Subject Specific League Tables and Students' Application Decisions

Arnaud Chevalier
IZA

Xiaoxuan Jia*
Anglia Ruskin University, and Royal Holloway, University of London

Abstract

Do applicants to higher education rely on expert judgement about the quality of the course when applying? Using application data across UK universities over a period of 8 years, we investigate how league tables affect prospective students' application decisions. We use subject specific ranking rather than the commonly used institution level ranking. We find that a one standard deviation change in the subject-level ranking score of an institution is associated with on average a 4.3% increase in application numbers per faculty. This effect is particularly pronounced among faculties with the best scores, and overseas applicants. Limits to the number of applications have increased the preponderance of league tables.

JEL codes: I23

Keywords: Higher education applications, league tables

* Corresponding author. xiaoxuan.jia@anglia.ac.uk
Chevalier is also associated to Royal Holloway, University of London, Geary (Dublin), ROA (Maastricht) and SFI (Copenhagen)
The data are collected from the Guardian and UCAS websites, neither of these organisations can be held accountable for the conclusions of this manuscript. The manuscript is part of Jia's PhD thesis. We want to thank the editor and 2 anonymous referees, Jonathan Wadsworth and participants at the Royal Economic Society and WPEG (Sheffield) conferences for comments on previous versions of the manuscript.

I. Introduction

Higher education is an experience good for which it may a-priori be difficult to evaluate its quality, especially when it varies both between but also within provider; i.e. quality might be subject specific. Since in the UK higher education quality has been linked to future higher earnings for graduates (Chevalier, 2014), there should a strong demand by applicants for private third parties evaluations of the said quality. Indeed a number of British media publish university league tables[1] every summer to help prospective students; each of them differs slightly in terms of methodology but all attempt to approximate the quality of degree courses based on a set of objective criteria.

The onus of a league table is to provide information on 'quality' that prospective students find useful when making their decisions about where to apply. While some in the sector view league tables as a limited and somewhat noisy signal of quality (HEFCE, 2008), previous research found that an improvement in the rankings is associated with an increase in the number of applications received (Sauder and Lancaster, 2006; Bowman and Bastedo, 2009; Soo and Elliott, 2010; Broecke, 2012), highlighting their importance to prospective students. However, the literature relies either on institutional-level rankings or a limited group of subject. These may thus be biased if there is heterogeneity in the quality of different subject within an institution.

This paper contributes to the literature in three distinct ways. First, we estimate the elasticity of demand for higher education at the subject level and not at the institution level[2]

[1] The Times university rankings were first published in 1992, the Sunday Times introduced theirs in 1998, the Guardian followed in 1999 and the Complete University Guide (the Independent) in 2007.
[2] A recent manuscript by Gibbons et al (2014) also uses subject level information but relies on the National Student Survey, a national survey of finalists, to approximate quality. This measure obviously correlates with league table scores since it is used as one of the input in producing them.

and assess the extent of the bias in estimates of the ranking effect on application numbers resulting from measuring quality at the institution level.

Second, we investigate whether the relevance of information on degree programme quality changes when the institutional framework changes. In particular we examine two important changes: i) the 2004 Higher Education Act amended the financing of higher education in England and lifted the maximum tuition fees for home and EU students from 2006 onwards, ii) starting from 2008, the maximum number of choices (university/degree programme) per applicant was reduced from 6 to 5. Both events should increase the demand for information on quality and thus the demand elasticity with respect to league table.

Third, we test for heterogeneity in the impact of league tables by focusing on different types of applicants. In particular, since the UK is one of the main destinations for international students we test whether overseas applicants have a greater demand for information as they have more limited knowledge of the UK higher education sector.

Since applicants' decisions are primarily bound by their preferences for the subject they intend to study (Roberts and Thompson, 2007; HEFCE, 2008), we collected data on application numbers at the subject level ((Joint Academic Coding System, JACS) for each British higher education institution for the period 2004 to 2011, from the Universities and Colleges Admissions Service (UCAS). UCAS centralises all applications to under-graduate courses, as such we observe the universe of applications, apart from prospective students applying through clearing. In some of our models, we disaggregate this data by geographic origin (home, EU, non-EU) and/or gender of applicants. We match this data on number of applicants to subject specific league tables. We rely on the most popular league table,

provided free of charge by the Guardian newspaper[3]. We then use fixed effect models, where the identification comes from variations in the subject quality score over the years, and estimate that when an institution's subject ranking score improves by one standard deviation, degree application numbers increase on average by 4.3%. There is also heterogeneity by institutional regime (reducing the maximum number of applications per candidate increased this elasticity), by origin (non-UK domiciled applicants are more responsive to changes in the ranking score), by subject groups (Arts applicants are less responsive) and by initial position (larger for institutions with higher ranking scores). We also report that estimates of the elasticity of demand with regards to quality are biased when quality is measured at the institutional level. The results are robust to various specifications of time and quality measures.

The rest of the manuscript is organised as follows. The next section reviews the literature on the influence of university league tables on higher education demand. The third section details the institutional set-up of higher education in the UK and describes the data. The fourth section presents the model and research method and section five details our findings. The last section provides the conclusion.

II. Literature review

The literature on university rankings mostly originates from the U.S. and the U.K.. Monks and Ehrenberg (1999), Sauder and Lancaster (2006), Griffith and Rask (2007), Bowman and Bastedo (2009), Luca and Smith (2013) studied the effect of the U.S. News and

[3] Circulation figures of The Guardian online edition show it surpasses both The Times and The Sunday Times, and according to figures released by the newspaper, its annual university guides attract 370,000 users (online) a month. See http://image.guardian.co.uk/sys-files/Guardian/documents/2010/09/13/UniversityGuide.pdf, and February 2010 circulation figures for Guardian newspaper online edition http://news.bbc.co.uk/1/hi/8588432.stm.

