 (0.025)***	-0.142 (0.024)***
Bangladeshi	-0.151 (0.037)***	-0.102 (0.058)	-0.133 (0.039)***	-0.128 (0.039)***
Chinese	-0.277 (0.028)***	-0.322 (0.040)***	-0.278 (0.028)***	-0.240 (0.029)***
Other Asian ethnic group	-0.151 (0.030)***	-0.116 (0.044)**	-0.150 (0.030)***	-0.142 (0.032)***
Mixed ethnic	-0.052 (0.022)*	-0.055 (0.033)	-0.053 (0.022)*	-0.036 (0.023)
Other ethnic group	-0.099 (0.039)*	0.106 (0.065)	-0.105 (0.041)**	-0.082 (0.042)
Unknown/Refused ethnic group	-0.097 (0.028)***	-0.147 (0.039)***	-0.106 (0.029)***	-0.075 (0.031)*
Lives at home full-time	0.008 (0.009)	0.008 (0.009)	0.008 (0.009)	-0.011 (0.009)
Disabled	-0.045 (0.012)***	-0.045 (0.012)***	-0.045 (0.012)***	-0.039 (0.012)**
Medicine & dentistry	-0.044 (0.047)	-0.047 (0.047)	-0.053 (0.047)	-0.062 (0.047)
Subjects allied to medicine	-0.025 (0.016)	-0.025 (0.016)	-0.026 (0.016)	-0.016 (0.017)
Biological sciences	0.030 (0.012)*	0.030 (0.012)*	0.031 (0.012)*	0.023 (0.012)
Veterinary science	-0.369 (0.118)**	-0.368 (0.118)**	-0.361 (0.118)**	-0.381 (0.119)**
Agriculture & related subjects	0.014 (0.039)	0.013 (0.039)	0.014 (0.039)	-0.000 (0.039)
Physical sciences	-0.109 (0.016)***	-0.108 (0.016)***	-0.107 (0.016)***	-0.123 (0.016)***
Mathematical sciences	-0.136 (0.024)***	-0.135 (0.024)***	-0.137 (0.024)***	-0.148 (0.024)***
Computer science	0.093 (0.018)***	0.090 (0.018)***	0.097 (0.018)***	0.079 (0.018)***
Engineering & technology	-0.068 (0.022)**	-0.068 (0.022)**	-0.066 (0.022)**	-0.075 (0.022)**
Architecture, building & planning	-0.076 (0.028)**	-0.075 (0.028)**	-0.075 (0.028)**	-0.085 (0.028)**
Law	-0.149 (0.015)***	-0.148 (0.015)***	-0.149 (0.015)***	-0.156 (0.015)***
Business & administrative studies	-0.001 (0.014)	-0.002 (0.014)	0.000 (0.014)	-0.008 (0.014)
Mass communications & documentation	0.111 (0.018)***	0.111 (0.018)***	0.112 (0.018)***	0.103 (0.018)***
Languages	0.086 (0.015)***	0.086 (0.015)***	0.087 (0.015)***	0.094 (0.015)***
Historical & philosophical studies	0.100 (0.014)***	0.100 (0.014)***	0.102 (0.014)***	0.101 (0.014)***
Creative arts & design	0.116 (0.014)***	0.116 (0.014)***	0.115 (0.014)***	0.146 (0.014)***
Education	-0.070 (0.025)**	-0.070 (0.025)**	-0.071 (0.025)**	-0.069 (0.025)**
Combined	0.006 (0.043)	0.006 (0.043)	0.007 (0.043)	0.005 (0.044)
Mix of A-levels and vocational qualifications	-0.072 (0.013)***	-0.072 (0.013)***	-0.073 (0.013)***	-0.093 (0.013)***
Vocational qualifications only	-0.128 (0.020)***	-0.129 (0.020)***	-0.122 (0.020)***	-0.150 (0.020)***
Neighbourhood level IMD score	-0.015 (0.003)***	-0.015 (0.003)***	-0.015 (0.003)***	-0.014 (0.003)***
Institution level Russell Group indicator	0.048 (0.044)	0.048 (0.045)	0.047 (0.045)	0.058 (0.046)
Institution level mean UCAS tariff score	-0.077 (0.030)**	-0.077 (0.030)**	-0.079 (0.030)**	-0.077 (0.031)*
Institution level std. dev. of UCAS tariff score	-0.257 (0.089)**	-0.260 (0.089)**	-0.260 (0.090)**	-0.250 (0.091)**
Institution level proportion of females	-0.403 (0.151)**	-0.404 (0.151)**	-0.403 (0.151)**	-0.375 (0.154)*
Institution level proportion of non-White	0.267 (0.083)**	0.265 (0.083)**	0.267 (0.083)**	0.313 (0.085)***
Institution mean IMD score	-0.005 (0.051)	-0.005 (0.051)	-0.005 (0.051)	-0.023 (0.052)
Other White*female		-0.100 (0.055)		
Black Caribbean*female		0.032 (0.077)		
Black African*female		0.028 (0.057)		
Other Black ethnic group*female		0.151 (0.156)		
Indian*female		-0.030 (0.029)		
Pakistani*female		-0.088 (0.044)*		
Bangladeshi*female		-0.081 (0.074)		
Chinese*female		0.088 (0.054)		
Other Asian ethnic group*female		-0.065 (0.059)		
Mixed ethnic*female		0.005 (0.044)		
Other ethnic group*female		-0.322 (0.081)***		
Unknown/Refused ethnic group*female		0.104 (0.056)		

Other White*UCAS score		0.039	(0.026)					
Black Caribbean*UCAS score		0.024	(0.038)					
Black African*UCAS score		0.056	(0.031)					
Other Black ethnic group*UCAS score		-0.013	(0.072)					
Indian*UCAS score		0.068	(0.014)***					
Pakistani*UCAS score		0.040	(0.023)					
Bangladeshi*UCAS score		0.057	(0.038)					
Chinese*UCAS score		0.018	(0.025)					
Other Asian ethnic group*UCAS score		-0.011	(0.030)					
Mixed ethnic*UCAS score		0.016	(0.022)					
Other ethnic group*UCAS score		-0.011	(0.038)					
Unknown/Refused ethnic group*UCAS score		-0.045	(0.028)					
Aged 22 or over				0.404	(0.013)***			
Other White*Aged 22 or over				-0.080	(0.080)			
Black Caribbean*Aged 22 or over				-0.292	(0.101)**			
Black African*Aged 22 or over				-0.219	(0.076)**			
Other Black ethnic group*Aged 22 or over				-0.195	(0.203)			
Indian*Aged 22 or over				-0.352	(0.065)***			
Pakistani*Aged 22 or over				-0.247	(0.076)**			
Bangladeshi*Aged 22 or over				-0.567	(0.136)***			
Chinese*Aged 22 or over				-0.519	(0.092)***			
Other Asian ethnic group*Aged 22 or over				-0.222	(0.092)*			
Mixed ethnic*Aged 22 or over				-0.207	(0.075)**			
Other ethnic group*Aged 22 or over				-0.286	(0.116)*			
Unknown/Refused ethnic group*Aged 22 or over				-0.086	(0.083)			
Between institution variance	0.013	(0.002)***	0.013	(0.002)***	0.013	(0.002)***	0.014	(0.002)***
Between student within institution variance	0.610	(0.003)***	0.610	(0.003)***	0.610	(0.003)***	0.620	(0.003)***
Deviance (-2*log likelihood)	311907.2		311839.1		311837.5		313964.1	
Akaike Information Criteria (AIC)	156063.6		156053.5		156052.7		157106.0	
Bayesian Information Criteria (BIC)	156564.3		156663.5		156662.7		157670.5	
Variance partition coefficient (VPC)	0.021		0.021		0.021		0.022	
Number of institutions	120		120		120		120	
Number of students	66431		66431		66431		66431	

Key: standard errors in parentheses; $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table A4b

