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Art or Science?

A Business School Experience

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Admissions of International Graduate Students: Art or Science? A Business School Experience[a]

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Abstract

International students are often well represented in graduate programmes in North America and Europe. Information on foreign countries' education systems and grading schemes is available but cross-country comparisons are often challenging and highly subjective. Therefore, universities have a clear need for calibrating admissions of international students to ensure a fair and cost effective selection process. By comparing the performance of international students in their host institution with their entry qualifications we devise a simple approach to detecting systematic biases in the perceived quality of the applicants and propose corrective actions. We find that by using public information on cross-country comparisons of academic qualifications, country selection biases can occur and produce a substantial impact on international students' performance and failure rates. Our model is based on admission data that are routinely collected by universities which should ensure its broad applicability.

JEL classification: I2
Keywords: admissions, country bias, entry qualifications, failure probability

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1. Introduction

The substantial and increasing presence of international students in North American and European universities calls for selection procedures that are fair and as far as possible country-neutral, that is without any element of geographical discrimination.[1] While national students are at times admitted to university on the basis of factors other than academic strength,[2] university entry of international students are mainly driven by academic criteria. But, which criteria should be taken into consideration is an open question. Researchers have tried to establish the type of quantitative and qualitative information admissions should use to predict student performance (see King et al 1993, Hoefer and Gould 2000 and Koys 2005) and have come up with a broadly consistent set of indicators. This study explores a different but related issue that pertains to the difficulty of comparing such information when the applicants come from abroad. This, which is a common problem in disciplines with a large population of international students, such as business studies and engineering, is not only important to ensure fairness but is also crucial to a cost effective selection process. There are costs to both universities and students when graduate admissions lack consistency. If well qualified students are refused admission due to under-estimation of their academic ability, universities are certainly worse off because of the resulting loss of fee income. Indirect social and political costs may also be among the undesirable consequences.[3] On the other

[1] Clearly, universities often have the objective of creating and maintaining a culturally and hence geographically diverse student body, which leads to admission policies that aim to prevent over-representation of certain nationalities. But by and large, most fields of study in most countries are unlikely to face explicit quotas.

[2] In the US, affirmative action rules imply that different entry requirements may be applied to students from different ethnic groups. An example is the University of California's general admission policy which includes the following statement "Mindful of its mission as a public institution, the University of California has had a historic commitment to providing a place within the University for all eligible applicants who are residents of California, and to achieving, on each campus, a student body that both meets the University's high academic standards *and encompasses the cultural, racial, geographic, economic and social diversity of California itself*" (emphasis added).

[3] In relation to the potential loss of international students following stricter visa requirements in the aftermath of 9/11, the US Assistant Secretary of State for Consular Affairs Maura Harty stated, "Most important to me, though, we have lost the chance for a student to see the wonders of America through his or her own eyes, rather than through the prism of a foreign news-media outlet that may be biased. When a student grows up and becomes a social, civic, political, or perhaps religious leader at home, we want that leader to have had the quintessential experience of life on an American college or university campus. A young person's positive experience in America strengthens and enriches our nation." (Harty, 2004)

hand, students who are not sufficiently qualified but are admitted when their qualifications are over-estimated, risk to invest time and considerable financial resources in a postgraduate programme for which they may be unsuitable and from which they may not reap the opportunities for personal and professional growth they seek to achieve.

Resorting to standardised tests such as the GRE or GMAT to foster a level playing field in admissions, may help. However, such tests do not allow for a straightforward comparison among students. For example, King et al 1993 report large standard errors of measurement in GRE scores. The Education Testing Service (ETS), who manages the GRE, recommends not to use its scores as the sole criteria for admission. Furthermore, all else equal, non-native English speakers may score lower than comparably talented students from English speaking countries due to language difficulties.[4] For all these reasons, universities tend not to give excessive weight to such tests in admissions. As indicated by Oltman and Hartnett (1985) typically, these tests may be a determinant factor only for marginal students, in which case the test score is used to compensate for weak credentials.

In this study, we endeavour to produce a simple method to detect cross-country inconsistencies among indicators of academic strength typically used by admission officers when selecting international students for postgraduate study. We do so by comparing the actual performance and failure rates of international students at the host institution against their country of origin, while at the same time controlling for academic strength. If students from a specific country systematically perform better than average for a given level of academic strength, then we conclude that such level is underestimated in that country and that entry requirements for students from that country are probably too strict. By contrast, systematic under-performance will indicate that a country's qualifications are over-rated and that entry requirements should be tightened. To test our

[4] For this reason the quantitative section of the test is often given more weight in admissions. In an extensive survey of US universities covering 48 leading graduate schools in five disciplines, Attiyeh and Attiyeh, (1997) find that the quantitative section of the GRE is given more importance by admissions in Economics, Mathematics and Mechanical Engineering, while similar weight to other sections is applied by Biochemistry, and preference to the verbal section of the test is given in English departments. Moreover, the verbal test score of students from non-English speaking countries tends to be scaled up for a fairer comparison with native English speakers.

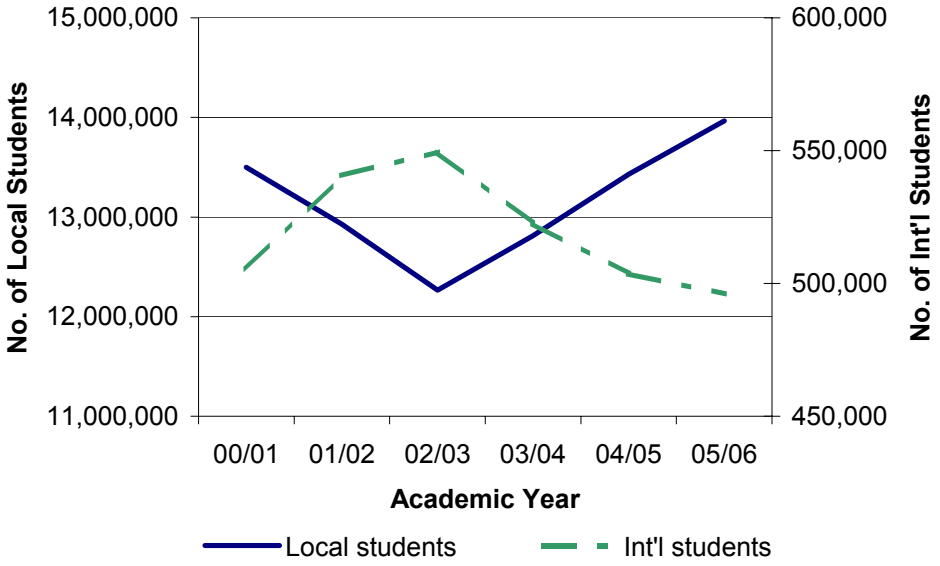
model we use admission and performance data from the ICMA Centre a department of the business school at the University of Reading in the United Kingdom.
The paper is organised as follows. Section 2 provides general information about international student flows to the US and UK. Section 3 discusses student qualification comparisons across and within countries. Section 4 is an overview of the admission procedures at the ICMA Centre. Section 5 is a description of the models used in our analysis. In Section 6 we present our results and Section 7 concludes the paper.

