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An analysis of the degree performance of those entering HE with the international baccalaureate

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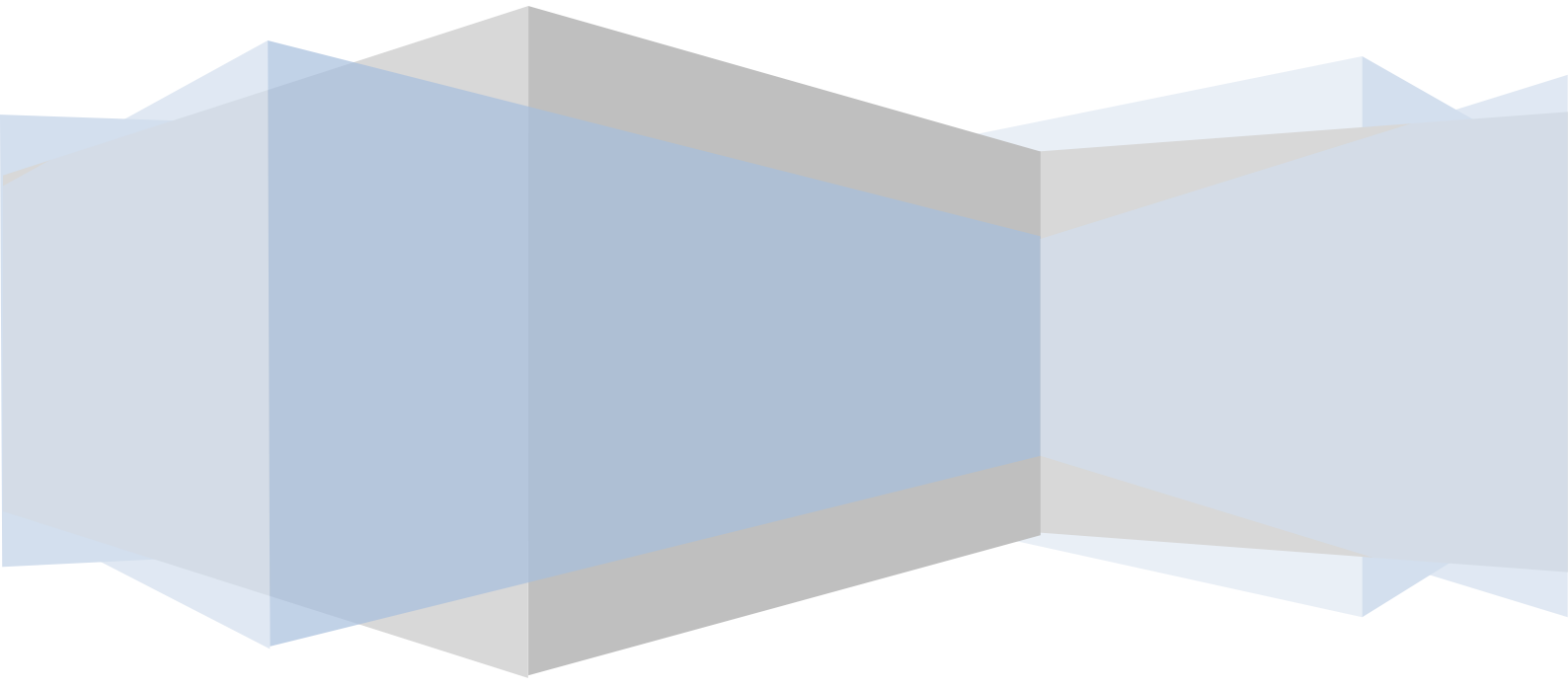

Introduction

Increasingly higher education is a global activity. Students enter higher education institutions across the world with a range of different qualifications, and admissions tutors need to make comparisons between students with quite different entry qualifications. The UK higher education system is one example where globalisation, and indeed attempts to widen participation to a broader range of domestic students, have meant that an increasing proportion of students now enter higher education with alternative qualifications rather than the "standard" set of A levels. For instance, the UK Higher Education Statistics Agency (HESA) reports that in 2008/9 just 56.7% of first degree full time entrants to higher education entered with A levels (10% had qualifications equivalent to A level; HESA, 2010). A number of key policy questions arise as a result of this increasing diversity in entry qualifications for higher education. One set of issues is around whether certain combinations of qualifications, for example qualifications that encompass a broader curriculum such as the International Baccalaureate, have a more positive impact on students' HE achievement than qualifications that cover a narrower curriculum. A second and closely related question, which is the central focus of this paper, is how effectively universities are able to equate these different entry qualifications to ensure that appropriate offers are made to students with different qualifications. In this paper we propose a post hoc - empirically grounded - method of assessing the comparability of different qualifications based on students' actual performance in HE.

The increasingly diverse range of qualifications with which students enter higher education in the UK has already been recognised as an issue by the sector itself. Indeed, the UK higher education admissions body, UCAS, has designed a tariff system that is expressly designed to guide universities on how to equate different qualifications. It does this by quantifying the magnitude and level of each qualification in such a way that they can be compared[1]. These equivalencies are determined by detailed professional judgements about how one qualification compares with another in terms of the amount of work required and the difficulty of the subject matter. An alternative approach is to retrospectively consider the higher education achievement, specifically the degree performance, of those who enter university with different qualifications (see Ogg, Zimdars and Heath, 2009, for an example of this type of approach). Then one can judge (after the event) the extent to which students with different entry qualifications perform relative to those with A levels. Of course degree classification is just one, quite narrow, measure of how well a student does at university. It is

[1] See www.ucas.com for further details of specific qualifications.

however, a measure that will have a clear impact on the student's future labour market success and hence is, we argue, a valid metric by which to measure student performance (Bratti, Naylor and Smith, 2005; Chevalier and Conlon, 2003). We propose to look specifically at how students who enter university with the International Baccalaureate (IB) compare, in terms of their degree performance, with those who enter with A levels. In 2010, the IB was available in nearly 3,000 schools and across 139 countries (Bunnell 2010) and it is a qualification of growing international importance. In the UK in 2008/9 only 1.5% of full time first degree students entered higher education with an IB and hence it remains a niche qualification. It has however, been admitted to the UCAS tariff and full details of the judgements made to determine the number of UCAS tariff points awarded to the IB is given at

http://www.ucas.com/documents/tariff/tariff_reports/ibreport.pdf.

One specific aim of this paper is therefore to consider whether universities have the equivalence between IB points and A level grades approximately right. We study the degree performances of students who enter with an IB (hereafter termed 'IB students') and those who enter with A levels ('A level students'). When we do this for similar students, and control also for their subjects and universities, we can compare performance by type of entry qualification and according to their scores in each. This gives us a way of estimating a neutral equivalence mapping between the two qualification grade scales, such that the predicted performance of students is the same no matter which type of entry qualification is taken. We are able then to measure by how much the official equivalence scale between IB and A level scores should be adjusted in order to ensure that for a given score on either qualification, students have similar degree performance. We also study the implicit mapping that universities have followed by comparing the entry grades of the two types of students across universities.