	(5) Interaction: ethnicity and living at home	(6) Interaction: ethnicity and IMD score	(7) Interaction: ethnicity and A-levels only
Intercept	0.037 (0.073)	0.035 (0.073)	-0.034 (0.075)
UCAS tariff score	0.371 (0.006)***	0.371 (0.006)***	0.370 (0.006)***
UCAS tariff score (squared)	-0.017 (0.005)***	-0.018 (0.005)***	-0.017 (0.005)***
UCAS tariff score (cubed)	-0.022 (0.001)***	-0.022 (0.001)***	-0.022 (0.001)***
UCAS tariff score (quadrupled)	0.004 (0.001)***	0.004 (0.001)***	0.004 (0.001)***
Female	0.126 (0.007)***	0.127 (0.007)***	0.127 (0.007)***
Age 21	0.209 (0.008)***	0.209 (0.008)***	0.211 (0.008)***
Age 22	0.302 (0.016)***	0.300 (0.016)***	0.302 (0.016)***
Age 23	0.333 (0.026)***	0.332 (0.026)***	0.332 (0.026)***
Age 24	0.501 (0.035)***	0.499 (0.035)***	0.501 (0.035)***
Age 25 to 29	0.609 (0.030)***	0.608 (0.030)***	0.610 (0.030)***
Age 30 or older	0.948 (0.032)***	0.951 (0.032)***	0.955 (0.032)***
Other White	-0.073 (0.031)*	-0.083 (0.028)**	-0.098 (0.089)
Black Caribbean	-0.208 (0.044)***	-0.288 (0.054)***	-0.235 (0.085)**
Black African	-0.312 (0.033)***	-0.358 (0.045)***	-0.352 (0.068)***
Other Black ethnic group	-0.101 (0.094)	-0.166 (0.092)	-0.270 (0.209)
Indian	-0.194 (0.019)***	-0.158 (0.017)***	-0.250 (0.038)***
Pakistani	-0.222 (0.033)***	-0.179 (0.034)***	-0.249 (0.050)***
Bangladeshi	-0.270 (0.057)***	-0.138 (0.063)*	-0.442 (0.092)***
Chinese	-0.302 (0.031)***	-0.268 (0.029)***	-0.295 (0.082)***
Other Asian ethnic group	-0.168 (0.037)***	-0.159 (0.032)***	-0.201 (0.096)*
Mixed ethnic	-0.051 (0.024)*	-0.056 (0.022)**	-0.090 (0.077)
Other ethnic group	-0.093 (0.050)	-0.122 (0.045)**	-0.131 (0.100)
Unknown/Refused ethnic group	-0.077 (0.031)*	-0.095 (0.028)***	-0.088 (0.092)
Lives at home full-time	-0.013 (0.010)	0.007 (0.009)	0.008 (0.009)
Disabled	-0.045 (0.012)***	-0.045 (0.012)***	-0.045 (0.012)***
Medicine & dentistry	-0.041 (0.047)	-0.044 (0.047)	-0.046 (0.047)
Subjects allied to medicine	-0.024 (0.016)	-0.025 (0.016)	-0.026 (0.016)
Biological sciences	0.029 (0.012)*	0.029 (0.012)*	0.030 (0.012)*
Veterinary science	-0.372 (0.118)**	-0.371 (0.118)**	-0.369 (0.118)**
Agriculture & related subjects	0.013 (0.039)	0.014 (0.039)	0.014 (0.039)
Physical sciences	-0.109 (0.016)***	-0.109 (0.016)***	-0.108 (0.016)***
Mathematical sciences	-0.135 (0.024)***	-0.136 (0.024)***	-0.137 (0.024)***
Computer science	0.091 (0.018)***	0.092 (0.018)***	0.094 (0.018)***
Engineering & technology	-0.068 (0.022)**	-0.068 (0.022)**	-0.068 (0.022)**
Architecture, building & planning	-0.077 (0.028)**	-0.076 (0.028)**	-0.076 (0.028)**
Law	-0.150 (0.015)***	-0.149 (0.015)***	-0.149 (0.015)***
Business & administrative studies	-0.002 (0.014)	-0.001 (0.014)	-0.001 (0.014)
Mass communications & documentation	0.111 (0.018)***	0.111 (0.018)***	0.111 (0.018)***
Languages	0.085 (0.015)***	0.086 (0.015)***	0.087 (0.015)***
Historical & philosophical studies	0.099 (0.014)***	0.100 (0.014)***	0.101 (0.014)***
Creative arts & design	0.116 (0.014)***	0.117 (0.014)***	0.115 (0.014)***
Education	-0.068 (0.025)**	-0.070 (0.025)**	-0.071 (0.025)**
Combined	0.006 (0.043)	0.006 (0.043)	0.008 (0.043)
Mix of A-levels and vocational qualifications	-0.074 (0.013)***	-0.072 (0.013)***	
Vocational qualifications only	-0.129 (0.020)***	-0.129 (0.020)***	
Neighbourhood level IMD score	-0.015 (0.003)***	-0.019 (0.004)***	-0.015 (0.003)***
Institution level Russell Group indicator	0.052 (0.044)	0.048 (0.044)	0.048 (0.044)
Institution level mean UCAS tariff score	-0.080 (0.030)**	-0.077 (0.030)**	-0.078 (0.030)**
Institution level std. dev. of UCAS tariff score	-0.258 (0.089)**	-0.258 (0.089)**	-0.259 (0.089)**
Institution level proportion of females	-0.403 (0.151)**	-0.402 (0.151)**	-0.404 (0.151)**
Institution level proportion of non-White	0.255 (0.083)**	0.265 (0.083)**	0.266 (0.083)**
Institution mean IMD score	-0.005 (0.051)	-0.005 (0.051)	-0.005 (0.051)
Other White*Lives at home	-0.003 (0.066)		
Black Caribbean*Lives at home	-0.105 (0.072)		
Black African*Lives at home	0.090 (0.062)		
Other Black ethnic group*Lives at home	-0.133 (0.153)		
Indian*Lives at home	0.141 (0.030)***		
Pakistani*Lives at home	0.149 (0.044)***		
Bangladeshi*Lives at home	0.220 (0.074)**		
Chinese*Lives at home	0.120 (0.065)		
Other Asian ethnic group*Lives at home	0.067 (0.063)		
Mixed ethnic*Lives at home	0.001 (0.055)		
Other ethnic group*Lives at home	0.003 (0.080)		
Unknown/Refused ethnic group*Lives at home	-0.116 (0.076)		
Other White*IMD		0.045 (0.027)	
Black Caribbean*IMD		0.041 (0.041)*	
Black African*IMD		0.063 (0.031)*	
Other Black ethnic group*IMD		0.017 (0.069)	
Indian*IMD		0.026 (0.015)	
Pakistani*IMD		0.034 (0.024)	
Bangladeshi*IMD		-0.005 (0.038)	
Chinese*IMD		-0.016 (0.026)	
Other Asian ethnic group*IMD		0.027 (0.029)	
Mixed ethnic*IMD		0.023 (0.021)	
Other ethnic group*IMD		0.047 (0.038)	
Unknown/Refused ethnic group*IMD		-0.011 (0.028)	
A-levels only			0.068 (0.013)***
Other White*A-levels only			0.023 (0.093)

Black Caribbean*A-levels only		-0.025	(0.092)	
Black African*A-levels only		0.068	(0.074)	
Other Black ethnic group*A-levels only		0.127	(0.224)	
Indian*A-levels only		0.118	(0.041)**	
Pakistani*A-levels only		0.119	(0.055)*	
Bangladeshi*A-levels only		0.342	(0.100)***	
Chinese*A-levels only		0.019	(0.087)	
Other Asian ethnic group*A-levels only		0.056	(0.101)	
Mixed ethnic*A-levels only		0.041	(0.080)	
Other ethnic group*A-levels only		0.036	(0.108)	
Unknown/Refused ethnic group*A-levels only		-0.011	(0.097)	
Between institution variance	0.013 0.610	(0.002)*** (0.003)***	0.013 0.610	(0.002)*** (0.003)***
Between student within institution variance				
Deviance (-2 ^{log likelihood})	311807.0	311875.9	311871.3	
Akaike Information Criteria (AIC)	156037.5	156071.9	156067.7	
Bayesian Information Criteria (BIC)	156647.5	156681.9	156668.5	
Variance partition coefficient (VPC)	0.021	0.021	0.021	
Number of institutions	120	120	120	
Number of students	66431	66431	66431	

Key: standard errors in parentheses; $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Appendix 5: Exploring ethnicity interactions using grouped ethnicity variable with four categories (White, Black, Asian, and Other: three dummies relative to White)

