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Philip Noden[a], Michael Shiner[a] & Tariq Modood[b]
[a] London School of Economics and Political Science, UK
[b] University of Bristol, UK
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University offer rates for candidates from different ethnic categories

Philip Noden[a*], Michael Shiner[a] and Tariq Modood[b]
[a]*London School of Economics and Political Science, UK;* [b]*University of Bristol, UK*

Previous research suggested that candidates from some black and minority ethnic groups were less likely to receive an offer of a place from an 'old' university. These findings were disputed in a re-analysis carried out for HEFCE which found that only Pakistani candidates were significantly less likely to receive offers (from both 'old' and 'new' universities). In this paper we return to the question of ethnic differences in university offer rates, examining UCAS admissions data for 2008. We use a cross-classified multi-level modelling approach to predict the probability that applications from candidates from different ethnic groups will receive an offer. Controlling for variables seeking to capture the academic quality of applications we find significant differences between offer rates for different ethnic groups. Significantly lower offer rates remained for the main ethnic groups when social characteristics were also taken into account in the model (social class background, gender and school type). However, offer rates for candidates from mixed ethnic groups were not significantly different from those for white British candidates. Our analysis did not find evidence of differences in offer rates from higher and lower status institutions for black and minority ethnic candidates relative to white British applicants.

Keywords: *higher education; ethnicity; offer; quantitative*

Introduction

In this paper we revisit the question of whether applicants from different ethnic groups are equally likely to receive offers to attend university. Studies of admission to medical schools during the 1990s found that, controlling for predicted qualifications, minority ethnic applicants were less likely to *receive an offer* to attend university than white British applicants (Arulampalam, Naylor, & Smith, 2005; McManus, 1998; McManus, Richards, Winder, Sproston, & Styles, 1995). Similarly, Shiner and Modood (2002) found that, controlling for A-level results, candidates from minority ethnic groups applying to 'old' universities in 1996–1997 were significantly less likely to receive offers than white applicants.

*Corresponding author. London School of Economics and Political Science, Houghton Street, London WC2A 2AE, UK. Email: p.noden@lse.ac.uk

Shiner and Modood reported differences between applications to 'old' and 'new' universities (the latter acquiring university status in 1992). In particular, they found that black African, Pakistani, Bangladeshi, Indian, and black Caribbean applicants to 'old' universities were significantly less likely to receive an offer than white applicants. Their model included controls for A-level performance relative to other applicants to the course and a measure of the level of demand for places on the course. Comparable conclusions were drawn by Boliver (2006, 2013) in relation to offers from high status universities although this analysis did not take account of different levels of demand for places on different courses.

In relation to applications to new universities, Shiner and Modood found that no minority ethnic group was less likely to receive an offer than white British candidates. Indeed, Indian, Bangladeshi and Chinese candidates were significantly *more* likely to receive an offer than those from the white British group. Thus the authors concluded that universities' offer decisions operated as a filtering mechanism directing black and minority ethnic candidates away from old universities.

The study had a clear impact on politicians and policymakers, and was drawn to the attention of HEFCE in a letter from the then Minister of State for Lifelong Learning and Higher Education. In response, HEFCE carried out a re-analysis of the data used by Shiner and Modood.

It is difficult to compare the findings of the two analyses because they were based on different subsets of cases. Nevertheless, the HEFCE analysis identified a significantly lower probability of receiving an offer for Pakistani applicants to both old and new universities (Gittoes & Thompson, 2005). It also identified a lower probability of receiving an offer for Black African applicants to new universities. In addition, separate analysis of applications to law courses indicated that Bangladeshi, black African, black Caribbean, black other, Indian and Pakistani applicants were all less likely to receive offers than white applicants. However, Gittoes and Thompson did not conclude that there was a general bias against black and minority ethnic applicants to old universities.

Thus both Shiner and Modood (2002) and Gittoes and Thompson (2005) identified significantly lower offer rates for applications from particular minority ethnic groups, although the pattern of those differences was clearly different across the two analyses. Gittoes and Thompson suggested four possible reasons why their analysis reached different conclusions from those presented by Shiner and Modood. First, their analysis excluded applications to medicine and dentistry. This was the subject area with the largest proportion of entrants from minority ethnic groups and, in addition, was the only subject area in which the authors acknowledged that previous research evidence had established the existence of lower offer rates for minority ethnic applicants. Consequently we would expect the exclusion of these cases to reduce the size of the ethnic effects and also the chances of detecting statistically significant differences. Gittoes and Thompson also suggested that the inclusion of additional predictor variables, as well as numerous interaction terms (mostly relating to differences between new and old universities) and the use of multi-level modelling were other possible explanations of the different findings.

Since these analyses were undertaken, the Schwartz review (2004), prompted by high profile controversies surrounding university admission, has contributed to the greater professionalisation, transparency and also centralisation of admission practices within universities (Adnett, McCaig, Slack, & Bowers-Brown, 2011; SPA, 2008).

Access to higher education is clearly an important issue as it has the potential to act as a vehicle for social mobility and for the integration of minority ethnic groups into particular segments of society, especially elite occupational groups. It is important to note at the outset that minority ethnic groups have higher participation rates in higher education than the white British ethnic group (Chowdry, Crawford, Dearden, Goodman, & Vignoles, 2008; Connor, Tyers, Modood, & Hillage, 2004) and that higher education may be seen as playing a positive role in generating upward mobility among minority groups. In addition, minority ethnic students are more likely to study subjects with higher wage returns (Chowdry et al., 2008), although graduates from black and minority ethnic groups do then face particular ethnic barriers when entering the labour market (Connor et al., 2004; Heath & Cheung, 2006).

