Student satisfaction, league tables and university applications

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Abstract We investigate the impact of information about student satisfaction on university choice, using data from the UK's National Student Survey (NSS) and on applications to undergraduate degree courses. We show that the NSS has a small, statistically significant effect on applications at the university-subject level. This effect operates primarily through the influence of the NSS scores on a university's position in separately published, subject-specific, league tables, implying greater salience of league table rankings. The impact of rankings is greater amongst the most able students, for universities with entry standards in the upper-middle tier, and for subject-departments facing more competition.

JEL codes: I2, D8

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1 Introduction

A growing number of governments are seeking to apply market principles in the operation of domestic higher education systems (Teixeira and Dill, 2011). An oft-cited rationale for these market-based reforms has been to expand choice, increase competition and ultimately drive-up the quality of provision by making universities more responsive to students' needs. The efficient functioning of consumer markets in higher education crucially depends on prospective students possessing adequate information on quality (and price) in order to make rational, informed choices (Jongbloed, 2003). Yet, as an experience good, information on product quality in higher education may be difficult to acquire, potentially leading to sub-optimal decisions.

It is within this context that the UK's Higher Education Funding Council for England (HEFCE) initiated the National Student Survey (NSS) in 2005, with the over-riding aim 'to help prospective students, their families and advisors to make study choices' (HEFCE, 2013). Administered by an independent market research company, the NSS is an online survey which collects information from final year undergraduate students on satisfaction levels with various aspects of their university course. The annual results are published online, including on the HEFCE and Unistats[1] websites, and typically receive media coverage following their release.

In this article, we empirically investigate the extent to which demand by applicants to universities responds to the quality signal provided by the NSS. Assuming that prospective students are utility maximizing agents, one might logically expect them to take a cue from existing consumer feedback, resulting in greater demand for university courses with higher levels of student satisfaction. Indeed, given the high costs of pursuing a degree course and the potentially significant benefits of making an informed choice, economic theory suggests that actors should expend considerable effort to acquire such pre-purchase information (Chetty *et al.*, 2009; Stigler, 1961).

We make a number of contributions to the existing literature. Firstly, most previous studies have examined the influence of quality indicators at the university level (Broecke, 2012; Meredith, 2004) or for one or two single subject areas (Sauder and Lancaster, 2006; Soo and Elliott, 2010). We go further than these studies by using information on quality at the subject-by-university level, with a dataset which captures a large number (40-60) of subjects for the majority of Britain's domestic universities/colleges (120-177 universities). Motivating our unit of

[1] The Unistats website, which provides quality-related information on higher education in the UK, replaced the Teaching Quality Information (TQi) website in 2007. The latter also published NSS results.

analysis is recognition that prospective students are most likely to be attentive to satisfaction scores – as well as third-party league table rankings – for the departments to which they are applying rather than the university. While subject and university rankings are positively correlated across UK institutions, there is also significant variation, with some subject-departments ranked significantly higher or lower relative to the university as a whole (Cheng and Marsh, 2010). Moreover, having this information by subject, university and year allows us to control for time varying institutional differences and other group fixed effects and trends, in order to better identify the causal effects of quality indicators on student demand.

Second, our central focus on "user reviews" of quality distinguishes the present study from an existing body of work which explores the links between student choice and quality (Meredith, 2004; Monks and Ehrenberg, 1999; Soo and Elliott, 2010). A defining feature of this literature is an almost exclusive focus on the use of composite league tables or rankings, comprising a weighted bundle of input, output and process-based metrics, as a measure of quality. To the best of our knowledge, ours is the first study to examine the influence of independently published data on user satisfaction on student choices.

A third contribution is that we additionally examine the links between the influence of the NSS on student demand and the influence of one of the UK's leading league tables – *The Times Good University Guide* (TGUG). This allows us to investigate which individual quality dimensions (student satisfaction, research quality, employability, etc.) of composite league tables matter most and, moreover, whether new information conveyed by NSS scores affect student applications directly or indirectly. The NSS might impact demand directly if prospective students respond to the constituent information published independently of third-party league tables. Alternatively, to the extent that the satisfaction scores are now included in most of these league tables, it could be that the impact of student satisfaction scores operate indirectly by influencing subject-departments' ranking. In order to identify the relevant pathway of influence, we exploit the fact that the NSS scores that are used to compile major league tables lag those published independently for the respective year of entry. Our findings strongly support the idea that the influence of NSS primarily operates through league tables.

A fourth contribution is that we examine how the impact of subject-department league table rankings is conditioned by various factors. One is prospective students' academic ability. Higher ability candidates should be better placed to respond to league tables in that their superior grades grant them greater freedom to choose

amongst a larger set of providers. Along similar lines, the influence of league tables might be shaped by entry standards, as well as perceptions about the "elite" or "prestige" status of universities. We find that the league table rankings have the greatest effect on the most able students and for courses in the upper-middle entry standard tariff group, whereas the effect for the elite Russell Group[2] of universities does not differ from other universities. Another conditioning factor is market concentration. Novel to the literature on university choice, we examine how the impact of league tables on demand is influenced by competition, as given by the number of alternative providers in respective subject-department groupings. Consistent with predictions derived from economic theory and empirical evidence in other markets (Beckert *et al.*, 2012; Gaynor and Town, 2011), we find that the elasticity of demand with respect to league table rankings to be greater in courses in which universities compete more strongly with one another.

The present article relates to a number of broader streams of literature in economics. One is work concerned with the role of signals in informing consumer choice (Daughety and Reinganum, 2008; Nelson, 1970; Spence, 1973). User reviews, expert ratings and rankings are one example of signals (or quality indicators) which may serve as a substitute for actual knowledge of particular products and services in settings where potential consumers find it difficult to judge quality (Dranove and Jin, 2010). Our findings add to a growing body of literature which investigates how consumer demand is affected by standardised quality indicators provided by external parties in areas such as schooling (Hastings and Weinstein, 2008), health care (Cutler *et al.*, 2004; Werner *et al.*, 2012) and the environment (Delmas *et al.*, 2010). Additionally, the article is instructive for recent debates in economics about salience, and the propensity of market actors to pay disproportionately more attention to information presented in some formats than others (Chetty *et al.*, 2009; Falkinger, 2008; Hirshleifer and Teoh, 2003). Our findings also relate to work in industrial organization and the under-researched questions of how demand responsiveness to beliefs about quality is moderated by the degree of market competition (Beckert *et al.*, 2012; Gaynor *et al.*, 2012; Porter, 1974).

Our article is also of applied interest. Decision-makers, both at university and departmental levels, have increasingly confronted questions about the pay-offs from investments to improve student satisfaction scores and popular league table rankings (Hazelkorn, 2008; *The Economist*, 2013). For example, many "elite" universities

[2] The Russell Group represents 24 leading universities in England, Wales, Scotland and Northern Ireland.

have become increasingly concerned about their low rankings in student satisfaction surveys, and how it might affect future recruitments. By providing more refined insights into the extent to which quality metrics affect applicant numbers, our paper provides valuable information which might help university planners in their resource allocation decisions.

The remainder of the paper is structured as follows. Section 2 reviews the findings and limitations of previous literature on the effects of quality rankings and other information on choice in higher education (and other public services). Section 3 explains our research design and method of estimation. Section 4 provides information on the UK higher education context, including the applications process, the NSS, TGUG and other specific information about our data sources. Section 5 describes and discusses the results and Section 6 presents our overall conclusions.