Table A5a

	(1) Base Main effects Model	(2) Interaction: ethnicity and gender	(3) Interaction: ethnicity and UCAS score	(4) Interaction: ethnicity and Aged 22 or over
Intercept	0.034 (0.074)	0.033 (0.074)	0.033 (0.074)	0.085 (0.076)
UCAS tariff score	0.370 (0.006)***	0.370 (0.006)***	0.366 (0.006)***	0.339 (0.006)***
UCAS tariff score (squared)	-0.017 (0.005)***	-0.017 (0.005)***	-0.015 (0.005)**	-0.013 (0.005)**
UCAS tariff score (cubed)	-0.022 (0.001)***	-0.022 (0.001)***	-0.022 (0.001)***	-0.022 (0.001)***
UCAS tariff score (quadrupled)	0.004 (0.001)***	0.004 (0.001)***	0.004 (0.001)***	0.004 (0.001)***
Female	0.127 (0.007)***	0.129 (0.007)***	0.128 (0.007)***	0.125 (0.007)***
Age 21	0.208 (0.008)***	0.209 (0.008)***	0.209 (0.008)***	
Age 22	0.298 (0.016)***	0.298 (0.016)***	0.298 (0.016)***	
Age 23	0.330 (0.026)***	0.330 (0.026)***	0.329 (0.026)***	
Age 24	0.498 (0.035)***	0.498 (0.035)***	0.498 (0.035)***	
Age 25 to 29	0.605 (0.030)***	0.605 (0.030)***	0.603 (0.030)***	
Age 30 or older	0.949 (0.032)***	0.948 (0.032)***	0.944 (0.032)***	
Black	-0.265 (0.022)***	-0.294 (0.036)***	-0.250 (0.025)***	-0.243 (0.024)***
Asian	-0.164 (0.012)***	-0.147 (0.017)***	-0.157 (0.012)***	-0.155 (0.012)***
Other	-0.072 (0.016)***	-0.066 (0.024)**	-0.073 (0.016)***	-0.054 (0.017)**
Lives at home full-time	0.009 (0.009)	0.009 (0.009)	0.010 (0.009)	-0.010 (0.009)
Disabled	-0.044 (0.012)***	-0.044 (0.012)***	-0.045 (0.012)***	-0.038 (0.012)**
Medicine & dentistry	-0.047 (0.047)	-0.047 (0.047)	-0.056 (0.047)	-0.063 (0.047)
Subjects allied to medicine	-0.024 (0.016)	-0.024 (0.016)	-0.025 (0.016)	-0.014 (0.017)
Biological sciences	0.030 (0.012)*	0.030 (0.012)*	0.031 (0.012)*	0.024 (0.012)
Veterinary science	-0.368 (0.118)**	-0.369 (0.118)**	-0.364 (0.118)**	-0.380 (0.119)**
Agriculture & related subjects	0.013 (0.039)	0.013 (0.039)	0.013 (0.039)	-0.000 (0.039)
Physical sciences	-0.108 (0.016)***	-0.108 (0.016)***	-0.107 (0.016)***	-0.123 (0.016)***
Mathematical sciences	-0.136 (0.024)***	-0.136 (0.024)***	-0.137 (0.024)***	-0.148 (0.024)***
Computer science	0.092 (0.018)***	0.091 (0.018)***	0.095 (0.018)***	0.078 (0.018)***
Engineering & technology	-0.070 (0.022)**	-0.070 (0.022)**	-0.069 (0.022)**	-0.077 (0.022)**
Architecture, building & planning	-0.078 (0.028)**	-0.078 (0.028)**	-0.078 (0.028)**	-0.086 (0.028)**
Law	-0.148 (0.015)***	-0.147 (0.015)***	-0.148 (0.015)***	-0.155 (0.015)***
Business & administrative studies	-0.002 (0.014)	-0.002 (0.014)	-0.001 (0.014)	-0.009 (0.014)
Mass communications & documentation	0.111 (0.018)***	0.111 (0.018)***	0.111 (0.018)***	0.104 (0.018)***
Languages	0.087 (0.015)***	0.087 (0.015)***	0.088 (0.015)***	0.094 (0.015)***
Historical & philosophical studies	0.100 (0.014)***	0.100 (0.014)***	0.102 (0.014)***	0.101 (0.014)***
Creative arts & design	0.116 (0.014)***	0.116 (0.014)***	0.115 (0.014)***	0.146 (0.014)***
Education	-0.070 (0.025)**	-0.070 (0.025)**	-0.071 (0.025)**	-0.068 (0.025)**
Combined	0.006 (0.043)	0.007 (0.043)	0.007 (0.043)	0.005 (0.044)
Mix of A-levels and vocational qualifications	-0.073 (0.013)***	-0.073 (0.013)***	-0.073 (0.013)***	-0.094 (0.013)***
Vocational qualifications only	-0.127 (0.020)***	-0.127 (0.020)***	-0.123 (0.020)***	-0.152 (0.020)***
Neighbourhood level IMD score	-0.015 (0.003)***	-0.015 (0.003)***	-0.015 (0.003)***	-0.014 (0.003)***
Institution level Russell Group indicator	0.048 (0.045)	0.048 (0.045)	0.047 (0.045)	0.059 (0.046)
Institution level mean UCAS tariff score	-0.076 (0.030)*	-0.076 (0.030)*	-0.077 (0.030)*	-0.076 (0.031)*
Institution level std. dev. of UCAS tariff score	-0.257 (0.090)**	-0.257 (0.090)**	-0.259 (0.090)**	-0.251 (0.092)**
Institution level proportion of females	-0.407 (0.152)**	-0.408 (0.152)**	-0.407 (0.152)**	-0.381 (0.155)*
Institution level proportion of non-White	0.261 (0.087)**	0.261 (0.087)**	0.262 (0.087)**	0.306 (0.089)***
Institution mean IMD score	0.000 (0.051)	0.000 (0.052)	0.001 (0.052)	-0.017 (0.053)
Black*female		0.043 (0.044)		
Asian*female		-0.029 (0.021)		
Other*female		-0.010 (0.032)		
Black*UCAS score			0.035 (0.023)	
Asian*UCAS score			0.039 (0.010)***	
Other*UCAS score			-0.006 (0.016)	
Aged 22 or over				0.401 (0.013)***
Black*Aged 22 or over				-0.239 (0.059)***
Asian*Aged 22 or over				-0.349 (0.039)***
Other*Aged 22 or over				-0.178 (0.051)***
Between institution variance	0.013 (0.002)***	0.013 (0.002)***	0.013 (0.002)***	0.014 (0.002)***
Between student within institution variance	0.610 (0.003)***	0.610 (0.003)***	0.610 (0.003)***	0.620 (0.003)***
Deviance (-2*log likelihood)				
Variance partition coefficient (VPC)	0.021	0.021	0.022	0.022
Number of institutions	120	120	120	120
Number of students	66431	66431	66431	66431

Key: standard errors in parentheses; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table A5b

