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Issues paper

This report is for information

This study re-examines previous research carried out by Shiner and Modood that suggested particular biases in higher education admissions.

Higher education admissions: assessment of bias

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Acknowledgements

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To	Heads of HEFCE-funded higher education institutions
	Heads of universities in Northern Ireland
Of interest to those responsible for	Admissions, Widening participation, Equal opportunities
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Summary

Purpose

1.   This study re-examines previous research carried out by Shiner and Modood that suggested particular biases in higher education admissions.

Key points

2.   Previous research found evidence that, when applying to 'old universities', applicants from ethnic minorities had been penalised. In our investigation the data underpinning that research has been reanalysed, and it is concluded that the apparent general bias against ethnic minorities at 'old universities' was, in fact, the result of an inadequate specification of the original statistical model.

3.   Although our further analysis shows that a general 'ethnic penalty' specific to 'old universities' does not exist, it has found that Pakistani applicants have a slightly lower than expected offer rate across the whole higher education sector. It should be noted that this assessed disadvantage for Pakistani applicants is much smaller than that estimated by Shiner and Modood.

4.   In a limited investigation of particular subjects we showed that applicants from all ethnic minorities, apart from Chinese applicants, have lower than expected offer rates when applying to study law. Previous work by McManus showed that applicants from ethnic minorities are disadvantaged when applying to certain medical schools. The data used in this analysis is insufficient to confirm these findings, though we do show that the statistical model we developed is consistent with these results.

5.   It is possible that our results are also due to limitations in the data, or weakness in the specification of the model. Even so, we make the following recommendations because we have shown that some biases in the admission process may exist. We recommend that:

- further analysis be undertaken with larger, more recent, datasets, to see if the results we found are confirmed

- the University and Colleges Admissions Agency (UCAS) take steps to ensure that more information can be efficiently extracted from the application process to enable fuller analysis and monitoring to be carried out in future

- the Committee of Heads of Law Schools (CHULS) should commission, or provide input to, an investigation into applications to study law.

6.   Ethnicity may be identified through the applicant's name and so we recommend that UCAS gives urgent consideration to a long standing proposal to withhold applicants' names for the first stages of the application process. This would reduce the possibility of discrimination being exercised and would build confidence in the application process.

Action required

7.   No action is required in response to this document.

Introduction

Background

8.   In June 2002 Shiner and Modood reported the results of their assessment of racial bias in the admissions process to higher education in the UK (Shiner and Modood, 2002). This analysis was the first to look at a wide range of courses in a way that isolated the decisions of institutions rather than applicants, and that took account of a range of factors, including predicted A-level grades. Their findings distinguished between 'old' and 'new' universities: those higher education institutions (HEIs) that had status as HEIs prior to 1992 are referred to as 'old', while post-1992 HEIs are 'new'. They concluded that:-

> 'New universities respond more positively than old universities to (non-white) ethnic minority applicants and, within this sector, Chinese, Bangladeshi and Indian applicants appear to be favoured over whites. When applying to old universities, however, there is strong evidence that minority applicants face an ethnic penalty. Institutions within this sector are most likely to select white and, to a lesser extent, Chinese applicants from among a group of similarly qualified applicants. Although ethnic minority applicants may be admitted to old universities in reasonable numbers, they generally have to perform better than do their white peers in order to secure a place.'

They went on to argue that:

> 'any suggestion of ethnic disadvantage in the allocation of higher education places should be a considerable cause of concern. The biases that are evident within the old university sector contradict its self-image of excellence, the principle of selection on merit, and the causes of access and inclusivity that are being urged by the government.'

Though the study was focused on ethnicity, they also reported that,

> 'there was evidence of a slight bias against women'

9.   Given that discrimination on the grounds of race or sex is illegal, these results gave cause for concern. The then Minister of State for Lifelong Learning and Higher Education subsequently wrote to us, drawing our attention to that study. In our response we set out what we intended to do. Among other measures, we proposed to look at the dataset on which this analysis had been based and to explore some alternative hypothesis. These plans were made public with the publication of our widening participation and fair access research strategy (HEFCE 2004). Here we report the findings from our further analysis.

The application process

10.	The application process involves a number of decisions by both applicants and institutions. For applicants to full-time undergraduate programmes made through the Universities and Colleges Admissions Service (UCAS) we can identify the following steps:

  a.	An applicant makes up to six applications.

  b.	Institutions decide whether to make an offer. Usually the applicant does not have their examination results at the time of the application and the offer will be conditional on the applicant achieving certain grades in these examinations. This decision may, or may not, follow an interview.

  c.	Applicants may select one offer as a 'firm offer' and one as an 'insurance offer'.

  d.	The firm and insurance offers will be automatically confirmed if the applicant meets the conditions of the offers.

  e.	Institutions may exercise discretion and confirm an offer even if the applicant does not fulfil the conditions.

  f.	The applicant is committed to accepting the firm offer if confirmed, or to accepting the insurance offer if that is confirmed and the firm offer is not.

  g.	Applicants without a confirmed offer may then apply through a 'clearing' process which matches these applicants with unfilled places.

  h.	The applicant may or may not actually enrol at the institution making the confirmed offer.

Through this process we can identify key decisions for institutions at steps 'b', 'e' and 'g'.

Focus on the decision to make an offer

11.	At each institutional decision point there is potential for bias. The study by Shiner and Modood concentrated on the initial decision to make an offer or not. They also looked at whether firm offers, that is offers selected by applicants as their first choice, were confirmed. They found that applicants to old HEIs from ethnic minorities were less likely to have their offer confirmed than White applicants. However, this result is hard to interpret. The 'confirmation rate' will depend on the nature of the offer, the applicant's A-level results, along with any discretion exercised by the institution when the applicant fails to get the grades specified in the offer.

12.	In this study we have only re-analysed initial offers. We have not looked at the confirmation of firm offers. We agree that there is the potential for bias both in setting the grades required in a conditional offer, and in exercising discretion when an applicant fails to get these grades; however, the data available did not enable us to isolate these decisions. We propose that this part of the application process be explored in future work.

Outline of discussion

13.　For brevity throughout the discussion we refer to 'Shiner and Modood' or to the '2002 study', '2002 results', and so on, when referring to the paper published by Shiner and Modood in 2002. The analysis reported here is referred to simply as 'this study', 'our analysis' and so on.

14.　The discussion is set out as follows:

    a.　Comparison with 2002 analysis

    b.　Offers and rejections – an overview

    c.　Offers to male and female applicants

    d.　Offers to applicants from different ethnic groups

    e.　Offers to applicants in specific subject areas

    f.　Subject areas selected for separate analysis

    g.　Comparisons with other investigations

    h.　Discussion and conclusions

    i.　Recommendations

15.　Details of the analysis and references are set out in a series of annexes:

    a.　Annex A: Factors taken into account by Shiner and Modood

    b.　Annex B: Our model

    c.　Annex C: Stages in development of our model

    d.　Annex D: Subject-specific sex and ethnicity results

    e.　Annex E: Comparison with studies of applications to medical schools

    f.　Annex F: References

Comparison with 2002 analysis

Scope of analysis

16.   The 2002 study investigated an applicant's chances of getting an initial offer, and also a confirmed offer from an institution. In this report we only examine initial offers.

Data sources

17.   The data used in this analysis are the same as collected and analysed in the 2002 study. These data were a sample of applicants who made applications to university in 1996-97, were 20 years old or younger, resident in the UK, and for whom A-levels constituted their main qualification. The sample was randomly selected, but constructed in such a way that approximately equal numbers of White, Black Caribbean, Black African, Indian, Pakistani and Chinese applicants were included, and also that sufficient numbers of White students with poor A-level results to make meaningful comparisons were included.

Records included

18.   Applicants who had no predicted A-levels and no previous A-level results were included in the 2002 study, but have been excluded from both the descriptive statistics and the modelling analysis in this study.

Presentation of univariate 'descriptive' statistics

19.   The 2002 study reported cross-tabulations with weighted data; this was to allow for the different sampling fractions when reporting percentages and averages. In this report, all percentage and averages reported are based on unweighted data. They should not, therefore, be taken as estimates of the percentages in the population. They are provided as background to the results from the modelling.