2. Trends of international students in the US and the UK

According to the Institute of International Education (IIE), the top two destinations for international students in 2006 were the United States and the United Kingdom which attracted 22% and 14% of a global flow of about 2.5 million students respectively. Other top destinations were Germany (10%), France (10%), Australia (7%) and China (6%). Statistical data on flow and origin of international students is particularly rich in the US and the UK thanks to the IIE for the US and the Higher Education Statistics Agency, which is a central source for publicly funded (virtually all) UK universities.

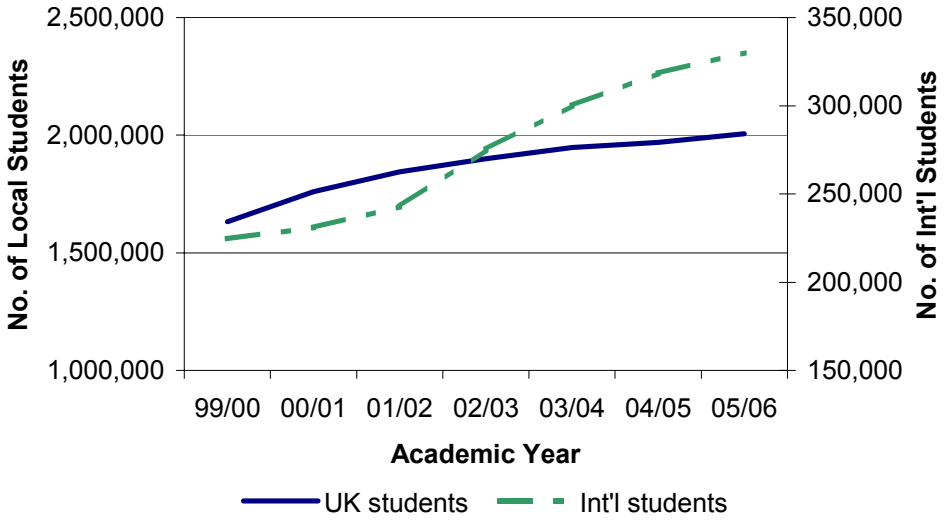
The flow of international students to the US shows an upward trend for a stretch of 50 years, between 1953 to 2002, before a drop in the last few years. Changes in visa policy following 9/11 are thought to be the main cause behind the fall. The trend from the 2000/01 academic year is illustrated in Figure 1. The inflow of international students is plotted against the population of US local students. Interestingly, the two patterns exhibit negative correlation. In the UK, as shown in Figure 2, the trends are rather different and do not show reversals but a steady increase during the 7 year observation period. The fall in numbers in the US which coincides with a sharp acceleration in international students in the UK in 2002/03 suggests a substitution effect between the two countries.

Figure 1. Local and International Students in US Higher Education



Note: The number of local and international students includes undergraduates and postgraduates and excludes students enrolled in practical training, non-degree and intensive English language courses.

Figure 2. Local and international students in UK higher education.



Note: The number of local and international students includes undergraduates and postgraduates in higher education (HE) and excludes students enrolled in further education (FE) courses.

Figure 3 describes a shift in the level of degree chosen by international students, with graduate studies overtaking undergraduate studies and becoming the most popular choice. The shift is common to both the US and the UK and the timing also appears to coincide

and begin in 2001/02. This suggests that the finding is not a local phenomenon. An explanation may be that sending countries have been improving the quality and variety of their undergraduate education and are now able to attract an increasing share of local students. Figure 4 shows the extent to which the US and UK education sectors rely on international students. In the US only about 4% of total students are international, whereas in the UK the proportion is between 3 to 4 times higher in the observation period, with a peak of 14.1% of total students in 2005/06. This is interesting as it quantifies the exposure of the education sector in each country to international economic conditions and specifically to the conditions (e.g. business cycle effects) of the nations that contribute the most to a country's inflow of international students.

Figure 3. Undergraduate and Postgraduate Students in the US and the UK.