Although more likely to attend university, students from some minority ethnic groups are significantly *less* likely to attend higher status institutions (Boliver, 2013; Chowdry et al., 2008; Modood & Shiner, 1994). Chowdry et al. suggested that students from black and south Asian ethnic groups were less likely to attend high-status institutions although students from the Chinese, 'other Asian', 'other white', and 'mixed' groups were more likely to attend such universities.

The application process

University admissions are coordinated through the Universities and Colleges Admissions Service (UCAS). The process involves several stages:

(i) Candidates may apply to up to five universities through the main application scheme (or four in the case of applications for medicine, dentistry and veterinary science).
(ii) Institutions then decide whether to make an offer of a place to the candidate. Most often, offers are conditional on the grades achieved in school leaving examinations.
(iii) Candidates may then select two offers to hold as a 'firm' offer and an 'insurance' offer. Candidates not receiving an offer may make an additional application through the 'extra' application scheme.
(iv) If the candidate achieves the grades required by a conditional offer, the university confirms the place. Candidates not achieving the grades required by a conditional offer may nonetheless be admitted to the university if places are available.
(v) Candidates not achieving their grades and not accepted onto a course may then apply to courses with vacancies through the 'clearing' process.

Clearly the admission process involves a series of choices made by applicants and universities with its outcome largely determined by examination results. In this paper we are concerned with step ii) the decision of universities to make offers to applicants. It is important to note that universities are not informed of the ethnicity of candidates until after they have made their offers, although they do receive the candidates' names.

Data

Our dataset, provided by UCAS, was based on the 2008 university application cycle. The data covers 50,000 candidates, stratified by ethnic group, who were randomly drawn from home domiciled applicants (excluding those living in Northern Ireland), aged under 21, with a minimum of two A levels (or AS equivalent). The white British group comprised 25,000 candidates.

Black and minority ethnic groups were oversampled. Where possible, a minimum of 1500 cases were drawn from each of 15 ethnic categories:

Asian:	Bangladeshi
	Chinese
	Indian
	Pakistani
	Other Asian
Black:	Black African
	Black Caribbean
	Black other
Mixed:	White and Asian
	White and black African
	White and black Caribbean
	Other mixed
White:	White not British
	White British
Other:	Other ethnic

The concept of an ethnic group is primarily based on a sense of group membership, shared cultural practices and heritage. Consequently, the 'black other', 'other ethnic group' and 'other mixed ethnic group' categories are somewhat unsatisfactory, and even 'black African' consists of people with disparate origins who may not have a sense of belonging to the same group.

The 'mixed white and black African' and 'black other' ethnic categories had fewer than 1500 candidates in total, all of whom were included in the sample. Additional cases were drawn from each minority group in proportion to their population size until a sample of 50,000 cases was achieved. Variables in the dataset related to applicants' qualifications, the courses to which they had applied and some other candidate characteristics. Importantly, the data included candidates' UCAS tariff scores. The UCAS tariff awards points for different qualifications for the purposes of university entrance and may be considered by universities when comparing applications.

The dataset also included population information relating to subjects of study within universities. Degree course subjects were divided into 156 subject categories using the Joint Academic Coding Sytstem (JACS2) classification. We used a subject of study within an institution as a proxy for a degree programme. For each subject within a particular university, the dataset included the total UCAS tariff scores of applicants and accepted applicants.

As previous analysis found that the effects of ethnicity varied between 'old' and 'new' universities, distinctions were made between types of institutions. Institutions were grouped into quartiles based on the *Times Good University Guide 2007* league table—a potential source of consumer information for applicants. Although 16 years had passed since the abolition of the binary divide between 'old' and 'new' universities, the top and bottom halves of the *Times* league table were almost identical to the list of 'old' and 'new' universities. The upper quartile group included many of the Russell group universities.

The analysis was based on applications made through the UCAS 'main scheme' to degree courses at universities listed in the *Times Good University Guide 2007*. Thus applications made through the 'extra' or 'clearing' schemes were excluded. In order to reduce the potential for institutions to be identifiable, UCAS suppressed data for courses if there were fewer than three institutions offering that course subject within a quartile of the *Times* league table and thus those courses were also excluded from the analysis.

Offer rates and the quality of applications

Previous research has noted that students from some black and minority ethnic groups are less likely to attend higher status institutions, and this was reflected in our dataset. Indeed, applications from different ethnic groups were also concentrated in different ranges of the university hierarchy (see Shiner & Noden, forthcoming).

Table 1 shows the percentage of applications to *Times* league table universities that led to offers for each ethnic group. Applications from white British candidates received the highest percentage of offers overall and from universities in the top two quartiles of the league table.