Multivariate analysis

20.   The 2002 study involved logistic and probit regressions to create 'models' of the propensity for an applicant to get an offer so that other factors could be taken into account when considering the effect of ethnicity. In this work we followed the same approach, with differences as outlined below. Annex B provides a detailed specification of the model used in this analysis.

Selection of records for analysis

21.   In the 2002 study, a single application was selected at random for each applicant so as to avoid problems with a lack of independence of applications within applicants. For our analysis we do not reduce the data in this way and make use of models that take such clustering into account.

22.   In the general multi-subject model reported here, students applying to medicine and dentistry programmes were excluded. This is because interpreting the results of analysing admissions for this group of students is particularly difficult. Firstly, many applicants are expected to get high A-level grades. Secondly 'soft' information, not available for this analysis, tends to be more important than for other subjects. Applications to medicine were modelled separately to see if the results were consistent with studies specifically concerned with applications to medicine.

Model structure

23.   The hierarchical structure of the data has been taken into account using multi-level modelling (Goldstein, 2003). This enables the applications for each applicant rather than a single randomly selected one to be used. It provides better estimates of the variable coefficients than in the 2002 study.

Additional variables

24.   The 2002 study considered a number of factors that could affect an applicant's chances of receiving an initial offer from an institution. These are given in Annex A. In addition to these factors, we look at the effect of four other factors that could affect an applicant's chances of getting an initial offer from a university. They are:

Applicant level

a.   Whether the applicant was predicted to be awarded an A or B grade in particular A-level subjects.

b.   Whether the applicant was retaking examinations (considered in the 2002 paper but not found to be significant in its modelling).

Programme level

c.   Mean A-level score of applicants to the programme of study.

d.   Subject area of the programme being applied for.

Additional interactions between variables

25.   The 2002 analysis only included interactions between 'institution type' and 'ethnicity' and between 'institution type' and 'relative predicted A-level score'. The model reported here includes interaction variables between 'institution type' with the two included in the 2002 study, and with a further 10 variables. (See Annex B for details.)

Offers and rejections – an overview

Offers and rejections for individual applicants

26.   The data are made up of 6,433 applicants who made a total of 36,102 applications to HEIs in 1996-97. Table 1 shows that the majority of applicants in the sample (70 per cent) got a mixture of both offers and rejections when making their applications to HEIs. Only a small minority (3 per cent) received rejections from all of the HEIs they applied to.

Table 1 Offers and rejections for applicants

State	No.	%
Offers from all applied to	1,706	27%
Rejections from all applied to	215	3%
Offers and rejections	4,512	70%
Total	**6,433**	**100%**

Offers by institution type

27.   As previously noted, Shiner and Modood reported quite different results for 'old' and 'new' HEIs. Table 2 shows that the sample data contains 184 institutions, of which 67 were old HEIs. Although there are fewer old HEIs in the data than new, the number of applications made to old HEIs was approximately the same as the number made to new HEIs (around 18,000). The new HEIs gave more offers than old HEIs, giving 75 per cent of applicants an initial offer compared to 64 per cent in old HEIs.

Table 2 % offers by institution type

Institution type	No. institutions	No. applications	% offers
Old	67	18,126	64%
New	117	17,976	75%
Total	**184**	**36,102**	**69%**

Offers to male and female applicants

28.   Table 3 shows the simple unadjusted rates of gaining an initial offer for female and male applicants at old and new HEIs.

Table 3 Offers to male and female applicants by university type

Sex	Old HEIs		New HEIs		All HEIs	
	No.	% Offers	No.	% Offers	No.	% Offers
Female	8,737	61%	10,023	72%	18,760	67%
Male	9,389	66%	7,953	78%	17,342	71%
Total	**18,126**	**64%**	**17,976**	**75%**	**36,102**	69%

29.   Table 3 shows that at both old and new HEIs female applicants have a lower proportion of offers than male, 5 per cent lower for old HEIs and 6 per cent for new. The difficulty in

interpreting the results in Table 3 is that men and women differ in a number of respects. For example, 37 per cent of applications from men were in science and engineering, whereas 18 per cent of applications from women were in these subjects.

30.   To make a 'like for like' comparison taking account of the other factors we can use the output of the model to show what the percentage of applications from male applicants would be if they had the characteristics of female applicants – or, to put it another way, how we would expect female applicants to fare if they were male. This approach can involve combinations of personal characteristics that rarely or never appear in the original data. In this case, and for the comparisons between different ethnic groups below, there is enough commonality in the characteristics of the applicants to be able to use this approach. Table 4 below shows these comparisons for old and new HEIs.

Table 4 Actual and model offer rates for male and female applicants

	Old HEIs			New HEIs		
		Model (sex = male)	Model less actual		Model (sex = male)	Model less actual
Sex	**Actual**	**male)**	**actual**	**Actual**	**male)**	**actual**
Female	61%	60%	-1%	72%	74%	1%
Male	66%	ref.	ref.	78%	ref.	ref.

Table 4 notes: Based on Model 6, Annex C.

31.   The differences between the actual and model results, while statistically significant, are small, indicating that almost all the difference between offer rates for male and female observed at both old and new HEIs is due to factors other than sex. Further, the differences between actual and model results are not consistent, which suggests that on a 'like for like' basis females are slightly favoured at old universities and males at new. Given this inconsistency, and the size of the difference due to sex, the result could be due to some slight weakness in the specification of the other variables. We conclude that there is no general and material bias against men or women in the initial stage of the application process on the whole. However, there do appear to be some subject-specific effects which are discussed at paragraphs 44 to 50 below.

32.   The differences between male and female applicants were not discussed in detail in the 2002 study, and it is unclear why their results differed slightly from those reported here. Given the differences in the model formations, differences of this order are to be expected.

Offers to applicants from different ethnic groups

33.   Table 5 shows the simple unadjusted rates of gaining an initial offer for each ethnic group at old and new HEIs. It shows that those from White and Chinese ethnic groups have rates of over 72 per cent at all institutions.

Table 5 Offers to applicants from different ethnic groups by university type

	Old HEIs		New HEIs		All HEIs	
		%		%		%
Ethnicity	No.	Offers	No.	Offers	No.	Offers
Bangladeshi	2,706	59%	2,727	78%	5,433	69%
Black African	2,278	57%	2,167	72%	4,445	65%
Black Caribbean	1,470	55%	2,249	70%	3,719	64%
Black other	794	58%	1,100	71%	1,894	66%
Chinese	3,687	74%	2,231	80%	5,918	76%
Indian	2,153	63%	2,491	77%	4,644	70%
Pakistani	2,139	55%	2,444	75%	4,583	65%
White	2,899	72%	2,567	74%	5,466	73%
Total	**18,126**	**64%**	**17,976**	**75%**	**36,102**	**69%**

34.   As with the difference between male and female applicants, the comparison is complicated by differences between the applicants from different ethnic groups. For example, the median A-level points for Black Caribbean applicants was 18, while for Chinese applicants it was 22.

35.   Table 6 shows the results of our modelling of initial offers with regard to the effect of ethnicity. The result of the model is illustrated by showing the effect of modifying the ethnic group of students in the data to White, or equivalently, the rate a group of White applicants would have with the same characteristics as a group of students from a given ethnic minority.

Table 6 Actual and model offer rates for applicants from different ethnic groups

	Old HEIs			New HEIs		
		Model (ethnicity	Model less	Actual	Model (ethnicity	Model less
Ethnicity	Actual	= White)	actual		= White)	actual
Bangladeshi	59%	59%	0%	78%	78%	0%
Black African	57%	58%	0%	72%	75%	3%
Black Caribbean	55%	55%	0%	70%	70%	0%
Black other	58%	58%	0%	71%	71%	0%
Chinese	74%	71%	-3%	80%	80%	0%
Indian	63%	63%	0%	77%	77%	0%
Pakistani	55%	57%	2%	75%	76%	2%
White	72%	72%	ref.	74%	74%	ref.

Table 6 notes: Based on Model 6, Annex C. Non-significant ethnicity terms have been excluded. This gives the 0% estimates for these ethnicities.

36.   All the non-zero model less actual values, or relative offer rates, in Table 6 are statistically significantly different from zero[1]. We see that Pakistani applicants have an offer rate 2 per cent lower than expected at both old and new HEIs. Chinese students have a higher offer rate than

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[1] 5% significance level. All significances are based on unweighted data for this report (Shiner and Modood used a similar approach).

expected at old HEIs but not new, and Black African applicants have a lower offer rate than expected at new HEIs but not at old.