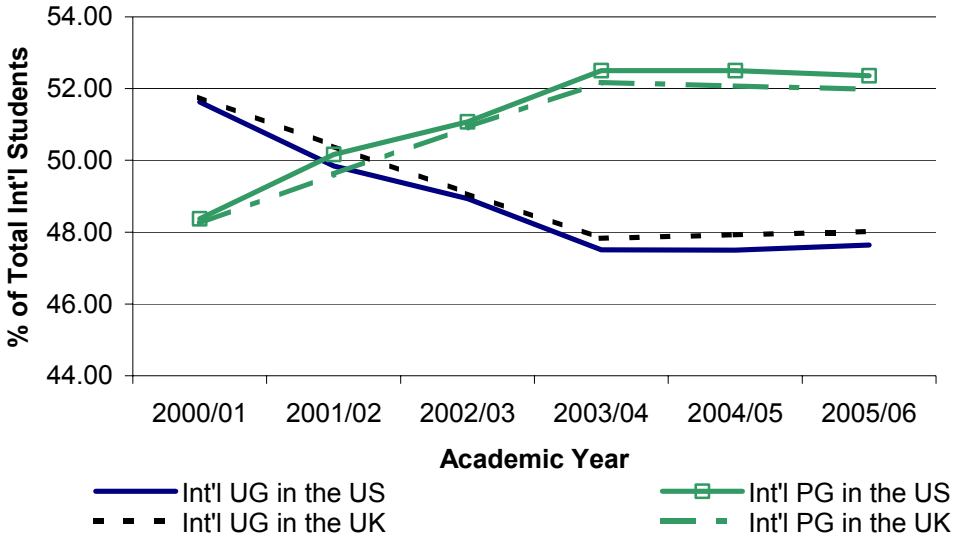
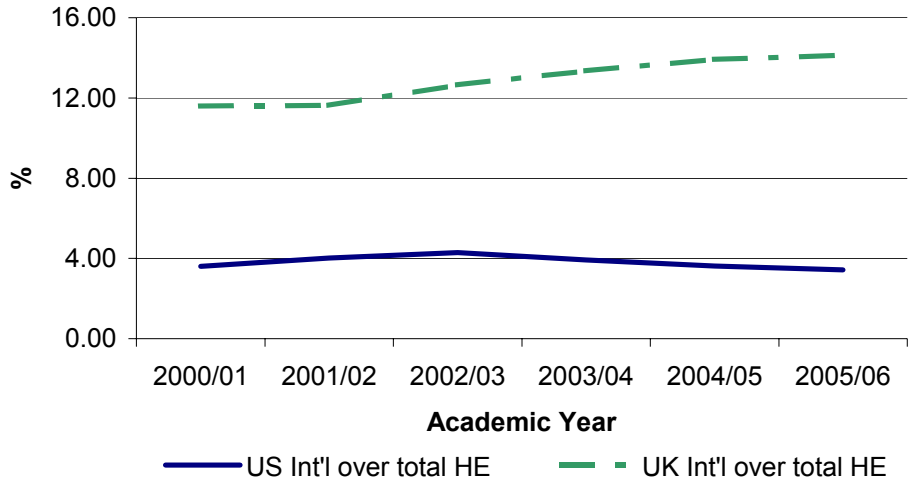


Figure 4. International Students in the US and UK as a Percentage of Total Students in Higher Education.



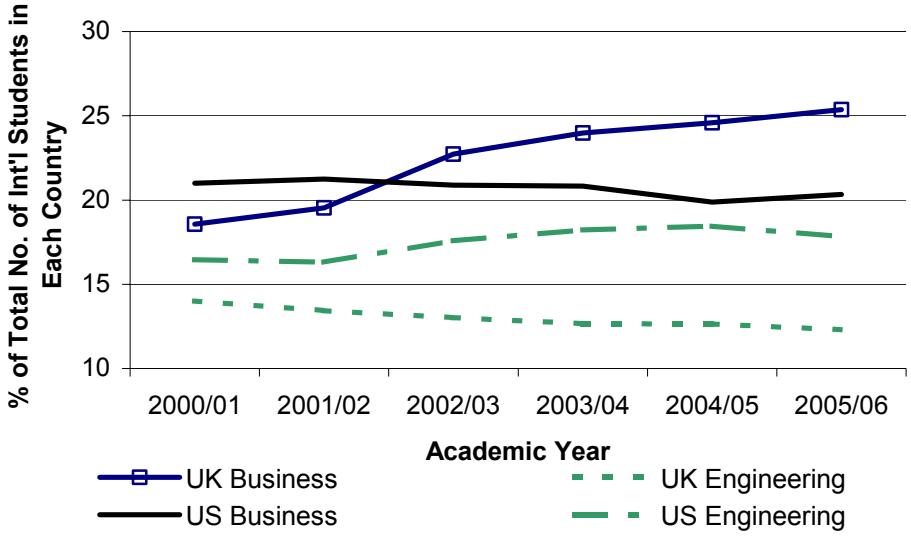
Note: The number of local and international students in the US includes undergraduates and postgraduates and excludes students enrolled in practical training, non-degree and intensive English language courses. The number of local and international students in the UK includes undergraduates and postgraduates in higher education (HE) and excludes students enrolled in further education (FE) courses.

Statistics for leading places of origin of international students entering the US and the UK are summarised in Table 1. India and China are among the top senders to both US and UK. However, while the UK includes 3 European countries among the top 6 senders (Greece, Ireland and Germany), the 6 largest student inflows to the US are all from Asia with the exception of Canada. The distribution of international students is less concentrated in the US with the top three countries of origin, China, India and South Korea, accounting for a similar proportion of total student flow, 14.2%, 11.1% and 9.4% respectively. In the UK, instead, China is farther ahead than all other countries with a 16.5% of total flow, followed by Greece (6.2%), India (5.2%), Ireland (5.1%) and the US (4.5%).

Finally, Figure 5 shows the top fields of study for international students in the US and the UK. Historically, in both countries, business has been the leading field followed by engineering. In 2005/06, 20.3% of international students in the US and 25.4% in the UK enrolled for business studies, while the proportions for engineering were 17.8% and 12.3% respectively. However, the trends in the two countries are different. International

business students are increasing in the UK while they reveal a fluctuating pattern in the US. On the other hand, UK numbers for engineering are steadily declining while the US shows a general upward trend with only a slight reversal in 2005/2006.

Figure 5. International Students' Top Fields of Study in the US and UK.



3. International comparisons of undergraduate qualifications

The diversity of education systems throughout the world makes it difficult to compare undergraduate grading policies across countries. Although there is no common world-wide GPA system, many universities do provide equivalent letter grading for international comparison. By using this information we have constructed conversion guide which is reported in Table 2.

There are several issues that need to be considered when comparing grading schemes. Firstly, one should be aware of the procedure followed by the foreign institution to arrive at a student's final classification. Some universities use a cumulative GPA throughout the degree programme. Others only use the final two years to assign a degree classification, occasionally with undisclosed weighting of individual courses or other

rules[5]. Secondly, when credits are transferred from one institute to another in joint programmes, the latter may adjust the results achieved in the former without providing a clear guidance on how the adjustment was done. In other cases, transferred credits are not graded on the second institute's transcript. Lastly, we have also found that different departments within the same university can occasionally use different GPA schemes or classification rules, which adds to overall complexity of the evaluation process. In conclusion, when considering overseas applications, it is often necessary to take a holistic approach that combines internal as well as external information and often, if not always, a great deal of patience!