	(5) Interaction: ethnicity and living at home	(6) Interaction: ethnicity and IMD score	(7) Interaction: ethnicity and A- levels only
Intercept	0.038 (0.074)	0.034 (0.074)	-0.035 (0.075)
UCAS tariff score	0.371 (0.006)***	0.370 (0.006)***	0.370 (0.006)***
UCAS tariff score (squared)	-0.018 (0.005)***	-0.018 (0.005)***	-0.017 (0.005)***
UCAS tariff score (cubed)	-0.022 (0.001)***	-0.022 (0.001)***	-0.022 (0.001)***
UCAS tariff score (quadrupled)	0.004 (0.001)***	0.004 (0.001)***	0.004 (0.001)***
Female	0.126 (0.007)***	0.127 (0.007)***	0.127 (0.007)***
Age 21	0.208 (0.008)***	0.208 (0.008)***	0.210 (0.008)***
Age 22	0.299 (0.016)***	0.298 (0.016)***	0.299 (0.016)***
Age 23	0.331 (0.026)***	0.330 (0.026)***	0.330 (0.026)***
Age 24	0.500 (0.035)***	0.498 (0.035)***	0.500 (0.035)***
Age 25 to 29	0.607 (0.030)***	0.606 (0.030)***	0.608 (0.030)***
Age 30 or older	0.947 (0.032)***	0.950 (0.032)***	0.953 (0.032)***
Black	-0.260 (0.026)***	-0.308 (0.033)***	-0.301 (0.052)***
Asian	-0.215 (0.014)***	-0.174 (0.013)***	-0.263 (0.028)***
Other	-0.063 (0.018)***	-0.074 (0.016)***	-0.097 (0.052)
Lives at home full-time	-0.014 (0.010)	0.008 (0.009)	0.009 (0.009)
Disabled	-0.045 (0.012)***	-0.045 (0.012)***	-0.045 (0.012)***
Medicine & dentistry	-0.041 (0.047)	-0.046 (0.047)	-0.048 (0.047)
Subjects allied to medicine	-0.024 (0.016)	-0.024 (0.016)	-0.025 (0.016)
Biological sciences	0.029 (0.012)*	0.030 (0.012)*	0.030 (0.012)*
Veterinary science	-0.372 (0.118)**	-0.368 (0.118)**	-0.368 (0.118)**
Agriculture & related subjects	0.012 (0.039)	0.013 (0.039)	0.013 (0.039)
Physical sciences	-0.109 (0.016)***	-0.109 (0.016)***	-0.108 (0.016)***
Mathematical sciences	-0.135 (0.024)***	-0.136 (0.024)***	-0.137 (0.024)***
Computer science	0.089 (0.018)***	0.091 (0.018)***	0.093 (0.018)***
Engineering & technology	-0.070 (0.022)**	-0.070 (0.022)**	-0.071 (0.022)**
Architecture, building & planning	-0.078 (0.028)**	-0.078 (0.028)**	-0.079 (0.028)**
Law	-0.149 (0.015)***	-0.148 (0.015)***	-0.148 (0.015)***
Business & administrative studies	-0.003 (0.014)	-0.002 (0.014)	-0.002 (0.014)
Mass communications & documentation	0.111 (0.018)***	0.111 (0.018)***	0.111 (0.018)***
Languages	0.086 (0.015)***	0.087 (0.015)***	0.087 (0.015)***
Historical & philosophical studies	0.099 (0.014)***	0.100 (0.014)***	0.101 (0.014)***
Creative arts & design	0.116 (0.014)***	0.116 (0.014)***	0.114 (0.014)***
Education	-0.068 (0.025)**	-0.070 (0.025)**	-0.070 (0.025)**
Combined	0.006 (0.043)	0.007 (0.043)	0.008 (0.043)
Mix of A-levels and vocational qualifications	-0.073 (0.013)***	-0.073 (0.013)***	
Vocational qualifications only	-0.130 (0.020)***	-0.128 (0.020)***	
Neighbourhood level IMD score	-0.015 (0.003)***	-0.019 (0.004)***	-0.015 (0.003)***
Institution level Russell Group indicator	0.052 (0.045)	0.048 (0.045)	0.048 (0.045)
Institution level mean UCAS tariff score	-0.079 (0.030)**	-0.076 (0.030)*	-0.077 (0.030)*
Institution level std. dev. of UCAS tariff score	-0.258 (0.090)**	-0.257 (0.090)**	-0.259 (0.090)**
Institution level proportion of females	-0.407 (0.151)**	-0.408 (0.151)**	-0.408 (0.152)**
Institution level proportion of non-White	0.248 (0.087)**	0.258 (0.087)**	0.261 (0.087)**
Institution mean IMD score	0.000 (0.051)	0.000 (0.051)	0.000 (0.052)
Black*Lives at home	0.003 (0.046)		
Asian*Lives at home	0.146 (0.022)***		
Other*Lives at home	-0.029 (0.039)		
Black*IMD		0.045 (0.023)	
Asian*IMD		0.021 (0.010)*	
Other*IMD		0.016 (0.015)	
A-levels only			0.069 (0.013)***
Black*A-levels only			0.039 (0.057)
Asian*A-levels only			0.114 (0.030)***
Other*A-levels only			0.028 (0.054)
Between institution variance	0.013 (0.002)***	0.013 (0.002)***	0.013 (0.002)***
Between student within institution variance	0.610 (0.003)***	0.610 (0.003)***	0.610 (0.003)***
Deviance (-2*log likelihood)			
Variance partition coefficient (VPC)	0.021	0.021	0.021
Number of institutions	120	120	120
Number of students	66431	66431	66431

Key: standard errors in parentheses; $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Appendix 6: Exploring interactions with gender

Table A6a

	(1) With IMD model (As in A2a) The Base	(2) Interaction: gender and ethnicity	(3) Interaction: gender and UCAS score	(4) Interaction: gender and Aged 22 or over
Intercept	0.035 (0.074)	0.035 (0.074)	0.036 (0.074)	0.086 (0.076)
UCAS tariff score	0.371 (0.006)***	0.370 (0.006)***	0.365 (0.007)***	0.338 (0.006)***
UCAS tariff score (squared)	-0.017 (0.005)***	-0.017 (0.005)***	-0.018 (0.005)***	-0.013 (0.005)**
UCAS tariff score (cubed)	-0.022 (0.001)***	-0.022 (0.001)***	-0.022 (0.001)***	-0.022 (0.001)***
UCAS tariff score (quadrupled)	0.004 (0.001)***	0.004 (0.001)***	0.004 (0.001)***	0.004 (0.001)***
Female	0.127 (0.007)***	0.131 (0.007)***	0.127 (0.007)***	0.127 (0.007)***
Age 21	0.209 (0.008)***	0.209 (0.008)***	0.209 (0.008)***	
Age 22	0.301 (0.016)***	0.301 (0.016)***	0.301 (0.016)***	
Age 23	0.331 (0.026)***	0.331 (0.026)***	0.331 (0.026)***	
Age 24	0.500 (0.035)***	0.500 (0.035)***	0.500 (0.035)***	
Age 25 to 29	0.607 (0.030)***	0.606 (0.030)***	0.607 (0.030)***	
Age 30 or older	0.950 (0.032)***	0.949 (0.032)***	0.952 (0.032)***	
Other White	-0.076 (0.027)**	-0.018 (0.042)	-0.075 (0.027)**	-0.067 (0.028)*
Black Caribbean	-0.252 (0.035)***	-0.275 (0.065)***	-0.251 (0.035)***	-0.262 (0.035)***
Black African	-0.291 (0.028)***	-0.308 (0.046)***	-0.291 (0.028)***	-0.305 (0.029)***
Other Black ethnic group	-0.157 (0.075)*	-0.256 (0.125)*	-0.157 (0.075)*	-0.169 (0.075)*
Indian	-0.147 (0.015)***	-0.130 (0.023)***	-0.147 (0.015)***	-0.167 (0.015)***
Pakistani	-0.149 (0.023)***	-0.095 (0.035)**	-0.148 (0.023)***	-0.164 (0.023)***
Bangladeshi	-0.151 (0.037)***	-0.102 (0.058)	-0.151 (0.037)***	-0.174 (0.037)***
Chinese	-0.277 (0.028)***	-0.322 (0.040)***	-0.277 (0.028)***	-0.291 (0.028)***
Other Asian ethnic group	-0.150 (0.030)***	-0.115 (0.044)**	-0.150 (0.030)***	-0.168 (0.030)***
Mixed ethnic	-0.052 (0.022)*	-0.055 (0.033)	-0.052 (0.022)*	-0.055 (0.022)*
Other ethnic group	-0.098 (0.039)*	0.106 (0.065)	-0.098 (0.039)*	-0.118 (0.040)**
Unknown/Refused ethnic group	-0.097 (0.028)***	-0.146 (0.039)***	-0.096 (0.028)***	-0.084 (0.029)**
Lives at home full-time	0.008 (0.009)	0.008 (0.009)	0.008 (0.009)	-0.010 (0.009)
Disabled	-0.045 (0.012)***	-0.045 (0.012)***	-0.045 (0.012)***	-0.038 (0.012)**
Medicine & dentistry	-0.044 (0.047)	-0.047 (0.047)	-0.046 (0.047)	-0.058 (0.047)
Subjects allied to medicine	-0.025 (0.016)	-0.025 (0.016)	-0.025 (0.016)	-0.014 (0.017)
Biological sciences	0.030 (0.012)*	0.030 (0.012)*	0.029 (0.012)*	0.023 (0.012)
Veterinary science	-0.369 (0.118)**	-0.368 (0.118)**	-0.372 (0.118)**	-0.383 (0.119)**
Agriculture & related subjects	0.014 (0.039)	0.013 (0.039)	0.014 (0.039)	-0.000 (0.039)
Physical sciences	-0.109 (0.016)***	-0.108 (0.016)***	-0.109 (0.016)***	-0.124 (0.016)***
Mathematical sciences	-0.136 (0.024)***	-0.135 (0.024)***	-0.135 (0.024)***	-0.148 (0.024)***
Computer science	0.093 (0.018)***	0.090 (0.018)***	0.092 (0.018)***	0.078 (0.018)***
Engineering & technology	-0.068 (0.022)**	-0.068 (0.022)**	-0.070 (0.022)**	-0.079 (0.022)***
Architecture, building & planning	-0.076 (0.028)**	-0.075 (0.028)**	-0.077 (0.028)**	-0.084 (0.028)**
Law	-0.149 (0.015)***	-0.148 (0.015)***	-0.149 (0.015)***	-0.156 (0.015)***
Business & administrative studies	-0.001 (0.014)	-0.002 (0.014)	-0.002 (0.014)	-0.010 (0.014)
Mass communications & documentation	0.111 (0.018)***	0.111 (0.018)***	0.111 (0.018)***	0.104 (0.018)***
Languages	0.086 (0.015)***	0.086 (0.015)***	0.085 (0.015)***	0.094 (0.015)***
Historical & philosophical studies	0.100 (0.014)***	0.100 (0.014)***	0.099 (0.014)***	0.101 (0.014)***
Creative arts & design	0.117 (0.014)***	0.116 (0.014)***	0.116 (0.014)***	0.146 (0.014)***
Education	-0.070 (0.025)**	-0.070 (0.025)**	-0.069 (0.025)**	-0.069 (0.025)**
Combined	0.006 (0.043)	0.006 (0.043)	0.006 (0.043)	0.005 (0.044)
Mix of A-levels and vocational qualifications	-0.072 (0.013)***	-0.072 (0.013)***	-0.072 (0.013)***	-0.093 (0.013)***
Vocational qualifications only	-0.128 (0.020)***	-0.129 (0.020)***	-0.128 (0.020)***	-0.159 (0.020)***
Neighbourhood level IMD score	-0.015 (0.003)***	-0.015 (0.003)***	-0.015 (0.003)***	-0.014 (0.003)***
Institution level Russell Group indicator	0.049 (0.045)	0.049 (0.045)	0.049 (0.045)	0.060 (0.046)
Institution level mean UCAS tariff score	-0.076 (0.030)*	-0.076 (0.030)*	-0.076 (0.030)*	-0.076 (0.031)*
Institution level std. dev. of UCAS tariff score	-0.258 (0.090)**	-0.260 (0.090)**	-0.258 (0.090)**	-0.245 (0.092)**
Institution level proportion of females	-0.410 (0.151)**	-0.411 (0.152)**	-0.407 (0.151)**	-0.376 (0.155)*
Institution level proportion of non-White	0.262 (0.087)**	0.260 (0.087)**	0.262 (0.087)**	0.318 (0.089)***
Institution mean IMD score	-0.001 (0.051)	-0.001 (0.052)	-0.001 (0.051)	-0.022 (0.053)
Female*Other White		-0.100 (0.055)		
Female*Black Caribbean		0.032 (0.077)		
Female*Black African		0.028 (0.057)		
Female*Other Black ethnic group		0.151 (0.156)		
Female*Indian		-0.030 (0.029)		
Female*Pakistani		-0.088 (0.044)*		
Female*Bengali		-0.081 (0.074)		
Female*Chinese		0.088 (0.054)		
Female*Other Asian ethnic group		-0.065 (0.059)		
Female*Mixed ethnic		0.005 (0.044)		
Female*Other ethnic group		-0.322 (0.081)***		
Female*Unknown/Refused ethnic group		0.104 (0.056)		
Female*UCAS tariff score			0.010 (0.006)	
Aged 22 or over				0.365 (0.017)***
Female*Aged 22 or over				-0.025 (0.023)
Between institution variance	0.013 (0.002)***	0.013 (0.002)***	0.013 (0.002)***	0.014 (0.002)***
Between student within institution variance	0.610 (0.003)***	0.610 (0.003)***	0.610 (0.003)***	0.621 (0.003)***