We see that universities in the bottom half of the league table made offers to a much greater proportion of applications. Weighting the sample to take account of sample stratification, the proportion of applications leading to offers in each of the league table quartiles was: 68%, 83%, 88% and 90% respectively. Thus the potential for candidates from different ethnic groups to be treated differently by universities in the bottom half of the league table was much lower than within the top half. Within the sample data, many courses made offers to all applications. Under such circumstances there can be no possibility of discrimination against a group of applicants because there is no discrimination between applicants. As our primary interest was in modelling the variation in the probability of receiving an offer, only

Table 1. Offer rates for applications to quartiles of the Times league table by ethnic group

League table quartile	1	2	3	4
White British	71	86	89	90
Mixed—White and Asian	67	82	87	89
Chinese	66	82	87	90
Mixed—White and Black Caribbean	64	83	86	87
White—not British nationality	63	84	86	91
Mixed—Other mixed background	62	80	85	87
Mixed—White and Black African	62	80	88	87
Indian	60	74	90	92
Black Caribbean	57	77	85	88
Other Asian background	54	76	89	90
Other ethnic background	53	72	84	86
Black African	53	74	87	88
Black other	53	77	84	88
Pakistani	52	64	88	88
Bangladeshi	49	68	88	89

courses that rejected at least 5% of applicants in the sample were included in the detailed analysis.

The probability of receiving an offer is shaped by two key factors—the overall selectiveness of a course (in effect the course offer rate) and the quality of the application relative to applications from other candidates (Modood & Shiner, 1994).

Differences between ethnic groups in mean levels of attainment are well documented although, for the purposes of admission to a particular degree course, the level of attainment relative to other candidates will be more important than the raw attainment level. The tariff score of an application was therefore compared to a benchmark for the relevant course, namely the mean tariff score of all accepted applicants to that course. It is important to note that the tariff score was calculated from candidates' actual grades rather than their predicted grades, which were not included in the dataset. Although initial offers would have been made on the basis of predicted rather than actual grades, we maintain that actual results offer a better assessment of candidates' ability, and therefore of the fairness of the admission system, across ethnic groups. Notably previous studies using both approaches found the choice of predicted or actual grades made little difference to the results (Gittoes & Thompson, 2005; Shiner & Modood, 2002).[1]

Mean relative tariff scores for each ethnic group are shown in Table 2. The highest mean relative tariff score was for applications from Chinese candidates and this is in line with high attainment levels for this group (DCSF, 2008). In general, as the mean values for ethnic groups' total tariff scores decrease so too do relative tariff scores. It is however notable that the mean *relative* tariff scores of applications from black Caribbean and mixed white and black Caribbean candidates suggest a tendency for these candidates to apply to courses with low entry requirements compared with other minority ethnic groups.

Table 2. Mean total tariff scores of applicants and mean relative tariff scores (relative to other applications to the same course) by ethnic group

	Total tariff score		Relative tariff score	
	Mean	SD	Mean	SD
Chinese	20.8	7.1	2.9	6.3
Mixed—White and Asian	19.6	6.1	2.0	5.7
White—not British nationality	19.1	6.2	2.1	6.1
White British	18.7	5.7	2.6	5.6
Mixed—Other mixed background	18.0	6.0	1.7	5.8
Indian	17.5	5.9	1.0	5.5
Other Asian background	17.4	6.2	1.0	6.1
Mixed—White and Black African	17.2	5.6	1.2	5.9
Other ethnic background	16.8	5.8	1.2	5.9
Mixed—White and Black Caribbean	16.3	5.7	1.9	5.8
Pakistani	15.8	5.5	0.7	5.7
Other Black background	14.9	5.1	0.8	5.9
Bangladeshi	14.8	5.2	0.4	5.8
Black African	14.8	5.4	−0.1	5.7
Black Caribbean	14.5	5.0	1.0	5.5

While the UCAS tariff provides a useful metric for comparing the quality of applications it does not capture all aspects of the academic quality of an application. For example, the number of A levels taken by a candidate has been previously shown to be associated with the probability of receiving an offer, and so this was also included as an explanatory variable. It is worth noting that ethnic differences in total tariff scores are partly explained by the number of A levels taken. For ease of interpretation the number of A levels was centred on three.

Although the sample was selected from candidates offering at least two A levels (or AS level equivalent) as entry qualifications, some candidates' UCAS tariff scores could be substantially derived from non-A level qualifications. The contribution of non-A levels to the UCAS tariff score was banded (less than half a grade, half a grade to two grades, two to three grades and more than three grades equivalent) and included as a predictor variable.

Some higher education courses stipulate that applicants should have studied particular A-level subjects. Indeed, the preference for particular subjects was recently codified by universities in the Russell Group (2011). Exploratory single level binary logistic regressions revealed that particular A-level subjects could be associated with an increased probability of receiving an offer in one subject area but could be detrimental to an application in another subject area. This was the case for a substantial number of A-level subjects.

In order to avoid the need for a large number of interaction terms between A-level subjects and degree programmes applied for, we used a broad categorisation of A-level subject difficulty, drawing on the work of Coe et al. (2008).[2] A-level subjects were split into three groups and an applicant was awarded one point for taking an A-level subject categorised in the most difficult group and minus one point for subjects from the least difficult subject group. Points were aggregated to give a 'net A-level difficulty' score for each candidate. This produced a more consistent and interpretable pattern across different subject areas and was included as a predictor variable.

Finally, previous studies found that retaking A levels could reduce the probability of receiving an offer. UCAS was unable to identify candidates who had retaken A levels but, as an alternative, indicated if an applicant had made an application through UCAS during the previous two years. This was included as a predictor variable in our model.