37.   Paragraphs 44 to 50 look at selected subject areas separately and the analysis shows some specific subject effects. This seems to confirm that the offer rate for Pakistani applicants is lower than expected.

Comparisons with 2002 results

38.   The 2002 paper presented the results by reference to an 'average' applicant which we are unable to re-create. To facilitate a comparison we reproduced the 2002 model and presented the results in the same way as in Table 6 above. (See Table 10 in Annex C). We find that the 2002 model results in ethnic minorities applying to old HEIs with offer rates between 3 per cent and 16 per cent lower than expected, and that all these differences were significantly different from zero apart from the 3 per cent figure for the Chinese applicants. In contrast the applicants to new HEIs from all ethnic minorities had higher than expected offer rates. We can sum up the differences between the 2002 and the model developed here as:

   a.   For old HEIs the 2002 study found statistically significant[2] disadvantages for all non-White ethnic backgrounds apart from the Chinese ethnic group, for whom the disadvantage was not significant. In our analysis, only the Pakistani ethnic group showed any statistical disadvantage compared to those from a White background and to a much lesser significance than was found in the 2002 study.

   b.   For new HEIs the 2002 study found advantages for all applicants from non-White ethnic backgrounds, whereas we concluded that there was no advantage for any non-White group and disadvantages for Black Africans and Pakistanis.

   c.   In comparing old to new HEIs, the 2002 model shows opposite effects for all ethnic minority groups when applying to old and new HEIs. Our model shows broadly similar results for both old and new HEIs: no ethnic minorities were found with opposite effects between old and new HEIs, and the only differences were found for Black African and Chinese.

Why do the new models give different results to those found from the 2002 study?

39.   We conclude that the ethnicity effects found previously are a consequence of the model specification used. The most important aspect is the limitation of interactions with institution type to 'institution type and ethnicity' and 'institution type and academic performance'. The characteristics of the two groups of institutions cannot be sufficiently captured with these two interactions, and the interaction with ethnicity is probably acting as a proxy for some other differences, leading to marked ethnicity effects and differences in the direction of these effects between old and new HEIs.

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[2] 1% significance level and below.

40.   It could be argued that that the ethnicity effects found previously were real, and that they have been lost in the new models through 'over fitting'. This could happen through the introduction of a large number of variables that cannot be distinguished from ethnicity with the data available. In our formulation, a number of extra interaction variables are introduced, but it should be remembered that 'HEI types' divides the data into two large groups. The 'old HEI' and 'new HEI' data are sufficient to support the construction of separate models. These are equivalent to a single model with interaction terms between HEI type and all other variables, so that the combined model presented here is relatively parsimonious, further reducing the risk of over-fitting.

41.   At Annex C we provide details of a range of models starting with the 2002 model, and then cumulatively introducing the various modifications. This shows in more detail how the estimated ethnicity effects can change.

Using actual rather than predicted grades

42.   The final section of Annex C shows what ethnicity effects are found when using actual A-level grades rather than predicted. It shows that there is little change when actual A-levels are used rather than predicted grades. This indicates that a variation in the relationship between predicted and actual grades for different ethnic groups (that is, over- or under- estimation of actual grades) does not explain the ethnicity effects seen.

Offers to applicants in specific subject areas

43.   In the analysis described above, subject of study was included as an explanatory variable, but this may not sufficiently capture differences between different subjects. Because applicants tend to make all their applications to one subject area it is possible to partition the applicants into different subject area and model each subject separately. This approach can enable effects specific to a particular subject area to be identified which can be lost in a general analysis of applicants to all subjects.

Subject areas selected for separate analysis

44.   Partitioning applicants into different subject area and modelling each subject separately makes greater demands on the data. For this reason we have limited this approach to the four largest subject areas from the general analysis. These are shown in Table 7.

Table 7 Number of applications by HE subject area

HE subject area	No.	Selected?
Business and administrative studies	5,364	
Law	4,207	Selected
Social studies	3,816	
Mathematical sciences and informatics	3,284	
Biological sciences	2,682	
Allied to medicine	2,635	
Engineering and technology	2,508	
No preferred subject group	1,784	
Languages and related	1,658	
Education	1,417	
Physical sciences	1,126	
Mass communications and documentation	970	
Creative arts	787	Not selected
Humanities	712	
Social studies combined with arts	698	
Architecture, building and planning	592	
Combined arts	517	
Other general and combined studies	402	
Science combined with social studies	367	
Combined social studies	305	
Combined sciences	177	
Agriculture and related	94	

45.   The same model structure is applied to each subject (as given in Annex B), but now only for data relating to each subject area studied in turn. Variables relating to the programme level have been removed. Annex D provides the sex and ethnicity effects derived from these subject-specific models.

Results of specific subject analysis

Sex

46.   When looking at the sector as a whole, males experience a lower than expected offer rate at old HEIs and a higher than expected offer rate at new HEIs. This pattern is reproduced in the analysis of specific subjects, for all subjects apart from law, where no differences are found. For subjects other than law the direction of advantage and disadvantage follows that found in the general analysis. However, these effects are only significant for social studies at new HEIs and mathematics at old and new HEIs, where the size of the effects are much larger, between four to six percentage points. This apparent variation in the magnitude of the effect by subject may be the result of the random variation resulting from smaller sample sizes. Further work will be needed to establish whether this variation is real.

Ethnicity

47.   The lower than expected offer rate for those from a Pakistani ethnic group that is found when subjects are analysed together, is also seen for: business and administrative studies; law;

social studies; and mathematical sciences and informatics. The only exception is for applications to Social Studies at new HEIs where the offer rate for Pakistani applicants is as expected.

48.   The higher than expected offer rate for Chinese students that is found using the whole data is not detected in the separate analysis of any of the four subject areas.

Law and ethnicity

49.   The largest variation from the ethnicity effects discovered using the whole data is found when considering applications made to law courses. At old HEIs, those from Bangladeshi, Black African, Black other, Indian and Pakistani ethnic groups all have lower than expected offer rates in comparison to those from a White background. Similar results are found for applicants to new HEIs, with lower than expected offer rates also found for those from a Black Caribbean group. Table 8 is equivalent to Table 6 but only refers to applications to higher education courses in law.

Table 8 Actual and model offer rates for law applicants from different ethnic groups

Ethnicity	Old HEIs			New HEIs		
	Actual	Model (ethnicity = White)	Model less actual	Actual	Model (ethnicity = White)	Model less actual
Bangladeshi	31%	38%	7%	74%	81%	7%
Black African	38%	44%	6%	70%	83%	13%
Black Caribbean	48%	51%	3%	73%	82%	9%
Black other	41%	50%	9%	66%	75%	9%
Chinese	52%	52%	0%	89%	89%	0%
Indian	47%	53%	6%	74%	79%	5%
Pakistani	40%	47%	7%	75%	82%	7%
White	59%	ref.	ref.	85%	ref.	ref.

50.   Despite these low absolute and relative offer rates, an analysis of the data collected by the Higher Education Statistics Agency (HESA) shows that the proportion of students studying law from ethnic minorities was 19 per cent, higher than for any other single subject area except medicine (28 per cent).

Comparisons with other investigations

51.   There have been numerous studies which purport to examine this issue of bias with respect to admissions. However, all are based on the ratio of the number of 'accepted applications' to the numbers of applicants or applications, and so they do not distinguish between decisions made by the institution and those made by the applicant. Such studies are not considered here. The study by Shiner and Modood is the only investigation to isolate decisions by institutions for applicants across the full range of subjects. However, the application process for medicine has been analysed in considerable detail by McManus (McManus et al., 1995 and McManus, 1998a&b), with further analysis recently reported by Arulampalam, Naylor and Smith (Arulampalam et al., 2005).

52.   In the main analysis reported here we exclude applicants to medicine and dentistry, because of the greater difficulty in interpreting results for these subjects. However, the existence of datasets and analysis for applicants to medicine, gives us the opportunity to compare the model developed here with alternatives. Details of this comparison are at Annex E.