We start by reviewing the small literature on the performance of IB students in university. We then go on to describe our data and the empirical strategy we will use to measure the relative achievement of IB students and A level students in terms of degree performance. We also discuss how one might determine the extent to which universities ask for too high, or too low, a score for IB students. We then present results and recommendations and note possible future extensions to this research on the International Baccalaureate and on the comparability of university entrance qualifications in general.

Literature and Research Issues

The history of the international baccalaureate and its spread globally, and particularly its adoption in the US, has been well documented (Bunnell, 2008, 2009; Conner, 2008). However, whilst there is (generally favourable) evidence on the attitudes of students, teachers and higher education admissions tutors towards the IB (Hayden and Wong, 1997; International Baccalaureate Organisations, 2003; Kuwar, 2008; Suldo et al., 2008), there is much less in the way of robust quantitative evidence on the effectiveness of the IB in securing students entry into higher education, or in affecting their subsequent performance at university and in the labour market. Two features of the IB may or may not afford the student better performance in higher education or indeed in the labour market. Firstly, the IB is based on a particular pedagogical philosophy which focuses on teaching first principles and developing a concept based understanding of topics that promotes critical thinking. Secondly, the IB provides students with potentially greater curriculum breadth, particularly relative to a standard A level curriculum.[2] Indeed securing breadth of study, and not necessarily at the expense of depth of study, was one of the main motivating factors behind the introduction of the IB. Yet in the UK context it is not clear whether studying a broader range of subjects at age 16-19 will really help students secure access to HE. Moreover, one study has shown that employers are not willing to pay more for students who have followed a broader curriculum at A level (Dolton and Vignoles, 2002).[3]

The focus of this paper is on the performance of IB students at university, and once again there is only limited quantitative evidence to draw upon. The International Baccalaureate Organisation recently commissioned the Higher Education Statistics Agency (HESA) in the UK to evaluate the degree performance of IB students, as well as considering the characteristics of IB students, their choice of degrees and their post-degree outcomes. This research found that on average those entering HE with an IB were more likely to be at "top" universities (i.e. research intensive universities who tend to top league tables of university quality, such as institutions which belong to the Russell Group). IB students also had a higher probability than A level students of obtaining a good degree, that is, a first or upper second, and were more likely to complete their degree than non-IB students. This HESA research went beyond degree performance and also looked at the post-university short run outcomes for IB students. It concluded that graduates who entered HE with an IB had a higher probability of going on to post-graduate study, were more likely to be employed and

[2] For details, see www.ibo.org. IB candidates take 6 subjects, 3 at higher level. Whatever 'Highers' are opted for, all students must do maths, a foreign language, a literature course in their own language, and a science course. Each subject is graded 1 to 7; including 3 for assessment of non-subject-specific work, the maximum is 45.

[3] Of course it could nevertheless be maintained that a greater breadth of study has wider benefits than those that are purely economic.

specifically more likely to be employed in higher paying graduate level jobs. The HESA report does not, however, control for the selective nature of students who take the IB. On average IB students are more socio-economically advantaged and higher achieving and are more likely to have been at schools that recruit on academic achievement. This selectivity manifests itself in IB students being more likely to attend higher ranking universities, but does not establish whether the IB itself is the source of the higher attainment. Again this needs to be taken into account when determining whether the degree performance of IB students is superior or not. In this paper we build on this descriptive analysis from HESA using multivariate regression models that enable us to take account of a range of factors simultaneously and making use not just of the information as to whether a student enters with an IB but the specific points they achieved in the IB.

Our research also relates to another literature on the efficacy of the degree class outcome measure that we use. We have already acknowledged that this outcome measure is limited, measuring only one aspect of student performance in HE, albeit an important one. Evidence suggests there is variation in the proportion of different degree classes awarded across institutions with similar student intakes and certainly there are problems with consistent grading across departments and institutions (see, Richardson and Woodley, 2003; Chapman, 1996; Silver et al. 1996, Molinero and Portilla, 1993; UUK, 2007; Yorke, 2002 and Yorke, 2007). This justifies our approach which is to control for both institution attended and subject studied. We also know that the proportion of students achieving a 1st or upper second class degree has grown substantially in recent years, particularly in pre-1992 institutions (Yorke, 2007). However, since we are using a single cross section this problem does not affect our empirical analysis per se. Lastly, there is evidence that degree performance varies by demographic characteristics, such as gender (Barrow, Reilly and Woodfield 2009; Simonite, 2005), thereby requiring us to account for a range of personal characteristics when identifying the relationship between entry qualification type and degree class.

The reason for focusing on degree performance is that this criterion is likely to be central for university admissions officers in recruiting students. When faced with applications from students with minority qualifications, admissions officers can use official equivalence scales or else they can make personal/institutional judgements on the basis of their limited knowledge of previous students' performances. The problem they face, in making commensurate the grades of A levels and the IB, is one instance of a wider class of analytical and practical issues for education policy-makers, wherein different qualification types need to be compared to ease education and labour market flexibility. The essential choice is between input-oriented and output-oriented criteria. The official IB/UCAS equivalence scale is an example of the former. In arriving at their tariff, education experts

compare the content of the syllabi and exams (hence also the knowledge acquired), but do not aim to predict subsequent performance.

In the application here it can be hypothesised that admissions officers would prefer to base their judgements on prospective degree performance.[4] Yet even if officers remain in the same role for many years, they encounter relatively few IB students, and are unlikely to acquire an accurate knowledge of their subsequent performance in relation to entry IB points. They may therefore underestimate the marginal association between the two, and indeed one can hardly be confident that admissions officers would be able to recruit so accurately that the degree performance of their IB students is indistinguishable on average from that of their A level students. There are, therefore, in principle two potential mappings between IB points and UCAS points, in addition to the official, input-based, mapping. The neutral mapping is one which, on average in each university and subject, would yield no difference between students holding IB or A level entry qualifications. The actual mapping is revealed in the recruitment choices the officers and students make, through the IB points and UCAS points of students in the same subject and university. Because each officer deals with small numbers, the actual and neutral mappings may diverge. Because using input equivalences to determine the UCAS tariff for these qualifications may predict degree performance with some bias, both the actual and the neutral mappings may differ from the official mapping.

We thus arrive at several key questions. First, can it be confirmed that IB students do indeed perform especially well when they reach university, and if so is this attributable to their coming on average from more privileged backgrounds and other socio-economic characteristics? Second, what would be a genuinely "neutral" mapping, one which would see performance as unrelated to type of entry qualification? Third, what is the average actual mapping that universities draw, as revealed by the students in each university? Finally, how do the neutral and actual mappings compare with the official tariff recommended by UCAS?