In addition to the grade achieved at the undergraduate level, admissions should also consider the selectivity of the institution in which the grade was achieved. University rankings are available for some but not all countries. For instance, China has been covered by the online service Netbig and Canada by an annual Guide published by Maclean's.[6] Useful information is provided by NARIC which lists "recognised" universities worldwide and provides a "prestigious" label to some Chinese universities. However, for the majority of countries it does not provide formal rankings. Similarly to degree classifications, rankings should also be handled with care. Different criteria can be employed to produce university rankings or similar criteria can be weighted differently often producing wide variations in rankings. Also, a rapidly changing environment implies that league tables may not provide an up-to-date evaluation of a university's standing even after relatively short periods of time. Yet, in the absence of anything more substantial, such tables are still a useful working tool especially for those institutions for which the tables offer a roughly consistent outlook.

4. Admissions at the ICMA Centre

The postgraduate finance programme that we run at the ICMA Centre is offered on a full time basis as well as on distance learning and flexible learning, which is partly

[5] Some universities in recognition of the fact that students tend to perform better in the last year of study, have devised rules that give the final year greater weight in the overall degree classification (this is sometimes called "exit velocity").
[6] See, www.netbig.com and www.macleans.ca.

residential. In this study, we only consider full time students. The Centre receives applications from about 80 countries from graduates with a variety of academic backgrounds and work experience. A team of admission officers screens all applications that are complete with all the required documentation. Offers can be unconditional or conditional on satisfactory completion of an undergraduate degree, if applicants have not yet obtained one.

The factors we consider when admitting students to our programme are:

1. Grade point average (GPA) or equivalent indicator of undergraduate performance;
2. Ranking of undergraduate institution;
3. Reference letters;[7]
4. Work experience,
5. Postgraduate degree (if applicable). This becomes an important factor when the student has a poor undergraduate record and more evidence of his/her academic abilities is needed.
6. GMAT/GRE tests (only for weak candidates and those requesting financial assistance).

The selection criteria we use in admissions are consistent with standard policies in other graduate schools as reported by Brink (1999), King et al (1993), Oltman and Hartnett (1985), Hoefer and Gould (2000) and Attiyeh and Attiyeh (1997). The main problem we face in the selection phase is to translate the academic curriculum of international students into an equivalent UK degree and degree classification. To do so, we use the National Academic Recognition Information Centre for the United Kingdom (NARIC UK). This service provides detailed information on 180 countries' education system and

[7] The value of reference letters has decreased significantly in the UK over recent years for several reasons. The Freedom of Information Act 2000 has led referees to be increasingly cautious of putting negative comments in writing. Moreover, competition for access to the most selective programmes encourages referees to "over-sell" their students. Cultural factors may also reduce the usefulness of references. It is not common practice or indeed acceptable in several countries to give a negative indication of a student's performance. There is also the problem of fake references whose fraudulent origin may be difficult to uncover.

qualifications to higher education institutions, professional bodies and commercial organisations.

We normally admit students that have graduated with at least an average B-grade or equivalent. However, occasionally, applicants with a lower classification are admitted when they have relevant and substantial work experience and can provide alternative evidence of their academic ability (e.g. a good GMAT or GRE score or significant professional qualifications, e.g. CFA, ACCA, and others). Also, lower classifications may be considered when (1) the institution awarding the degree ranks among the top in its country, (2) documented extenuating circumstances may have impaired the academic performance of the applicant, (3) the undergraduate degree taken by the applicant has a strong quantitative element. The last point is justified as most of the students who struggle in our programme tend to have difficulties in our more quantitative modules.

5. The Models

The objective of this study is to design a simple procedure to highlight cross-country inconsistencies in students' qualifications. On average, students with equivalent qualifications should perform similarly. If this is not the case for students from a specific country or region, then we infer that the meaning we attribute to qualifications from that country is out of line with similar qualifications in other countries.

To test this idea we use a linear regression and a probit model. In the former we regress the grades students achieve in our MSc programme against a set of demographic and background variables. A detailed description of the variables is reported in Table 3. As we run the analysis across 5 academic years, from 2002/03 to 2006/07, we also introduce dummies to capture for systematic differences in performance in each year's cohort. This appears to be advisable due to the lack of granuarlity of some of the other conditioning variables. For example, students with a particular grade in a year, say A-grade students, may be concentrated at the top end of the A-grade in that year, while in other years they

may be more equally distributed or concentrated at the bottom end of the grade. Then, time dummies will capture the deviation in average performance that will result from these time inconsistencies. The regression we use is,

$$PG\_MARK_s = \mu + D_s'd + B_s'b + Y_s'y + \varepsilon_s \quad (1)$$

where the dependent variable PG_MARK_s is the mark received at first attempt by student *s* at completion of the post-graduate degree at our institution. D's is a vector of a set of demographic variables relative to student *s*. These include gender, age and the country in which the student completed her first degree. We consider the latter to be more representative of a student's background than the country of origin. However, in most cases the two coincide. Countries for which not enough students are available for robust statistical inference are grouped into regions. Regions are formed on the basis of geographical proximity and similarities in education systems. Countries that can not be grouped into regions based on these criteria and are poorly populated in our sample are pooled together into the "other" category. B's is a vector of background variables including, undergraduate degree classification, ranking of undergraduate institution within its own country, degree subject, work experience, native language and any postgraduate degree possessed by the student before enrolling for our postgraduate programme. GRE and GMAT scores are not used as explanatory variables as they are not a requirement for non-marginal (i.e. most) applicants. Y's denote time dummies for each year in the sample period and ε_s is an error term. μ, the regression constant and the vectors *d*, *b* and *y* are the parameters we need to estimate.