53.   The analyses of applications to medicine (McManus, 1998a&b, Arulampalam et al., 2005) were based on whole cohorts of applicants in 1996-97 and 1997-98 and the data on which it is based has a wider range of variables than the data used by Shiner and Modood and for this study. The principal deficiencies in these data, compared to the data extracted by Shiner and Modood, is the lack of predicted grades, and a less detailed description of A-level subjects grades. Note that an earlier study (McManus et al, 1995) used data that not only had predicted A-level grades, but also GCSE/O-level grades.

54.   McManus found that, in comparison with White applicants, those from each of the ethnic minorities (using the same seven ethnic minority categories as in this study) all received fewer offers than would be expected (McManus, 1998b). Using the same data, but with a different model specification, Arulampalam got similar results using four broader groupings of ethnic minorities: Black, Indian, Pakistani, and Other Asian.

55.   Using the Shiner and Modood data and the model structure reported here for applicants to medicine, we find no significant differences between offers for ethnic groups. However, given the size of the effects reported first by McManus and then by Arulampalam, this is to be expected with the sample data used in this study.

56.   McManus and Arulampalam found a significantly higher offer rate for female applicants. Our own analysis finds a similar effect which is also significant, though smaller in magnitude. However, again taking into account the difference in sample sizes, our results are consistent with theirs.

57.   These comparisons are in part reassuring. The results from independently assembled and analysed datasets are consistent. However, the results also remind us that an analysis based on a sample may not be able to detect biases for sub-groups of applicants, like those applying to a particular subject.

Discussion and conclusions

Offer rates for male and female applicants

58.   We find that most of the observed higher rates for male compared to female applicants can be explained by other factors. The remaining overall differences, with females appearing to be advantaged at old HEIs and disadvantaged at new HEIs, though formally significant, may simply reflect inadequacies of the data and should not be a cause for concern. There is some evidence that these differences between male and female applicants may be larger for some subjects, in particular for mathematics, but more work with larger datasets is needed to confirm this.

Offer rates for applicants from different ethnic groups

59.   The 2002 results, which imply that there is a bias against applicants from ethnic minorities applying to old HEIs, are not reproduced with different model formulations. We find that models allowing for the specific effects of institution type on the impact of ethnicity (the institution type by ethnicity 'interaction'), that do not also allow for other institution type interactions, tend to show an apparent ethnicity bias. We think that it is this feature of the 2002 modelling that is mainly responsible for the results which led them to conclude that there was an 'ethnic penalty' at old universities.

60.   The analysis reported here – in which, crucially, the effects of institution type are more fully specified – does not imply a general bias against non-White ethnic groups at old HEIs, nor do non-White ethnic minorities now appear to be generally favoured at new HEIs. It does appear, however, that Pakistanis are slightly disadvantaged at old and new HEIs, as are Black Africans at new HEIs, while Chinese students appear to be favoured over White applicants at old HEIs. We need to be cautious, however, since these effects seem to be sensitive to the precise model formulation. Further, though these differences between what offer rates were found and what were expected from the modelling are significant, they are not large. We therefore cannot be sure that these results are due to weaknesses in the available data and/or in the model specification.

61.   Of particular concern is the fact that all non-White ethnic minority applicants, apart from Chinese, do have lower than expected offer rates when applying to study law. Again, it is possible that this result could be an artefact of the modelling, but we certainly should not assume that this is the case.

Need for further analysis

62.   Given these concerns and uncertainties, a fuller analysis is called for. It would also be helpful to obtain a more up-to-date picture. The main difficulty would be in obtaining predicted grades. These cannot be obtained automatically, but involve reading through the application to find the information. Given the costs involved, it would only be possible to obtain a sample. If we are to sample, we should be sampling programmes, but that would prevent us from over-sampling ethnic minorities. It was for this reason that in characterising the relative competitiveness of different programmes, Shiner and Modood were forced to use actual rather than predicted grades. In a recent exercise by UCAS it was found that in many cases, the predicted grades could not be extracted at all, or if they were found a range of values were given. For these reasons, we propose to carry out an analysis using actual grades. Clearly, this does not re-create the information that was available to those making the decision whether to make an offer, but we have found, as Shiner and Modood did earlier, that analysis using actual grades of the data produces similar results to the analysis using predicted grades. If we are also able to obtain actual GCSE or other level two results, which, in general, are known to the admissions tutors, the analysis would be more realistic. Using this approach we should be able to analyse the whole cohort from any particular application cycle, enabling us to carry out a far more rigorous analysis.

63. The ethnicity returned on the UCAS application form of applicants is not made known to the institutions until after the application process is complete. This means that, for direct discrimination to operate, the ethnicity of the applicant would have to be deduced by other means. For applicants given, or refused, an offer without an interview, the most likely identification would be through the name. Indeed, the notorious case of direct discrimination that was identified at St George's Hospital Medical School in 1986 was based on classifying names (CRE, 1988). Further, analysis by McManus showed particular low rates of success for applicants to study medicine with non-European surnames (McManus et al, 1995). For these reasons we think it important to analyse the propensity to be given an offer by name type as well as reported ethnicity.

64. Making an offer, or not, is the main, but not the only decision made by institutions. In particular, if the applicant fails to get the grades required by the offer, the institution may still exercise discretion and accept the applicant. It has been suggested that the final decision in accepting applicants who do not meet the conditions could be a source of bias to disadvantaged applicants (McCrum, 2001). It is at least possible that it could be a source of bias against disadvantaged applicants of any ethnic background, because well connected parents and schools will be better able to make the case for admission. To investigate this, it would be necessary to extract whether or not an offer was confirmed automatically and what grades were required, as well as the grades obtained.

Recommendations

65. We have found that Pakistani applicants to all subject areas, and applicants to law courses from all non-White ethnic minorities, have offer rates significantly lower than we might expect given their predicted grades and other characteristics. While these lower rates may not be the result of discrimination or other unjustifiable bias, it would be better to adopt the precautionary principle, and assume that they are, and see what practical steps can be taken to reduce the possibility of bias. This is the stance that forms the basis of these recommendations.

66. The recommendations below are mostly directed to HEFCE and UCAS in the first instance. The particular issue of law will also need an input from those with detailed knowledge of the subject. There is likely to be a need for further actions involving institutions, in dissemination, informing the development of best practice, and in monitoring the admissions process. It is likely that this further work will be undertaken through the 'Supporting Professionalism in Admissions' (SPA) programme[3].

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[3] The formation of the SPA follows a recommendation from 'The Admissions to Higher Education Steering Group', chaired by Professor Stephen Schwartz. One of the recommendations in its report 'Fair Admissions to Higher Education: Recommendations for Good Practice' was the creation of a central source of expertise and advice on admissions issues. The SPA will be located within the UCAS offices while working in partnership with the Higher Education Academy. It will provide resources for institutions which wish to maintain and enhance excellence in admissions practice and policy.

Further analysis – HEFCE and UCAS

67.   The sample dataset used in this analysis could only detect large or general biases in the offer decision. This was illustrated with the results for application to medicine (see paragraphs 51 to 57 above). While the sample dataset produced results that were consistent with earlier studies, the apparent biases found in those studies were not identified by us. In fact those biases could not be expected to be identified given the sample size we used. In the short term the only practical approach would be to carry out an analysis, similar to that conducted by McManus, across all subject areas, using actual A-level grades. An attempt should also be made to investigate the exercising of discretion when applicants fail to meet the conditions of the offer.

68.   We propose to commission this further research, which will need the help and cooperation of UCAS to make the data available. Such research should provide the basis for intelligent monitoring of admissions, which may help institutions efficiently and effectively meet their statutory responsibilities under the Race Relations (Amendment) Act 2000.

Information used to predict results of entry qualifications – UCAS

69.   Analysis of the application process is greatly impeded by the cost and difficulty of extracting predicted grades. This is because these grades are embedded in the text of the application. If this information was recorded in a structured way, it could be extracted at low cost, particularly as the proportion of applicants making electronic applications increases. This would not only make a more rigorous analysis possible, but it would also facilitate the monitoring of admissions.

70.   It has been suggested that providing predicted grades in a structured way could lead to more mechanical and less thoughtful consideration of the application. If this is the reason for the present arrangements, it would be possible to capture the information but not pass it on to institutions, as currently is the case with ethnicity.