2 Previous literature

A growing body of literature has examined the links between information on quality and student choice in higher education – albeit almost exclusively focused on composite league table rankings. Much of the early work in this area focused on admission outcomes for US universities and colleges. In one of the first studies of its kind, Monk and Ehrenberg (1999) find that a move to a less favourable position in the U.S. News & World Report (USNWR) ranking is associated with private universities/colleges having a higher admittance rate, a lower yield rate (i.e. fewer applicants who are admitted end up matriculating) and an admitted pool of applicants with weaker incoming academic scores. Very similar findings emerge in subsequent US studies (Bednowitz, 2000; Meredith, 2004). Consistent with the interpretation that a falling rank compels institutions to be less selective on account of reduced demand, Sauder and Lancaster (2006) show that US law schools with higher ranks receive more applications, while Mueller and Rockerbie (2005) provide similar findings for universities in Ontario, Canada[3].

Three further insights emerge from the North American literature. One is that the impact of rankings is most pronounced amongst the top-tier of highly ranked institutions with their influence dwindling, or even disappearing altogether, for lower tiers (Bowman and Bastedo, 2009; Griffith and Rask, 2007; Sauder and

[3] However, when disaggregated by university type, university rankings do not appear to impact applications from male students.

Lancaster, 2006). Second, the influence of rankings may vary with individual characteristics, such as race (Bowman and Bastedo, 2009), gender (Mueller and Rockerbie, 2005) and fee-paying status (Griffith and Rask, 2007). A third insight is that the influence of information contained in league tables depends on its salience. Luca and Smith (2013) find that, when presented as an ordinal ranking of institutions, the USNWR has a statistically significant impact on applications. Conversely, when the same underlying data are presented alongside universities listed in alphabetical order, the information contained in the USNWR has no statistically discernible effect.

Turning to the UK, Abbott and Leslie (2004) show that higher ranked universities receive more applications over the period from 1996/97-1999/2000, although the effect of quality is comparatively small. Prestigious universities, as proxied by membership of the Russell Group, receive more applications. A more nuanced picture emerges from Gunn and Hill (2008). Following the introduction of league tables (2000–2005), the authors find that a large part of the variation in applications growth across institutions could be explained by their respective ranking, although league table influence subsequently declined significantly. The above studies focus on the university level. One of the few multivariate studies to examine the influence of subject-department rankings is Soo and Elliott (2010) which focuses exclusively on applications by non-European Union (EU)/home-domiciled students. Application numbers of business studies students are found to be sensitive to subject-specific rankings, but not their equivalents applying for engineering subjects.

Two recent UK studies have gone on to examine how changes in universities' ranking position affect applications at the university level. Soo (2013) finds that *The Sunday Times* ranking had no impact on applications to UK universities for the period 2005-2009. Contradicting these results, Broecke (2012) shows that applications from UK-domiciled students over the period 2002-2009 responded to changes in university-level ranking position, with the effect greater amongst more prestigious universities. The author also finds that high-ability candidates are more responsive to league tables. Yet the overall impact of changes in university rankings is found to be modest. A possible explanation for the limited influence of quality in this and other studies could be the importance of geographic barriers in constraining choice (Briggs, 2006). Gibbons and Vignoles (2012) therefore show that distance has a large negative impact on the selection of universities by prospective students domiciled in England while Abbott and Leslie (2004) find evidence of a strong regional effect on applications to universities.

Mixed results emerge from work which has examined the individual quality metrics which are used to compile composite league tables. Soo (2013) finds some evidence that research quality positively affect applications amongst EU and home-domiciled students applying to pre-1992 universities, but reduces applications by home students to post-1992 universities (i.e. former polytechnics). Teaching quality, as 'measured as a percentage of the number of departments rated excellent during teaching quality assessments from 1995 onwards' (pg.183) by an external quality assurance agency, has no effect. In one of the few studies to include a measure of user satisfaction, Horstschräer (2012) examines how applications by high-ability students to medical schools in Germany are affected by various quality indicators, published as part of the Center for Higher Education (CHE) University Ranking[4]. Metrics which capture mentoring, faculty infrastructure and overall student satisfaction are shown to have a greater additional impact on prospective student choices than those which capture research quality. Apposite in relation to the question about whether the information contained in the NSS might have an influence over and above its effect on league table rankings is the work of Bowman and Bastedo (2009). The authors examine the impact of instructional expenditures and tuition fees as 'alternative markers' of quality and prestige on US university/college admissions outcomes. After controlling for USNWR rankings, they find that the two markers do positively impact applications, although their influence varies across different categories of institutions in different quality tiers.

Additional evidence on the impact of quality indicators comes from work into school and health care markets. Most studies in this area find that rankings, ratings and report cards provide additional information which, to a greater or lesser extent, affects consumer choice (Friesen *et al.*, 2012; Hastings and Weinstein, 2008; Pope, 2009; Varkevisser *et al.*, 2012). Furthermore, underscoring the significance of salience, there is some evidence to suggest that consumers tend to focus on the most readily understood aspects of information conveyed by rankings (Scanlon *et al.*, 2002). Few of the ratings schemes studied within the realm of health care and schooling contain information on user satisfaction. Yet, where such information is provided on health plan report cards, Dafny and Dranove (2008) show that decision-making is influenced by consumer satisfaction scores. The result that user reviews affect demand is also found in many, but not all (Duan *et al.*, 2008), studies which investigate

[4] Note, while the CHE ranking categorises departments into top, middle and bottom quality groups, information on the respective quality dimensions are not published in rank order.

the impact of online reviews for consumer goods and services – including those sold online (Chevalier and Mayzlin, 2006) or through conventional bricks-and-mortar businesses (Anderson and Magruder, 2012).

As discussed in the Introduction, our study is the first to look at how explicit survey information about previous students' satisfaction with courses affects subsequent applicant choices. Moreover, our work goes further than all previous studies in terms of the coverage and detail in our data, and the extent to which these data allow us to successfully control for unobserved fixed and time-varying effects which may confound causal estimation of the impact of quality indicators on choices. The next section sets out the design of our empirical work in further detail.

3 Research design

Our primary focus in the present paper is on the impact of student satisfaction scores and league table rankings on undergraduate applications by home-domiciled students to British universities. An advantage of focusing on undergraduate applications by home-domiciled students is that we do not have to account for price-related effects, given that fees are set at a relatively low standard level across all universities – with some national differences documented below in Section 4.1.

However, our study faces a number of other identification challenges. To begin with, some components of university league tables are endogenous to student demand. For example, the entry tariff set for a course will in part be a function of student demand, with high demand allowing universities and their departments to set higher tariffs in order to attract more able students. There are also selection effects in that high-ability students will apply to the most sought-after institutions who, in turn, will try to select the highest-ability students. Students applying to the most sought-after institutions might have the highest expectations about university quality. However, these institutions in turn might be able to afford to devote fewer resources to certain aspects relevant to the student experience, e.g. teaching quality, in order to provide their staff with more time for research in the full knowledge that their status as a sought-after institution allows them to get away with focusing on the research-related aspects of quality. Most importantly, there is the possibility that any effect of quality rankings might be spurious in that applicants already have knowledge of university quality independently from

league tables, in which case the publication of rankings would have no true causal impact (Dafny and Dranove, 2008; Horstschräer, 2012).

Our research design goes a long way in tackling these challenges. We have created a panel of university subject tariff groups observed annually over the period 2006-2011 (based on year of applicants' potential entry), which allows us to base estimations on year-on-year first differences in NSS scores and league table rankings on the number of applicants by university-specific subject categories. It also allows us to eliminate certain confounding factors, both time-invariant and time-variant, and to exploit the timing of information relevant to potential applicants in order to provide further evidence for causal claims. In our most stringent specification, we control for university-year, subject-year and tariff-year fixed effects, and we additionally account for university-by-subject-by-tariff heterogeneity by differencing out the corresponding fixed effects. As shown below, estimates change dramatically moving from a naïve estimation model without controlling for such fixed effects to more stringent specifications, suggesting that accounting for such heterogeneity is important for retrieving reliable effects. The panel structure also enables us to test whether the publication of NSS scores and league tables has the hypothesized effect in the year in which potential applicants get access to this new information. Conversely, it allows us to confirm that information that comes too late for impacting on applications in a specific year has no effect, which would be suggestive of the published information having a causal effect rather than being correlated with course quality unobserved to us but observed by potential applicants. Lastly, it enables us to see whether the most recent timely revelation of new NSS scores and league table information dominates the effect of older information.