The use of dummy variables raises a question of interpretation. To avoid multicollinearity with the regression constant one dummy should be omitted from each group of dummies (e.g. country dummies). The implication is that the estimated dummy coefficients measure students' performance in relation to the excluded variables. So, for example, if among the country dummies we omit the US, then the performance of all the students from the other countries or regions included in the regression will be measured with respect to the average performance of US students, with positive coefficients indicating

better performance and negative coefficients worse performance than US students. Although the home country may be the natural benchmark, difficulties may arise when deciding the benchmark with respect to gender, work experience, language and all other categorical variables. Interpretation of results may also suffer as one would have to bear in mind the benchmark that combines all categorical variables in order to interpret regression coefficients. For example a combined benchmark may be a female US student with no work experience, no postgraduate degree, with a B average in her undergraduate studies with a major in finance from a second tier undergraduate institution. Not an easy concept to wrap one's mind around! To solve the problem we adopt Suits (1984)'s suggestion as refined by Kennedy (1986) and, after estimation, "recover" the omitted dummies' coefficients by imposing linear constraints. The constraints ensure that the weighted sum of the coefficients of each set of dummies denoting the same group of categorical variables (including the omitted one) is zero. The weights are the proportion of students represented by each dummy. This implies that the "reference student" becomes the average student rather than one with a specific background and demographic profiles, which simplifies matters considerably. In addition the constraints allow us to report regression estimates for all categorical variables, which makes it even easier to interpret our results.

By conditioning our analysis on the country where the undergraduate degree was taken, we can now determine if there is any systematic bias in the way cross-country information has been compared and interpreted by the admission officers. If any country exhibits a statistically significant regression coefficient, then a selection bias has occurred. A country with a positive (and statistically significant) coefficient will indicate that the students from that country have systematically out-performed, all else being equal, relative to the average student. One can then conclude that entry requirements applied to students from that country are too strict and need to be relaxed. By symmetry, a negative coefficient indicates that students from that country have systematically under-performed and hence that entry requirements are probably too loose and need to be tightened. The admission officers can adjust entry requirements in several ways, for example by revising how stringently to apply all the criteria discussed in Section 4.

However, from the results discussed in the next section, it turns out that only some background variables would make a real difference in the ex post performance of the students.

In addition to the linear model of performance we also estimate a probit model to check if there is any pattern among the students who fail our degrees. The probability that student *s* does not achieve pass marks at first attempt is modelled as,

$$Pr(Fail_s) = \Phi(\mu + D_s'd + B_s'b + Y_s'y) \qquad (2)$$

where Φ is the cumulative probability of a standard normal. The probability depends on the same conditioning variables as for the liner model. As before, country neutral admission policies would translate in failure probabilities that are not dependent on country variables. On the other hand, if the coefficients of country dummies are found to be significant, then some corrective actions in admission policies may be needed. Given the non-linearity of the probit model, the simple constraints used to simplify interpretation in the linear model can not be employed here. Therefore, for this model we shall not report the coefficients of the omitted variables. Also, the non-linearity of the model implies that the variables' coefficients can not be seen as the marginal effects on the probability of failure. We compute marginal effects for any binary independent variable δ as,

$$\Phi(\bar{x}'_{\delta=1}\beta) - \Phi(\bar{x}'_{\delta=0}\beta) \qquad (3)$$

where $\bar{x}'_{\delta=\alpha}$ denotes the mean of all independent variables with the exception of the variable δ, which takes value α. β represents all variables' coefficient estimates.[8] The only non-binary variable is age which enters the model in parabolic form and hence is not suitable for marginal effect analysis.

[8] See Greene (2003), p. 668 for details.

Finally, for confidentiality reasons, sample descriptive statistics will not be reported nor will the names of the countries represented in the sample. Countries will instead be labelled with consecutive numbers. Also, the constant in both the linear and probit model will not be shown to prevent disclosure of expected marks and failure probabilities which we consider to be sensitive information.

6. Results

Through the linear model discussed in the previous section we can estimate the deviations from the average mark due to our applicants' demographic and background profiles. Our students are awarded a mark between 0 and 100, with 70-100 being a distinction or A grade, 60-70 a merit or B grade and 50-60 a pass or C grade. Table 4 shows the estimated deviations from the average mark and their statistical significance. All else equal, students from country 2, 6 and 7 appear to perform more poorly with -1.92, -4.74 and -4.10 points below the average mark respectively. On the other hand, students from country 3 and 9 systematically achieve higher results (+5.71 and +2.96). This clearly indicates that "all else" in not equal. As the largest weight in our admission procedure is given to undergraduate classifications, it is likely that there exist inconsistencies among cross-country classifications that are considered to be equivalent. In other words a B-grade in country 3, the best performing one is probably harder to achieve than for the average student in the sample, while in country 6, the worst performing country, the opposite may be the case.

The results also indicate that other factors should be given due consideration, some of which may be lawfully incorporated in the admission process, while others may not. Examples of the latter type are gender and age. Although these variables can not inform admissions for legal reasons, the variables should nevertheless be included in the regression in order to control for their effect and prevent mis-specification bias. Interestingly, the coefficients for age and age-squared are significant and imply that the age at which students achieve their best performance in our programme is 31 (see also

Figure 6). Younger students under-perform, all else equal, probably because of lack of relevant work experience, which makes it more difficult for them to contextualise the material being taught. Consistent with these findings we observe that work experience improves performance and is significant. Another factor that probably benefits older students may be motivation. Students who take a career break to do a degree are highly driven individuals with very clear focus and determination to succeed. However age appears to help performance up to a point. Students that have left education for considerably long periods may find it harder to cope with full time postgraduate studies. As a result we find that individuals in their mid thirties or older perform marginally worse than average. On the gender side of the equation, we find that female students tend to perform marginally better than male students. The result however is not statistically significant.