World Report Rankings (USNWR) on students' application decisions and institutions' admission behaviours. The USNWR divides American universities and liberal arts colleges into four tiers; institutions in the top tier are ranked, the remaining institutions are listed alphabetically per tiers. This literature has generally concluded that improvements in the ranking are associated with increased number of applications, increased selectivity and increased conversion of accepted applications (Monks and Ehrenberg, [1999], Sauder and Lancaster [2006]). Bowman and Bastedo (2009) showed that institutions moving into the top tier of the USNWR see a 3.9% increase in the number of applications received, and an increase of 1.2 point in incoming students' average SAT scores. Using individual-level applicant data, Griffith and Rask (2007) analysed the effect of USNWR on students' enrolment decisions and report that an institution ranked in the top 20 will see a 0.45% change in accepted students' probability of enrolment for each one unit change in rank. Using application data to the top 50 universities, Luca and Smith (2013) estimated the impact of USNWR rankings from changes in the ranking methodology, i.e., institutions' rank changed without any change in underlying quality. They find that a one unit improvement in rank leads to one percentage point increase in the number of applications. To summarise the US findings, the USNWR rankings affects top-tier institutions the most, with the most responsive students being the most able.

For the UK, Broecke (2012) used individual-level data for home applicants and a set of different ranking providers, and found that on average an institution experiences a fall of 100 applications for each 10 places it drops in a league table. His findings also suggest heterogeneity in the impact of rankings across applicants; with male, young, Asian, high-achievers, higher socio-economic classes, and privately educated applicants being more responsive. Using student satisfaction scores published in the National Student Survey (NSS)

and the Times university rankings as measures of quality, Gibbons et al. (2013) find that a 10 percentage points increase in NSS score leads to a 2.3% increase in applications, whereas a 10-percentile improvement in the Times (subject-level) ranking score increases the number of applications by 1.5 to 2%. However, they find that NSS score affects applications via its impact on universities' league table positions. In addition, they also found that changes in Times (subject-level) rankings matters more to better ranked institutions.

While most previous studies have relied on static panel and fixed effect models, Soo (2013), used dynamic panel data analysis, and found that changes in the Sunday Times overall rankings as well as changes in entry requirements have no significant impact on applications numbers but found strong inertia in application numbers. Soo and Elliott (2010), like us, investigates subject specific rankings but only for overseas students in two subject areas: Business and Engineering. From this limited unrepresentative population, they found that overseas Business application numbers vary between 0.5% to 0.9% for a one unit change in subject rank. We expand this work by looking at all subject and applicant groups.

III. Institutional set-up and Data

3.1 Institutions

Higher education reforms since the mid-eighties, particularly after the 1987 White Paper and the 1992 Further and Higher education Act, have created an increasingly competitive market for higher education in the UK. Applicants have a large number of institutions/degree courses to choose from, and institutions compete to attract them. As participation to higher education increased throughout the nineties, the model of public financing of higher education became un-sustainable; income per under-graduate student

dropped from £8,000 in 1980s to £4,850 in 1997 (Wyness et al., 2011). To limit the burden of higher education on public finances and improve funding, maintenance grants were abolished and an up-front fee of £1000 was applied to new undergraduate students from 1998 onwards. In 2004, a new round of funding reforms were announced replacing up-front tuition fees with a tuition fee of up to £3000 payable from an income-contingent loan (Higher Education Act, 2004)[4]. The tuition fee reforms differ somewhat in Wales and Scotland. Tuition fees went up to £3000 in Wales in 2007 but Welsh students studying at Welsh institutions benefited from a grant of around £2000 towards their tuition fees till 2010[5]. Scottish students studying in Scotland benefited from free education but had to pay an end of study endowment of £2,000 up to 2007[6]. Institutions in Northern Ireland followed the same institutional framework as English institutions during the period of interest. These differences in fee regimes will be mostly captured by institution specific time trends and our results are robust to restricting the sample to English institutions only[7].

For the period of interest, universities received payments from the central government via the Higher Education Funding Councils, based on their number of home and EU students. This funding was fixed by the government, implicitly fixing the number of home and EU students by institutions. The maximum tuition fees that institutions can charge were also fixed. As such, to increase funding, institutions have over time expanded their programmes to overseas students for which numbers and tuition fees are not capped. As a result, the number of overseas students studying at UK universities almost tripled between 1994/95 and 2009/10 (Universities UK, 2011). Having less prior information on degree programmes

[4] Further funding reforms were implemented in 2012 which increased the tuition fees cap to £9,000, but this does not directly affect the cohorts investigated here.
[5] For Wales, http://www.studentfinancewales.co.uk/continuing-students/201415-what-financial-support-is-available/tuition-fee-support.aspx#.VMz7Y2Byb4g, and http://www.bbc.co.uk/news/education-11515828,
[6] Scottish Parliament Information Centre Briefing on Graduate Endowment, http://www.scottish.parliament.uk/ResearchBriefingsAndFactsheets/S3/SB_07-54.pdf
[7] The data does not allow us to distinguish applicants from the 4 constituent countries of the UK, but there is little mobility across the Scottish border apart from students from Northern Ireland.

at UK universities and paying higher fees, it is possible that they are more reliant on league tables as an indicator of quality.

For full time undergraduate degrees, the U.K. university application process is centralised. Prospective students apply via the Universities and Colleges Admissions Service (UCAS), which passes their applications to universities for them to decide whether an offer is made. Until 2007, each applicant, regardless of domicile was allowed a maximum of six program choices (institution-subject). This was reduced to five in 2008[8]. As such we can define three regimes: top-up fees and 6 applications until 2005, tuition fees and 6 applications in 2006 and 2007, and tuition fees and 5 applications since 2008.

3.2 Data

The data originate from two main sources: the UCAS annual report which provides aggregate level data on application numbers[9] by institutions, JACS (Joint Academic Coding Systems) subject groups and student origin and gender, and the Guardian subject-level rankings across more than 40 different academic disciplines[10]. We only keep applications to full time undergraduate degrees for the years 2004 to 2011. Figure 1 presents the trends in the number of applications submitted every year from 2004 to 2011, by applicants' geographic origins. Overall, applications have increased throughout the period of interest to reach 2.4 million, with the rise being the steepest for students originating from the EU. The two dips in the overall number of applications coincide with the increase in tuition fees from £1000 to £3000 in 2006 and the change in the UCAS application systems in 2008 which saw

[8] Applicants to Oxford or Cambridge universities can only apply to one of the two institutions, not both, and are further restricted to four choices only. Applicants to medical schools and veterinary schools are also limited to four choices. These applications must be completed by the autumn preceding entrance to higher education.

[9] The data excludes clearing applications since those are not centralised via UCAS.

[10] These were obtained from the education section of the Guardian website with the exception of the 2009 ranking which we took from the printed edition of the Guardian University Guide. We have not been able to track down the Guardian data before 2003. (2004 rankings were published in 2003).

the number of choices per applicant restricted from 6 to 5. The trends by origin of applicants are fairly similar, even if the levels are very different.