Data and Descriptive Analysis

To address these questions, we use data from the Higher Education Statistics agency for full time undergraduate entrants who potentially graduated in 2009/10 i.e. who entered higher education in 2007/8, or 2006/7 if they did a 4 year degree. Since most IB students are young entrants, we have to limit the analysis to those under 24. The advantage of focusing on relatively young entrants is we can be more certain that we are comparing the degree results of a more homogenous group. We include

[4] A small survey in 2003 of UK universities' attitudes to the IB, carried out by the International Baccalaureate Organization, implied that attitudes were derived from assessments of performance in degree studies; but that these were generally based on impressions, not on formal tracking mechanisms (International Baccalaureate Organization,2003).

non UK domiciled students in the sample but we take account of this in the modelling by including a mean effect for these students.

HESA data for those graduating in 2010/11 contain detailed information on their highest qualification on entry and this includes an indicator of whether an individual entered HE with an IB. The data also includes the UCAS tariff point score for each student's qualifications including those who enter with IB[5]. Using the official UCAS tariff mapping of IB points to UCAS tariff point scores, we convert the IB score provided in the HESA data back into the standard IB points system used by the International Baccalaureate Organisation. We are also able to determine the highest entry qualification for non-IB students and in our modelling, to ensure a more homogeneous comparison group, those with non-A level qualifications (bar Scottish equivalents) are dropped from the sample. Hence we have two groups of interest, IB students and A level students (against which our comparisons are made).[6] The UCAS tariff[7] score for an individual will incorporate other qualifications achieved e.g. AS levels and Highers. We cannot separate out the points from A levels from the other points achieved through AS levels or other qualifications. Hence we include these additional points but we are making the assumption that these points (which are not numerically that important) are similar across A level and IB students.[8]

We also omit those with medical degrees from the analysis since their degrees are not awarded on the same classification system. After excluding those aged 24 and over on graduation, and those for whom we have no information on their UCAS or IB scores, we are left with 139,414 students, of whom 1,744 (1.25%) entered via the IB route, the rest via A-level.

Key descriptive statistics about the entry grades of the students in the sample are shown in Table 1. The first row shows the mean UCAS score for those with A levels and, using the official mapping, those with IB qualifications. As can be seen, the entry grades of IB students are far in excess of those with A levels; and while the official mapping might not be fully followed by universities, this evidence confirms the substantial difference in the prior achievements of the two categories of students. This large difference remains even using the 2010-revised official mapping. Worth noting, also, is that for

[5] Note that the UCAS tariff has been revised since this period and we use the tariff valid for those entering HE in 07/08.

[6] Note that A level students henceforth refers to those with A levels or Scottish equivalents (e.g. Highers). Also, in the rare cases where an IB student holds an A level as well they are classified as an IB student.

[7] http://www.ucas.ac.uk/students/ucas_tariff/tarifftables

[8] To avoid any suggestion of outlier effects, we excluded 3 A level cases with a score of more than 800. As a robustness check we also determined that 77 IB students for whom we knew their UCAS tariff score had other qualifications. We included the part of the UCAS score that was from these additional qualifications into the regression modelling; their effect was small with a large standard error, and their inclusion had no significant impact on our findings.

both types of students the variation in prior achievements is considerable, rather less so in the case of IB students. The third row shows that the mean IB points level is 34.3, which is above the global median of approximately 30[9]. This is as expected, since all in the sample have gained university access. Figure 1 plots a histogram of the IB points among the students in the sample. It can be seen that the mean is less than the mode which is 36.

Our outcome variable of interest is the person's degree classification obtained. In our models we use the five degree classifications provided by HESA: a) first, b) upper second, c) lower second/undivided second, d) third/fourth/pass and e) unclassified. The third row of Table 1 shows, consistent with the recent Higher Education Statistics Agency report, that IB students perform much better than A level students at university; the difference in the proportions gaining a "good" degree (at least an upper second) being 9.0 percentage points. However, these outcomes could be attributable to a range of sources, including different socio-economic backgrounds, being at different universities, doing different subjects, and, not least, having different prior education achievements. University admissions officers would naturally allow for such differences in considering their admissions requirements. Before developing our model to account for these differences, it is informative first to note how the two types of students differ across these control categories.

The relevant descriptive statistics are shown in Table 2. The first panel examines the type of institution, where we divide the universities into Cambridge and Oxford, other members of the Russell Group, other pre-1992 institutions and post-1992 institutions. These groupings are by their very nature relatively arbitrary though they are correlated with research intensiveness and performance in the research assessment exercise. As can be seen, IB students are disproportionately concentrated in the Russell Group universities, and relatively scarce in the post-1992 universities.

In the second panel, which looks at degree subjects studied, it can be seen that IB-qualified students are more prominent in social studies & history but less common in the creative arts, in education, and also slightly less common in most of the STEM subjects. Yet no subject is entirely unpopulated by IB students. The third panel demonstrates the unrepresentative social character of IB students: they are disproportionately from private schools, domiciled outside the UK, and from a social background where the highest-paid parent or guardian is/was in either a professional or a managerial occupation. Given that these and other personal characteristics are known to affect student performances in a range of institutions (Broecke and Nicholls, 2007; McNabb, Pal and Sloane, 2002; Naylor and Smith, 2004; Richardson and Woodley, 2003), it will be important to include these as controls in our analysis. In addition, we also include dummy variables to capture

[9] http://www.ibo.org/facts/statbulletin/dpstats/documents/May2010Statisticalbulletin.pdf

specific institutions, and other variables that the literature indicates may be relevant, specifically dummies for 10 ethnicity categories, age, part-time study, self-assessed disability and institution attended.

When we come to modelling performance we exclude students at Oxford and Cambridge, because both use intensive interview methods of assessment, sometimes with additional testing, and hence obtain substantial information about candidates additional to (predicted) A level/IB grades that other universities do not. They typically do not raise A-level entry requirements (for example, by asking for more subjects) to match the abilities of the students they aim to recruit. We do, however, include a separate analysis of the entry points and degree performance of the small number of IB students at Oxford and Cambridge. This reduces the main sample further to 134,908 students, of whom 1,669 (1.24%) are IB students.

Model

The first purpose of our analysis is to determine how one might equate the prior achievement of a student in the IB to the prior achievement of a student with A levels, in such a way as to generate similar degree performance for similar students doing the same subject in the same university. Such an equivalence scale will be, by definition, the neutral mapping. We will propose that this should be the adopted equivalence scale of any university aiming to treat equally the two types of entry qualification.