As one might expect, among the background variables that are statistically significant, those with largest effect on performance are the ranking of the undergraduate institution and undergraduate classification. This is consistent with current practice in the US where, according with Brink (1999) and King, Bruce and Gilligan (1993), universities tend to favour these criteria for student selection. Looking at the results, students from top tier universities have on average 1.08 marks above average while those from the bottom tier under perform by 2.83 marks. A-grade students obtain 3.45 marks above average. Students with a grade below B receive -0.95 marks less than average but the result is not statistically significant. In other words, we can not conclude that students admitted with a grade below B perform differently from the average. This is encouraging as it suggests that the additional evidence of academic strength required by admission officers before granting admission to these candidates (primarily GMAT and occasionally professional qualifications or relevant work experience) proves to be a good measure of academic performance.

Surprisingly, holding a postgraduate degree or being a native English speaker do not seem to affect performance. An explanation of the latter result may be that students can only be admitted if they provide convincing evidence of their proficiency with the

English language by achieving minimum scores in tests such as the IELTS or the TOEFL. Students that satisfactorily pass these tests should not be at a substantial disadvantage relative to students with English as mother tongue. The result about the postgraduate degree is more counterintuitive. At first sight, we assumed that the finding was caused by postgraduate students applying to our programme when they wanted to "convert" to finance, having previously obtained a postgraduate degree in an unrelated subject. As a result, the previous degree might not give the student an edge over others with only an undergraduate qualification. But, we were puzzled to find that most postgraduate applicants have a postgraduate degree in a relevant subject, often an MBA. However, in such cases the performance of the students at the undergraduate level was frequently unimpressive. So, the small size and lack of significance of the coefficient of postgraduate degree holders (0.28) probably reflects the fact that the postgraduate degree was undertaken to boost the students' academic profile in order to increase the chances of employment and/or to gain access to a further postgraduate degree to which the students might not have been admitted on the basis of their undergraduate record alone.

Interestingly, the subject of the undergraduate degree does not have much explanatory power. Students with a more quantitative background (Mathematics, Engineering, Computer Science or Physics) perform marginally better than average (+0.82 marks). Those with a non-quantitative and non-finance background perform worse than average (-0.47), while those with a finance background perform close to average (-0.09). These results are not surprising given the significant quantitative content that finance courses may have at the post graduate level. However, the finding is interesting as it hints that the mathematical content of postgraduate finance may be more of a hurdle to finance undergraduates than the finance content may be to highly numerically skilled undergraduates with no finance background.

Another interesting question is whether students' background and demographic profile influence the likelihood that the students will fail in their postgraduate studies. We answer this question by computing conditional and unconditional failure rates for each of the categorical variables in the linear model. Unconditional failure rates as deviations

from the unconditional average failure rate are reported in Table 5. The results broadly confirm our previous findings. Students from Country 3, the best performing one according to the linear model, have a probability of failure that is 9.94% below average. The worst performing countries, Country 6 and 7, are also those with the highest failure rates standing at +12.83% and +14.66% above average respectively. Having a post graduate degree increases the probability of failure by 2.83% which confirms our previous conjecture about the average academic quality of such candidates. Non native English speakers are more likely to fail than the average by 1.6% and no work experience causes the failure rate to inflate by 2.95%. Having achieved an undergraduate degree from a third tier university pushes the failure probability up by 5.35% and having graduated with a below-B grade increases the chances of failure by 7.83%. Finally, a non-finance and non-quantitative background increases the failure rate by only 1.83%.

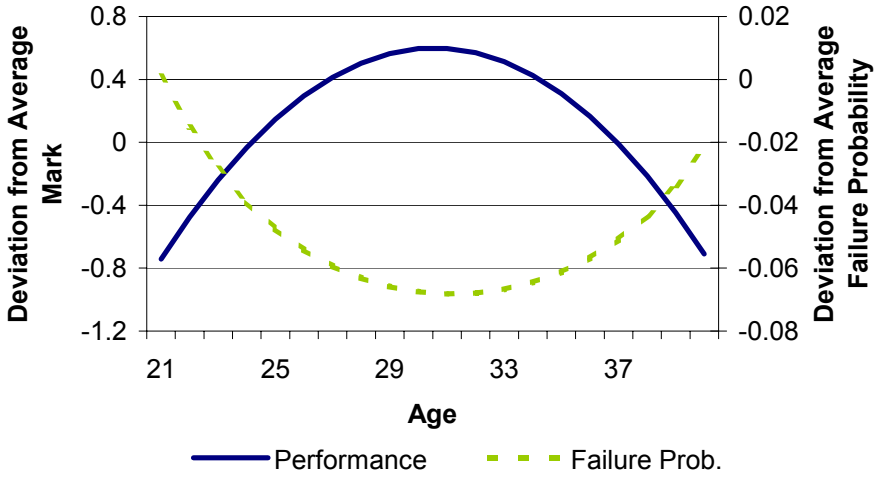
However, the point is whether the above deviations preserve sign and magnitude when we condition upon other factors and, if that is the case, whether they are significantly different from zero. To check this we analyse fails with a probit model. Results are reported in Table 6. Positive (negative) coefficients indicate an increase (decrease) in the probability of failure. Here Suits's constraints can not be used owing to the non-linearity of the probit model. Therefore, reported coefficient estimates are no longer deviations from the average student but deviations from the combined benchmark defined by the dummy variables we choose to omit. To help interpretation, however, we exclude those variables in each group of dummies that exhibit the lowest deviation from the unconditional failure rate shown in Table 5. In so doing, the benchmark becomes again the average student, even though now it is only approximately so. The approximation appears to be reasonable as shown by the marginal probabilities obtained from the probit model, which are often very similar to the unconditional ones.[9] The results show that among the countries with large deviations from the average, only the best performing country, Country 3, display a statistically significant coefficient. Worst performing countries (6 and 7) have a positive coefficient and hence a positive marginal probability

[9] Discrepancies between marginal probabilities and unconditional deviations from the mean failure rate are to be expected even if the average student was replicated perfectly in the probit model. This is because of the influence on the marginal probabilities of all the conditioning variables in the model.

of failure but they are not statistically significant. This is encouraging as it implies that although the performance of students from worse performing countries is systematically lower than average, as shown by the linear model, this does not necessarily translate in failure rates that are significantly higher than average. Again, the results implies that admission officers probably require sufficient "collateral" or additional evidence of academic strength before admitting weaker students.