Many of these additional academic factors also varied between ethnic groups and did so in ways that might be expected to affect their offer rates. In terms of the number and difficulty of their A levels, Chinese candidates were very competitively placed as they tended to study more A levels and tended to do so in more difficult subjects than the white British group. Black Caribbean candidates were less well placed because of a tendency to take fewer than three A levels and to do so in less difficult subjects. Black African, Bangladeshi and Pakistani candidates were in a different position because although they tended to take fewer A levels than white British candidates they did not show a particular tendency towards less difficult subjects and, if anything, seemed to favour more difficult subjects.

The modelling approach

Our analysis used a version of binary logistic regression to model the probability of receiving an offer. In developing the model, our primary focus was on whether applicants from black and minority ethnic groups were significantly less (or more) likely to receive an offer than comparable white British applicants.

Binary logistic regression assumes that cases are independent of one another. Our data violate this assumption because applications from the same candidate will share many characteristics (such as academic record and UCAS statement).[3] Similarly, applications to the same *course* are not independent because, for example, they are assessed by the same admissions staff applying the same admissions policy. The clustering of applications within candidates and courses was therefore taken into account through a cross-classified multilevel model (Goldstein, 2011).

A consequence of ignoring the multilevel structure of the data would be to underestimate the standard errors of predictor variables and therefore risk identifying spurious results. In addition, the cross-classified multilevel approach avoids any potential bias arising from a relationship between the ethnic group of applicants and the number of applications made. A third advantage of the multilevel approach is that it allows the effect of a predictor variable to vary at a higher level within the model.

Shiner and Modood's (2002) previous analysis was based on a single level binary logistic regression analysis and used a 'course competitiveness' variable as a proxy for course offer rates. This variable was computed from population data as the ratio of applicants for a course to places (as indicated by the number of accepted applicants). Using the same data, but within a cross classified multi-level modelling framework, Gittoes and Thompson used the same proxy measure. Such a measure has significant limitations as a proxy for the probability of receiving an offer. In particular, there is substantial variation between courses in terms of the proportion of offers that are subsequently held by students as firm (or insurance) offers at stage three of the application process described earlier.

In the analysis presented here we took a different approach to incorporating course level differences in offer rates. Multi-level data structures take account of the clustering of unexplained variance, which meant, in effect, that the inclusion of course as a level in the model controls for variation in course offer rates.[4]

The model may be represented as:

$$\begin{aligned} \textit{Log odds}(\textit{offer})_{ijk} = {} & \textit{constant} + \beta \textit{application characteristics}_i + \beta \textit{ethnic group}_j \\ & + \beta \textit{other candidate characteristics}_j + \beta \textit{course characteristics}_k \\ & + \textit{course residual}_k + \textit{candidate residual}_j \end{aligned}$$

The levels in our model are indicated by subscripts i (application), j (candidate) and k (course).[5]

Our model was developed in three stages. First we sought to identify differences between ethnic groups in the probability of receiving an offer. Second we included predictor variables relating to academic achievement to identify whether these accounted for any differences in offer rates. This model is referred to as the 'academic model'. Some course characteristics were also included as predictor variables at this stage. Third, a number of social characteristics were added to the model to see whether differences between ethnic groups disappeared when applicants' sex, social class and the type of school attended were taken into account (the 'academic + social model').

At each stage of the model building process we developed a parsimonious model although predictors for ethnic groups—the key items of interest—were included in all models, regardless of whether or not they were statistically significant.

Are differences between ethnic groups explained by the academic quality of applications?

In our first stage model, variables relating to candidates' ethnic groups were added to an empty model. Two ethnic groups, the Chinese and mixed white and Asian categories, had coefficients that were not significantly different from the white British reference category (model not shown). Applications from all other ethnic groups were significantly less likely to lead to an offer than applications from white British candidates.

We then investigated whether differences between ethnic groups persisted when we controlled for the academic quality of the application and our 'best model', controlling for academic factors, is shown in Table 4. The model was developed in several stages and started by estimating main effects for variables relating to academic quality. Academic predictors were entered into the model with relative tariff score included as a curvilinear effect on the chances of receiving an offer. This took account of the fact that applications with the lowest relative tariff scores were much less likely to receive an offer than other applications. All of the main effects for academic variables were statistically significant in all of the models estimated.

The effect of relative tariff score was then allowed to vary between different courses. For example we might imagine that an additional A level grade was very valuable to applications for a particular course and that the chances of receiving an offer greatly increased with the academic quality of applications. For another course, perhaps in art and design, an additional A-level grade may be of lesser importance in admissions because other considerations such as a portfolio of work or a grade specifically in art may be of paramount importance. The model was set up so that it allowed the impact of tariff scores, on the probability of an offer, to vary between courses. In technical terms, this meant a random slopes model was created, with the linear component of the relative tariff score allowed to vary at course level.

The analysis highlighted substantial variation in the effects of an additional grade for different courses and also between subjects. Further investigation showed that courses with the lowest slopes were dominated by subject areas in which tariff scores may not be a key consideration in the selection process such as social work, nursing, medicine and psychology. The inclusion of a random slope also substantially improved the fit of the model (as indicated by the Deviance Information Criterion).

Degree subjects were included as a set of dummy variables to take account of the relatively low chances of receiving an offer in some subject areas such as medicine and dentistry.[6] Finally, interaction terms were included in the model to assess whether the relative value of an additional A-level grade (or equivalent) differed between courses.

The other academic variables included in the models were also statistically significant. A previous application through UCAS and larger contributions to the UCAS tariff score from non-A level qualifications were both associated with reduced chances of receiving an offer. The number of A levels taken was negatively associated with receiving an offer once overall tariff score was controlled for. A higher net A-level difficulty score was also associated with an increased chance of receiving an offer.