Our main empirical analysis is based on estimation of variants of the following simple regression model[5]:

[5] This specification can be given a theoretical underpinning based on a Random Utility Model in which the information about quality of a university k provided by the NSS or TGUG score affects an individual's expected utility from making a choice k from amongst the available alternatives j. Standard assumptions (McFadden 1974) give rise to the conditional logit specification of the probability of individual i making choice k:

$$prob(k) = \frac{\exp(\beta score_k)}{\sum_j \exp(\beta score_j)}$$

Replacing the probability $prob(k)$ with its sample estimate, the proportion of applicants making choice k in a given year, taking logs and adding a corresponding error term gives:

$$\ln apps_k = \beta score_k + \left[\ln \sum_j apps_j - \ln \sum_j \exp(\beta score_j) \right] + \varepsilon_k$$

$$\ln apps_{usat} = \beta score_{ust} + \theta_t + \varepsilon_{usat} \quad (1)$$

in which $\ln apps_{usat}$ is the natural log of application numbers to university *u*, in subject *s*, by applicants in tariff group *a* for entry in year *t*. Quality indicator $score_{usat}$ is one of a number of potential NSS student satisfaction scores or university league table ranking indicators that are available at the time of application, for the same university-subject-year group (note, in the empirical work, this information relates to quality information from various years prior to application). Variable θ_t is a year specific constant, and ε_{usat} represents other unobservables. The aim is to estimate the causal effect (β) of the NSS score or university league table rankings on applications, and our various specifications become increasingly more stringent with respect to the way we control for unobserved university, subject, applicant tariff-group and time effects. We start with a model only controlling for year fixed effects θ_t as in (1), then we add university, subject and tariff dummy variables to control for fixed effects η_u, φ_s and μ_a:

$$\ln applications_{usat} = \beta score_{ust} + \eta_u + \varphi_s + \mu_a + \theta_t + \nu_{usat} \quad (2)$$

In a third specification, we allow for unobserved university-by-subject-by-tariff fixed effects and wipe these out of the regression by taking first differences within university-by-subject-by-tariff categories, while controlling additionally for year fixed effects. In this specification, identification comes from year-on-year shocks to the quality score variable for each university-subject group, i.e.:

$$\begin{aligned} &\ln apps_{usat} = \beta score_{ust} + \sigma_{usa} + \theta_t + \omega_{usat} \\ &\Rightarrow \Delta \ln apps_{usat} = \beta \Delta score_{ust} + \Delta\theta_t + \Delta\omega_{usat} \end{aligned} \quad (3)$$

In our fourth model we replace, in the first-difference specification (3), the simple year dummy variables with dummy variables to control for university-year, subject-year and tariff-year fixed effects. In our last and most stringent specification, we additionally eliminate potential university-by subject-by tariff linear trends by double-differencing the data over years within university-by subject-by tariff categories, i.e. regressing $\Delta \ln apps_{usat} - \Delta \ln apps_{usat-1}$ on $\Delta score_{usat} - \Delta score_{usat-1}$, with a full set of university-year, subject-year and tariff-

The terms $\ln \sum_j apps_j$ and $\ln \sum_j \exp(\beta score_j)$ are constants and are subsumed in the constant and fixed effects terms in equations (1)-(3).

year fixed effects, such that identification comes from year to year changes-in-the-changes to the quality indicator variable.

These regression models are estimated using administrative data on applications from British residents for entry to British universities from 2006 to 2011, linked to information on student satisfaction from the UK's NSS and quality rankings from the TGUG. These data sources and related institutional background are described in the next section.

4 Data sources and institutional background

4.1 Dependent variable: university applications

Applications by prospective higher education students to UK universities and colleges are administered centrally by the University and Colleges Admissions Service (UCAS). Individuals can apply for up to five courses and/or institutions[6] - a figure which was reduced from six from 2008 onwards. We acquired annual data from 2006 to 2011 from UCAS, aggregated to the university-by-subject-by-tariff group level. There are four tariff groups, namely up to 135, between 136 and 270, between 271 and 405 and above 406. Whilst covering the full range of abilities, the very highly able applicants are not distinguishable from the highly able applicants with these data. Table 3 provides the mean and standard deviation of applicants by tariff group in each year by university-subject. We also have information on the post town of residence of applicants, with around 3 contiguous post towns aggregated by UCAS to maintain cell sizes to form 40 geographical groups covering the whole of England, Wales and Scotland (Northern Ireland students and universities are excluded from our sample).

As mentioned in Section 3, there was little difference between universities in terms of tuition fees faced by applicants over the period we study, with the tuition regime remaining more or less constant. There were, however, some potentially important differences relating to the applicant's home country (i.e. England, Scotland or Wales) and the location of the university to which they apply. Starting in 2006, all domestic students entering universities in England faced a maximum tuition fee of £3000 per annum, although very few universities charged less than this cap. The equivalent figure for Welsh universities in 2006 was £1200, increasing to £3000 in 2007.

[6] There are a number of restrictions: applicants can only apply to either one of Oxford or Cambridge and only to a maximum of four courses in any one of medicine/dentistry/veterinary medicine/veterinary science.

In Wales, means-tested grants (up to £1500 per year) were available to Welsh students, and from 2007 to 2010 all Welsh students studying in Wales were entitled to a tuition fee grant of £1890. The situation in Scotland was more complex. Initially, Scottish students studying in Scotland were exempt from any fees but had to pay an endowment fee (£2289) after graduation. This endowment was scrapped in 2007. Students from other parts of the UK were charged £1700 per annum (£2700 for medical students) from 2006. Given our empirical analysis concerns the effects of changes in satisfaction scores and league table rankings, and these do not vary according to the applicants' country of domicile, the national differences in fee structure across countries should not affect our findings. However, we carried out some robustness checks using a sample of Englanddomiciled students only, to confirm that these national differences and changes in fee structure do not affect our results.[7]

4.2 National Student Survey

The NSS asks respondents to rate their study experience on a 5-point likert scale from 'definitely agree' to 'definitely disagree' in 21 dimensions covering 6 domains (teaching, feedback, support, personal development, organisation skills and resources) plus overall satisfaction with their study course[8] (see Figure 1). Consistent series are available from the HEFCE website from 2005 onwards at the so-called 'JACS2' (Joint Academic Coding Scheme) subject level, and from 2007 onwards at the more dis-aggregated 'JACS3' level, which allows matching NSS scores with league table rankings and applications data. There are on average around 80-90 respondents on each university-subject specific course with a variation from as low as 10 to above 1200. Table 1 shows the relative shares of respondents expressing overall satisfaction on each scale. Around one half of responding students agree with the statement, 'Overall, I am satisfied with the quality of the course', while another roughly one third of students 'strongly agree' with the statement. Student satisfaction seems to have slightly improved on average over time.

4.3 Times Good University Guide

For our league table analysis, we use *The Times Good University Guide (TGUG)*, published as a guidebook primarily aimed at prospective students and their families (O'Leary, various years). We chose the TGUG over competitor league tables (*The Sunday Times*, *The Guardian and The Complete University Guide*) because survey evidence reveals

[7] We explicitly report some of these robustness tests in our analysis of the effects of university competition on the elasticity of response to quality indicators, since it is in this context that the differential financial incentives facing students in England, Wales and Scotland seem most likely to affect our results.