The only significant background variables are work experience and the ranking of the undergraduate institution. Absence of work experience causes a higher failure probability (+4.74%) as do having graduated from a third tier university (+8.56). The sign of the coefficients of undergraduate classification is as expected (negative for A-grade students and positive for below-B grade students, which mean lower and higher failure rates than average respectively), but are not significant. Consistently with the liner model, as shown in Figure 6, the age at which the probability of failure is lowest is 31.

Figure 6. Age, Performance and Failure Probability



7. Conclusion

In this study we propose a method to detect inconsistencies in the selection process of international graduate students. Our approach may help admission officers to assess the

accuracy and comparability of student qualifications from a variety of geographical, professional and educational backgrounds. As a result one should achieve greater fairness in student admissions and prevent unintended discrimination against specific countries, especially when little or no information is available regarding the foreign education system and grading criteria. The analysis in this paper is simple and easy to implement and interpret which should make it attractive to both academic as well as administrative staff involved in admissions in higher education.

We find that the typical qualifications requested of international students for admission to postgraduate studies are not fully comparable across countries. We conclude that the ranking of the foreign institution that awarded the international applicants their first degree, the undergraduate classification achieved and work experience are the main factors admission officers should look at to compensate for any country bias. Indeed we find that these factors are the most important background variables in explaining performance. University ranking and work experience are also significant in explaining the probability of a student failing a postgraduate degree. Whether or not a student is a native English speaker or already possesses other postgraduate degrees do not seem to influence performance significantly. Also the area of undergraduate training does not appear to affect the performance nor the failure rate of our postgraduate students. Among the demographic variables, age is significant in explaining both performance and failure probabilities. The relationship between age and indicators of a student's academic ability is non linear. Best performance and lowest failure rates are achieved by mature students. We find the "golden" age to be 31.

Our investigation leads us to conclude that admissions is both an art and a science. It can and should use quantitative tools to check its impact on students' performance, and to prevent systematic errors in the selection process. But experience has taught us that selection and calibration processes require a degree of common sense and judgement that do not make it possible to handle such processes in a purely mechanical way.

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Table 1
Leading Countries of Origin in 2004/05

Ranking	Country of origin	No. of students	% of total int'l students
	Destination: US		
1	India	80,466	14.2
2	China	62,523	11.1
3	South Korea	53,358	9.4
4	Japan	42,215	7.5
5	Canada	28,140	5
6	Taiwan	25,914	4.6
	Destination: UK		
1	China	52,675	16.5
2	Greece	19,685	6.2
3	India	16,685	5.2
4	Ireland	16,345	5.1
5	US	14,385	4.5
6	Germany	12,555	3.9

Table 2
Cross Country Comparison of Undergraduate Grading Schemes

	GPA (4 point scale)*				
	3-4	2-3	1-2	0-1	
	Letter scale				
Country name	A	B	C	D	**Comment**
Belgium	100-90%	90-70%	70-60%	60-50%	
Canada	GPA: 3.7/4. 100 point scale: minimum 83%. 10 point scale: minimum 8/10	GPA: 3.0/4. 100 point scale: minimum 70% when pass is 50% or 75% when pass is 60%. 10 point scale: 6.5/10	GPA: 2.0/4. 100 point scale: minimum 60% when pass is 50% or 65% when pass is 60%. 10 point scale: 5.0/10	GPA: 1.0/4. 100 point scale: minimum 54% when pass is 60%. 10 point scale: 3/10	We find three types of grading scale in Canada. A 4 point GPA scale, a 100 point scale and a 10 point one. Variations in interpretation within each scale are also possible.
China	100-90%	90-80%	80-70%	70-60%	There are approximately 1000 NARIC recognised institutes in China. Some higher ranking universities adopt a different grading scheme, for example Peking and Shanghai Jiatong Universities use the following scheme: 85-100: A Grade, 75-84: B Grade, 60-74: C Grade, 0-59: D Grade.
France	Très bien (20-17)	Bien (17-13)	Assez bien (13-12)	Passable (12-10)	The 20 point scale can vary considerably by institute. Some higher ranking Universities will issue relatively lower results so that a 12/20 could be considered for entry to a postgraduate programme in the UK.
Germany	1-2	2-3	3-4	4-5	
Greece	10-8	8-7	7-6	6-5	The American College of Greece uses the 4 point grading scale of US universities
Hong Kong	1st (4)	2:1 (3)	2:2 (2)	3rd (1)	
India	1st Division/ Class with Distinction (70%+)	1st Division/ Class (60%+)	2nd Division/ Class (50%+)	3rd Division/ Class (40%+)	
Ireland	1st	2:1	2:2	3rd	
Italy	na	na	na	na	"The final standard of degree is shown as the aggregate of individual marks ranging between 66-110. According to the 1995 national statistics, the average mark for the Diploma di Laurea is 104. Sometimes the degree is awarded "con lode/cum laude" and, exceptionally, "con lode e pubblicazione" which implies publication of a thesis. These two can be taken as marks of distinction. Marking of individual examinations taken during the degree course is on a scale of 0-30 with 18 as the minimum pass-mark." Source: NARIC UK
Japan	100-80%	79-70%	69-60%	0-59%: FAIL	
Malaysia	1st	2:1	2:2	3rd	The International Islamic University uses a different grading scheme: 4: A Grade, 3.5-3.9: B+ Grade, 3.0-3.4: B Grade, 2.5-2.9: C+ Grade, 2.0-2.4: C Grade, 0.0-1.9: F Grade
Netherlands	10-9	9-8	8-7	7-6	
Nigeria	1st (5-4)	2:1 (4-3)	2:2 (3-2)	3rd (2-0.5)	
Pakistan	Division 1 (4-3.5)	Division II (3.5-2.5)	Division III (2.5-1.5)	Pass (1.5-1)	
Portugal	20-18	18-16	16-14	14-10	
Spain	10-9	9-7	7-6	6-5	
Taiwan	100-80%	80-70%	70-60%	60-50%	National universities are believed to have higher academic standards than private colleges.
UK	1st	2:1	2:2	3rd	
US	4-3	3-2	2-1	1-0	

Note: * GPA scales vary both across countries and across institutions within the same country. Comparisons between GPA and letter grade also vary across institutions. In this table we show how GPAs are typically, but not always, converted into letter grades.