71.   A project is under way to consider changes to the application process (Department for Education and Skills, 2005). One of the proposals is for schools and colleges not to supply students' predicted exam results. But under the scenarios being considered, institutions will still be making decisions prior to results being known: either, as now, on whether to make an offer, and what that offer should be, or in indicating to students what is the likelihood of their gaining a place once the results are known. Under these circumstances, if 'predicted grades', are not provided there will need to be other information to take their place. Proposals include unit information for A and AS-levels and extracts from applicants' 'Progress File' (the successor to the National Record of achievement). We recommend that predicted grades are still collected in a way that can be extracted until or if they are discontinued, and that full details of the proposed alternative information is also extracted. This would not only ensure that future investigations and monitoring could take place, but it would also provide a means to compare the accuracy of predicted grades with the alternatives.

Other information for analysing admissions – UCAS

72.   The development of electronic admissions gives the potential to extract much useful information at low marginal cost. Some particularly useful items are listed here.

  a. GCSE and other Level 2 qualifications of the applicant.

  b. What the offer is, and, consequently, whether the applicant meets the offer. (Note that an offer may be confirmed at the discretion of the institution even if the terms of the offer are not met.)

  c. Whether the applicant was invited to an interview.

Examination of the processing of applications to law schools – CHULS

73.   We have found that the offer rates for applicants to law are lower than expected for all ethnic minorities. There is therefore a particular need for a more extensive and detailed investigation into admissions for this subject. The Committee of Heads of University Law Schools (CHULS) may be best placed to commission of research, following the example of the Council of Heads of Medical Schools and Deans of UK Faculties of Medicine (CHMS), with respect to admissions to medicine. Alternatively, they may be able to provide expert input into an investigation organised and commissioned by HEFCE.

74.   Such an investigation would need to take account of the adoption by eight law schools of a common law admissions test. It has already been proposed that this process should be monitored to ensure fairness in admissions (Bibbings, 2004) and, in view of the findings reported here, such monitoring should include a consideration of the ethnicity of applicants.

Removing names from first stage of application process – UCAS

75.   McManus proposed ten years ago (McManus et al., 1995) that the application process should be made as anonymous as possible.

76.   UCAS already withholds the ethnicity of applications from institution until the end of the application process. While it would not be practical to withhold names for this long, it should be possible to withhold names until there is an invitation to an interview, or an offer is made, whichever is the earliest. Currently, referees frequently refer to the applicant by name, so to implement this policy it would be necessary to issue guidance to change this practice.

Annex A
Factors taken into account by Shiner and Modood

1.   In Shiner and Modood's 2002 report into racial bias the analysis looked at a wide range of courses, and took account of a range of factors. The factors taken into account are at three levels: applicant, programme and university level.

Applicant level

a.   Relative A-level score of the applicant to the mean A-level score of applicants to the programme of study.

b.   Whether the applicant's predicted grades included a range.

c.   Whether the applicant took any A-levels early.

d.   Number of A-levels taken.

e.   Ethnic group of the applicant.

f.   Sex of the applicant.

g.   Age of the applicant.

h.   Social background of the applicant.

i.   Type of school or college the applicant attended prior to university.

j.   Geographical region of residence of the applicant.

k.   Whether the applicant was a resident from the same region as the university being applied to.

Programme level

l.   Ratio of applicants to places on a particular programme of study.

m.   Whether the course applied for was a HND course.

University level

n.   Geographical region of the university.

o.   Whether the institution being applied to was an old or new university.

For further details on these variables, see Table V of Shiner and Modood's report.

Annex B
Our model

1.   The main statistical model used in this report is a cross-classified multi-level probit model using variance components. The structure of the model is given below along with the parameter estimates for each term. The hierarchical structure assumed for the data is applications nested within applicants, and applications nested within programmes of study nested within HEIs. Applicants are crossed with HEIs. The models are screen images taken from the MLwiN software package (Rasbash et al., 2004, http://mlwin.com).

2.   Table 9 provides the definitions of the variables included in the model.

$\text{GivenOffer}_{ijkl} \sim \text{Binomial}(\text{cons}_{ijkl}, \pi_{ijkl})$

$\text{probit}(\pi_{ijkl}) = \beta_{0jkl}\text{cons} + -0.019(0.057)\text{E\_BlackA}_l + -0.110(0.044)\text{E\_Pakistani}_l + 0.250(0.050)\text{E\_Chinese}_l + 0.087(0.038)\text{Female}_l +$

$-0.657(0.184)\text{Hnd}_{jkl} + -0.141(0.010)\text{Comp}_{jkl} + -0.645(0.169)\text{R\_NI}_l + -0.211(0.095)\text{R\_North}_l + -0.073(0.045)\text{R\_WestM}_l +$

$0.842(0.243)\text{I\_Scotland}_l + 0.090(0.028)\text{Within}_l + -0.017(0.087)\text{MeanA}_{jkl} + 0.135(0.049)\text{ST\_Ind}_l +$

$-0.160(0.032)\text{ST\_FEColl}_l + -0.234(0.065)\text{ST\_HEI}_l + -0.099(0.037)\text{SC\_SkillM}_l + -0.104(0.094)\text{SC\_Unskill}_l +$

$-0.182(0.047)\text{SC\_Unk}_l + -0.409(0.255)\text{Relative}_{jkl} + -0.331(0.092)\text{S\_AllM}_l + -0.350(0.239)\text{S\_Arch}_l + 0.213(0.092)\text{S\_Bio}_l +$

$-0.187(0.089)\text{S\_Bus}_l + -0.428(0.124)\text{S\_CombA}_l + -0.905(0.105)\text{S\_CrArt}_l + -0.822(0.096)\text{S\_Ed}_l + 0.691(0.102)\text{S\_Eng}_l +$

$-0.506(0.103)\text{S\_Law}_l + -1.123(0.207)\text{S\_Media}_l + 0.544(0.079)\text{S\_Maths}_l + -0.187(0.071)\text{S\_NoSub}_l + 1.149(0.116)\text{S\_Phy}_l +$

$0.151(0.057)\text{A\_Hist}_l + -0.384(0.084)\text{A\_Art}_l + -0.436(0.167)\text{A\_RelS}_l + 0.262(0.139)\text{A\_Class}_l + 0.305(0.071)\text{A\_ELang}_l +$

$0.200(0.078)\text{A\_Geog}_l + 0.305(0.072)\text{A\_Maths}_l + 0.232(0.062)\text{A\_Chem}_l + -0.359(0.159)\text{A\_PhysEd}_l +$

$0.026(0.134)\text{A\_Account}_l + -0.176(0.025)\text{Age}_l + 0.066(0.029)\text{Relative.Relative}_{jkl} + 0.001(0.000)\text{Comp.Comp}_{jkl} +$

$-0.005(0.002)\text{Meana.Meana}_{jkl} + 0.195(0.012)\text{Meana.Relative}_{jkl} + 0.136(0.141)\text{DidRetake}_l +$

$0.780(0.451)\text{A\_ALang.DidRetake}_l + -0.690(0.288)\text{A\_Account.DidRetake}_l + -0.059(0.014)\text{DidRetake.Comp}_{jkl} +$

$4.455(0.958)\text{Newhei}_l + -0.171(0.074)\text{Newhei.E\_BlackA}_l + -0.226(0.075)\text{Newhei.E\_Chinese}_l +$

$-0.163(0.052)\text{Newhei.Female}_l + 0.056(0.012)\text{Newhei.Comp}_{jkl} + -0.422(0.123)\text{Newhei.MeanA}_{jkl} +$

$0.272(0.114)\text{Newhei.SC\_Unskill}_l + -0.698(0.097)\text{Newhei.Relative}_{jkl} + 0.757(0.288)\text{Newhei.S\_Arch}_l +$

$-0.418(0.128)\text{Newhei.S\_Bio}_l + 0.192(0.104)\text{Newhei.S\_Bus}_l + 0.442(0.175)\text{Newhei.S\_Eng}_l + 0.470(0.133)\text{Newhei.S\_Law}_l +$

$0.592(0.222)\text{Newhei.S\_Media}_l + -0.001(0.000)\text{Newhei.Comp.Comp}_{jkl} + 0.012(0.004)\text{Newhei.MeanA.MeanA}_{jkl} +$

$-0.163(0.154)\text{Newhei.DidRetake}_l + -1.199(0.528)\text{Newhei.DidRetake.A\_ALang}_l + 0.049(0.016)\text{Newhei.DidRetake.Comp}_{jkl}$