[Figure 1 here]

Although recent surveys suggest an increasing number of prospective students refer to league tables before making their decisions (Roberts and Thompson, 2007; HEFCE, 2008), such league tables have attracted much criticism about their accuracy and reliability. The main gripe with league tables is that the methodology employed changes over time and hence they do not capture changes to the true quality of programmes (HEFCE, 2008). For this paper, we do not take side in this debate regarding the merit of methodologies used to construct league tables but only use them as a source of information available to prospective students. Gunn and Hill (2008) find high and significant level of correlation between league tables across different publishers (the Telegraph, the Financial Times, the Guardian, the Sunday Times and the Times). Our choice of the Guardian league tables to conduct this research is no endorsement that it provides a more accurate measure of educational quality, but only reflects that it is easily accessible and currently the most popular ranking (see footnote 3).

The methodology behind the Guardian league tables has changed over time (see table A1 in Appendix). The most recent set of criteria used to construct them includes *expenditure per student*, *student staff ratio*, *job prospects*, *value added*, *entry tariff*, *course satisfaction* (from the annual National Student Survey (NSS)), *teaching quality* (from NSS), and *feedback* (from NSS). Compare to most of the literature we use ranking scores rather than ranks since each subject has different numbers of institutions offering them, making rank comparisons between subjects meaningless. The National Student Survey became an input in the ranking score in 2008 and brought substantial changes to the set of criteria used, which then led to

noticeable changes in the mean subject (group)-level ranking scores[11]. With this in mind, we standardised the subject-level Guardian ranking score by year and subject groups in all of the regressions, to make the mean value consistent throughout the period.

Over the period 2004 to 2011, the list of subjects covered by the Guardian league tables changed somehow. When subjects were merged, we take the average score across the two subjects in the years that they were treated independently to create a consistent series. These subject tables were then collapsed further to form new league tables based on the list of JACS subject groups used by UCAS, details of which is provided in Appendix 3.

The Guardian does not rank all UK higher education providers but has a focus on institutions catering for full time undergraduate education. It also omits institutions which decline to provide the full set of information and courses with less than 35 full-time equivalent students. Finally, there were some consolidations of the higher education sector over the period; in such cases, we treat the institutions as separate before the merger and as a new institution afterwards[12]. We then merge the UCAS application number and guardian league table information taking care that information on league tables published in year t (and named Guardian ranking year t+1) is linked to applications in year t+1. The final data is an unbalanced panel with gaps; there are 162 institutions across 8 years, and 17 subject groups in total, which give us a sample of 10,753 observations. The split of observations by subject and year is available in Annex 2. Table 1 contains the summary statistics of the main time-varying variables (raw data, not standardised) at various levels of dis-aggregation, and shows that faculties receive on average 1,400 applications, 16% of which are from foreign applicants (EU and Non EU).

[11] We attempted to use change in methodology as an exogenous shock to ranking, independently of true quality. To do so, we replicated the 2008 rankings using the 2007 methods. Unfortunately, the information publicly provided does not allow to replicate grading scores or ranking.

[12] Institutions that changed name are recoded as the same institution throughout.

[Table 1 here]

IV. Model

We estimate whether the number of applications to a given subject-group *(i)* at a given institution *(u)* in period *(t)*, y_{iut} is a function of the subject group-level Guardian ranking score/ranks (x_{iut}). The main equation depicting the relationship is

$$\log(y_{iut}) = \beta_1 X_{iut} + \alpha_i + \delta_{iu} + f(T_t) + \varepsilon_{iut} \qquad (1)$$

where: α_i is the subject fixed effect, δ_{iu} is the faculty fixed effect, where faculty refers to subject group *i* at institution *u*, $f(T_{tu})$ is a function of time that includes either year dummies, a linear trend or institution specific trends. Dummies reflecting institutional environment (fees regime and maximum number of choices regime) were also added in some specifications, and ε_{iut} is the random error term. The main coefficient of interest to be estimated, β_1, represents the percentage change in the number of applications associated with a one standard deviation change in the ranking score X_{iut} (about 8 points in the ranking score).

Any correlation between the ranking score and unobserved variables (such as reputation of the faculty, location of the university, etc.) is assumed constant over time and accounted for by the faculty-level fixed effect[13]. Standard errors are clustered at the institutional level to control for within-institution correlations[14]. The model is identified by changes in the ranking score for a given faculty over time, as such it is crucial to assess that there is enough within faculty variation. This is explored in Figure 2 which plots for each

[13] We use the Hausman test to verify the appropriateness of the specification and the result shows the null hypothesis of no systematic difference between fixed and random effects estimates is rejected, which confirms fixed effects is preferred as the consistent estimator to be used here.
[14] Clustering at the faculty/institution level produces similar standard errors.

institution/subject pair the mean and standard deviation in Guardian ranking score. The average variation is around 8 points with a few outliers, as such subject specific scores appear to vary substantially over time.

[Figure 2 here]

V. Results

5.1 Main results

In Table 2 we present results using different treatment of the time effect. The first column uses year dummies to account for year-on-year changes in the number of applications. We estimate that when the subject group-level Guardian ranking score improves by one standard deviation, the number of applications received increases by 4.2%. In the second column, we reduce the flexibility of the model by imposing a linear time trend and dummy variables for years under different tuition fees regime and maximum number of applications allowed. The fee increase and the cap on number of applications reduced the total number of applications by 14% and 21% respectively, but the coefficient estimate for the score variable remains the same. In column 3, we estimate the fully flexible model specified above and include institution specific linear trends. An F-test of equality of the time trends between institutions is rejected, confirming that models using only faculties and year fixed effects are biased, as such this is our preferred specification. Note that the R-square also doubles when this specification is used. The estimates are extremely stable to the treatment of the time effect and range from 4.2% to 4.3% change in application numbers for a one standard deviation change in Guardian ranking score.