Deviance (-2*log likelihood)				
Variance partition coefficient (VPC)	0.021	0.021	0.021	0.022
Number of institutions	120	120	120	120
Number of students	66431	66431	66431	66431

Key: standard errors in parentheses; $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table A6b

	(5) Interaction: gender and living at home	(6) Interaction: gender and IMD score	(7) Interaction: gender and A-levels only
Intercept	0.027 (0.074)	0.036 (0.074)	-0.013 (0.076)
UCAS tariff score	0.370 (0.006)***	0.370 (0.006)***	0.370 (0.006)***
UCAS tariff score (squared)	-0.017 (0.005)***	-0.017 (0.005)***	-0.018 (0.005)***
UCAS tariff score (cubed)	-0.022 (0.001)***	-0.022 (0.001)***	-0.022 (0.001)***
UCAS tariff score (quadrupled)	0.004 (0.001)***	0.004 (0.001)***	0.004 (0.001)***
Female	0.141 (0.007)***	0.127 (0.007)***	0.062 (0.020)**
Lives at home full-time	0.059 (0.013)***	0.008 (0.009)	0.008 (0.009)
Age 21	0.210 (0.008)***	0.209 (0.008)***	0.209 (0.008)***
Age 22	0.301 (0.016)***	0.301 (0.016)***	0.300 (0.016)***
Age 23	0.330 (0.026)***	0.331 (0.026)***	0.331 (0.026)***
Age 24	0.500 (0.035)***	0.500 (0.035)***	0.500 (0.035)***
Age 25 to 29	0.606 (0.030)***	0.607 (0.030)***	0.609 (0.030)***
Age 30 or older	0.948 (0.032)***	0.950 (0.032)***	0.953 (0.032)***
Other White	-0.075 (0.027)**	-0.075 (0.027)**	-0.076 (0.027)**
Black Caribbean	-0.251 (0.035)***	-0.250 (0.035)***	-0.252 (0.035)***
Black African	-0.291 (0.028)***	-0.289 (0.029)***	-0.293 (0.028)***
Other Black ethnic group	-0.159 (0.075)*	-0.156 (0.075)*	-0.157 (0.075)*
Indian	-0.147 (0.015)***	-0.147 (0.015)***	-0.149 (0.015)***
Pakistani	-0.147 (0.023)***	-0.148 (0.023)***	-0.151 (0.023)***
Bangladeshi	-0.149 (0.037)***	-0.151 (0.037)***	-0.152 (0.037)***
Chinese	-0.276 (0.027)***	-0.277 (0.028)***	-0.276 (0.028)***
Other Asian ethnic group	-0.152 (0.030)***	-0.151 (0.030)***	-0.151 (0.030)***
Mixed ethnic	-0.052 (0.022)*	-0.052 (0.022)*	-0.052 (0.022)*
Other ethnic group	-0.098 (0.039)*	-0.097 (0.039)*	-0.098 (0.039)*
Unknown/Refused ethnic group	-0.097 (0.028)***	-0.097 (0.028)***	-0.097 (0.028)***
Disabled	-0.045 (0.012)***	-0.045 (0.012)***	-0.045 (0.012)***
Medicine & dentistry	-0.046 (0.047)	-0.045 (0.047)	-0.045 (0.047)
Subjects allied to medicine	-0.025 (0.016)	-0.025 (0.016)	-0.025 (0.016)
Biological sciences	0.029 (0.012)*	0.029 (0.012)*	0.029 (0.012)*
Veterinary science	-0.372 (0.118)**	-0.370 (0.118)**	-0.371 (0.118)**
Agriculture & related subjects	0.012 (0.039)	0.014 (0.039)	0.014 (0.039)
Physical sciences	-0.108 (0.016)***	-0.109 (0.016)***	-0.108 (0.016)***
Mathematical sciences	-0.136 (0.024)***	-0.136 (0.024)***	-0.136 (0.024)***
Computer science	0.089 (0.018)***	0.092 (0.018)***	0.088 (0.018)***
Engineering & technology	-0.069 (0.022)**	-0.068 (0.022)**	-0.069 (0.022)**
Architecture, building & planning	-0.076 (0.028)**	-0.076 (0.028)**	-0.077 (0.028)**
Law	-0.148 (0.015)***	-0.149 (0.015)***	-0.149 (0.015)***
Business & administrative studies	-0.002 (0.014)	-0.001 (0.014)	-0.003 (0.014)
Mass communications & documentation	0.110 (0.018)***	0.110 (0.018)***	0.111 (0.018)***
Languages	0.085 (0.015)***	0.086 (0.015)***	0.085 (0.015)***
Historical & philosophical studies	0.099 (0.014)***	0.100 (0.014)***	0.099 (0.014)***
Creative arts & design	0.115 (0.014)***	0.116 (0.014)***	0.117 (0.014)***
Education	-0.068 (0.025)**	-0.070 (0.025)**	-0.069 (0.025)**
Combined	0.004 (0.043)	0.006 (0.043)	0.005 (0.043)
Mix of A-levels and vocational qualifications	-0.072 (0.013)***	-0.072 (0.013)***	
Vocational qualifications only	-0.129 (0.020)***	-0.128 (0.020)***	
Neighbourhood level IMD score	-0.015 (0.003)***	-0.007 (0.005)	-0.015 (0.003)***
Institution level Russell Group indicator	0.049 (0.045)	0.049 (0.045)	0.048 (0.045)
Institution level mean UCAS tariff score	-0.076 (0.030)*	-0.076 (0.030)*	-0.076 (0.030)*
Institution level std. dev. of UCAS tariff score	-0.257 (0.090)**	-0.258 (0.090)**	-0.259 (0.089)**
Institution level proportion of females	-0.408 (0.151)**	-0.410 (0.151)**	-0.407 (0.151)**
Institution level proportion of non-White	0.262 (0.087)**	0.262 (0.087)**	0.263 (0.087)**
Institution mean IMD score	-0.002 (0.051)	-0.001 (0.051)	-0.002 (0.051)
Female*Lives at home full-time	-0.082 (0.016)***		
Female*Institution mean IMD score		-0.014 (0.006)*	
A-levels only			0.047 (0.017)**
Female*A-levels only			0.071 (0.021)***
Between institution variance	0.013 (0.002)***	0.013 (0.002)***	0.013 (0.002)***
Between student within institution variance	0.610 (0.003)***	0.610 (0.003)***	0.610 (0.003)***
Deviance (-2*log likelihood)			
Variance partition coefficient (VPC)	0.021	0.021	0.021
Number of institutions	120	120	120
Number of students	66431	66431	66431