Separate academic models for different degree subject areas indicated that this pattern was not consistent across all degree subjects. In particular, for applications to medicine and creative arts, having made an application through UCAS previously was *positively* associated with receiving an offer. In contrast, a previous application had a particularly negative effect for applications to study business and administrative studies. As a result of these separate analyses, various interaction terms were introduced into the model which improved the fit. One interpretation of the increased probability of an offer for medicine for candidates applying for a second time would be that those reapplying would be likely to have achieved the required A-level grades and therefore reapplication may indicate particular determination to study medicine or may be associated with greater relevant experience acquired after completing A levels.[7]

We see from the academic model that, taking into account the variables relating to academic quality, all of the coefficients for the main ethnic groups were statistically significant with a negative sign.[8] That is, controlling for the academic quality of applications, course offer rates and other course characteristics, candidates from all the main black and minority ethnic groups were significantly less likely to receive offers than their white counterparts. Of the mixed groups, however, only the 'mixed other' category had a statistically significant coefficient. Taking academic factors into account, candidates from the mixed ethnic categories combining white and either Asian, black African or black Caribbean ethnic origins were not significantly less likely to receive an offer than white British candidates.

The academic model thus confirms the findings of Shiner and Modood (2002) in that candidates from the main black and minority ethnic groups were significantly less likely to receive offers than comparable white British candidates. However, our findings differ from Shiner and Modood's in that we did not find significant differences in the treatment of black and minority ethnic applications between old and new universities. While Shiner and Modood suggested that institutional biases served to filter black and minority ethnic candidates into the new university sector, our analysis indicated that differences between the top and bottom halves of the *Times* league table were explained by differences in the mix of subjects available in the different groups of universities and different course offer rates.

At each stage interactions between ethnic group and type of university were considered to examine whether individual ethnic groups had a different probability of being given an offer according to the prestige of the university. None of these interactions were significant in any of the models. A single level logistic regression model similar to that used by Shiner and Modood did reveal a similar pattern of interaction effects to those reported in their paper but these were not significant in the multi-level model. Our substantive interpretation of this is that by taking account of the way applications are clustered within courses, the multi-level modelling better captured the course-offer rate than the fairly crude proxy measure that was available to Shiner and Modood.

Are 'ethnic penalties' in offer rates explained by factors such as social class and schooling?

We expanded the model by adding social characteristics, such as applicants' sex, social class and school type—all of which have been found to be associated with the probability of receiving an offer (Gittoes & Thompson, 2005). If these predictors had a significant effect and the coefficients for the black and minority ethnic groups became non-significant, we would conclude that differences in offer rates between ethnic groups arise from social and educational differences.

Descriptive statistics for selected social factors included in the model are shown in Table 3. The figures for school type are perhaps the most striking and, in particular, the very high proportion of candidates from the Chinese, mixed white and Asian and Indian ethnic groups who attended grammar schools or independent schools. In the case of Chinese and Indian applicants, they were also more likely to be drawn from lower social class groups.

The proportion of candidates from the Bangladeshi and black Caribbean ethnic categories originating from the highest social class group was also notably small, although relatively large proportions of black African, black Caribbean and black other candidates came from lower managerial and professional families. The proportions for the mixed white and Asian and white not British categories were, in contrast, higher than those from the white British category.[9] We see also that the proportion of applications from female candidates was particularly high for each of

Table 3. Social characteristics of candidates (percentage table)

	Sex	Socio-economic group*			School type+	
	Female	Higher managerial and professional	Lower managerial and professional	Not known	Selective	Independent
Bangladeshi	56	6	14	27	6	4
Chinese	54	18	18	19	20	27
Indian	53	20	21	17	15	21
Other Asian	53	17	21	22	16	18
Pakistani	55	14	14	26	10	10
Black African	61	17	31	23	7	8
Black Caribbean	67	11	33	17	7	6
Black Other	67	14	29	30	6	12
Other mixed	59	22	28	19	10	19
Mixed white and Asian	51	29	27	15	13	29
Mixed white and black African	54	21	31	16	8	17
Mixed white and black Caribbean	63	13	31	17	9	11
Other ethnic background	59	23	21	23	9	14
White—not British	56	28	25	18	8	24
White British	57	26	28	14	11	20

*Remaining candidates drawn from intermediate occupations, small employers and own account workers, lower supervisory and technical occupations, semi-routine and routine occupations.
+Remaining candidates attended maintained comprehensive schools, FE colleges and other types of school.