- Table 2 here -

We then test whether the effect of ranking score on applications has changed over time, especially following the aforementioned institutional reforms, tuition fee increase and restriction on application choices, which should have increased the demand for information about course quality. We thus interact the ranking score with a dummy for the higher fee regimes (post-2006) and with a restricted choice dummy (post-2008). Results are presented in Table 3 Column 1. Only the interaction of score with the reduction in the number of applications per candidate is significant and positive, increasing the elasticity of application with respect to quality by 2 percentage points[15]. In the second column, we report estimates for an even more flexible model, using year dummies and their interactions with the ranking score. These interactions overall are statistically significant as shown by the F-test, and confirm that the demand for quality information sharply increased in the two years following the reduction in the number of choices allowed before going back to trend. Overall the evidence appears consistent with our assumption that in the short-run the demand for information grew when the returns to information increased.

- Table 3 here -

We then turn to assessing heterogeneity in the impact of ranking score for applicants of different geographic origins (domiciles) and gender. Non-UK students typically have less a-priori knowledge about the quality of various institutions, so one may expect them to be more reliant on external information, as published in various university guides, and consequently be more sensitive to changes in the ranking scores. In addition, while EU students pay the same fees as home students, those from outside the EU are not publicly subsidized and face uncapped tuition fees (typically around £10,000 for this period), which

[15] Additionally, we tested incorporating each interaction separately to the model, the effects are then larger, and the change in fees interactions becomes marginally significant. A three-way interaction of *fee increase*, *ranking score* and *limit on choices* again reveals positive but not statistically significant results and the three ways interactions terms are not substantially different from those presented.

should also make them more sensitive to changes in 'quality'. We split the applicant cells by the geographical origin of applicants, and interact the standardised ranking score with applicants' domiciles (Column 3)[16]. The results confirm that changes in the ranking score have a disproportional effect on non-UK students. While a one standard deviation change in the ranking score marginally increases the number of British applications by 1.8%, for EU and non-EU applicants this stands at 5.8% and 7.4% respectively. Overseas applicants are 4 times more sensitive to change in quality information which could reflect the higher costs of education or their lack of initial information. These differences in the effect of ranking score on applications by applicants origin are large and significant different from each other (Chow test F=11.93)

Finally, we test whether there is any heterogeneity in the response to quality information changes by gender. To do so, we split the applicant cells by gender and include an interaction term of ranking score and gender. The last column in Table 3 reports results from this model which reveals no significant difference in behaviour by gender.

In Table 4, we assess whether the impact of the ranking score differs for applicants to different subject groups. For doing so, we interact of each subject group with the standardised Guardian ranking score. We find little difference in the responsiveness of prospective students to quality score across subject groups. The only exception being Creative Arts & Design, which has a slightly different application process, whereby applicants provide a portfolio demonstrating their artistic competence. As such, they probably gather information about the quality of the institutions at this stage. Alternatively, they might have strong preferences for being taught in a given university where the faculty

[16] Conclusions are similar if the analysis is run for each group separately.

better match their artistic interest, which could make them less sensitive to changes in ranking scores.

- Table 4 here -

Finally, we test whether information on educational quality is more valuable when the higher education market is more crowded. For doing so, the standardised ranking score is interacted with the number of institutions offering the subject (group). The second column of Table 4 reports these estimates. We can reject this hypothesis since the number of institutions reported in a subject (group)-specific league table does not affect the impact of the ranking score. Perhaps this is not entirely surprising, since the subject group used in this analysis are quite broad and the model includes subject fixed effects, as such the effect on number of institutions is identified from changes in the number of providers per subject which does not vary substantially from year to year.

Finally, we assess possible non-linearity in the relationship between quality score and application numbers. More talented applicants who typically apply to better ranked institutions may be more sensitive to information that suggests change in `quality' of those institutions. Figure 3 shows estimates of the quality effect at each decile of the quality distribution. There is some evidence of non-linearity. The effect of a score improvement in quality is greater for departments in the top three deciles of the quality distribution, and especially for the top one. Like previous U.S. and British studies have shown for institution quality, the impact of information on course quality is non-linear and increases sharply at the top, this is also true when quality is measured at the subject level.

- Figure 3 here -

Overall, it appears that the reaction to a change in quality information is broadly similar between subjects (with the exceptions of Creative Arts & Design) and gender, and that the only heterogeneity originates from applicants' geographical origin, whereby applicants with the least a-priori knowledge of British institutions and paying higher fees are more sensitive to quality information. The effects are also much stronger for institutions moving to the top deciles of the quality distribution.

5.2 Robustness checks

In this section, we conduct various robustness checks of our specification (Table 5). First, we assess whether the results are sensitive to the use of rank rather than ranking score. The reason for focusing on ranking score is that rank is difficult to interpret when the number of Higher Education providers differs between subject groups. To compare with the rest of the literature we re-run our favoured specification using subject (group) rank as the independent variable, and estimate that a one unit changes in rank is associated with a 0.1% change in application numbers (Column 1). The estimated results are rather small compared to Soo and Elliott (2010) which may be driven by Soo and Elliott (2010) focus on overseas applicants only, a group that has a greater elasticity to quality information. To attenuate our concerns that rank is sensitive to the number of competitors, we change the dependent variables to market share in the specific subject group, i.e. we implicitly control for the number of competitors (Column 2). This has little effect on the size of the estimated coefficient.

To interpret the size of the coefficients on rank in terms of the number of applications, we find that a 10-place change in rank, for an institution with on average 11 subject groups, will lead to a fall on average of 183 applications. This is significantly higher than Boecke (2012), where a 10 place change in rank is associated with a drop of 100 applications, and is

consistent with the hypothesis that institutional level analysis on the impact of rankings could be biased due to the fact that they do not account for heterogeneity in the quality of different subjects an institution offers. To further test whether applicants put more weight to the subject or institution-level ranking score, we include both in the model. The results confirm that applicants are more focused on the subject specific quality information. A one standard deviation increase in quality score has a 25% larger effect on number of applications when quality is measured at the department rather than the institution level. This jumps to 50% when ranking score rather than ranking is used as a measure of quality. This is consistent with the findings of Roberts and Thompson (2007) that applicants are mostly focused on subjects rather than institutions. As such, previous research has largely underestimated the effect of quality information on the decision of applicants.

Finally, as detailed in the institutional set-up, Welsh and Scottish institutions adopted different tuition fees regimes compare to their English counterparts during the period of interest. We re-run our favoured specification using English institutions only (column 5). The estimated coefficient remains very stable and marginally increases to 4.5%, for a one standard deviation change in ranking score.