Let there be a neutral mapping from IB points, x in equation 1 below, to UCAS points, y in equation 1. We assume it is linear:[10]

$$y = a + bx \qquad (1)$$

The objective is to determine the mapping, i.e. the value of the parameters *a* and *b* such that students would achieve the same outcome. Let dp_i stand for degree performance, in this case the fivefold classification of degree class outlined in the previous data section. Since *y* is chosen to equate performance the following equation (2) holds, where IB_i is an indicator variable which takes the value of 1 if the person entered with an IB and hence $[1 - IB_i]$ indicates whether the person entered with A levels, $\boldsymbol{Z}_i$ is a vector of personal characteristics that may determine degree performance and the model includes vectors of both institution effects ($\boldsymbol{uni_k}$) and subject effects ($\boldsymbol{subj}_j$):

[10] In our empirical estimations we looked for evidence that the relationship might be non-linear and found none.

$$dp_i = [\alpha + \beta . y_i]IB_i + [\alpha + \beta . UCAS_i][1 - IB_i] + \boldsymbol{\pi}.\boldsymbol{Z}_i + \sum_k \delta_k . \boldsymbol{uni}_k + \sum_j \varphi_j . \boldsymbol{subj}_j + \varepsilon_i \quad (2)$$

Substituting for *y* gives a model which it is possible to estimate[11]:

$$dp_i = \alpha + \beta . a . IB_i + \beta . b . x_i IB_i + \beta . UCAS_i[1 - IB_i] + \boldsymbol{\pi}.\boldsymbol{Z}_i + \sum_k \delta_k . \boldsymbol{uni_k} + \sum_j \varphi_j . \boldsymbol{subj_j} + \varepsilon_i \quad (3)$$

To operationalise this model we estimate an ordered probit model, where the dependent variable is the five-fold degree classification variable described above. The vector of explanatory variables used in this model ($\boldsymbol{Z_i}$) consists of the demographic controls discussed in the data section. We include institution fixed effects by entering a dummy variable for each institution bar the base case: we include subject fixed effects by entering a dummy variable for each subject bar the base case. This is to allow for mean differences in the proportions of students achieving good degrees across both subjects and types of higher education institutions, as indicated in the literature. Sample sizes preclude us from estimating institution-subject interactions so we are unable to allow for systematic differences in the proportion achieving a good degree that differ within institutions across subjects.

To set the scene, we will first report estimates of equation (3) but excluding the entry scores and all the controls. We term this the baseline model, which will indicate whether, taken overall, the IB students perform better or worse than A level students at university. This baseline model is essentially a re-presentation of the descriptive analysis seen in Table 1, Row 4. We then report a specification that just includes the fixed effects – that is, the dummy variables for all the subjects and the universities. This specification will show whether the association of IB with good performance is attributable to any extent to the fact that IB students go to higher-ranked universities, and do a somewhat different mix of subjects.

We next will report a model like equation (3) which controls for both socio-economic characteristics, and the institution-specific and subject-specific effects, but which still excludes the entry scores. This model will provide our best estimate of the average association of IB with degree performance, comparing students with given observed demographic and family background characteristics, and given degree subject and institution. Note, however, that such a finding will not finally establish the causal effect of IB on performance, since there are other factors underpinning the route that the IB students have previously taken, which are not observed in our data. To gain entry to a secondary school offering IB might require a level of academic selection that is not fully captured by our socioeconomic or other control variables. However, we are proposing that universities be concerned with the subsequent performance of their IB students, whatever the reason for that performance

[11] We also tried including quadratic terms for the input grades, in case their effects were non-linear; but their inclusion was rejected as statistically insignificant, and so we maintained the parsimonious linear formulation.

being high or low; so we do not need to establish the causal effect of following IB studies in school for our analysis to be relevant.

Next we will report estimates of equation (3) as it stands in full, including the measures of the achievement of both IB students and A level students according to their own scales. Specifically, we include variables measuring the number of points the individual achieved in the IB (IBScore) or in their A levels (A score) depending on which qualification they entered HE with.[12] So the estimating equation becomes:

$$dp_i = \alpha + \beta_1 IB_i + \beta_2 IBScore_i + \beta_3 Ascore_i + \boldsymbol{\pi}.\boldsymbol{Z}_i + \sum_k \delta_k . \boldsymbol{uni_k} + \sum_j \varphi_j . \boldsymbol{subj_j} + \varepsilon_i \qquad (4)$$

The coefficients $\beta_1 \; and \; \beta_2$ combine to measure how achievement in the IB is correlated with the likelihood of getting a good class of degree. Likewise, the coefficient on *Ascore* (β_3) measures how additional achievement at A level is correlated with the likelihood of getting a good class of degree. By including both variables rather than simply using the student's UCAS score regardless of whether they have an IB or A levels, the specification allows for a different relationship between IB point score and degree class as compared to A level score and degree class. From equation (4), in comparison with equation (3), we can then recover the neutral mapping parameters: $a = \beta_1/\beta_3$, and $b = \beta_2/\beta_3$. We can then compute, using equation (1), the best estimate of the neutral equivalent scores that universities might ask for, in relation to what they decide to require for their A level students. This will ensure an equal likelihood of getting a good degree as compared to A level students admitted with the same score.

A second objective for the analysis is to determine what universities obtain in practice from IB students in terms of UCAS tariff points. Of course, one cannot observe the universities' requirements directly from this data. In determining their offers, universities typically position themselves in a competition for students who will perform well; students then can choose between whatever offers they receive. Some universities, especially Oxford and Cambridge, include requirements in particular subjects, in addition to their overall UCAS or IB points requirements. Moreover, both A-level and IB scores can differ from either the standard or personal "offers" made by admissions officers, most applications being made before results are known. Offers are typically minimum requirements, though they are sometimes relaxed by admissions officers once results are revealed. There might therefore be a gap between offers and the expected realised achievements of universities' recruits. Nevertheless, universities would expect to see a firm relationship between their offer grades and the grades of the students they recruit, and this can be assumed to be broadly similar for both types of

[12] The *IBScore* variable is set to zero for A level students and vice versa.

entry qualification. On this assumption, by examining the entry grades of the students that are actually recruited, one can observe the equivalences that universities are working to in the decisions that they make. Thus, across universities we shall compare and plot the average entry grades of the two types of students that are recruited.

Based on the above, we can then show the following graphically:

1) the official mapping between IB points and UCAS point scores as determined by the official tariff;
2) the "actual" equivalence scale that universities achieve on average, mapping average grades of A level and IB students across universities.
3) the points that universities "should" obtain from IB students to ensure parity of degree performance between IB and A level students based on our degree class model from equation 4.

Modelling Results

Table 3 shows the estimated results using the models described in the previous section. In the first column is seen the baseline model. The estimated coefficient is positive and highly significant statistically, thus confirming the finding from Table 1, namely that students with IB entry perform better than those with A level entry.