[8] A further question on satisfaction with the Students' Union was added in 2012 after the end of our panel.

that it has been the most widely consulted source amongst prospective home students in making university choices (Roberts and Thompson, 2007). The TGUG has also been analysed in previous academic work into the impact of UK rankings (Abbott and Leslie, 2004; Broecke, 2012). The university and subject tables have (with the exception of the edition for university entry in 2008[9]) been published annually since 1992 – making the TGUG by far the longest established of the UK league tables. Moreover, prior to mid-2010, the annual rankings were available to freely view online. Hence, for the period of our study, it is plausible to assume that the (new) information contained in the TGUG should inform choice for a significant share of prospective applicants. Gunn and Hill (2008) report correlations of 0.86-0.97 between the TGUG and other league tables, at the institution level, which is unsurprising given that all the tables present slightly different configurations of more or less the same information. For our empirical analysis, we use the TGUG tables aimed at university entrants in 2006-2011, respectively published in 2005-2010.

The TGUG university-level ranking is a composite of the following quality metrics: completion rate; entry standards; average per student facilities spend; average per student expenditure on libraries and computing resources; proportion of good degrees (i.e. 2:1 or above) achieved; graduate employment prospects; research quality; student satisfaction; and the staff-student ratio. The subject tables used in our analysis are based on a sub-set of the above criteria: entry standards; research quality; graduate prospects; and, since 2009, student satisfaction scores. Research quality indicators in the TGUG are derived from the national Research Assessment Exercise (RAE) that is carried out every 5-6 years at British universities. Prior to 2010, there were two research indicators, one on research quality, with categories 1, 2, 3b, 3a, 4, 5 and 5* in increasing order, and the other on the number of research active staff. We use the research quality indicator and convert it to a simple integer ranking (0-6). From 2010 on, the TGUG uses a single numerical ranking. For a few subject categories there are multiple research entries, e.g. separate entries for mathematics and statistics research within the Mathematics subject group, and we use the first one listed. Entry standards are the average A-level 'UCAS Tariff' points of students enrolled on courses in the subject-university category (with data from the Higher Education Statistics Agency (HESA)). The UCAS Tariff point system is a type of grade point average based on school-level qualifications (mainly A-Levels, typically taken at age 17-18, for university entrants). The conversion of

[9] The 2008 rankings were only published online and, in condensed form, in a supplement to the print version of *The Times* newspaper (in 2007). The more extensive online data were kindly supplied to the authors by Nicola Horseman who was involved in compiling the original league tables for *The Times*.

qualifications to Tariff points is available in published tables, with a single top A-level A* qualification worth 200 points, and an E grade worth only 60 points. Student satisfaction in the TGUG comes from the NSS described above in Section 4.2. The score is the mean proportion reporting 'mostly agree' or 'definitely agree' across all the NSS survey statements, and relates to the NSS survey data that is released in the year prior to the TGUG publication. The measure of employment prospects in the TGUG rankings is the proportion of graduates employed after 6 months, and is derived from HESA survey data on students' 'First Destinations' after university. Prior to 2007, the TGUG also reported a teaching quality metric, based on assessments by the Quality Assurance Agency for Higher Education (QAA). From 2007, this metric is only available for teaching-related degrees, and was replaced by the NSS satisfaction scores in the rankings for other degree subjects.

The overall scores reported in the TGUG subject tables are derived by aggregating across the separate quality metrics, with a weight of 1 on all metrics, except student satisfaction and research quality which are weighted by 1.5. In these subject tables, the overall score takes a maximum value of 100 for the top ranked university. For our empirical analysis we convert all the TGUG scores – the separate metrics and the overall score – into percentiles, by year, and rescale them to range between 0 and 1. Given this standardisation, the descriptive statistics are not interesting or informative, so for illustration purposes we present, in Figure 2, one example of the TGUG tables, for the top 20 universities in Economics in 2009.

One complication in the TGUG data set up is that only 33 of the 62 subject tables are available for 2008 when, as mentioned above, the guide was only published online and (in a shortened form) in the print copy of *The Times* newspaper. Therefore we use the data for the 33 main subject areas in 2008, and impute the missing data on the overall TGUG score from the university mean scores for the year, and a moving average of the university-by-subject scores. This procedure allows creating a complete time series of subjects from 2006 to 2011. Note, the results we present in the empirical work below are insensitive to the inclusion or not of these imputed values in the analysis. Various other elements in the TGUG tables are missing in some years (e.g. due to low response rates on the NSS). These elements are zero encoded and our regressions include additional dummy variables coded 1 for missing/imputed data and zero otherwise, to control for any differences in the means between observations with missing/imputed and non-missing data.

4.4 Data linking and timeline of events

Linking these datasets together is not completely straightforward. Firstly, the subject categories differ in each data set, with up to 62 bespoke categories in the TGUG, JACS codes in the NSS at JACS2 or finer JACS3 levels, and different UCAS codes in the UCAS application data. Moreover, some universities enter, exit, move site, change names or merge during the period and there are no standard institution codes. Linking the data therefore requires some painstaking comparison of the subject categories, and inspection of university names (with web based research to understand name change, merger and relocation patterns). We end up with two main datasets. Our final NSS-UCAS linked dataset contains 40 subject categories and 177 universities. The Times-UCAS linked data contains 60 subjects and 129 universities. Both datasets span the university entrance years 2006-2011. We had to drop all joint degrees (i.e. combined subjects) because it proved impossible to cleanly assign NSS or TGUG scores to combined subjects in a meaningful way. These joint degrees represent 27% of subject-university cells in 2011, but only 19% of university applications.

The sequence of events surrounding the NSS survey, publication of survey data, publication of the TGUG tables, student applications and student entry to university is important. We will use the timing of events to draw inferences about the causal impacts of the information sources on applications, and the salience effects of the TGUG. The timing of events is shown in Figure 3. All events are references to year t, which is the applicant's intended year of entry to university, assuming they are not deferring entry to a later year.

5 Results

5.1 Baseline regression results on NSS effects on applications

Table 3 presents our first regression results showing the relationship between NSS scores and applications to universities. In line with the timing of events discussed above, we focus initially on the NSS results published in the summer two years prior to entry (t-2, one year prior to application). The units of observation are university-by-tariff-by-subject-by-year groups and the data relates to entry years from 2007 to 2011. The coefficients show the association between the NSS scores for a university-subject group, and subsequent applications in that group. The dependent variable is the natural log of applications so the coefficients show the percentage increase in applications for a one percentage point improvement in the NSS score. Standard errors are clustered on

universities to allow for serial correlation within universities over time and correlation across subjects within universities. The left hand panel uses the mean proportion responding 'definitely agree' or 'mostly agree' across all NSS statements as the operational score, this being the indicator appearing in the published TGUG league tables[10]. The right hand panel uses the proportion responding 'definitely agree' to the overall satisfaction statement (Q22), which is publicly available and visible in the separately published online NSS data[11], but is not immediately accessible in the format in which most published information is presented.

The first column in each panel (column 1 and 6) is a simple OLS regression, with no control variables apart from year dummies (i.e. equation 1 in Section 3). Moving right across the five columns in each panel, we progressively control for a larger set of fixed effects and trends to account for unobserved differences between subject and university groups and applicant qualifications. Columns 2 and 7 add in subject, applicant tariff group and university dummies (equation 2 in Section 3). In columns 3 and 8, the data are transformed into first-differences between years, to eliminate subject-by-tariff-group-by-university fixed effects (equation 3 in Section 3). Columns 4 and 9 control further for university-by-year, tariff-group-by-year and subject-by-year fixed effects. In columns 5 and 10, the data is double-differenced to remove subject-by-tariff-group-by-university trends, while retaining the other fixed effects of columns 4 and 9.