VI. Conclusion

Do prospective students care about league Tables? Using data from the UK which allow us to observe all applications and detailed information on ranking scores at the subject level, we find that a one standard deviation improvement in the subject-level ranking score increases the number of applications by 4.3% in our favoured specification. The underlying information of the ranking score became more important, as the maximum number of choices allowed per applicant was curtailed, and for better ranked faculties. This is

consistent with previous findings that change in quality matters especially at the top. We find weak evidence of heterogeneity by subject groups but noticeable differences by prospective students' geographic origin. Non-British applicants, especially those paying the highest tuition fees, are four times more sensitive to information on the quality of the higher education. Finally, previous research, by focusing on institution level ranking, has underestimated the effect of league tables on applications; applicants are 50% more sensitive to information at the department level than at the university level.

Should institution care about their ranking? We now conduct some back of the envelope calculations to assess the size of the reported effects for an average institution. For the period covered in the data, numbers of home and EU students at each university were controlled and the only free market was for overseas students (assuming no visa restriction). An improvement in the Guardian ranking score of one standard deviation would lead to a 7.4% change in overseas applications, or 10.5 additional applications from overseas students per faculty, at the mean. With a conversion rate of 17% (computed from UCAS report), this loosely translates to an additional two students enrolled and £20,000 additional revenue per subject group, which does not appear very substantial. However, recent reforms have eliminated the caps on number of home students. Taking our overall estimates, the average 4.3% change in applications for a one standard deviation improvement in Guardian ranking score represents an additional 60 applications received by faculty. Given the current level of tuition fees and a conversion rate of applications to students of 20%, this loosely translates into a change in income of £108,000 for each subject group per year or £1,512,000 per institution, on average, or roughly a 1% increase in income[17]. The direct immediate impact on an institution's budget from variation in Guardian ranking score thus appears quite limited.

[17] The average institutional income is £168 million in the 2010/11 academic year (HESA).

References

Bathmaker, A.M. (2003) The Expansion of Higher Education: A Consideration of Control, Funding and Quality IN Bartlett, S. and Burton, D. (eds) Education Studies. Essential Issues, London: Sage, pp.169-189

Bowman, N. A., and Bastedo, M. N. (2009) Getting on the Front Page: Organizational Reputation, Status Signals, and the Impact of U.S. News and World Report on Student Decisions. *Research in Higher Education*, 50, 415-436

Broecke, S. (2012). University rankings: do they matter in the UK?, *Education Economics*, 20, 1-25

Chevalier, A. (2014) Does Higher Education Quality Matter in the UK?, *Research in Labor Economics*, 40, 257-292

Dearden, L., Fitzsimons, E., and Wyness, G. (2011) The Impact of Tuition Fees and Support on University Participation in the UK. IFS Working Papers, W11/17

Gibbons, S., Neumayer, E., and Perkins, R. (2013) Student satisfaction, league tables and university applications, Spatial Economics Research Centre SERCDP0142, London School of Economics

Griffth, A., and Rask, K. (2007) The influence of the U.S. News and World Report collegiate rankings on the matriculation decision of high-ability students: 1995-2004. *Economics of Education Review*, 26, 244-255

Gunn, R., and Hill, S. (2008) The Impact of League Tables on University Application Rates. *Higher Education Quarterly*, 62(3), 273 – 296

HEFCE (2008) Counting what is measured or measuring what counts? League tables and their impact on higher education institutions in England. April 2008/14. Issue Paper.

HEFCE (2010) Guide to funding: How HEFCE allocates its funds. September 2010/24

Luca, M., and Smith, J. (2013) Salience in Quality Disclosure: Evidence from the U.S. News College Rankings, *Journal of Economics and Management Strategy*, 22(1), 58 – 77

Monks, J., and Ehrenberg, R. G. (1999) The Impact of U.S. News & World Report College Rankings on Admission Outcomes and Pricing Policies at Selective Private Institutions. *Change*, 31(6), 42-51

Roberts, D. and Thompson, L. (2007) University League Tables and the Impact on Student Recruitment, Reputation Management for Universities, Working Paper Series No. 2

Sauder, M., and Lancaster, R. (2006) Do Rankings Matter? The Effects of U.S. News & World Report Rankings on the Admissions Process of Law Schools. *Law & Society Review*, 40, 105-134

Soo, K. T. (2013) Does anyone use information from university rankings? *Education Economics*, 21(2), 176-190

Soo, K. T., and Elliott, C. (2010) Does price matter? Overseas students in UK higher education. *Economics of Education Review*, 29, 553-565

Times Higher Education Supplement, (2012). Satisfaction and its discontents

Universities UK. (2011) Higher education in facts and figures http://www.universitiesuk.ac.uk/Publications/Documents/HigherEducationInFactsAndFiguresSummer2011.pdf

Wyness, G. (2010) Policy Changes in UK Higher Education Funding, 1963-2009. Institute of Education, Department of Quantitative Social Science (DoQSS) Working paper

Table 1 Descriptive Statistics

Variable		Mean	Std. Dev.	Observations
Number of applications (institutional level)		16744.72	2343.73	10753
Number of applications (faculty/subject-group level)		1389.52	354.00	10753
By applicants' domiciles	UK	1178.42	309.09	10726
	EU (excl. UK)	95.41	48.61	9706
	Non EU	142.71	61.10	9641
By gender	Male	705.22	157.73	9532
	Female	812.63	246.53	9840
Guardian (subject group-level) ranking score		62.84	8.19	10753

Note: Cells report the average application numbers figures for institutions with available institution/subject-level ranking information (more specifically, there are 127 institutions with available institution-level ranking information, and 162 institutions with available subject group-level ranking information).