In column (2), we have entered just the fixed effects for university and subject, the coefficient estimates for which are not shown in order to conserve space. As can be seen, the impact of these controls is that the overall association of having done the IB with degree performance is very substantially reduced, and is now only significant at the 10% level. Thus, it can be concluded that much of the "raw" association is linked to the fact that IB-entry students go to universities and do subjects where students tend to have a better degree performance.[13]

In column (3), all the control variables are included. On average females perform better than males and those entering university at a later age do better, as confirmed by the previous literature (see Naylor and Smith, 2004; McNabb et al. 2002; Richardson and Woodley, 2003; Shimonite, 2005). Those from a professional or manager background marginally higher grades than those from other

[13] For example, in our sample the proportion of at least upper second class degrees awarded is 77.3% in the Russell group of universities excluding Oxford and Cambridge, as compared with 63.8% in other universities.

social class origins, consistent with the association between socio-economic status and degree class found by Smith and Naylor (2001). Students from abroad perform rather worse than those from the UK, an effect that may be attributable to differences in language abilities. Performance is also lower for those studying part time (confirming Richardson and Woodley, 2003) and for those with a self-assessed disability (as found by Broecke and Nicholls, 2007). Finally, as discovered by Smith and Naylor (2001), there is a small negative impact on performance from those who had previously been at a private school. This effect has been attributed to students performing above their ability level in gaining university entry, driven by the additional resources available to them in school, but which are then not available once at university. In short, the estimates for these control variables are reassuringly consistent with expectations and with earlier findings of previous studies. The issue here is whether their inclusion affects the overall association of IB with performance.

Compared with column (2) it can be seen that the coefficient on IB status is now substantially higher. It appears that the negative associations of being domiciled outside the UK or of coming from a private school, both of which are strongly linked with IB status (see Table 2) may have lowered the coefficient in Column (2), and that when these factors are controlled for in Column (3) the highly significant and substantial positive link of IB per se with performance is shown. Thus, in answer to the first research question posed in section 2 above, the overall conclusion from Column (3) is that IB-entry students who are similar on observed characteristics, and who follow the same university and subject, are predicted to perform better on average than A level students. But the caveat noted above remains: this association could be attributable to unobserved factors rather than the causal impact of following the IB.

Column (4) shows the findings from estimating equation (4), where the scores of both the A Level and IB students are included. As should be expected, for both types of student a higher score leads to a higher final degree class. In both cases the effect is highly significant statistically. We can now use these estimates to compute the "neutral" mapping between IB points and UCAS points, as follows. The estimates imply that:

$\hat{a} = -612.7\ (59.7);\ \hat{b} = 31.1\ (1.75)$, standard errors in brackets.

From these we derive the "neutral" equivalence scale shown in Table 4. As can be seen, the neutral mapping is less generous than the official tariff to IB students with UCAS-equivalent points, except at the sparsely populated top end of the scale. At most points the official UCAS score is too high, and if used to predict performance would tend to overestimate students' final degree performance. Another way to note this is to examine the goodness of fit in predicting degree performance,

comparing the use of the official mapping and the use of the neutral mapping. The log likelihoods are, respectively, -36650 and -141250 for the neutral and official mappings; while the pseudo-R^2s are 0.0852 and 0.0544.

The official and neutral mappings can now be contrasted with that implied by universities' actual recruitment, as described above. Figure 2 plots the average UCAS score for all A Level students in our sample in each university against the IB points of their IB students. It includes only the 89 institutions that recruited any IB students. As expected institutions that recruit higher grade A Level students also recruit higher grade IB students. There is inevitably some considerable noise, driven by the small numbers and variable strategies of some universities. The line on the Figure shows a regression weighted by the number of students in each university.[14] We use this line as our indicator of the equivalence mapping that the universities themselves use, and show in Table 4 the mapped UCAS scores at each IB point.

Figure 3 and Table 4 bring together the three mappings: the official (input-based) mapping, the observed universities' "actual" mapping, and the "neutral" mapping. As can be seen there are some notable differences as well as overlaps between these three. It can first be noted that universities, on average, pay relatively little heed to the official mapping. The two lines come close only at the bottom of the scale, and thereafter diverge. In practice, the official UCAS points of universities' IB students are far in excess of those of their A Level students. It would appear that universities do not accept that the input equivalences are a good guide to subsequent performance.

Second, for the upper part of the range, above 31 to 32 points, the universities are recruiting IB students whose grades, on the "neutral" equivalence scale, would put them above their peer students with similar characteristics and in similar universities and subjects. The converse is true for the lower part of the range: the universities appear to be recruiting IB students with too low grades in comparison with the A level students they recruit. Below about 40, the "neutral" mapping is below the official one, indicating that universities may be right to disregard the official one, assuming their objective is gain equivalent performance independent of the type of entry qualification. However, they appear to adjust too much from the official tariff at the top end, and insufficiently at the bottom end. The reassuring finding, however, is that for the large number of universities that recruit in the range 29 to 33, they have estimated their equivalences about right.

[14] In fact, there are especially small numbers at the lower end of the scale, as might be surmised from looking at the overall distribution of IB points (Figure 1). An unweighted regression would be slightly steeper than the weighted regression.

Another way of observing the significance of these contrasts is to note that, for the universities recruiting at the upper end of the scale one would expect that their IB students would perform better overall than their A Level students, and conversely at the lower end of the scale. To confirm whether this is the case, we estimated again the specification of column (3), first for those universities for whom the average IB score was 37 or above, second for those where the grade was below 28. The first group comprised just 7 institutions[15], the second 18.[16]

In column (5) of Table 3 is shown the overall association of the IB with degree performance in the first group of universities, after controlling for university and subject fixed effects and for all socio-economic characteristics. It can be seen that, as expected, the effect is highly significant, and far more substantial than it is for all universities taken together (the column (3) estimate). Using these estimates, the probability of gaining an upper second class degree or better in these universities is 4.4 percentage points greater for IB students than for similar A Level students. In contrast, column (6) shows that, for the universities with the lower-scoring students, the point estimate of the effect of the IB is negative. However, the estimate is imprecisely determined, and insignificantly different from zero. Almost certainly, this imprecision results from the fact that there were relatively few IB students (only 62) recruited at this end of the scale. These findings are not additional to, but make for another way of noting, the differences between the universities' and the neutral mappings shown in Figure 3.

An extension: recruitment and performance of IB students at Cambridge and Oxford.

The analysis above has not included the students at either Oxford or Cambridge, because of their strong reliance on additional recruitment methods. Nevertheless, it is of interest to examine the entry grades and performance of the students who are recruited to these universities. If their IB students do especially well or poorly in comparison to their A level students, this could reflect on the decision-making accuracy of their recruitment. Do these universities recruit IB-entry students who perform especially well?

In our sample there were 4,547 students at Oxford or Cambridge, of whom 75 had come with an IB, the rest with A levels. The key findings are shown in Table 5, and three observations can be made. First, there is no evidence of any association between degree performance and having entered via the IB rather than A levels. This is shown in the first row of the table, where the coefficient shown is

[15] Bristol, Imperial, LSE, University College London, Warwick, Edinburgh and the Courtald Institute.
[16] Edge Hill, Winchester, Roehampton, Southampton Solent, Anglia Ruskin, Bath Spa, Brighton, Coventry, Greenwich, Middlesex, Northumbria, Staffordshire, Chichester, Abertay Dundee, Brunel, Hull, Bangor, Liverpool Institute for the Performing Arts.

from the same specification as in column (3) of Table 3. That is, the specification allows for differences across subject, socio-economic characteristics, and between the two universities. As can be seen, the coefficient is small and insignificant. Though the number of cases is small, for this cohort one cannot reject the hypothesis that the two universities recruited in such a way as to be largely neutral between entry methods, which was presumably their intention.