Key: standard errors in parentheses; $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table A6c

	(5) Interaction: gender and subject	
Intercept	0.019	
UCAS tariff score	0.370	(0.006)***
UCAS tariff score (squared)	-0.017	(0.005)***
UCAS tariff score (cubed)	-0.022	(0.001)***
UCAS tariff score (quadrupled)	0.004	(0.001)***
Female	0.118	(0.018)***
Lives at home full-time	0.0	(0.008)
Age 21	0.210	(0.008)***
Age 22	0.300	(0.016)***
Age 23	0.330	(0.026)***
Age 24	0.495	(0.035)***
Age 25 to 29	0.603	(0.030)***
Age 30 or older	0.947	(0.032)***
Other White	-0.083	(0.027)**
Black Caribbean	-0.255	(0.035)***
Black African	-0.298	(0.028)***
Other Black ethnic group	-0.158	(0.075)*
Indian	-0.150	(0.015)***
Pakistani	-0.151	(0.022)***
Bangladeshi	-0.152	(0.037)***
Chinese	-0.280	(0.027)***
Other Asian ethnic group	-0.154	(0.030)***
Mixed ethnic	-0.054	(0.022)*
Other ethnic group	-0.098	(0.039)*
Unknown/Refused ethnic group	-0.0104	(0.028)***
Disabled	-0.046	(0.012)***
Medicine & dentistry	-0.015	(0.068)
Subjects allied to medicine	-0.081	(0.031)*
Biological sciences	0.046	(0.019)*
Veterinary science	-0.218	(0.186)
Agriculture & related subjects	-0.032	(0.081)
Physical sciences	-0.195	(0.022)***
Mathematical sciences	-0.209	(0.032)***
Computer science	0.100	(0.021)***
Engineering & technology	-0.080	(0.025)**
Architecture, building & planning	-0.049	(0.035)
Law	-0.139	(0.015)***
Business & administrative studies	-0.046	(0.019)
Mass communications & documentation	0.146	(0.028)***
Languages	0.196	(0.026)***
Historical & philosophical studies	0.130	(0.020)***
Creative arts & design	0.203	(0.020)***
Education	-0.082	(0.053)
Combined	0.036	(0.077)
Mix of A-levels and vocational qualifications	-0.073	(0.013)***
Vocational qualifications only	-0.127	(0.020)***
Neighbourhood level IMD score	-0.011	(0.004)***
Institution level Russell Group indicator	0.047	(0.045)
Institution level mean UCAS tariff score	-0.077	(0.030)*
Institution level std. dev. of UCAS tariff score	-0.262	(0.091)**
Institution level proportion of females	-0.372	(0.154)**
Institution level proportion of non-White	0.258	(0.085)**
Institution mean IMD score	-0.006	(0.052)
Female*Medicine & dentistry	-0.046	(0.086)
Female*Subjects allied to medicine	0.076	(0.036)*
Female*Biological sciences	0.115	(0.024)***
Female*Veterinary science	-0.243	(0.253)
Female*Agriculture & related subjects	0.064	(0.090)
Female*Physical sciences	0.194	(0.032)***
Female*Mathematical sciences	0.178	(0.048)***
Female*Computer science	-0.049	(0.044)
Female*Engineering & technology	0.066	(0.056)
Female*Architecture, building & planning	-0.084	(0.058)
Female*Law	-0.011	(0.030)
Female*Business & administrative studies	0.098	(0.027)***
Female*Mass communications & documentation	-0.052	(0.035)
Female*Languages	-0.145	(0.032)**8
Female*Historical & philosophical studies	-0.057	(0.027)*
Female*Creative arts & design	-0.134	(0.025)***
Female*Education	0.016	(0.059)
Female*Combined	0.058	(0.091)
Between institution variance	0.014	(0.002)***
Between student within institution variance	0.608	(0.003)***

Deviance (-2*log likelihood)	
Variance partition coefficient (VPC)	0.021
Number of institutions	120
Number of students	66431

Key: standard errors in parentheses; $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Appendix 7: Separate models for groups of institutions according to proportion non-White and proportion female

Table A7a: Basic model of progress estimated on sample split by proportion of non-White students (low, medium and high)