$\beta_{0jkl} = 3.619(0.946) + f_{0l} + v_{0kl} + u_{0jkl}$

$\left[f_{0l} \right] \sim N(0, \ \Omega_f) : \ \Omega_f = \left[0.461(0.029) \right]$

$\left[v_{0kl} \right] \sim N(0, \ \Omega_v) : \ \Omega_v = \left[0.530(0.090) \right]$

$\left[u_{0jkl} \right] \sim N(0, \ \Omega_u) : \ \Omega_u = \left[0.664(0.045) \right]$

$\text{var}(\text{GivenOffer}_{ijkl} | \pi_{ijkl}) = \pi_{ijkl}(1 - \pi_{ijkl})/\text{cons}_{ijkl}$

$Deviance(MCMC) = 21134.130(36102 \text{ of } 36819 \text{ cases in use})$

Table 9 Variables in the multi-level model

Level	Type	Variable	Description
Application	Subscripts	i	Application level
	Subscript	l	Applicant level
	Hierarchical terms	f_{0l}	Random effect for applicant level
	Ethnicity	BASELINE	White, Black Caribbean/Other, Indian, or Bangladeshi background
		E_BlackA	From a Black African background
		E_Pakistani	From a Pakistani background
		E_Chinese	From a Chinese background
	Sex	BASELINE	Being male
		Female	Being female
	Age of applicant	Age	Whether the applicant was 18, 19 or 20
	Social class	BASELINE	Professional, Intermediate, Skilled non-manual social class
		SC_SkillM	Coming from a Skilled manual social class
		SC_Unskill	Coming from an Unskilled social class
		SC_Unk	Coming from an unknown social class
	A-level score	Relative	A-level score relative to mean points of applicant to programme
Applicant	Type of school or college attended	BASELINE	Maintained institution
		ST_Ind	Independent school
		ST_FEColl	Further education
		ST_HEI	HE institution, Other
	Applicant predicted A or B in A-level	A_Hist	History
		A_Art	Art
		A_RelS	Religious studies
		A_Class	Classics
		A_ELang	English languages
		A_Geog	Geography
		A_Maths	Mathematics
		A_Chem	Chemistry
		A_PhysEd	Physical education
		A_Account	Accounting
	Applicant is retaking at least one exam	BASELINE	Applicant is not retaking any exams
		Did_Retake	Applicant is retaking at least one exam
	From within the region?	BASELINE	Not from the same region as the university
		Within	From the same region as the university
Programme	Subscripts	j	Programme level
	Hierarchical terms	u_{0jkl}	Random effect for programme level
	Entry standards of programme	MeanA	Mean A-level points of applicants to that programme of study
	Programme type	BASELINE	Not a HND course
		Hnd	HND course
	Subject of HE programme applied for	BASELINE	Agriculture, Comb. sc., Humanities, Lang., Social st., Other
		S_AllM	Allied to medicine
		S_Arch	Architecture, building and planning
		S_Bio	Biological sciences
		S_Bus	Business and administrative studies
		S_CombA	Combined arts
		S_CrArt	Creative arts
		S_Ed	Education
		S_Eng	Engineering and technology
		S_Law	Law
		S_Media	Media
		S_Maths	Mathematical sciences and informatics

		S_NoSub	No preferred subject group
		S_Phy	Physical sciences
University	Subscripts	k	University level
	Hierarchical terms	v_{0kl}	Random effect for university level
	University type	BASELINE	Old university
		Newhei	New university
All	Outcome	BASELINE	Applicant was not given an initial offer
		GivenOffer	Applicant was given an initial offer

Annex C
Stages in development of our model

Explanation

1.	Our model has a substantially different form to the original 2002 approach and this annex shows the effect on the ethnicity results of each change we made to the original 2002 approach.

2.	The model differs from the original 2002 approach (Model 1 below) in the following ways:

   a.	Those applying for medical courses are excluded (Model 2).

   b.	Additional key factors have been included (Model 3).

   c.	Additional key interactions have been included; those related to old/new HEIs being particularly significant (Model 4).

   d.	A multi-level structure has been included: in particular, a cross-classification that allows for all the data to be incorporated (Model 5).

   e.	Non-significant and non-necessary terms have been excluded (Model 6).

3.	The final section of this annex shows the ethnicity effects that would be seen if actual rather than predicted A-level grades are used in the modelling.

4.	Significant effects reported in the tables are different for old and new HEIs. For old HEIs, significances show whether there is a difference relative to White applicants at old HEIs [labelled 'Sig. (from White)']. For new HEIs, the significances show if there is a difference to the ethnic effect at old HEIs [labelled 'Sig. (from old)'].

Model 1

5.	Table 10 shows what our ethnicity results would look like if the original Shiner and Modood approach[4] was used. The results show, at old HEIs, that there are strong significant advantages to being White compared to any ethnic minority apart from Chinese: Sig.(from White) <= 0.05 for all non-Chinese ethnic groups.

6.	Table 10 also shows that there is a significant change in these differences at new HEIs, with White applicants experiencing disadvantage compared to all ethnic groups in new HEIs. Only the ethnic effect of being from the Black other group is not statistically different between old and new HEIs: Sig.(from old HEIs) >= 0.05.

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[4] In Table 10 the same factors have been taken into account as in the Shiner and Modood report. The sample of the data that we used produces approximately the same parameter estimates as stated in Table V of Shiner and Modood.

Table 10 2002 model

Ethnic group	Old institutions		New institutions	
	Advantage to White	Sig. (from White)	Advantage to White	Sig. (from old)
Bangladeshi	13%	0.00	-8%	0.00
Black African	13%	0.00	-6%	0.00
Black Caribbean	9%	0.01	-5%	0.00
Black other	8%	0.04	-2%	0.05
Chinese	3%	0.22	-11%	0.00
Indian	11%	0.00	-10%	0.00
Pakistani	16%	0.00	-6%	0.00
White	ref.	n/a	ref.	n/a

Model 2

7.   Table 11 shows the effect on Model 1 of removing applications to medical courses from the sample data. The results for new HEIs are very similar to those in Model 1 because there were few applications to medical courses at new HEIs recorded in the data.

8.   For old HEIs, the pattern of disadvantage against non-White/Chinese ethnic groups remains the same but is diminished. However when considering those from a Chinese background, the model now indicates a non-significant advantage (-2 per cent) towards them rather than a non-significant disadvantage against them seen in Model 1 (+3 per cent).

Table 11 2002 model with applications to medical courses removed

Ethnic group	Old institutions		New institutions	
	Advantage to White	Sig. (from White)	Advantage to White	Sig. (from old)
Bangladeshi	8%	0.01	-8%	0.00
Black African	6%	0.00	-5%	0.00
Black Caribbean	8%	0.00	-5%	0.00
Black other	7%	0.10	-2%	0.10
Chinese	-2%	0.34	-11%	0.01
Indian	7%	0.02	-10%	0.00
Pakistani	8%	0.01	-6%	0.00
White	ref.	n/a	ref.	n/a

Model 3

9.   In Model 3, we extend Model 2 by adding new factors that potentially affect an applicant's chances of getting an initial offer. These are:

a.   Type of school or college the applicant attended prior to university.

b.   Social background of applicant.

c.   Age of applicant.

d.   Whether the applicant was predicted an A or B grade in particular A-level subjects.

e.   Whether the applicant was retaking any exams.

f.   Mean A-level score of applicants to the programme of study.

g.   Subject area of the programme being applied for.

Factors a-c were found to be non-significant by Shiner and Modood in their 2002 report.

10.   Model 3 also extends Model 2 by changing the factor relating to relative predicted A-level score to a continuous variable rather than the categorical one used in the Shiner and Modood approach.

11.   The effects of these changes on ethnicity are given in Table 12. For old HEIs it shows a diminished advantage for those from a White background compared to all ethnic minority groups. For example, in Model 2 the advantage for the White group over the Indian group was 7 per cent, which was statistically significant. In Model 3 that advantage is reduced to 5 per cent and is not statistically significant (p-value = 0.07).

12.   Model 3 still shows a significant difference in most ethnicity effects between old and new HEIs. However the model now indicates that the effect of being a Chinese applicant is similar at new and old HEIs (advantage towards those from a Chinese background, though not significant).