Second, it can be noted that the average IB points score (41.6) is at the high end, but within the range, of grades typically required by Oxford and Cambridge colleges. A consultation of college web sites shows that IB points requirements at Oxford and Cambridge start from 38, but it is not unknown for scores as high as 42 to be required in individual offers. It is also normal for the top grade of 7 to be asked for in particular subjects studied at the higher level. This top grade corresponds to a "high" A at A level. The range of IB points among the students runs from 38 to the top grade of 45. In contrast, the average UCAS score of the A level students at Oxford and Cambridge (521) in our sample is very much higher than that implied by the typical A level requirement at the time (3 grade 'A's, equalling 360 points). The reason for this contrast is not apparent from our data.[17]

Our third observation is that the official UCAS entry score of IB students is far in excess of that for the recruited A level students. It appears that Oxford and Cambridge pay even less heed than other universities to the official equivalence scale. If, hypothetically, the IB students had had the same number of UCAS points as the A level students, then using the official mapping the average score in IB points would have been around 35, very much less than is asked for and obtained.

[17] It is likely that most A level entrants, accepted through the interviews and other assessments, could achieve much in excess of what is asked of them, further reason why one cannot deduce the colleges' equivalence judgements.

Conclusions

In an international higher education environment, where the comparability of similar educational qualifications but with incommensurate scales is increasingly a practical issue for policy makers and educational decision-makers, there are in principle two methods available to derive equivalence maps between otherwise incommensurate scales. One can closely examine what students do and have to know in order to obtain the qualification with varying grades -- the input method. Or one can deduce equivalences from the effects of holding the qualification at each grade – the output method. The latter can be especially problematic when the outputs themselves are not precisely determined, and where their effects may differ according to the state of the labour market.[18] In the instance studied in this paper, however, where the outputs of the two qualifications once at university are completely comparable, and where there are sufficient numbers to make plausible statistical estimates given the heterogeneity of individual performances, the output method might be recommended in preference to the input-method judgements of educational experts. There does, at least, appear to be something awry when two groups of students, with equivalent grades according to an official tariff, performed distinctly differently from one another.

According to our findings, if universities were to recruit using the equivalence scales officially recommended for the IB, most would find that their IB students performed distinctly worse than their officially-equivalent A level students. For example, a student recruited with 30 IB points (the world average) would be treated as equivalent to a similar A level student with 419 points, but our results suggest that the student's performance would be similar to an A level student with just 322 UCAS points (see Figure 3); this would entail a 10.8 percentage points lower predicted probability of achieving at least an upper second class degree, compared to the student's peers.

Our results also confirm, however, that universities systematically deviate from UCAS recommendations in the offers they make to IB students. Faced with the decision on how to assess applications from IB students, they may use the official mapping as a guide but they appear not to regard it as a directive. We have hypothesised that their objective has been to treat students equally, regardless of qualification type, the equivalence to be judged by how well they expect students to perform at their institutions; but that equivalence is hard to judge when each has only direct experience of small numbers. It is difficult to extract and aggregate the equivalence scales that universities do in practice use for their offers, but what is important for them is that the students they succeed in recruiting are broadly equivalent between qualification types. We have

[18] Hence the problematic character of the European Qualifications Framework (Brockmann et al., 2011).

therefore examined the relationship between the A level UCAS points and IB points of the students they recruit. This "actual" scale of equivalence reveals that most universities recruit in order to bracket their IB students with students that have A level UCAS scores that are much higher than would be indicated by the official equivalence scales – that is, they ask their IB applicants for higher IB points than officially recommended.

We find that the amount that the equivalence scale is adjusted by universities is approximately right in the low-to-middle of the range, when judged by the neutral mapping that we have estimated. In other words, IB students perform similarly to A level students in universities that recruit IB applicants with grades in the low 30s. At the top end of the scale, however, we find that the universities have adjusted too far away from the official mapping. In institutions with IB students having an average grade of 37 or more, for example, we find that the IB students are 5.4 percentage points more likely to achieve an upper second class degree or better. We would recommend, therefore, that consideration be given to lowering the required points in their offers to IB students, in order to obtain a more neutral outcome between IB and A level entrants. This recommendation needs to be qualified, of course, by the knowledge that other factors affect expected performance and the offers therefore made. It is important to note, in this context, the association between following an IB programme and being at a private school; the latter has been shown to be associated with a small diminution in degree performance, a result that is reproduced in this study. Hence it is the predicted performance of IB students from state education that is especially high compared with the average A level student drawn from either sector.

This recommendation has not been applied, however, to Oxford and Cambridge Universities, for whom extensive additional recruitment methods are followed, and where the official equivalence scale is apparently ignored. In their case, the small numbers across both universities in one cohort of data present no evidence of non-neutral recruitment of students by qualification type; but we have noted their puzzling tendency to make very high offers to IB applicants, within their recruited students' range of achievement, while their offers to A level applicants are much lower than their recruited students' average entry grades.

In light of the above, our second recommendation is that consideration be given by UCAS to altering the tariff in their IB to UCAS point equivalence scales. We note that, subsequent to the point of entry of the 2010-graduating cohort examined in this study, the scale was adjusted downwards by a small amount (see Figure 3), for those entering university in 2010. We believe that more substantial change is required, in line with the estimated neutral output-based mapping, that would both lower the intercept and raise the slope of the relationship, thus giving more weight to marginal differences

in achieved points than are currently afforded. If we are right that neutrality is the main objective for universities, an official neutral mapping based on the latest cohorts should be expected to gain credibility and provide a useful guide to admissions officers, especially those new to that role.

Future research can incorporate data from the cohort that were awarded a potential A* grade for A levels sat in 2010. Moreover, if data became available on specific subject-grade requirements such information could be useful in adjusting and updating the neutral mapping. Even without that, an updating of the neutral scale using statistical methods with the latest results should be possible at low cost on a regular basis. A second direction for research could be to examine intermediate outcomes at university, such as the propensity to withdraw, given that completion rates are of considerable financial importance to universities. Third, there are other entry qualifications for which the method followed in this study could be relevant, and for which it could be useful to provide admissions officers with outcome-neutral equivalence scales. Finally, a quite different tack for future research could be to investigate the causal impact of taking the IB on subsequent experiences, whether at university or beyond. However, as we have stressed, to be confident that the associations found in the data between taking the IB and subsequent experience are causal, a convincing method of controlling for, or instrumenting for, selection to IB on prior ability would need to be found. In that eventuality, it would also be of interest to consider a broader set of outcomes than performance at university.