Looking at column 1 in the left hand panel, the coefficients have counterintuitive signs, large standard errors and are not significant at conventional levels. If nothing else, these results show that little can be learnt from the simple association between student feedback on course quality and course popularity among potential applicants. This evidence reinforces the arguments made in Section 3 that student feedback is endogenous to student demand in the cross section. Potential reasons for popular courses receiving poor NSS scores include congestion effects leading to an inferior student experience on bigger courses, that courses sought after for academic research kudos and employment prospects are more academically challenging, or because high-calibre students admitted to high-demand courses have high expectations. Controlling for university, subject and applicant ability effects in column 2 attenuates the coefficient of NSS scores, but it remains negative and insignificant. However,

[10] A closely related indicator, the mean score on the 5 point scale across all statements is used in another popular table, *The Complete University Guide*. *The Guardian University Guide* presents separate figures for NSS responses on feedback, teaching and overall satisfaction but these are aggregated to arrive at the final university rankings presented in their tables.

[11] Percentage scores for the statement about overall satisfaction are presented as the top-level statistic for the NSS results on the Unistats website.

our preferred, differenced specifications start in column 3. Here, when we control for fixed over-time university and course quality differences with university-by-tariff-group-by-subject fixed effects, a positive and statistically significant effect of changes in NSS scores on changes in applications emerges. The effect is moderate in size, the coefficient implying that a ten percentage point improvement in the proportion mostly or definitely agreeing with the NSS statements would generate only a 2.3% increase in applicant numbers. Note, a ten percentage point improvement in this NSS score is a large change, corresponding to about 1.5 standard deviations, or a move from the median to the 95th percentile across courses. Adding further controls for time varying subject-by-year, tariff-group-by-year and university-by-year effects in column 4, or double differencing to remove trends, leaves the coefficients largely unchanged. This stability in the coefficients provides reassurance that first-differencing alone renders the NSS scores uncorrelated with other determinants of application numbers and that the year-on-year shocks to NSS scores for each course are, in effect, random. We have also re-estimated these specifications using the sample of England-domiciled applicants, to address potential concerns about differences in the incentives to attend domestic universities for English, Welsh and Scottish students, but the results are essentially unchanged.

In the right hand panel, the picture is substantively different. All the coefficients are positive, but in the specifications in first differences the effects are small and insignificant. Comparing the results from columns 3-5 with those of columns 8-10 shows that changes in the overall satisfaction score alone have very little effect on student applications. The most plausible explanation for this is that students are responding to the mean score that is presented in the TGUG and other league tables. Overall satisfaction is just one of up to 22 components of this mean score and the components are not perfectly correlated. Therefore, movements in the overall satisfaction rating have only weak effects on the mean score, and hence weak impacts on applications. This provides some preliminary evidence on the salience effects of the way the NSS results are published in the TGUG and other tables. In particular, additional information provided by the NSS would appear to matter mainly through its impact on the published league tables, not directly through its availability in separate online tables, datasets and other formats. We investigate this question further in subsequent analysis.

In Figure 5 we examine the extent to which the relationship between NSS scores and (log) applications is linear, by reporting the coefficients and confidence intervals from a first-differenced regression analogous to Table 3, column 4, but with 20 dummy variables for each semi-decile of the NSS score distribution. The results here

show that applications are increasing throughout the NSS score distribution, but the biggest and statistically significant impacts are concentrated in the upper half of the distribution, where 80% or more of students 'mostly' or 'definitely agree' with the NSS statements. Recall, from Table 1, the mean proportion mostly or definitely agreeing with the statements is around 82% for the years in the estimation sample.

5.2 Baseline regression results on league table effects on applications

Turning attention now to the impacts of published league tables, Table 4 shows regression results on the effect of the TGUG rankings on student applications. The structure of the table is similar to that of one of the panels of Table 3, but with the TGUG ranking (scaled here between 0 and 1) as the explanatory variable. The coefficients therefore indicate the percentage response in applications to a one percentile move up the TGUG ranking. As discussed in Section 4, the TGUG ranking is published in the summer of the year prior to the year of student entry (t-1), and makes use of information from the NSS scores of the previous year (t-2). Note, these are the same NSS scores we used in Table 3, but also include further components as explained in section 4.3 above. The first point to observe is that the coefficients on the TGUG rankings are positive and significant in all specifications. Nevertheless, the effects shown in the basic cross-sectional analysis in column 1, and with basic university, subject and applicant tariff fixed effects, are clearly not causal estimates of the expected change in applications in response to a change in rankings. Firstly, this is because components of the TGUG scores – e.g. the tariff score for students already enrolled, and NSS student satisfaction – are partly determined by long run demand, as discussed in Section 3. Secondly, the TGUG rankings may simply reflect underlying institutional quality and status differences that are already well known to applicants, and influence demand independently of whether or not the rankings were actually published. In the first-differenced specifications that control for these unobserved factors, we still find positive significant effects, although of lower magnitude. Once we control for yearly subject, university and applicant tariff effects in column 4, and remove subject-by-university-by-tariff-group trends in column 5, the point estimates remain stable at around 0.15-0.2, implying that a 10 percentile improvement in the TGUG rankings increases applications by 1.5-2%. The standard deviation in our TGUG score is 0.28 (28 percentiles) by construction, so a one standard deviation change increases applications by up to 5.6%. In the following, we report results from first differenced regressions rather than double-differenced regressions, given that double differencing makes only a marginally difference and results in the loss of a year of data. As with the NSS regressions, we have also re-estimated these TGUG models for England-domiciled

applicants, for whom there are no financial incentives to attend universities in their home country, but the results are only marginally different.

We further checked for non-linearities in response by estimating the first-differenced specification of Table 4, column 3 with dummies for each decile of the TGUG score. The graph of the resulting coefficients and confidence intervals is shown in Figure 5 where it is evident that the marginal effects of changes in the rank are mildly increasing with the rank, and with little impact below the 40th percentile. Similar to the NSS scores, it is amongst the higher ranked university-subject groups that changes in the rankings are more important.

5.3 Results regarding salience of the league table information and timing

Initial evidence from Table 3 suggested that applications respond primarily to the mean NSS scores that affect the published league table rankings rather than other potential indicators of quality taken directly from the NSS data. Next, we provide further evidence on whether applications respond specifically to the league table rankings, or whether the NSS student satisfaction scores have direct effects. Table 5 presents results on the timing of impacts from the NSS. As in the left hand panel of Table 3, we use the mean proportion responding 'mostly agree' or 'definitely agree' across all the NSS statements as the operational score, from two years before the year of potential entry (t-2). These scores are those that influence the league table rankings for applications in year t. The subsequent year's NSS scores (t-1) are made public in the summer of application and could, theoretically, affect an applicant's decision if she/he refers to these NSS scores directly. By contrast, the NSS scores made public in the year of potential entry (t) are released too late to have any theoretical effect on applications. If it is the contribution of the NSS scores to the league tables that matters for applications, then we expect the effects of the t-2 NSS scores to dominate those from the adjacent years and the NSS score from year t should have no effect at all. To test this theoretical prediction, column 1 in Table 5 repeats the specification of column 4 in Table 3 that estimates the effect of this t-2 NSS variable, but with the addition to the regressions of the year t-1 and year t NSS scores. Column 2 repeats the specification, but with t-3, t-2 and t-1 NSS scores. In both cases, the t-2 NSS scores evidently have the biggest positive impact on applications and are the only ones that are statistically distinguishable from zero. In column 1, the year t NSS scores have a near zero insignificant effect, as expected given that they post-date applications. The coefficient on the NSS scores released just prior to applications is negative, but imprecisely measured and statistically insignificant in column 1. In column 2, year t-1 scores show

no effect, and year t-3 scores have a positive point estimate, but are again imprecisely estimated and insignificant (note, the sample years change as we move between columns 1 and 2 due to the different structure of lags and leads).