Table 12 2002 model (medics removed) with additional variables included

Ethnic group	Old institutions		New institutions	
	Advantage to White	Sig. (from White)	Advantage to White	Sig. (from old)
Bangladeshi	4%	0.13	-7%	0
Black African	5%	0.1	-4%	0.03
Black Caribbean	6%	0.05	-3%	0.02
Black other	4%	0.31	-3%	0.18
Chinese	-3%	0.18	-8%	0.12
Indian	5%	0.07	-6%	0
Pakistani	5%	0.08	-5%	0.01
White	ref.	n/a	ref.	n/a

Model 4

13.   Model 4 includes key interactions between variables. The most important of these relates to interactions between old/new HEIs and other non-ethnic factors. In their original approach, Shiner and Modood considered interactions between status of institution and relative predicted

A-level score, and also ethnicity. However a number of other status of institution interactions are important and should be included, such as the impact of the disparate levels of course competitiveness between old and new HEIs.

14.   The inclusion of these key interactions has a dramatic effect on the ethnicity effects. Table 13 shows that, for old HEIs, all ethnic effects are now statistically non-significant at the 5 per cent level. Table 13 also indicates that there are no statistically significant interactions between ethnic group and new institutions.

Table 13 2002 model (medics removed) with additional variables and interactions included

Ethnic group	Old institutions		New institutions	
	Advantage to White	Sig. (from White)	Advantage to White	Sig. (from old)
Bangladeshi	0%	0.96	-3%	0.40
Black African	0%	0.89	0%	0.99
Black Caribbean	4%	0.22	-1%	0.23
Black other	3%	0.47	-1%	0.43
Chinese	-4%	0.06	-5%	0.74
Indian	2%	0.50	-3%	0.17
Pakistani	3%	0.38	-3%	0.15
White	ref.	n/a	ref.	n/a

Model 5

15.   In Model 5 the whole dataset is used rather than a sample of it. This is an important step because Model 5 allows the hierarchical structure of the data to be taken into account. A cross-classified multi-level model is fitted at this stage rather than a single-level model. Applications are now assumed to be nested within applicant, and applications are nested within programmes within institutions, with applicants crossed with institutions – in other words any applicant will be associated with up to six institutions.

16.   For old HEIs, the introduction of the full-data and multi-level structures produces two statistically significant ethnic effects. The first indicates an unexplained advantage towards those from a Chinese background compared to white applicants (-4 per cent, p-value <= 0.005). An unexplained disadvantage against those from a Pakistani background is also found (+2 per cent, p-value <= 0.05).

17.   For new HEIs, the effect for Black Africans and Chinese is found to be different to those seen at old HEIs. The model indicates that there is a bigger disadvantage against Black Africans at new HEIs that there is at old HEIs (where no advantage or disadvantage is seen). For Chinese students, the unexplained advantage they have in admissions seen at old HEIs is not seen at the new HEIs.

Table 14 2002 model (medics removed) with additional variables, interactions and multi-level terms included

Ethnic group	Old institutions		New institutions	
	Advantage to White	Sig. (from White)	Advantage to White	Sig. (from old)
Bangladeshi	-1%	0.24	0%	0.32
Black African	0%	0.92	3%	0.04
Black Caribbean	0%	0.71	2%	0.20
Black other	0%	0.94	0%	0.94
Chinese	-4%	0.00	0%	0.01
Indian	0%	0.76	0%	0.92
Pakistani	2%	0.04	1%	0.52
White	ref.	n/a	ref.	n/a

Model 6

18.   Model 6 is Model 5 with non-necessary and non-significant terms removed. It provides a route for clear interpretation of the data as non-significant ethnicity effects are removed. Table 15 shows a very similar picture to Table 14, as expected, with higher significance levels for the significant ethnic terms. This is the model that the main results have been derived from in the report. It is given in more detail in Annex B.

Table 15 2002 model (medics removed) with additional variables, interactions and multi-level terms included, and non-significant terms excluded

Ethnic group	Old institutions		New institutions	
	Advantage to White	Sig. (from White)	Advantage to White	Sig. (from old)
Bangladeshi	0%	n/a	0%	n/a
Black African	0%	0.74	3%	0.02
Black Caribbean	0%	n/a	0%	n/a
Black other	0%	n/a	0%	n/a
Chinese	-3%	0.00	0%	0.00
Indian	0%	n/a	0%	n/a
Pakistani	2%	0.01	2%	n/a
White	ref.	n/a	ref.	n/a

Table 15 notes: n/a indicates that the term for the ethnic group by institution type previously found to be not significant has been excluded from the model.

19.   This model shows that there is statistically significant non-independence between observations with the same group at each of the three hierarchical levels. This means that in order to use all the applications, it was important to allow multi-level structures in the modelling framework. Listed below are the variations in the random effects at each of the three hierarchical levels and their associated significances (p-values):

  a. 0.461 (<0.0001)   Individual level
  b. 0.664 (<0.0001)   Programme level

c. 0.530 (<0.0001)   Institutional level

Using actual A-level grades

20.   Tables 16 and 17 show what ethnicity effects would have been found using the same modelling approach to Model 6 above, but by using actual rather than predicted A-level grades. In comparison to Model 6, the same ethnicity variables in the model are found to be significant with approximately the same level of effect. For example, at old HEIs Chinese students are found to be favoured by around 3 percentage points using predicted A-level grades and by around 4 percentage points using actual A-level grades.

Table 16 Advantage to White using actual rather than predicted grades (old HEIs)

Ethnic group	A-level used	
	Predicted	Actual
Bangladeshi	0%	0%
Black African	0%	-1%
Black Caribbean	0%	0%
Black other	0%	0%
Chinese	-3%	-4%
Indian	0%	0%
Pakistani	2%	3%
White	ref.	ref.

Table 17 Advantage to White using actual rather than predicted grades (new HEIs)

Ethnic group	A-levels used	
	Predicted	Actual
Bangladeshi	0%	0%
Black African	3%	2%
Black Caribbean	0%	0%
Black other	0%	0%
Chinese	0%	-1%
Indian	0%	0%
Pakistani	2%	2%
White	ref.	ref.

Annex D
Subject-specific sex and ethnicity results

Introduction

1.   In this annex, the equivalent to Tables 4, 5 and 6 from the main report are given for the four largest subject areas: business, law, social studies, and mathematics. They show the model results for ethnicity and sex effects for each of these subject areas along with the raw proportion of offers to each ethnic group. Significances are not given, but effects that are significant at the 5 per cent level are denoted by * in the tables relating to model results.

2.   Significant effects denoted by * are treated differently between old and new HEIs. For old HEIs, significances show whether there is a difference relative to White applicants at old HEIs. For new HEIs, the significances show if there is a difference to the ethnic effect at old HEIs. For example, in Table 20 (business) the * for Pakistani students at old HEIs show that there is a significant difference (of around 5 percentage points) between that group and those from a White background. There is no * on the value of the effect for Pakistani students at new HEIs showing that the same significant difference is noted at new HEIs as well.

Business

Table 18 Sex effects for applications to business programmes

Sex	Old institutions Advantage to male	New institutions Advantage to male
Female	-4%	*2%
Male	ref.	ref.

Table 19 Offers to applicants from different ethnic groups by university type to business programmes

Ethnicity	Old HEIs No.	Old HEIs % offers	New HEIs No.	New HEIs % offers	All HEIs No.	All HEIs % offers
Bangladeshi	199	56%	475	82%	674	74%
Black African	124	48%	487	78%	611	72%
Black Caribbean	88	53%	336	85%	424	79%
Black other	34	44%	207	84%	241	78%
Chinese	507	70%	724	82%	1,231	77%
Indian	240	63%	727	79%	967	75%
Pakistani	156	54%	520	73%	676	68%
White	135	71%	405	83%	540	80%
Total	**1,483**	**62%**	**3,881**	**80%**	**5,364**	**75%**

Table 20 Ethnicity effects for applications to business programmes

Ethnic group	Old institutions	New institutions
Bangladeshi	0%	0%
Black African	0%	0%
Black Caribbean	6%	*-3%
Black other	0%	0%
Chinese	0%	0%
Indian	0%	0%
Pakistani	*5%	5%
White	ref.	ref.