Table 2: Fixed effects model – Guardian (subject group-level) ranking score and log applications numbers

	ln (applications by faculty)		
VARIABLES	(1)	(2)	(3)
ranking score (standardised)	0.042***	0.042***	0.043***
	(0.008)	(0.008)	(0.008)
year dummies	x		
linear trend		x	x
post top-up fees		x	x
5 choices per applicant max		x	x
institution specific trends			x
Constant	6.639***	6.546***	6.546***
	(0.015)	(0.016)	(0.005)
Observations	10,753	10,753	10,753
Number of groups	1,554	1,554	1,554
Adjusted R-squared	0.124	0.120	0.207
F test for institution specific trends	-	-	1923.60
(p-value)			(0.0000)

Note: "Number of groups" refers to observations by institution and subject groups. Degrees of freedom for the F tests are (3, 161). Robust standard errors, clustered at the institution level. *** p<0.01, ** p<0.05, * p<0.1

Table 3: Heterogeneity in the effect of Guardian (subject group-level) ranking score by institutional regime and applicants' type

	ln (applications by faculty)		ln (applications by faculty and applicant group)	
VARIABLES	(1)	(2)	(3)	(4)
ranking score (standardised)	0.032**	0.023	0.018*	0.050***
	(0.014)	(0.017)	(0.009)	(0.008)
ranking score x post top-up fees	0.0024			
	(0.013)			
post top-up fees	-0.135***		-0.174***	-0.174***
	(0.017)		(0.015)	(0.015)
ranking score x 5 choices	0.024**			
	(0.010)			
5 choices per applicant	-0.215***		-0.262***	-0.262***
	(0.013)		(0.014)	(0.014)
2005 x ranking score		0.020		
		(0.017)		
2006 x ranking score		0.002		
		(0.016)		
2007 x ranking score		0.023		
		(0.018)		
2008 x ranking score		0.047***		
		(0.018)		
2009 x ranking score		0.043**		
		(0.020)		
2010 x ranking score		0.025		
		(0.022)		
2011 x ranking score		0.022		
		(0.025)		
EU (ex UK) x ranking score			0.040***	
			(0.014)	
Non EU x ranking score			0.056***	
			(0.013)	
female x ranking score				-0.003
				(0.006)
Institution specific trends	x	x	x	x
Constant	6.546***	6.593***	3.709***	3.710***
	(0.004)	(0.010)	(0.004)	(0.004)
Observations	10,753	10,753	61,500	61,500
Number of groups	1,554	1,554	9,126	9,126
Adjusted R2	0.208	0.212	0.128	0.127
F test for: year x ranking score	-	2.66	-	-
(p-value)		(0.012)		
Chow test for: domicile x ranking score	-	-	11.93	-
(p-value)			(0.0000)	

Note: "Number of groups" refers to observations by institution and subject groups (and domicile and gender in column (3) and column (4). Controls for applicants' domiciles (UK, EU(ex UK), Non EU) and gender are included in column (3) and column (4). 2004 is the baseline year in column 5. The degrees of freedom for the F-test are (7, 161). Robust standard errors in parentheses, clustered at institution levels. *** p<0.01, ** p<0.05, * p<0.1

Table 4: Heterogeneity in the effect of Guardian (subject group-level) ranking score by subject and number of institutions

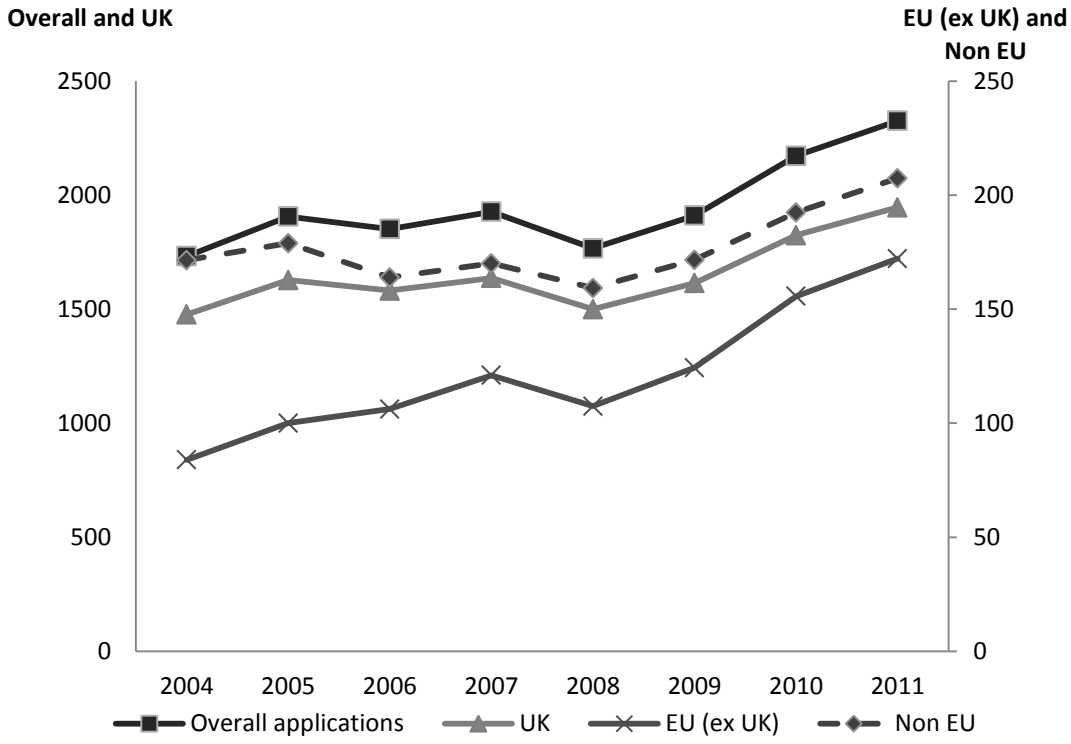
VARIABLES	ln (applications per faculty)	
ranking score (standardised)	0.044*	0.093**
	(0.024)	(0.038)
Group A Medicine & Dentistry x ranking score	-0.023	
	(0.031)	
Group B Subjects allied to Medicine x ranking score	-0.047	
	(0.032)	
Group C Biological Sciences x ranking score	-0.018	
	(0.025)	
Group D Vet Sci, Ag & related x ranking score	-0.086	
	(0.065)	
Group F Physical Sciences x ranking score	-0.006	
	(0.036)	
Group G Mathematical & Comp Sci x ranking score	0.013	
	(0.030)	
Group H Engineering x ranking score	-0.000	
	(0.033)	
Group J Technologies x ranking score	-0.012	
	(0.080)	
Group K Architecture, Build & Plan x ranking score	0.067	
	(0.055)	
Group M Law x ranking score	0.035	
	(0.031)	
Group N Business & Admin studies x ranking score	0.029	
	(0.031)	
Group P Mass Comms x ranking score	0.021	
	(0.040)	
Group Q Languages and Linguistics x ranking score	-0.021	
	(0.029)	
Group V Hist & Philosophical studies x ranking score	0.014	
	(0.031)	
Group W Creative Arts & Design x ranking score	-0.068*	
	(0.036)	
Group X Education x ranking score	0.074	
	(0.073)	
number of institutions (per subject group) /100		0.005
		(0.157)
ranking score x number of institutions / 100		-0.054
		(0.037)
post top-up fees	x	x
5 choices per application max	x	x
institution specific trends	x	x
Constant	6.546***	6.542***
	(0.005)	(0.145)
Observations	10,753	10,753
Number of groups	1,554	1,554
Adjusted R-squared	0. 210	0.207
F test of Subject Groups x ranking score	1.79	-
(p-value)	(0.0363)	