Next we cut the data a different way, with column 3 presenting the effects prior to application year t=2009, which is the first year that the NSS scores appear in the TGUG rankings (or in any other league table). Column 4 presents the effects from 2009 onwards. Here there is clear evidence that the NSS scores have a much stronger impact on applications in the years when they are published in the TGUG tables, and that the results in Table 3 are largely driven by the effects in the post-2009 period. Prior to 2009, the point estimates are less than one–third the magnitude of those in the post-2009 period and are non-significant. The overriding impression from the evidence in Table 5 is therefore that the NSS scores influence applications through the league table publications, indicating salience effects from the way the information is organised and disseminated in the TGUG (and other) publications.

Extending the analysis of salience and timing of the publication events, column 1 in Table 6 shows the effects of the TGUG rankings in different years prior to application. The year t publication in the year of entry is too late to influence applications, the t-1 publication is published in the previous summer and is targeted specifically at year t-1 applicants for year t entry – the university guidebook cover is labelled with the year of potential entry. The year t-2 publication is available but provides older information. As expected, the year t-1 TGUG ranking has by far the largest effect and, again, is the only statistically significant effect. Both the year t-2 and year t publications show some positive association with applications, but the coefficients are not statistically significant. The estimations for which results are reported in columns 2 and 3 go further in addressing the question of whether the NSS scores have independent effects on applications over and above the information already in the TGUG rankings. Column 2 presents the effects of the league tables on applications prior to the inclusion of the NSS scores, whilst column 3 shows the effects after inclusion. It is evident from these results that it is the league table rankings that matter, irrespective of the inclusion of NSS scores, and that the NSS scores only matter for applications in so far as they influence the league table rankings.

Note, the evidence on the timing of impacts in Table 5 and Table 6 also supports our argument that we estimate causal effects from year to year changes in the NSS scores and TGUG rankings, rather than correlations induced

by the changes in course quality that are unobserved to us, but are observed by potential applicants, by former students providing course feedback, and by the creators of the TGUG rankings. If our results were driven by such unobserved quality changes we would expect to see strong associations between applications and the year t/year t-1 NSS scores, and between applications and the year t TGUG scores, given that these indicators of quality are closer in time to the year of application, so potentially more prescient.

5.4 Separate components of the league table and NSS scores

So far we have looked at the effects of the mean NSS scores across all questions and the overall league table ranking. Table 7 presents some answers to more nuanced questions about which constituent quality metrics in the league tables matter, and whether student satisfaction with some aspects of their university experience are more important than others. The left hand panel relates to NSS scores split by their various domains (as set out in Section 4.2), although excluding the overall satisfaction domain to mitigate collinearity issues. The right hand panel splits the TGUG rankings into its separate components as they appear in the published tables. In both cases, we present simple OLS results for comparison (column 1 and 3), but our preferred estimates are based on the first-differenced specifications in columns 2 and 4.

The OLS estimates do not have a meaningful interpretation as estimates of the causal effects of the individual components on applications. The signs on the various sub-categories vary in incoherent ways and suggest the influence of omitted factors that affect demand and student feedback simultaneously. For instance, many traditionally sought-after, research-intensive and prestigious universities are, anecdotally, poor at providing feedback and support to students due to constraints on staff time and have a tradition of expecting students to study independently. This can explain the negative association between application numbers and student satisfaction with feedback and support. It can also explain the negative association with overall satisfaction and research in the TGUG criteria. On the other hand, these prestigious research-intensive universities are better resourced, which could explain the strong positive association between application numbers and satisfaction with resources. The fact that entry tariffs are high when demand is high explains the positive association of applications and entry tariff.

In the first-differenced NSS specifications which control for unobserved university, subject and applicant tariff-group effects, most of these coefficients become much smaller, positive, but insignificant. Satisfaction with

personal development (communication skills, problem solving and confidence) has a larger positive and more significant effect than the other domains on applications. However, we cannot reject the equality of the coefficients on all these domains (p-value=0.775), which is to be expected if the satisfaction scores influence demand via average satisfaction scores in the TGUG and other league tables. In the first-differenced TGUG regressions, we find significant positive impacts from the NSS overall satisfaction rating, employment prospects, and the teaching quality indicator. Note, the teaching quality indicator is available only in teaching-related degrees after 2006. In all these cases, a ten percentile increase in the rank on one of these criteria leads to less than 1% increase in applications. The effects of entry tariff and employment prospects are also positive, but not statistically significant. Again, however, we cannot statistically rule out equality in these coefficients (p-value 0.25), and overall the evidence suggests that applicants are not paying too much attention to rankings on these specific dimensions, but to the overall ranking in the league table.

5.5 Differences in response to league tables rankings, by student ability and university status

The preceding evidence shows that students respond to league table rankings in making their applications to university, and that information on student satisfaction affects choices through these league tables. Given this evidence, and because the matched TGUG-UCAS data provides us with a larger dataset with a longer time series, we focus on the effects of the league table rankings in all subsequent analysis.

So far we have only looked at the average response across applicants of all types and from all locations. Some types of student may, however, be more responsive to information than others, and applications to some types of university may be more sensitive than others. In particular, we would expect students with high qualifications to be more responsive, given their broader potential choice set. On the other hand, if strong reputational factors come into play in attracting students to prestigious universities, then the response of applications to changes in the league table rankings of top-tier universities might be more muted. Table 8 sheds light on this heterogeneity in response to league table rankings, by estimating the effects by applicant tariff group and the entry standards of universities. Column 1 allows the response to vary by applicant tariff group, with the first row giving the baseline response in the bottom tariff group, and the coefficients in the remaining rows showing the additional impact of the rankings on the higher-level tariff groups. The estimates indicate that response is constant across the lowest three tariff groups at around 0.17, but rises to around 0.30 for the highest tariff group. As expected, higher ability

students are more responsive to the league table rankings, a finding consistent with previous research on student choice in the UK (Broecke, 2012). Column 2 investigates differences by entry standards, based on the average tariff group of previous entrants (using the TGUG data). Here, it is evident that applications to universities of all entry standards respond to the TGUG rankings, but more so in the upper-middle tariff group, where the coefficient is almost twice that in the lowest two and highest tariff groups. These results suggest a greater degree of competition for students in this upper-middle tier of universities, where student demand is more elastic in response to variations in quality signals. We return to this issue of the competitiveness of the market faced by universities in Section 5.6. Clearly there are also potential interdependencies between applications in applicant tariff and university entry tariff groups, given that people are more likely to apply to courses for which they expect to be suitably qualified. Therefore, column 3 considers heterogeneity along these two dimensions in a single regression, although this does not change the general picture.[12] Lastly, in column 4, we interact the TGUG ranking with an indicator of university membership of the 24 leading universities which comprise the Russell Group. There is however no evidence of applications to these universities being more or less sensitive to changes in rankings.

Overall, the results of Table 8 indicate that applications from higher qualified students, and applications to middle-ranking universities (in terms of entry standards), are more responsive to changes in league table rankings. However, from the perspective of institutions interested in increasing student demand, the response of applications in general may be of less interest than the response of suitably qualified applicants. To estimate the response amongst suitably qualified applicants, we restricted the sample to applications in which the tariff group of the applicant meets (approximately) the requirements of the institution and subject to which they are applying.[13] These results (not tabulated) show that universities can expect a slightly greater response to league table ranking changes from suitably qualified applicants than applicants overall, with a coefficient of 0.27 (s.e. = 0.036), compared to 0.20 in the baseline estimates. This is in line with the greater response amongst high-tariff applicants in Table 8.