Table 4. Academic and Academic + Social models

	Academic model			Academic + social model		
	Estimate	SE	Sig	Estimate	SE	Sig
Fixed part of the model						
Constant	1.918	0.106	**	1.722	0.103	**
Ethnic group variables						
Bangladeshi	−0.545	0.072	**	−0.434	0.072	**
Pakistani	−0.649	0.055	**	−0.571	0.055	**
Indian	−0.215	0.044	**	−0.221	0.044	**
Other Asian	−0.326	0.065	**	−0.317	0.064	**
Chinese	−0.249	0.068	**	−0.265	0.069	**
Black African	−0.446	0.057	**	−0.413	0.057	**
Black Caribbean	−0.259	0.074	**	−0.237	0.074	**
Black other	−0.359	0.138	**	−0.341	0.138	*
Mixed white and Asian	−0.033	0.069		−0.059	0.068	
Mixed white and black African	−0.059	0.101		−0.049	0.100	
Mixed white and black Caribbean	−0.117	0.075		−0.092	0.075	
Mixed other	−0.138	0.069	*	−0.124	0.069	
Other ethnic group	−0.387	0.069	**	−0.356	0.068	**
White not British	−0.197	0.071	**	−0.193	0.070	**
Application level variables						
Relative tariff score	0.460	0.007	**	0.446	0.007	**
Relative tariff score squared	−0.007	0.000	**	−0.007	0.000	**
Candidate level variables						
Previously applied through UCAS	−0.799	0.051	**	−0.782	0.051	**
Non-A-level qualifications' contribution to tariff score						
0.5 to 2 grades	−0.546	0.033	**	−0.544	0.033	
2 to 3 grades	−0.648	0.040	**	−0.658	0.040	
>3 grades	−1.661	0.047	**	−1.615	0.048	
Number of A levels—3	−1.240	0.038	**	−1.190	0.038	**
Net A level difficulty	0.312	0.012	**	0.296	0.012	**
Course level variables						
Subject of study						
Medicine and dentistry	−3.207	0.335	**	−3.283	0.333	**
Subjects allied to medicine	−1.460	0.182	**	−1.444	0.179	**
Biological sciences	0.789	0.198	**	0.791	0.202	**
Physical sciences	1.708	0.249	**	1.731	0.238	**
Mathematical and computer sciences	1.184	0.231	**	1.276	0.233	**
Engineering	0.815	0.225	**	0.874	0.221	**
Law	1.019	0.277	**	1.000	0.292	**
Business and administrative studies	0.860	0.197	**	0.872	0.192	**

(*Continued*)

Table 4. (*Continued*).

	Academic model			Academic + social model		
	Estimate	SE	Sig	Estimate	SE	Sig
Mass communications and documentation	0.805	0.285	**	0.784	0.280	**
Linguistics, classics and related subjects	0.532	0.241	*	0.429	0.249	
European languages, literature and related subjects	0.93	0.293	**	0.850	0.291	**
Creative arts and design	−0.893	0.183	**	−0.878	0.175	**
Education	−0.932	0.296	**	−0.979	0.291	**
Combined arts	0.874	0.239	**	0.823	0.234	**
Combined sciences	0.673	0.312	*	0.742	0.316	*
Combined social sciences	1.188	0.310	**	1.163	0.301	**
Social sciences combined with arts and humanities	0.863	0.238	**	0.832	0.234	**
Times league table quartile						
2nd quartile	−0.030	0.119		0.006	0.122	
3rd or 4th quartile	−1.245	0.128	**	−1.071	0.129	**
Interaction terms						
Previous application to UCAS*Medicine and dentistry	0.877	0.133	**	0.863	0.133	**
Previous application to UCAS*Business and administrative studies	−0.430	0.156	**	−0.434	0.156	**
Previous application to UCAS*Creative arts and design	0.877	0.149	**	0.892	0.149	**
Number of A levels*3rd or 4th quartile	0.617	0.048	**	0.586	0.048	**
Number of A levels*2nd quartile	0.331	0.045	**	0.312	0.045	**
Number of A levels*Medicine and dentistry	−0.603	0.087	**	−0.569	0.086	**
Number of A levels*Law	−0.363	0.089	**	−0.350	0.088	**
Net A level difficulty*Biological sciences	0.208	0.038	**	0.209	0.038	**
Net A level difficulty*Engineering	0.280	0.053	**	0.296	0.053	**
Net A level difficulty*Linguistics, classics and related subjects	−0.158	0.050	**	−0.179	0.05	**
Net A level difficulty*Combined sciences	0.331	0.083	**	0.336	0.081	**
Candidate level social variables						
Female				0.196	0.026	**
Social class						
Lower managerial and professional occupations				−0.075	0.031	*
Small employers and own account workers				−0.235	0.05	**
Semi−routine occupations				−0.145	0.041	**
Routine occupations				−0.219	0.062	**
Unknown				−0.247	0.036	**

(*Continued*)

Table 4. (*Continued*).

	Academic model			Academic + social model		
	Estimate	SE	Sig	Estimate	SE	Sig
School type						
Grammar				0.357	0.042	**
Independent				0.505	0.035	**
Random part of the model						
Course level variance	3.669	0.148		3.643	0.146	
Relative tariff score slope variance	0.014	0.001		0.014	0.001	
Covariance between course level random terms	0.059	0.010		0.060	0.009	
Candidate level variance	2.083	0.062		2.023	0.061	
Deviance Information Criterion	100582			100421		

**p<0.01
*P<0.05
Model estimated using MCMC estimation method assuming flat priors, with estimates based on 200,000 iterations after a burn-in of 5,000 iterations. Effective sample sizes exceeded 145 for all course level predictors and exceeded 1000 for all applicant level variables.

the black ethnic categories and closer to 50% for the Asian groups (including mixed white and Asian).

Given these differences, it was possible that the addition of social characteristics, including school type, to the model might explain the effects associated with ethnicity. The results for the extended model show that candidates' sex, social class and school type were all significantly associated with the chances of receiving an offer (see Table 4). Being female, from the highest socio-economic category and attending independent and grammar schools all increased the probability of receiving an offer controlling for the other factors included in the model.