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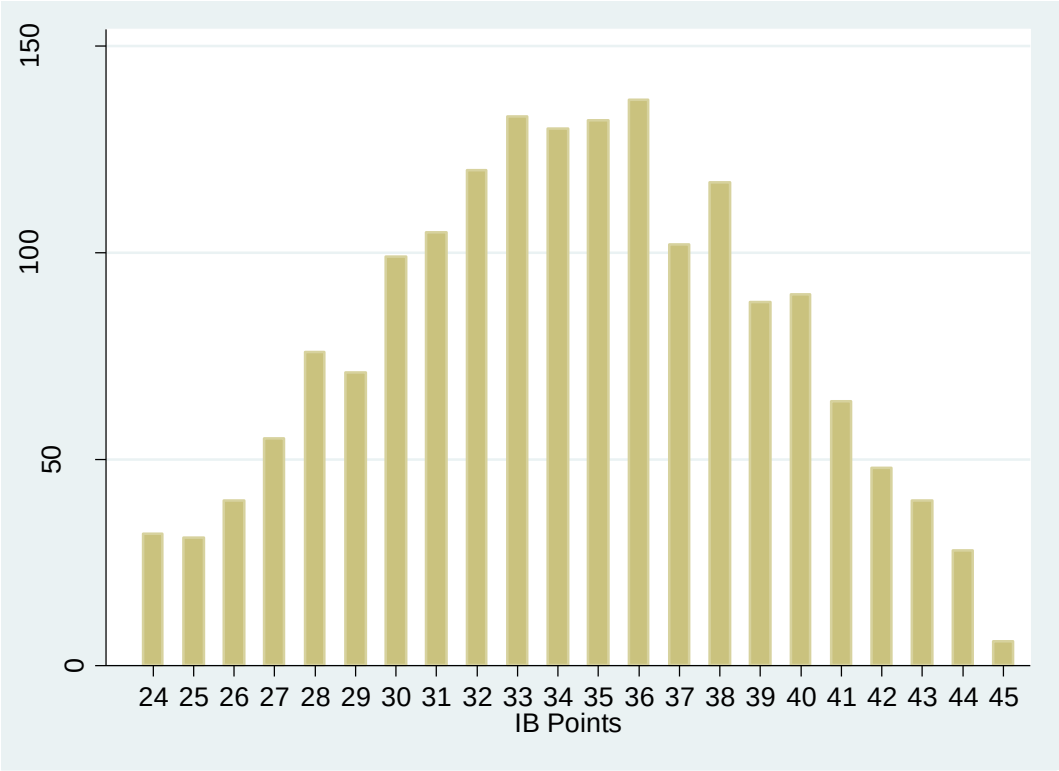
Figure 1 The Distribution of IB Scores Among University Students



Note: the base is all the 1,744 IB students who graduated in 2010 aged under 24.

Figure 2. Universities' Average A Level UCAS Scores and Average IB Points

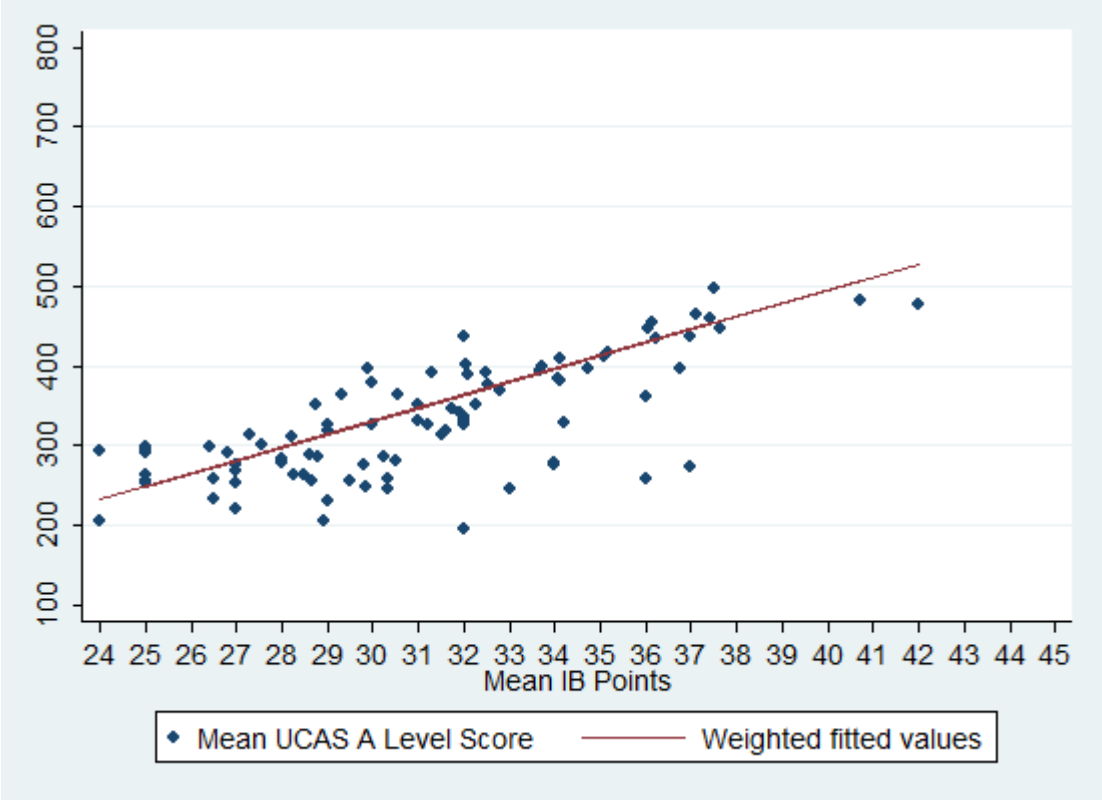
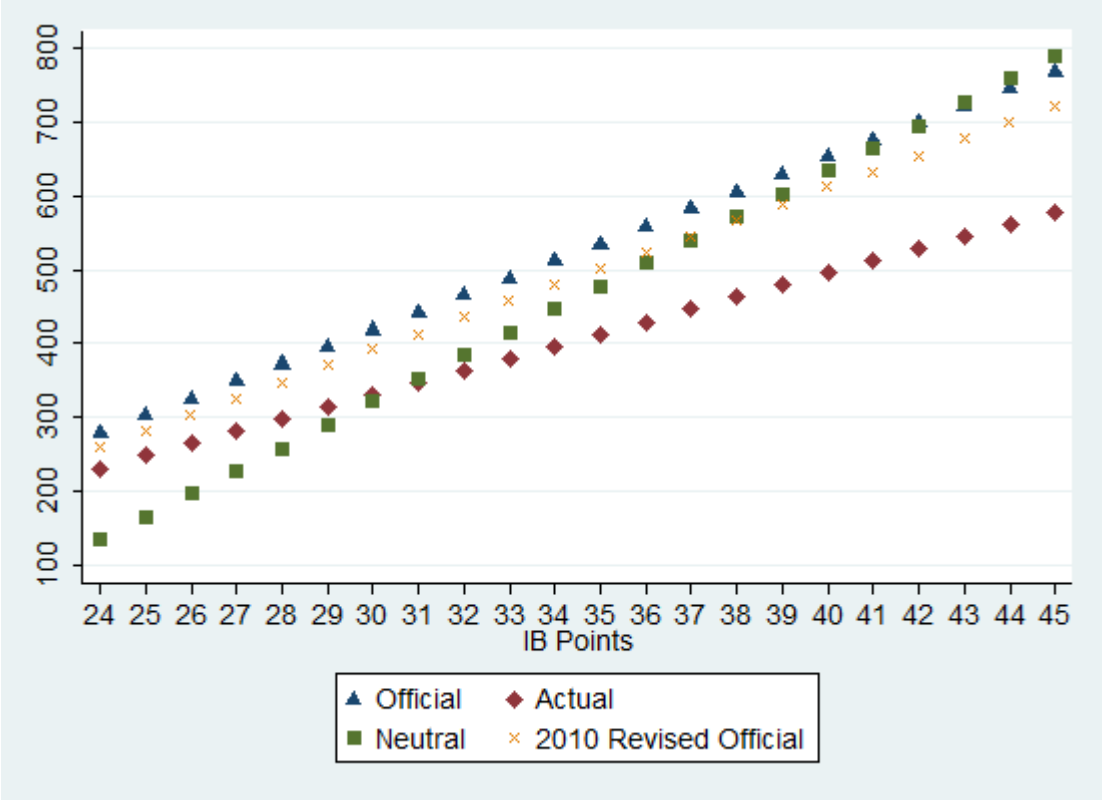