Table 3
Description of Demographic and Background Variables

Variable	Description
	Demographic variables
Country	Dummy variables referring to the country of the undergraduate institution from which the student graduated.
Gender	Dummy variable that takes the value of 1 when the student is female.
Age	Age of the student at the start of our postgraduate programme.
	Background variables
Grade	Grade achived by the students in their undergraduate studies. Three classifications are considered, A (very good), B (good) and below B.
Ranking	Ranking of the undergraduate institution from which the students graduated. Within any given country we distinguish among top third, second third and bottom third institutions.
UG degree subject	We distinguish among three broad areas: (a) Finance, Economics, Marketing, Management and Accounting, (b) Mathematics, Statistics, Physics, Engineering and Computer Science and (c) any other subject.
PG degree	Dummy that takes a value of 1 if a student already possess a postgraduate degree.
Language	Dummy that takes a value of 1 if a student is a native English speaker or if they completed their first degree in a university in which all courses are taught in English.
Work Experience	Dummy that takes a value of 1 if a student has work experience, regardless of area of length of placement and occupational area. Summer internships are not considered.

Table 4
Linear Regression Model

The table reports coefficients and p-values of the linear performance model. The marking scale is from 0 to 100 and betas represent deviations from the average mark. P-values are computed from t-statistics calculated with autocorrelation and heteroscedasticity adjusted standard errors (Newey-West). *,**,*** denote statistical significance at the 10%, 5% and 1% significance level respectively.

Variable	Beta	Two-sided p-value
Age	0.90*	0.0865
Age^2	-0.01*	0.0590
Country 1	1.16	0.4350
Country 2	-1.92*	0.0866
Country 3	5.71***	0.0000
Country 4	-0.66	0.7058
Country 5	1.78	0.6257
Country 6	-4.74**	0.0443
Country 7	-4.10**	0.0110
Country 8	0.78	0.4164
Country 9	2.96**	0.0467
Country 10	-0.43	0.6428
2002/03	0.18	0.7782
2003/04	-0.68	0.3386
2004/05	2.35***	0.0001
2005/06	-0.94	0.1517
2006/07	-1.30	0.1403
PG Degree Yes	0.28	0.7860
PG Degree No	-0.04	0.7860
English Yes	0.09	0.9112
English No	-0.10	0.9112
Work Experience Yes	1.08***	0.0010
Work Experience No	-1.27***	0.0010
Ranking: 0-33%	1.08***	0.0001
Ranking: 33%-66%	-1.94**	0.0268
Ranking: >66%	-2.83***	0.0013
A-grade	3.45***	0.0000
B-grade	-0.82***	0.0010
<B-grade	-0.95	0.3418
Female	0.45	0.3757
Male	-0.21	0.3757
UG Degree: Finance	-0.09	0.6461
UG Degree: Maths	0.82	0.4513
UG Degree: Other	-0.47	0.7475
Adjusted R-squared	0.119	

Notes: The regression constant is not reported for confidentiality reasons. The linear restrictions imposed on the model (see discussion in the text) imply that dummies from the same group with only two variables in their group (i.e. gender and YES/NO dummies) will have the same p-value.

Table 5
Unconditional Failure Rates

This table shows unconditional failure rates as deviations from the unconditional average failure probability.

Variable	Deviation from Average Failure Prob., %
Country 1	-4.06
Country 2	3.93
Country 3	-9.94
Country 4	-4.89
Country 5	-3.83
Country 6	12.83
Country 7	14.66
Country 8	-0.82
Country 9	-2.86
Country 10	-2.28
2002/03	-4.89
2003/04	0.18
2004/05	-6.40
2005/06	7.47
2006/07	5.48
PG Degree Yes	2.83
PG Degree No	-0.44
English Yes	-1.45
English No	1.60
Work Experience Yes	-2.51
Work Experience No	2.95
Ranking: 0-33%	-1.59
Ranking: 33%-66%	1.02
Ranking: >66%	5.35
A-grade	-5.32
B-grade	0.29
<B-grade	7.83
Female	-0.82
Male	0.38
UG Degree: Finance	-0.10
UG Degree: Maths	-0.34
UG Degree: Other	1.83

Table 6
Probit Model of Conditional Failure Rates

The table reports coefficients and p-values of the probit model used to estimate conditional failure probabilities. P-values are computed with robust (Huber-White) standard errors. *,**,*** denote statistical significance at the 10%, 5% and 1% significance level respectively. Marginal probabilities are derived as in equation (3) in the text.

Variable	Beta	Two-sided p-value	Marginal Probability, %
Age	-0.2687***	0.0064	-
Age^2	0.0043***	0.0046	-
Country 1	-0.3184	0.3216	-3.96
Country 2	0.2441	0.4804	4.08
Country 3	-0.9868*	0.0601	-8.19
Country 4	-0.2716	0.3635	-3.52
Country 5	-0.0227	0.9734	-0.34
Country 6	0.7562	0.1072	17.94
Country 7	0.5768	0.1567	12.20
Country 9	0.0683	0.8668	1.09
Country 10	-0.1621	0.6081	-2.27
2002/03	-0.4160**	0.0312	-5.42
2004/05	-0.5817***	0.0057	-7.05
2005/06	0.2265	0.2045	3.77
2006/07	0.0418	0.8467	0.65
PG Degree Yes	0.1445	0.4833	2.37
English No	0.0968	0.7540	1.48
Work Experience No	0.3041**	0.0145	4.74
Ranking: 33%-66%	0.0975	0.6312	1.56
Ranking: >66%	0.4609***	0.0039	8.56
A-grade	-0.2700	0.1719	-3.68
<B-grade	0.2971	0.1116	5.31
Female	-0.1073	0.4875	-1.59
UG Degree: Maths	-0.0434	0.8303	-0.65
UG Degree: Other	0.1961	0.4467	3.41
McFadden R-squared	0.122		

Notes: The regression constant is not reported for confidentiality reasons.