The model suggests that the disadvantage to candidates from most ethnic groups was somewhat reduced when social characteristics were included but remained statistically significant. As in the academic model, the effects of the mixed ethnic groups were not significantly different from the effect of being white British, with the 'mixed other' group also being not significantly different from white British candidates in the extended model.

Figure 1 illustrates the differences between ethnic groups in the probability of receiving an offer.[10] The differences in probability are calculated for an average application, from an average candidate, applying to an average course, varying only in their ethnicity. We see that, controlling for social factors, the disadvantage experienced by Pakistani applicants was larger than that for any other ethnic group.

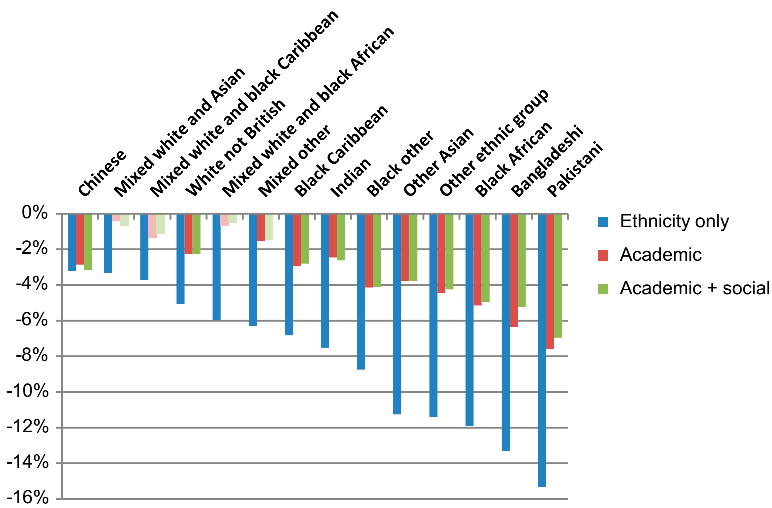

Figure 1. Percentage point differences in the probability of receiving an offer compared with a white British applicant (for the average candidate applying to the average course). Faded bars indicate estimates are not significantly different from white British group

Table 5 shows, for the academic model and the extended model, the number of additional rejections that would be received by each ethnic group, compared with the white British group, per 100 applications from average applicants to average courses. Thus we see that Pakistani, Bangladeshi and black African candidates faced the greatest levels of disadvantage according to these models.

Table 5. Number of additional rejections from selecting courses per 100 average applications compared with comparable applications from white British candidates

	Academic	Academic + social
Pakistani	−8	−7
Bangladeshi	−6	−5
Black African	−5	−5
Other ethnic group	−4	−4
Other Asian	−4	−4
Black other	−4	−4
Indian	−2	−3
Black Caribbean	−3	−3
Mixed other	−2	NS
Mixed white and black African	NS	NS
White not British	−2	−2
Mixed white and black Caribbean	NS	NS
Mixed white and Asian	NS	NS
Chinese	−3	−3

Conclusion

This paper has revisited the question of whether there are differences between ethnic groups in the probability of receiving university offers. Following in the wake of previous studies the analysis has been geared towards assessing the possibility of direct discrimination. Focusing on courses that rejected at least some applications included in the sample, we have identified substantial differences in offer rates for different ethnic groups. Applications from 12 of the 14 minority groups included in the analysis were significantly less likely to result in an offer than applications from white British applicants. Only the Chinese and mixed white and Asian groups' probability of an offer was not significantly less than that of the white British group.

From here we went on to control for a range of variables that might be expected to explain why different ethnic groups have different degrees of success when applying for university places. The implication being that any residual ethnic differences may be indicative of direct discrimination, though this is impossible to prove with certainty because of what statisticians call 'omitted variable bias' (a variable or combination of variables not included in the models might explain residual ethnic differences). What we have done in this paper builds on previous work and shows, on the basis of the most sophisticated analysis yet published, that residual ethnic differences remain even when we take account of a host of other relevant variables. When we controlled for academic factors, differences between black and minority ethnic groups' offer rates from the white British ethnic group offer rate diminished considerably, although applications from the main ethnic groups all remained significantly less likely to lead to offers. Indeed, Chinese candidates became significantly less likely to receive offers in this model, indicating that their reduced offer rates are masked by high levels of attainment.

We then extended the model to see whether ethnic differences remained when candidates' sex, social class and type of school were taken into account. The results showed that female candidates, those from higher social class groups and those who had attended selective schools or independent schools were all more likely to receive offers (controlling for the academic variables) than male applicants, those from lower social class groups and those who had attended comprehensive schools respectively.

Differences between the main ethnic groups and the white British group remained statistically significant although, once again, the differences were diminished for most minority groups. For average applications from Pakistani candidates, the model predicted seven additional rejections per 100 applications compared with the number arising from comparable white British applications. For applications from Bangladeshi and black African candidates, five additional rejections were predicted by the model, while for black Caribbeans three additional rejections were predicted.

It has previously been postulated that differences in offer rates across ethnic groups might arise from direct discrimination on the basis of candidates' names (McManus et al., 1995). This mechanism would be consistent with our findings relating to the main ethnic groups. In relation to the absence of differences between the various mixed ethnic categories and the white British group, it might be argued that the reduced proportion of identifiable surnames might explain the reduction in the size of differences in the probability of receiving an offer (relative to the main black and minority ethnic groups).