	(1)	(2)	(3)	
Intercept	0.167 (0.180)	-0.115 (0.118)	0.094 (0.154)	
UCAS tariff score	0.385 (0.012)***	0.362 (0.010)***	0.368 (0.011)***	
UCAS tariff score (squared)	-0.003 (0.010)	-0.017 (0.008)*	-0.026 (0.008)**	
UCAS tariff score (cubed)	-0.022 (0.003)***	-0.022 (0.002)***	-0.022 (0.002)***	
UCAS tariff score (quadrupled)	0.003 (0.002)*	0.004 (0.001)**	0.004 (0.001)***	
Female	0.168 (0.013)***	0.135 (0.010)***	0.083 (0.012)***	
Age 21	0.262 (0.016)***	0.204 (0.012)***	0.173 (0.013)***	
Age 22	0.417 (0.037)***	0.286 (0.026)***	0.246 (0.026)***	
Age 23	0.470 (0.061)***	0.282 (0.042)***	0.300 (0.040)***	
Age 24	0.595 (0.087)***	0.425 (0.056)***	0.515 (0.054)***	
Age 25 to 29	0.741 (0.071)***	0.566 (0.047)***	0.567 (0.046)***	
Age 30 or older	1.035 (0.067)***	0.977 (0.050)***	0.846 (0.053)***	
Other White	-0.097 (0.074)	-0.068 (0.044)	-0.102 (0.040)*	
Black Caribbean	0.136 (0.160)	-0.328 (0.078)***	-0.285 (0.042)***	
Black African	-0.250 (0.102)*	-0.217 (0.060)***	-0.347 (0.035)***	
Other Black ethnic group	-0.538 (0.236)*	-0.078 (0.150)	-0.154 (0.094)	
Indian	-0.124 (0.064)	-0.133 (0.030)***	-0.171 (0.020)***	
Pakistani	-0.078 (0.107)	-0.087 (0.045)	-0.195 (0.028)***	
Bangladeshi	0.067 (0.184)	-0.213 (0.099)*	-0.182 (0.042)***	
Chinese	-0.162 (0.084)	-0.295 (0.051)***	-0.308 (0.036)***	
Other Asian ethnic group	-0.126 (0.122)	0.015 (0.066)	-0.217 (0.036)***	
Mixed ethnic	0.024 (0.054)	-0.057 (0.035)	-0.090 (0.033)**	
Other ethnic group	-0.145 (0.134)	-0.154 (0.082)	-0.103 (0.048)*	
Unknown/Refused ethnic group	-0.053 (0.076)	-0.026 (0.041)	-0.202 (0.046)***	
Lives at home full-time	-0.009 (0.021)	0.011 (0.014)	0.014 (0.014)	
Disabled	-0.056 (0.022)*	-0.048 (0.019)**	-0.034 (0.022)	
Subjects allied to medicine	0.077 (0.039)*	-0.038 (0.024)	-0.052 (0.028)	
Biological sciences	0.018 (0.023)	0.063 (0.018)***	0.001 (0.023)	
Agriculture & related subjects	-0.128 (0.067)	0.047 (0.050)	0.439 (0.139)**	
Physical sciences	-0.044 (0.030)	-0.096 (0.024)***	-0.189 (0.032)***	
Mathematical sciences	-0.079 (0.047)	-0.182 (0.040)***	-0.130 (0.040)**	
Computer science	0.126 (0.037)***	0.099 (0.030)***	0.070 (0.029)*	
Engineering & technology	-0.213 (0.052)***	-0.052 (0.032)	-0.043 (0.037)	
Architecture, building & planning	-0.231 (0.069)***	-0.045 (0.037)	-0.065 (0.055)	
Law	-0.169 (0.032)***	-0.150 (0.022)***	-0.140 (0.025)***	
Business & administrative studies	0.074 (0.028)**	-0.008 (0.021)	-0.035 (0.025)	
Mass communications & documentation	0.158 (0.033)***	0.065 (0.028)*	0.132 (0.035)***	
Languages	0.129 (0.027)***	0.042 (0.023)	0.098 (0.027)***	
Historical & philosophical studies	0.152 (0.027)***	0.067 (0.022)**	0.100 (0.026)***	
Creative arts & design	0.137 (0.027)***	0.094 (0.020)***	0.121 (0.025)***	
Education	-0.031 (0.044)	-0.075 (0.037)*	-0.090 (0.052)	
Combined	0.061 (0.075)	-0.025 (0.054)	-0.165 (0.254)	
Mix of A-levels and vocational qualifications	-0.060 (0.028)*	-0.071 (0.021)***	-0.080 (0.022)***	
Vocational qualifications only	-0.081 (0.048)	-0.101 (0.031)***	-0.163 (0.031)***	
Neighbourhood level IMD score	-0.022 (0.008)**	-0.014 (0.006)*	0.001 (0.006)	
Neighbourhood level proportion of adults with a degree	-0.012 (0.070)	0.113 (0.049)*	0.148 (0.051)**	
Institution level Russell Group indicator	0.106 (0.099)	0.022 (0.074)	0.004 (0.085)	
Institution level mean UCAS tariff score	-0.107 (0.056)	-0.029 (0.056)	-0.059 (0.054)	
Institution level std. dev. of UCAS tariff score	-0.241 (0.174)	-0.024 (0.132)	-0.297 (0.188)	
Institution level proportion of females	-0.499 (0.252)*	-0.164 (0.256)	-0.362 (0.293)	
Institution level proportion of non-White	2.379 (1.429)	0.517 (0.705)	0.141 (0.159)	
Institution mean IMD score	-0.042 (0.091)	-0.047 (0.071)	0.127 (0.098)	
Medicine & dentistry		0.046 (0.079)	-0.084 (0.060)	
Veterinary science			-0.366 (0.121)**	
Between institution variance	0.015 (0.005)***	0.008 (0.002)***	0.013 (0.004)***	
Between student within institution variance	0.607 (0.007)***	0.586 (0.005)***	0.635 (0.006)***	
Deviance (-2*log likelihood)	80448.6	125959.9	104868.2	
Akaike Information Criteria (AIC)	40332.3	63090.0	52546.1	
Bayesian Information Criteria (BIC)	40750.8	63541.8	52993.9	
Variance partition coefficient (VPC)	0.024	0.013	0.020	
Number of institutions	40	40	40	
Number of students	17161	27316	21954	

Key: standard errors in parentheses; $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table A7b: Basic model of progress estimated on sample split by proportion of female students (low and high)

	(1)	(2)	
Intercept	-0.083 (0.099)	0.194 (0.109)	
UCAS tariff score	0.380 (0.008)***	0.364 (0.009)***	
UCAS tariff score (squared)	-0.020 (0.007)**	-0.021 (0.007)**	
UCAS tariff score (cubed)	-0.022 (0.002)***	-0.024 (0.002)***	
UCAS tariff score (quadrupled)	0.005 (0.001)***	0.003 (0.001)***	
Female	0.136 (0.009)***	0.116 (0.010)***	
Age 21	0.210 (0.010)***	0.206 (0.011)***	
Age 22	0.302 (0.025)***	0.297 (0.022)***	
Age 23	0.349 (0.040)***	0.311 (0.035)***	
Age 24	0.455 (0.056)***	0.524 (0.045)***	
Age 25 to 29	0.524 (0.047)***	0.659 (0.039)***	
Age 30 or older	0.898 (0.052)***	0.975 (0.040)***	
Other White	-0.101 (0.036)**	-0.059 (0.042)	
Black Caribbean	-0.168 (0.056)**	-0.325 (0.045)***	
Black African	-0.278 (0.039)***	-0.327 (0.041)***	
Other Black ethnic group	-0.233 (0.115)*	-0.125 (0.098)	
Indian	-0.118 (0.022)***	-0.188 (0.021)***	
Pakistani	-0.123 (0.032)***	-0.189 (0.032)***	
Bangladeshi	-0.144 (0.057)*	-0.188 (0.049)***	
Chinese	-0.313 (0.035)***	-0.221 (0.044)***	
Other Asian ethnic group	-0.114 (0.041)**	-0.211 (0.044)***	
Mixed ethnic	-0.080 (0.030)**	-0.035 (0.032)	
Other ethnic group	-0.085 (0.057)	-0.136 (0.054)*	
Unknown/Refused ethnic group	-0.099 (0.038)**	-0.102 (0.043)*	
Lives at home full-time	0.019 (0.014)	0.000 (0.012)	
Disabled	-0.051 (0.017)**	-0.039 (0.018)*	
Medicine & dentistry	-0.048 (0.047)	-0.026 (0.023)	
Subjects allied to medicine	-0.024 (0.025)	0.017 (0.019)	
Biological sciences	0.037 (0.016)*	-0.053 (0.056)	
Veterinary science	-0.363 (0.118)**	-0.028 (0.028)	
Agriculture & related subjects	0.082 (0.054)	0.017 (0.052)	
Physical sciences	-0.141 (0.020)***	0.144 (0.029)***	
Mathematical sciences	-0.171 (0.027)***	0.045 (0.034)	
Computer science	0.066 (0.023)**	-0.034 (0.042)	
Engineering & technology	-0.151 (0.029)***	-0.153 (0.024)***	
Architecture, building & planning	-0.116 (0.038)**	-0.006 (0.021)	
Law	-0.146 (0.019)***	0.090 (0.025)***	
Business & administrative studies	0.004 (0.019)	0.035 (0.025)	
Mass communications & documentation	0.138 (0.027)***	0.006 (0.025)	
Languages	0.116 (0.019)***	0.080 (0.020)***	
Historical & philosophical studies	0.145 (0.017)***	-0.092 (0.030)**	
Creative arts & design	0.154 (0.019)***	-0.021 (0.055)	
Education	0.004 (0.051)	-0.079 (0.019)***	
Combined	0.048 (0.071)	-0.118 (0.026)***	
Mix of A-levels and vocational qualifications	-0.069 (0.019)***	0.005 (0.005)	
Vocational qualifications only	-0.150 (0.030)***	0.127 (0.047)**	
Neighbourhood level IMD score	-0.022 (0.005)***	0.059 (0.064)	
Neighbourhood level proportion of adults with a degree	0.084 (0.042)*	-0.090 (0.043)*	
Institution level Russell Group indicator	0.059 (0.059)	-0.464 (0.134)***	
Institution level mean UCAS tariff score	-0.073 (0.040)	-0.412 (0.233)	
Institution level std. dev. of UCAS tariff score	-0.100 (0.121)	0.367 (0.104)***	
Institution level proportion of females	0.525 (0.440)	-0.082 (0.061)	
Institution level proportion of non-White	0.234 (0.123)		
Institution mean IMD score	0.015 (0.081)		
Between institution variance	0.014 (0.003)***	0.009 (0.002)***	
Between student within institution variance	0.607 (0.004)***	0.609 (0.005)***	
Deviance (-2*log likelihood)	172250.3	139231.6	
Akaike Information Criteria (AIC)	86237.2	69723.8	
Bayesian Information Criteria (BIC)	86713.9	70171.9	
Variance partition coefficient (VPC)	0.023	0.015	
Number of institutions	60	60	
Number of students	36763	29668	