[12] We also estimated models with interactions between applicant and university tariff groups, but these were uninformative due to collinearity issues.

[13] The lower limit of the tariff group of the applicant is at least as high as the average tariff points of students in previous years (which we can take from the TGUG tables).

5.6 The availability of alternatives and university market power

The findings in Table 8 provide evidence of greater elasticity in demand amongst upper middle-tier universities (in terms of entry standards). In Table 9, we investigate other aspects of university competition and explore the variation in sensitivity of applications to quality signals across universities with different degrees of market power. Standard models of competition in public services with product differentiation predict that demand is more elastic to changes in quality (or information about quality, or prices) in markets where there are more providers (e.g. see Gaynor & Town, 2011), if there is some degree of product differentiation within the market. Therefore we expect the effect of rankings on applications to a university to be increasing in the number of universities operating in its own market.

To define 'markets', we proceed in two ways. Firstly, in column 1 we use the subject group as the market, and use a simple definition of competition based on the number of universities throughout Britain offering the same subject. This definition is natural given the way that information is organised by subject in the TGUG tables. A student looking at a table for a subject like Librarianship will be faced with only 10 universities to choose from, whereas a student searching for a degree in Psychology can pick from around 100 universities. This index of competition is interacted with the TGUG ranking (note, the number of institutions by subject does not appear as a separate variable because it is captured by the subject-by-year fixed effects) in column 1 of Table 9. As predicted, the results show that the response of applications is strongly increasing in the number of universities offering a subject. The baseline effect of TGUG rankings is 0.03 and statistically insignificant, but the coefficient on the interaction terms is positive and highly statistically significant. The magnitude of the coefficients implies that the effect of the TGUG rankings in a subject offered by 10 universities is around 0.07, whereas the effect in a subject offered by 100 universities is over six times higher at 0.43. Column 2 repeats this analysis, but restricts the sample to England-domiciled applicants only, to allay any concerns about the impact of the different fee and grant structures on competition for applicants from Wales and Scotland. The fees and grants for Scottish and Welsh students act as an incentive for these applicants to attend domestic institutions implying that universities in the different countries offering the same subject are not entirely substitutable for non-England domiciled students. However, as can be seen, solely focusing on applicants from England gives nearly identical results to the full sample.

In column 3, we switch to a geographical market definition, and estimate the share of total applications that a university receives from amongst applicants living within 50km of the university. These distances are straight line distances between the university and the centroid of the postal zone from which the application is made, and are approximate given that the geographical resolution offered by our application post-town identifiers is fairly crude (see section 4.1). The shares are based on the year in which the university first appears in the data to mitigate biases induced by the endogeneity of the share to changes in the number of applications. Again, we find strong evidence that applications respond much more strongly to quality signals in competitive markets. In a (hypothetical) market where a university faces perfect competition and takes a vanishingly small share of the market, the effect of the TGUG ranking on applications is 0.28 (the main effect of the TGUG overall score in row 1). In a market where a university has a local market share of 11%– which is approximately 2 standard deviations above the mean share – the response is half that at 0.14 (0.28-1.25*0.11). Column 3 again tests the robustness of these competition results when we exclude Welsh and Scottish applicants. Column 4 provides an alternative competition measure based on the share that a university takes amongst applicants living within 50km who are applying only to universities within 50km (i.e. who have only local universities in their choice set). The coefficient on the interaction between this competition index and the TGUG rankings is also negative, though only marginally significant. The implications are similar, in that the baseline effect in competitive markets is 0.24, but a 2 standard deviation increase in the share of the local market taken by a university (increasing the share to 50%) reduces the effect of the TGUG ranking to 0.18.

5.7 Heterogeneity on other dimensions

In additional analysis we have looked for variation in response to the league table rankings across broad subject groups – physical and technical, medical and biological, languages and arts, and social, legal and business – but found no statistically significant differences (see the Appendix, Table 10). We also investigated differences by applicant-university distance, considering the possibility that more geographically remote applicants might be more sensitive to rankings than more proximate applicants who have local knowledge of institutional quality through, for example, social networks (c.f. Moscone *et al.*, 2012). We also looked for interactions between applicant tariff group and distance. However, in neither case were there notable differences by applicant-university distance (see Appendix, Table 11, column 1 for results on distance). Finally we extended the analysis of column 4 in Table 8 and interacted the indicator of university reputation (Russell Group membership) with

applicant-university distance. Here we find evidence that applications to Russell Group universities from individuals living relatively close-by are more responsive to league table rankings than applications from applicants further afield. The point estimates are plotted in Figure 6 to show the general pattern, and the regression results shown in full in the Appendix, Table 11 column 2. As documented in Gibbons and Vignoles (2012), distance is a dominant factor determining university choice, particularly amongst some ethnic minority and low income groups. The evidence here of higher sensitivity to information about the quality of Russell Group universities amongst applicants living close to these institutions suggests that information may be important for those students who are most constrained by distance costs, and who tend to choose universities close to home.

6 Conclusion

There is a trend towards the greater use of disclosure mechanisms in market settings where reliable information would otherwise be difficult or costly for prospective consumers to acquire (Dranove and Jin, 2010). The present article investigates the influence of a distinctive disclosure scheme, the UK's National Student Survey (NSS), which specifically collects and disseminates feedback on students' satisfaction with their university course. We show that the NSS has a statistically significant impact on demand by home-domiciled undergraduate students at the subject-department level. Yet the effects are comparatively small: it would require a move up 10 percentiles (7-8 places in Economics) in the proportion of students 'mostly' or 'definitely' agreeing with positive NSS statements about their university course to achieve a 2%-3% increase in demand at the subject-department level. Similar modest effects have been found in previous studies which have analysed the impact of changes in overall league table rankings at the university level (Abbott and Leslie, 2004; Broecke, 2012). One possible explanation is that students already have well-developed knowledge about aspects of product quality which are meaningful to them in higher education markets (especially reputation and prestige, see Briggs (2006)) and therefore the impact of additional information is correspondingly limited.

While the annual NSS scores are first published separately from composite league tables, including *The Times Good University Guide* (TGUG) analysed in our study, an important finding is that the influence of satisfaction scores primarily operates through these league tables. That is, although the NSS provides additional information

which informs choice, students do not appear to be responding directly to quality cues provided by satisfaction scores when they are publicly released in the year of collection. Instead, as revealed by the lag in the effect of NSS scores, students are updating their beliefs about product quality as a result of the inclusion of average student satisfaction responses in league tables. We posit that this reflects the greater salience of league tables in the sense that they are visible, readily available and, on account of the way in which universities and subject-departments are compared on an ordinal rank scale, easy to understand (Luca and Smith, 2013). The NSS lacks the high profile of league tables such as the TGUG and, in the online formats in which the consituent response data are available, typically requires users to spend time and effort to compare universities/subject-departments. Lending further weight to this interpretation regarding salience is our disaggregated analysis which suggests that students are mostly responding to the quality signal provided by the overall league table position rather than strongly to individual quality dimensions.