However, the significant differences in offer rates for candidates from different social class groups suggest that we should be cautious when considering this as a possible explanation. In the case of social class, we see that there are differences in the probability of receiving an offer that are not accounted for by the academic variables included in the model but for which direct discrimination on the basis of names is not a plausible explanation. This finding may suggest that there may be differences between applications that are not reflected in the model which are correlated with the social class predictor variable. This may also be the case for applications from black and minority ethnic candidates. For example, differences in the perceived quality of personal statements could be correlated with candidates' social class and / or ethnicity but not measured in the dataset.

It might be suggested that these ethnic differences in the probability of receiving an offer are modest; but we would counsel against viewing the issue simply in terms of direct discrimination because to do so is to miss an important part of the story. Variations in raw offer rates are substantial and while academic attainment is often considered a legitimate selection criterion, it is shaped by ethnic and other socio-economic inequalities (Blanden & Gregg, 2004; Jackson, 2012; Modood, 2004; Reay et al., 2005; Strand, 2011) that it serves to mask. Our analysis also indicates that other aspects of the educational process, including the type of school candidates attend and the qualifications they take, play an important role independently of attainment, indirectly disadvantaging some black and minority ethnic groups while advantaging others.

Thus the persistent finding of residual ethnic differences demands a policy response that extends beyond a preoccupation with direct discrimination. Addressing 'race' based inequality also means addressing the broader, indirect, mechanisms of exclusion that disproportionately affect some black and minority ethnic groups.

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Notes

1. The use of actual rather than predicted A level grades would be particularly problematic if candidates from black and minority ethnic groups were more likely to have overly pessimistic predictions compared with white candidates. However this is not the case (Everitt & Papageorgiou, 2011).
2. Coe et al. (2008) ranked subjects according to their average difficulty score calculated through five methods including Rasch models, subject pairs analysis and reference tests. Subject rankings across the different methods showed substantial agreement.
3. Shiner and Modood (2002) overcame this problem by randomly selecting one application for each applicant included in the dataset.
4. In short, in a multi-level model, unexplained variance is clustered at higher levels. In the case of our binary logistic model, the model could predict a high probability that a particular application would receive an offer. For example, this could be the case for an application with a relatively good academic record—yet in fact the application did not receive an offer. Such a case would have a large negative residual (the difference between the actual outcome, 0, and the predicted probability of the application receiving an offer). For some courses there may be a large number of such applications—that is, many good quality applications did not lead to offers being made. In a multi-level model such unexplained variation is partitioned between the different levels of the model. Thus, in this example, the course would have a negative residual indicating that, taking into account the characteristics of applications to the course, a smaller number of applications received offers than was predicted by the independent variables included in the model. That is, the course level residual captures the unexplained course level probability of receiving an offer. Similarly, unexplained variation clustered at candidate level captures the unexplained candidate level probability of receiving an offer.
5. Formally, using the general notation for multilevel models (Goldstein, 2011), the model may be represented as: $Logit(P_i^{(1)}) = (X\beta)_i + u^{(3)}_{course(t)} + u^{(2)}_{candidate(i)} + u^{(1)}_{application(t)}$
   $course_{(t)} \in (1, \ldots, \mathcal{J}_3), \quad candidate_{(i)} \in (1, \ldots, \mathcal{J}_2),$
   $application_{(t)} \in (1, \ldots, N)$
   $u^{(3)}_{course\,(i)} \sim N(0, \sigma^2_{u(3)}), \quad u^{(2)}_{candidate\,(i)} \sim N(0, \sigma^2_{u(2)})$
   $u^{(1)}_{application(i)} \sim N(0, \sigma^2_{u(1)}) \quad i = 1, \ldots, N$
6. Subject dummy variables were particularly valuable in producing more normally distributed course level residuals. One of the model assumptions is that higher level residuals are normally distributed.
7. This interpretation is of course somewhat speculative and could not be tested using the data available.
8. In order to check the robustness of the findings compared with the approach of Gittoes and Thompson (2005), measures of course popularity were added to the model as course level predictor variables. In each case the model fit and the substantive results relating to differences between ethnic groups remained the same. In addition, the model was run on a dataset excluding applications to medicine and dentistry but once again the conclusions remained substantively the same.
9. For each ethnic group a substantial portion of candidates' social class was recorded as 'not known'.
10. The process of converting estimates of log odds into probabilities is more complex in multi-level logistic regression than in single level models. In a single level logistic regression, predicted probabilities are often computed for exemplar individuals, illustrating the fact that a fixed effect implies a non-linear effect on a probability scale and that different combinations of fixed effects imply different non-linear functions. In a multi-level model higher level resid-

uals have a similar non-linear effect on a probability scale. The effect of a predictor variable on the predicted probability of receiving an offer is unique to each higher level cluster and the effects for predictor variables are estimated taking into account the clustering of that residual variation. Effects for predictor variables are consequently said to have a 'cluster-specific' interpretation. However, a 'population averaged' effect may be obtained by taking the mean probability over a simulated set of higher level residual values (see Steele, 2008).

Notes on contributors

Philip Noden is a Research Fellow in the Education Research Group at the London School of Economics and Political Science.

Mike Shiner is Associate Professor in the Social Policy Department at the London School of Economics and Political Science.

Tariq Modood is Professor of Sociology, Politics and Public Policy and Director, University of Bristol Research Centre for the Study of Ethnicity and Citizenship and his website is tariqmodood.com.

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