Note: "Group L Social Sciences" is the baseline group in column 1. "Number of groups" refers to observations by institution and subject groups. Degrees of freedom for the F test in column 1 are (16,161). Robust standard errors, clustered at university level in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 5 Fixed effect model: subject group/institution rankings and application numbers

VARIABLES	(1) ln (applications by faculty)	(2) ln (market share – by faculty)	(3) ln (applications by faculty)	(4) ln (applications by faculty)	(5) ln (applications by faculty) England only
subject group rank	-0.0012***	-0.0012***	-0.0010***		
	(0.0003)	(0.0002)	(0.0003)		
subject group ranking score				0.0380***	0.0450***
				(0.0090)	(0.0099)
institution rank			-0.0008*		
			(0.0004)		
institution ranking score				0.0253*	
				(0.0144)	
trend	x	x	x	x	x
post top-up fees	x	x	x	x	x
5 choices per applicant	x	x	x	x	x
institution specific trends	x	x	x	x	x
Constant	6.602***	-4.891***	6.646***	6.553***	6.593***
	(0.0129)	(0.0124)	(0.0262)	(0.0044)	(0.0053)
Observations	10,753	10,753	10,434	10,434	8,580
Number of groups	1,554	1,554	1,491	1,491	1,222
Adjusted R-squared	0.204	0.108	0.199	0.201	0.211

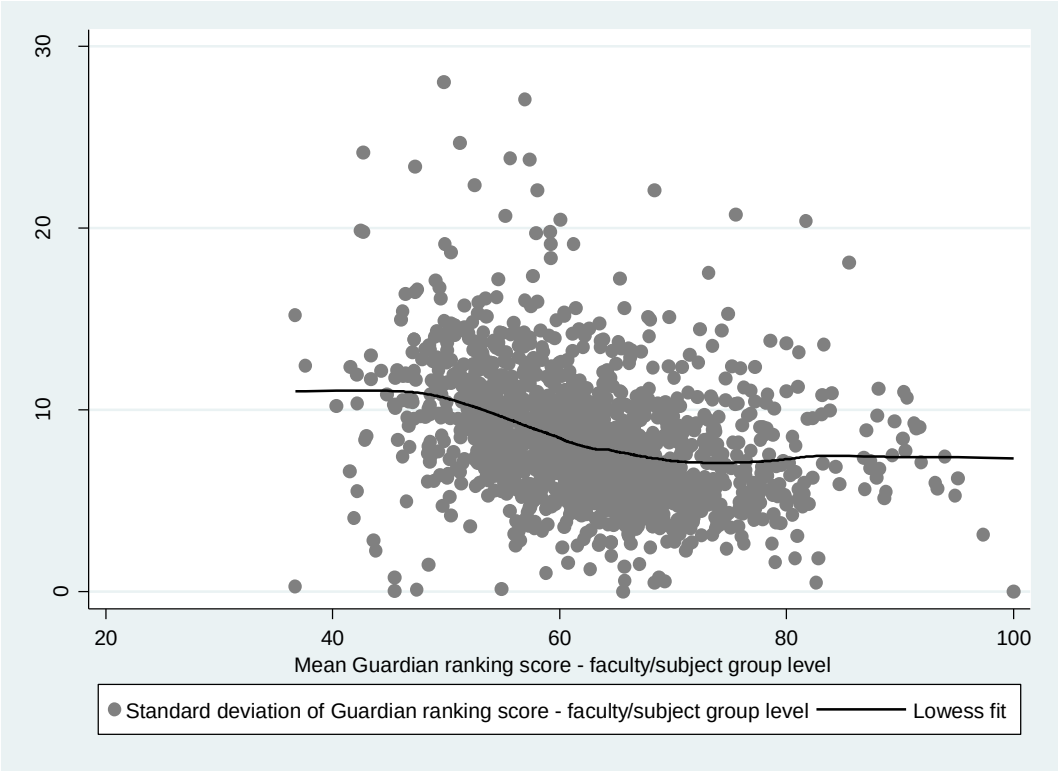
Figure 1: Number of degree applications by geographic origin: years 2004-2011 (in thousands)



Source: UCAS 2004-2011

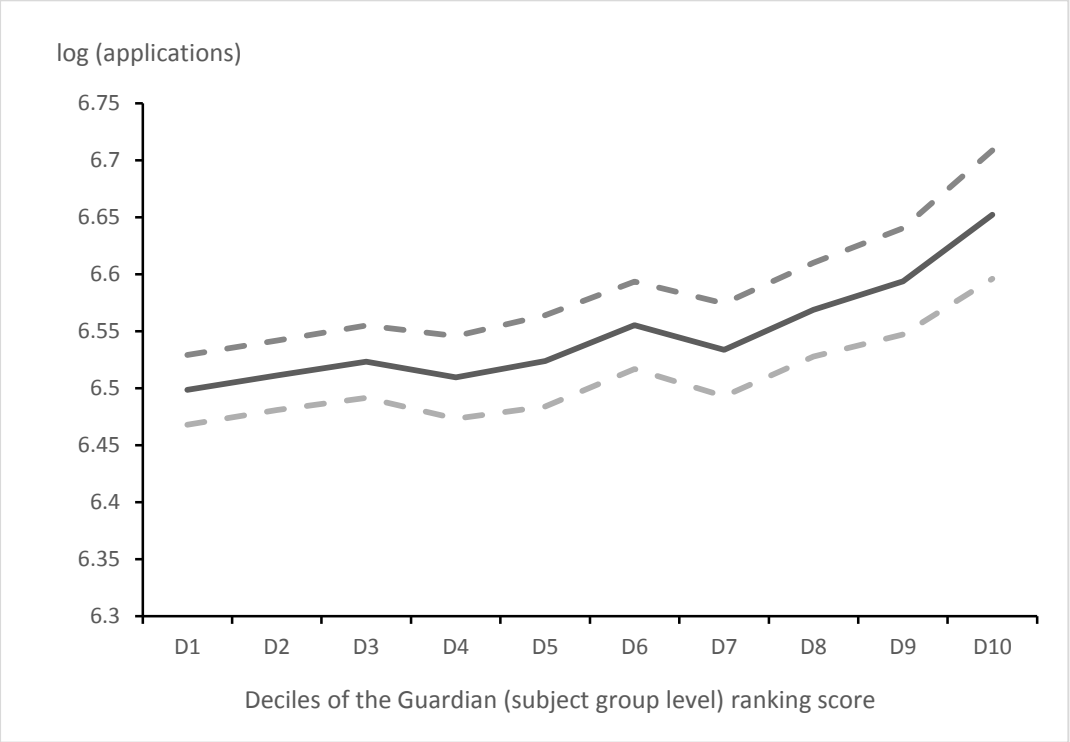
Note: graph based on the total number of degree applications submitted every year, which is the sum of all the choices applicants made on their application forms in that year.