Figure 3. Mapping IB Points To UCAS Points



Notes:
"Actual" computed from the weighted regression shown in Figure 2
"Neutral" computed from parameter estimates in Column (4), Table 3.

Table 1 Average UCAS Scores by Type of Entry Qualification.

	Students with A-Levels		Students with IB	
	Mean	s.d.	Mean	s.d.
Official UCAS Points	337.4	117.5	525.3	113.3
IB Points	n.a.	n.a.	34.3	4.81
Proportion Gaining At Least 2.1 Degree	0.680	0.466	0.770	0.421

Note: the base is all those 139,414 students who graduated in 2010 aged under 24 who have non-missing data on their scores and socio-economic characteristics.

Table 2 Distributions of Students by Type of Entry Qualification.

	A-Level (% of students)	IB (% of students)
University Group		
Cambridge/Oxford	3.2	4.3
Other Russell Group	26.1	43.5
Other Pre-1992 University	27.7	42.1
Post-1992 University	43.0	10.0
Degree Subject		
Subjects Allied to Medicine	4.6	3.1
Biological Sciences	12.8	10.7
Veterinary Sciences, Agriculture and related subjects	0.6	0.2
Physical Sciences	5.1	3.6
Mathematical and Computer Sciences	5.5	3.4
Engineering	1.8	2.6
Technology	0.6	0.3
Architecture, Building	1.9	1.4
Social studies	13.9	26.6
Law	6.0	5.8
Business and administrtion	11.8	15.9
Mass comms	4.8	2.5
Linguistics, classics	7.9	5.1
European languages and literature	0.4	1.0
Other languages	0.4	0.5
Historical and philosophy	8.7	11.4
Creative Arts	9.2	4.9
Education	3.8	0.6
Combined	0.4	0.5
	4.6	3.1
Socio-Economic Categories		
Male	41.7	47.0
Attended Private School	14.4	47.1
Domiciled in UK	95.7	41.4
Parent/Guardian is Manager or Professional	58.8	75.8
Disability (self-assessed)	8.6	4.9

Table 3 The Determinants of Degree Performance By A-Level and IB Students.

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
IB Dummy	0.244***	0.0459*	0.183***	-2.121***	0.158***	-0.168
	(0.0272)	(0.0277)	(0.0290)	(0.205)	(0.0584)	(0.138)
IB Score				0.108***		
				(0.00603)		
A Score				0.00346***		
				(3.68e-05)		
Age			0.0418***	0.110***		
			(0.00494)	(0.00503)		
Male			-0.140***	-0.107***		
			(0.00642)	(0.00648)		
Professional/ Managerial †			0.0523***	0.0302***		
			(0.00701)	(0.00707)		
Non-UK Domicile			-0.451***	-0.455***		
			(0.0193)	(0.0194)		
Private school			-0.117***	-0.0950***		
			(0.00996)	(0.0100)		
Disability			-0.105***	-0.0552***		
			(0.0108)	(0.0109)		
Part-time			-0.857***	-0.833***		
			(0.0447)	(0.0449)		
University and Subject Dummies	NO	YES	YES	YES	YES	YES
Log likelihood	-149340	-143068	-141234	-136650	-8828	-18533
Observations	134908	134908	134908	134908	8491	16529

Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1. †Whether highest-earning parent/step-parent/guardian is in a management or professional occupation. Dummies also included for missing data on social class and private school.

Table 4. Official, Neutral and 'Actual' IB to A level mapping.

IB Points	UCAS Tariff, 2006- *	UCAS Revised Tariff, 2010- *	Neutral Equivalence Mapping†	Mapping Based On Universities' Average Actual Recruitment‡
45	768	720	789 (22)	578 (11)
44	744	698	758 (20)	561 (10)
43	722	676	727 (18)	545 (9)
42	698	654	695 (17)	528 (8)
41	675	632	664 (15)	512 (7)
40	652	611	633 (14)	495 (6)
39	628	589	602 (13)	479 (6)
38	605	567	571 (11)	462 (5)
37	582	545	540 (10)	446 (4)
36	559	523	509 (9)	430 (4)
35	535	501	477 (9)	413 (3)
34	512	479	446 (8)	397 (3)
33	489	457	415 (9)	380 (3)
32	466	435	384 (9)	364 (4)
31	442	413	353 (10)	347 (4)
30	419	392	322 (11)	331 (5)
29	396	370	290 (12)	314 (6)
28	373	348	259 (13)	298 (6)
27	350	326	228 (15)	281 (7)
26	326	304	197 (16)	265 (8)
25	303	282	166 (17)	249 (9)
24	280	260	135 (19)	232 (10)

* http://www.ucas.com/documents/tariff/tariff_reports/ibreport.pdf
† Scores derived using equation (3) and estimates from column (4), Table 3; standard errors in brackets.
‡ Scores derived from weighted regression line shown in Figure 2; standard errors in brackets.

Table 5 IB students at Oxford and Cambridge

Estimated association of IB with degree performance	-0.017 (0.141)
Average IB points	41.6
Average Official UCAS Points of IB students	698
Average UCAS points of A Level students	521