Key: standard errors in parentheses; $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Appendix 8: The preparation of the HESA data

We were given two datasets and some SPSS syntax (whose purpose seemed to be to apply the filters, although this was opaque):

- **Dataset A:** Raw SPSS data file on 341,412 students (all qualifiers)
- **Dataset B:** Cleaned data on 66,649 students (the selected qualifiers). This was the second dataset that we received; it is a tab-delimited dataset with very little documentation; however, it might be possible to solve the jigsaw with a little ingenuity.

Together these datasets might have allowed us to replicate all the analysis presented in Broecke and Nicholls (2007), which we wanted to do in order to check the validity of the selection.

However, we could not use Dataset B directly for our analysis for the following fundamental reasons:

- there is no institution identifier contained within it, thus preventing a multilevel analysis
- furthermore, there is no student-level identifier present in this dataset. Such an identifier would have allowed us to merge in data from Dataset A.

We also received an SPSS syntax file which, in theory, should take us from Dataset A to Dataset B, and carry over generated documentation on this transfer that is currently lacking. In theory, we could have translated this SPSS syntax file into a Stata do-file in order to create a revised version of Dataset B that did contain the institution identifier and any further variables required for our multilevel analysis.

However:

- (i) the SPSS syntax file had a number of bugs that prevent it from running completely in SPSS
- (ii) the accuracy of some of the data manipulations in this file were questionable
- (iii) Dataset A was missing some crucial variables used in the SPSS filtering process.

Other major problems

1. There are no Index of Multiple Deprivation (IMD) related variables in Dataset A. Furthermore, there is no means of merging IMD data that might be available from other sources into Dataset A as the dataset does not contain student postcodes or other helpful geography such as their LSOA codes (IMD is normally measured at the LSOA level). The

finest geography provided in Dataset A is the students' county of residence. There were only 175 distinct values of this variable, which is, of course, a much coarser classification of geography than that of LSOA (of which there are approximately 8000) and would in any case not be a relevant covariate. Lack of IMD also creates a further problem as IMD acts as one of the filters to create Dataset B. IMD also enters the model specification of the Generalised Ordered Probit (GOP) model estimated by Broecke and Nicholls (2007), and ideally for comparability we wanted to use it as a crucial background covariate in our analyses.

2. The variables *ethnic_flag* and *ethnic_group* are referred to by the SPSS syntax file, but were not found in the raw data. However, these variables and variables derived from them appear to play no role in Broecke and Nicholls' (2007) analysis.
3. The variable *stemdum* is referred to by the SPSS syntax file, but was not found in the raw data. This variable and subsequently derived variables also do not appear to play a role in Broecke and Nicholls' (2007) analysis.
4. The variables *russ_grp* and *instid_type* are referred to by the SPSS syntax file, but are not found in the raw data. The former is an important variable as it provides the basis of the *russhe*/ variable that appears in the GOP model specification as a predictor. However, it was fairly easy to find this information and merge it in if required.
5. A lot of the data manipulations that appear in the SPSS syntax file appeared to treat missing values in a rather questionable and ad hoc manor. Missing values for each variable appear to be recoded to take the value 0 for most variables. Created dummy indicators also, therefore, do not explicitly take into account such missing values.
6. We may well want to write our own Stata do-file for the data manipulations rather than to rely on the SPSS syntax file.

Although we cannot exactly replicate Dataset B by applying the SPSS syntax file to Dataset A, we were able to get pretty close by trying to match the filters described in broad terms in the Broecke and Nicholls (2007) report. Table A8 shows this by comparing the summary statistics from Dataset B and our attempt at replicating this dataset from Dataset A. The means, standard deviations, and minimum and maximum values are very similar across the two datasets. No IMD filters could be applied to this SPSS syntax file.

After quite a bit of further investigation, we were able to solve some of the difficulties with these initial datasets with the help of Joseph Hamed of the Department for Innovation, Universities and Skills (DIUS). He was able to provide us with a file that matched student area IMD scores and ranks with their identifier from the full raw dataset. We could then apply our own filters, and finished up with the 66,431 cases used in the analysis. For multilevel analysis, we also dropped institutions that had fewer than 30 students. LSOA

ranks for IMD are unique, so this useful property enabled the merging of many census and other variables at the level of aggregation of the students LSOA, even though postcode information had not been preserved.

Table A8. Comparison of summary statistics based on Dataset B and my attempt at replicating this data based on Dataset A

Variable	Dataset B based on cleaned data on students, the selected qualifiers)				Replicated data based on Raw data (341,412 students, all qualifiers)			
	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
degclass	2.703	0.711	1	4	2.703	0.711	1	4
gender	0.579	0.494	0	1	0.580	0.494	0	1
totalt~fbby10	31.776	12.167	1	96	31.757	12.177	1	96
disabled	0.069	0.253	0	1	0.069	0.254	0	1
otherwhite~h	0.013	0.112	0	1	0.013	0.112	0	1
blackcareth	0.008	0.088	0	1	0.008	0.088	0	1
blackafreth	0.012	0.110	0	1	0.012	0.110	0	1
otherblack~h	0.002	0.041	0	1	0.002	0.041	0	1
indianeth	0.049	0.215	0	1	0.049	0.216	0	1
pakieth	0.021	0.142	0	1	0.021	0.142	0	1
banglaeth	0.007	0.084	0	1	0.007	0.084	0	1
chineth	0.013	0.112	0	1	0.013	0.113	0	1
otherasian~h	0.011	0.103	0	1	0.011	0.103	0	1
mixedeth	0.020	0.140	0	1	0.020	0.140	0	1
othereth	0.006	0.078	0	1	0.006	0.078	0	1
notknowneth	0.012	0.108	0	1	0.012	0.109	0	1
Rank(IMD variable)	6.750	2.658	1	10				
medden	0.006	0.074	0	1	0.005	0.074	0	1
alliedmed	0.056	0.231	0	1	0.056	0.231	0	1
biosci	0.149	0.356	0	1	0.149	0.356	0	1
vetsci	0.001	0.026	0	1	0.001	0.027	0	1
agrisci	0.007	0.085	0	1	0.007	0.084	0	1
physsci	0.052	0.223	0	1	0.052	0.223	0	1
mathscsi	0.019	0.136	0	1	0.019	0.136	0	1
compsci	0.041	0.198	0	1	0.041	0.198	0	1
engtech	0.024	0.154	0	1	0.024	0.154	0	1
archbuild	0.013	0.115	0	1	0.013	0.115	0	1
law	0.071	0.256	0	1	0.071	0.257	0	1
busadmin	0.091	0.288	0	1	0.091	0.288	0	1
masscomm	0.044	0.204	0	1	0.043	0.204	0	1
lang	0.069	0.254	0	1	0.069	0.254	0	1
histphilo	0.082	0.274	0	1	0.082	0.274	0	1
artdesign	0.132	0.339	0	1	0.132	0.339	0	1
educ	0.021	0.144	0	1	0.021	0.144	0	1
combined	0.006	0.075	0	1	0.006	0.075	0	1
russhei	0.313	0.464	0	1				
athomeft	0.180	0.385	0	1	0.180	0.384	0	1
logage	3.024	0.077	2.77	4.38	3.024	0.078	2.77	4.38
alevelmix	0.061	0.240	0	1	0.064	0.244	0	1
nonalevel	0.031	0.173	0	1	0.031	0.172	0	1
Total	66649				66975			