Figure 2: Variation in Guardian ranking score over time (per faculty/institution-subject group)



Source: The Guardian University Guides 2004 – 2011
Note: Lowess fit is a non-parametric fit of the data using locally weighted linear regressions.

Figure 3: Effect of a change in the (standardised) Guardian score at different points (deciles) of the score distribution



Source: The Guardian University Guides and UCAS 2004-2011
Note: Graph based on the regression of log (applications) on (dummies of) each decile of the Guardian ranking score.

Appendix

A1: Guardian methodologies over the period

Weights	Year							
Criteria used	2004	2005	2006	2007	2008	2009	2010	2011
(NSS) Course satisfaction								5%
(NSS)Teaching quality					10%	10%	10%	10%
(NSS)Feedback					5%	5%	5%	10%
Staff score			15%	15%				
Teaching Quality Assessment	40%	22%						
Spend per student	10%	15%	10%	10%	17%	17%	17%	15%
Student Staff ratio	10%	15%	20%	20%	17%	17%	17%	15%
Job prospects	15%	15%	17%	17%	17%	17%	17%	15%
Value added	15%	10%	10%	10%	17%	17%	17%	15%
Entry tariff	10%	15%	20%	20%	17%	17%	17%	15%
Inclusiveness		8%	8%	8%				

A2- Number of institutions for each subject group over the period

Subject \Year	2004	2005	2006	2007	2008	2009	2010	2011	Total number of institutions	Average number of institutions
Group A Medicine & Dentistry	23	25	25	27	30	30	30	30	32	28
Group B Subjects allied to Medicine	87	88	94	91	85	81	84	87	106	87
Group C Biological Sciences	110	112	113	114	112	110	110	111	119	112
Group D Vet Sci,Ag & related	24	29	30	24	18	16	19	19	37	22
Group F Physical Sciences	92	90	93	89	81	79	79	78	102	85
Group G Mathematical & Comp Sci	110	109	112	109	108	101	101	105	117	107
Group H Engineering	89	86	88	81	81	77	79	77	95	82
Group J Technologies	14	14	14	15	10	10	11	12	23	13
Group K Architecture,Build & Plan	60	57	59	57	54	48	54	53	66	55
Group L Social Studies	107	112	112	111	109	102	108	107	120	109
Group M Law	83	86	89	89	85	85	89	90	96	87
Group N Business & Admin studies	110	112	115	116	111	108	110	110	123	112
Group P Mass Comms and Documentation	60	66	77	77	73	70	73	73	91	71
Group Q Languages & Linguistics	101	105	106	108	105	98	102	104	114	104
Group V Hist & Philosophical studies	86	96	97	98	93	88	91	93	104	93
Group W Creative Arts & Design	111	115	123	118	115	111	113	113	132	115
Group X Education	67	66	69	68	64	61	62	62	78	65

A3- Mapping of Guardian subjects, and HESA cost centres to JACS subject groups

JACS Subject Groups (UCAS)	**Subjects** (Guardian)	**Cost centres** (HESA)
Group A Medicine & Dentistry	Medicine, Dentistry	(01) Clinical medicine; (02) Clinical dentistry
Group B Subjects allied to Medicine	Anatomy and physiology, Nursing and paramedical studies, Pharmacology and pharmacy	(04) Anatomy & physiology; (05) Nursing & paramedical studies; (06) Health & community studies; (08) Pharmacy & pharmacology
Group C Biological Sciences	Biosciences, Psychology, Sports and exercise science	(07) Psychology & behavioural sciences; (10) Biosciences; (38) Sports science & leisure studies
Group D Vet Sci,Ag & related	Agricultural and forestry, Veterinary science	(03) Veterinary science; (13) Agriculture & forestry
Group F Physical Sciences	Chemistry, Physics, Archaeology and forensics, Earth and marine sciences, Geography and environmental studies	(11) Chemistry; (12) Physics; (14) Earth, marine & environmental sciences; (28) Geography; (37) Archaeology
Group G Mathematical & Comp Sci	Mathematics, Computer sciences and IT	(24) Mathematics; (25) Information technology & systems sciences & computer software engineering
Group H Engineering	Chemical engineering, Civil engineering, Electrical & electronic engineering, General engineering, Mechanical engineering	(16) General engineering; (17) Chemical engineering; (19) Civil engineering; (20) Electrical, electronic & computer engineering; (21) Mechanical, aero & production engineering
Group J Technologies	Materials and mineral engineering	(18) Mineral, metallurgy & materials engineering
Group K Architecture, Build & Plan	Architecture, Building and town and country planning	(23) Architecture, built environment & planning
Group L Social Studies	Anthropology, Economics, Politics, Sociology, Social work, Social policy & administration	(29) Social studies
Group M Law	Law	(29) Social studies
Group N Business & Admin studies	Business and management studies, Tourism, transport and travel	(26) Catering & hospitality management; (27) Business & management studies
Group P Mass Comms and Documentation	Media studies, communications and librarianship	(30) Media studies
Group Q Languages & Linguistics	Classics, English, Modern languages & linguistics, American studies	(35) Modern languages
Group V Hist & Philosophical studies	History & history of art, Philosophy, Religious studies and theology	(31) Humanities & language based studies;
Group W Creative Arts & Design	Art & design, Drama and dance, Music	(33) Design & creative arts
Group X Education	Educational studies	(41) Continuing education; (34) Education