Law

Table 21 Sex effects for applications to law programmes

Sex	Old institutions Advantage to male	New institutions Advantage to male
Female	0%	0%
Male	ref.	ref.

Table 22 Offers to applicants from different ethnic groups by university type to law programmes

Ethnicity	Old HEIs		New HEIs		All HEIs	
	No.	% offers	No.	% offers	No.	% offers
Bangladeshi	366	31%	459	74%	825	55%
Black African	368	38%	303	70%	671	52%
Black Caribbean	209	48%	239	73%	448	62%
Black other	111	41%	92	66%	203	52%
Chinese	303	52%	118	89%	421	62%
Indian	225	47%	280	74%	505	62%
Pakistani	367	40%	499	75%	866	60%
White	180	59%	88	85%	268	68%
Total	**2,129**	**43%**	**2,078**	**74%**	**4,207**	**59%**

Table 23 Ethnicity effects for applications to law programmes

Ethnic group	Old institutions	New institutions
Bangladeshi	*7%	7%
Black African	*6%	*13%
Black Caribbean	3%	*9%
Black other	*9%	9%
Chinese	0%	0%
Indian	*6%	5%
Pakistani	*7%	7%
White	ref.	ref.

Social studies

Table 24 Sex effects for applications to social studies programmes

Sex	Old institutions Advantage to male	New institutions Advantage to male
Female	-1%	*6%
Male	ref.	ref.

Table 25 Offers to applicants from different ethnic groups by university type to social studies programmes

Ethnicity	Old HEIs		New HEIs		All HEIs	
	No.	% offers	No.	% offers	No.	% offers
Bangladeshi	429	62%	417	86%	846	74%
Black African	317	63%	255	82%	572	71%
Black Caribbean	174	64%	211	83%	385	75%
Black other	102	57%	72	81%	174	67%
Chinese	342	72%	129	83%	471	75%
Indian	259	66%	207	76%	466	70%
Pakistani	205	54%	192	78%	397	65%
White	313	77%	192	74%	505	76%
Total	**2,141**	**65%**	**1,675**	**81%**	**3,816**	**72%**

Table 26 Ethnicity effects for applications to social studies programmes

Ethnic group	Old institutions	New institutions
Bangladeshi	0%	0%
Black African	0%	0%
Black Caribbean	0%	0%
Black other	0%	0%
Chinese	0%	0%
Indian	0%	0%
Pakistani	*7%	*-3%
White	ref.	ref.

Mathematics

Table 27 Sex effects for applications to mathematics programmes

Sex	Old institutions Advantage to male	New institutions Advantage to male
Female	*-5%	*4%
Male	ref.	ref.

Table 28 Offers to applicants from different ethnic groups by university type to mathematics programmes

Ethnicity	Old HEIs		New HEIs		All HEIs	
	No.	% offers	No.	% offers	No.	% offers
Bangladeshi	363	80%	183	96%	546	86%
Black African	182	69%	103	90%	285	76%
Black Caribbean	79	72%	146	86%	225	81%
Black other	47	77%	56	98%	103	88%
Chinese	531	85%	246	96%	777	89%
Indian	246	76%	278	95%	524	86%
Pakistani	277	68%	231	89%	508	77%
White	189	88%	127	94%	316	91%
Total	**1,914**	**78%**	**1,370**	**93%**	**3,284**	**85%**

Table 29 Ethnicity effects for applications to mathematics programmes

Ethnic group	Old institutions	New institutions
Bangladeshi	0%	0%
Black African	0%	0%
Black Caribbean	*7%	5%
Black other	0%	0%
Chinese	0%	0%
Indian	0%	0%
Pakistani	*6%	4%
White	ref.	ref.

Annex E
Comparison with studies of applications to medical schools

Analysis of applicants to medicine and dentistry using Shiner / Modood data

1. In 1996-97 there should have been no students studying medicine and dentistry at new HEIs, so the small number of records showing applicants to new HEIs were excluded along with some applications to HND courses.

Sex

2. Table 30 is equivalent data as in Table 4 but for applications to old HEIs for medicine and dentistry only. It shows that, as when considering the sector as a whole, males experience a reduction in initial offers compared to females that is not explained through factors taken into account in our modelling.

Table 30 Actual and model offer rates for male and female applicants (medicine/dentistry, old institutions)

Sex	Actual	Model (sex = male)	Model less Actual
Female	25%	22%	-3%
Male	22%	ref.	ref.

Ethnicity

3. Table 31 is the corresponding analysis for ethnicity rather than sex. It shows that there is no strong statistical evidence for disadvantage against any ethnic group.

Table 31 Actual and model offer rates for applicants from different ethnic groups (medicine/dentistry, old institutions)

Ethnic group	Actual	Model (ethnicity = White)	Model less Actual
Bangladeshi	23%	23%	0%
Black African	17%	17%	0%
Black Caribbean	34%	34%	0%
Black other	41%	41%	0%
Chinese	26%	26%	0%
Indian	26%	26%	0%
Pakistani	18%	18%	0%
White	40%	ref.	ref.

Comparisons with other investigations into applications to medicine

4.   Previous analyses that used UCAS Council of Heads of Medical Schools (CHMS) applicant data[5] (McManus, 1998a&b, Arulampalam et al., 2005) differed from our analysis in a number of respects. The main differences are:

   a.   Our analysis used data for 1996 applications; the McManus/Arulampalam studies used data from 1996-97 and 1997-98.

   b.   Predicted A-level grades and subject of A-level studied were available for our analysis but not for the McManus/Arulampalam studies.

   c.   McManus/Arulampalam had data for the whole cohort; our analysis was based on a sample.

5.   The model formulated by McManus, and then further developed by Arulampalam, differed in a number of other respects. For all these reasons, we would not expect to replicate their results exactly, though we would expect the main results to be similar.

6.   Table 32 compares the number of applications for each ethnic group in the CHMS data, and in the Shiner and Modood data. It shows that the CHMS data is much larger than the Shiner and Modood data. Therefore the likelihood of finding significant differences is much reduced in our analysis due to a much smaller dataset.

7.   The Shiner and Modood sampling framework aimed to: get approximately equal numbers in each ethnic group overall; extra numbers of White students with weak A-levels; and no stratification by subject area. The net result of these sampling conditions was to produce uneven numbers of applicants to medicine by ethnic group, with only a small number of White applications to use as a baseline.

Table 32 Number of applications in each dataset

Ethnic group	Applications		CHMS /
	CHMS	**Shiner & Modood**	**Shiner & Modood**
Bangladeshi	1,690	704	2.4
Black African	2,525	516	4.9
Black Caribbean	439	64	6.9
Black other	404	65	6.2
Chinese	1,902	518	3.7
Indian	10,910	572	19.1
Pakistani	6,126	495	12.4
White	58,625	121	484.5
Total	**82,621**	**3,055**	27.0

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[5] CHMS Applicant, applications and offers data – 1996 and 1997 entry can be viewed at http://secure.ucas.com/new/press/chms/

8.   McManus found that, in comparison with White applicants, those from each of the ethnic minorities (using the same seven ethnic minority categories as in this study) all received fewer offers than would be expected (McManus, 1998b). Using the same data, but with a different model specification, Arulampalam got similar results using four broader groupings of ethnic minorities: Black, Indian, Pakistani, and Other Asian.

9.   Taking into account the different sample sizes and distributions of applicants across ethnic groups for the two data sources, our results are broadly consistent with those found by Arulampalam and by McManus [6].

10.   Table 33 shows the ethnic/sex parameter estimates using our modelling structure and data, and the equivalent estimates from Arulampalam. The main difference between the two sets of results relates to the Indian ethnic group but they are not contradictory. Arulampalam found a significantly lower rate of offer for those from an Indian background, whereas we do not have evidence of a lower or higher rate of offer for the same group.

Table 33 Ethnic/sex parameter estimates for each analysis

Ethnic group	Arulampalam	HEFCE
Black	-0.27	-0.30
Indian	-0.31	0.00
Pakistani	-0.54	-0.20
Other Asian	-0.37	-0.24
Sex		
Male	-0.25	-0.21

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[6] McManus did not include multi-level effects; we used a multi-level approach for our analysis, and we used the parameter estimates given by Arulampalam to make comparisons with analysis based on the CHMS data.

Annex F
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