Another novel finding of our study, which builds on recent work in health-care settings (Beckert *et al.*, 2012; Gaynor and Town, 2011; Gaynor *et al.*, 2012), concerns market concentration, competition and power. We show that the impact of information on quality derived from league tables is strongly influenced by the number of providers in a particular subject area. The magnitude of the impact of a ten percentile move up the TGUG ranking ranges from 0.07% for a discipline with 10 universities (Librarianship) to 4.3% for a discipline with 100 universities (Psychology). In other words, sensitivity to quality signals is a function of the degree of market concentration, with consumers proving more responsive in market settings where they have more choice. In line with previous work (Broecke, 2012), our findings suggest that high-ability candidates are more responsive to league tables, possibly as a result of their wider choice set. Interestingly, changes in rankings have the greatest impact on demand amongst departments with entry standards in the upper-middle tariff group, again possibly reflecting the high degree of competition within this tier. Applications to degree courses in Russell Group universities are not, in general, more or less sensitive to ranking changes than their counterparts outside of this club. Given that the reputation of these "elite" universities is already well-known, and also durable, it makes sense that additional information on quality is unlikely to have a major impact on demand. However, local applications to Russell Group universities (less than 50km from applicants' home address) are more responsive to quality rankings than applications from further away, and more responsive than applications to non-Russell

Group universities at similarly close distances. Both findings suggest that information about quality may be particularly important for applicants whose choices are highly constrained by the costs imposed by distance.

The main conclusions from our study are therefore three-fold. First, the format in which quality information is presented and disseminated is crucial, with prospective students paying attention to information which is more salient. Second, student satisfaction, or for that matter league tables, do not have a major impact on demand in the short-term. University or departmental managers expecting a large surge in demand from students in response to improved NSS scores or league table positions will be disappointed with our findings. Third, the degree to which quality indicators affect demand is strongly influenced by the degree of competition, with subject-departments facing least competition standing to lose/gain the least from the publication of lower/higher quality indicators.

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8 Tables

Table 1: Descriptive statistics for NSS data

	definitely disagree	disagree	neither	mostly agree	definitely agree	subject x uni groups
2005	0.019	0.063	0.095	0.523	0.299	1532
2006	0.020	0.061	0.093	0.523	0.304	1483
2007	0.026	0.064	0.091	0.502	0.317	2041
2008	0.025	0.059	0.085	0.479	0.351	2195
2009	0.028	0.063	0.089	0.479	0.341	2718
2010	0.029	0.063	0.090	0.476	0.344	2770

Table 2: Descriptive statistics for UCAS data

year		tariff1	tariff2	tariff3	tariff4
2006	mean	100	82	104	65
N=4258	s.d.	190	133	156	153
2007	mean	119	76	102	72
N=4265	s.d.	226	119	149	165
2008	mean	125	68	93	64
N=4259	s.d.	265	106	137	153
2009	mean	137	70	96	69
N=4360	s.d.	301	114	142	161
2010	mean	168	77	103	77
N=4391	s.d.	402	129	154	172
2011	mean	185	82	110	83
N=4274	s.d.	435	136	159	174

Note: data in university x subject x tariff x year cells

Table 3: Regression estimates of effect of NSS scores on applications

	Mean across domains					Overall satisfaction, Q22 only				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Definitely or	-0.543	-0.076	0.226**	0.252***	0.223**	0.101	0.059	0.024	0.028	0.018
mostly agree, t-2	(0.332)	(0.208)	(0.074)	(0.069)	(0.083)	(0.194)	(0.132)	(0.044)	(0.042)	(0.047)
Fixed effects:										
Year	Yes	Yes	Yes	No	No	Yes	Yes	Yes	No	No
Subject + uni. + tariff	No	Yes	No	No	No	No	Yes	No	No	No
Subject × uni. × tariff	No	No	Yes	Yes	Yes	No	No	Yes	Yes	Yes
Subject, uni, tariff × year	No	No	No	Yes	Yes	No	No	No	Yes	Yes
Subject × uni. × tariff trend	No	No	No	No	Yes	No	No	No	No	Yes
Observations	34,365	34,365	23,897	23,897	15,708	34,365	34,365	23,897	23,897	15,708
R-squared	0.003	0.319	0.039	0.191	0.113	0.002	0.319	0.038	0.190	0.112

Robust standard errors in parentheses, clustered on university
*** p<0.001, ** p<0.01, * p<0.05
Dependent variable is log applications
NSS scores are proportion reporting definitely or mostly agree reported in entry year minus 2
Data is in tariff x university x subject x year cells for entry in 2006-2011
All specifications include dummy variables for partly missing or imputed data

Table 4: Regression estimates of effect of TGUG ranking on applications

	(1)	(2)	(3)	(4)	(5)
Overall ranking	0.279*	0.439***	0.132***	0.200***	0.170***
	(0.113)	(0.062)	(0.023)	(0.031)	(0.038)
Fixed effects:					
Year	Yes	Yes	Yes	No	No
Subject + uni. + tariff	No	Yes	No	No	No
Subject × uni. × tariff	No	No	Yes	Yes	Yes
Subject, uni, tariff × year	No	No	No	Yes	Yes
Subject × uni. × tariff trend	No	No	No	No	Yes
Observations	58,988	58,988	46,883	46,883	35853
R-squared	0.080	0.429	0.035	0.159	0.115

Robust standard errors in parentheses clustered on university
*** p<0.001, ** p<0.01, * p<0.05
Dependent variable is log applications
Times scores are standardised to range between 0 and 1 (percentiles)
Data is in tariff x university x subject x year cells for entry in 2006-2011
All specifications include dummy variables for partly missing or imputed data

Table 5: Timing of NSS effects on applications

			Pre-2009	2009-on
	(1)	(2)	(3)	(4)
Def or mostly agree	-0.042	-	-	-
mean, t	(0.090)			
Def or mostly agree	-0.158	0.040	-	-
mean, t-1	(0.103)	(0.092)		
Def or mostly agree	0.206*	0.231*	0.104	0.339***
mean, t-2	(0.100)	(0.105)	(0.121)	(0.093)
Def or mostly agree	-	0.110	-	-
mean, t-3	-	(0.086)		
Fixed effects:				
Subject × uni. × tariff	Yes	Yes	Yes	Yes
Subject, uni, tariff × year	Yes	Yes	Yes	Yes
Observations	15,735	15,746	9,197	14,700
R-squared	0.202	0.164	0.198	0.168

Notes as Table 3

Table 6: Timing of TGUG effects on applications

		Pre-2009	2009-on
	(1)	(2)	(3)
Times overall, t	0.065	-	-
	(0.037)		
Times overall, t-1	0.224***	0.214***	0.190***
	(0.033)	(0.048)	(0.037)
Times overall, t-2	0.063	-	-
	(0.034)		
Fixed effects:			
Subject × uni. × tariff	Yes	Yes	Yes
Subject, uni, tariff × year	Yes	Yes	Yes
Observations	26,030	17,801	29,082
R-squared	0.186	0.174	0.131

Notes as Table 4

Table 7: Effects of separate TGUG and NSS criteria on applications

NSS domains	(1)	(2)	TGUG criteria	(3)	(4)
Teaching	1.409***	0.054	Satisfaction (2009 on)	-0.472***	0.087***
	(0.304)	(0.076)		(0.086)	(0.019)
Feedback	-1.963***	0.030	Teaching quality (teaching	0.380*	0.075*
	(0.206)	(0.058)	degrees only > 2006)	(0.146)	(0.030)
Support	-0.614*	0.049	Employment prospects	0.554***	0.079***
	(0.260)	(0.067)		(0.062)	(0.021)
Organisation	-0.165	-0.024	Entry standards (Tariff)	0.254*	0.027
	(0.193)	(0.053)		(0.121)	(0.022)
Resources	1.363***	0.023	Research	-0.442***	0.041
	(0.265)	(0.049)		(0.102)	(0.024)
Personal development	0.766**	0.154*			
	(0.245)	(0.059)			
Fixed effects:			Fixed effects:		
Year	Yes	No	Year	Yes	No
Subj. + uni. + tariff	No	No	Subj. + uni. + tariff	No	No
Subj.× uni. × tariff	No	Yes	Subj.× uni. × tariff	No	Yes
Subj., uni, tariff × year	No	Yes	Subj., uni, tariff × year	No	Yes
Subj. × uni. × tariff trend	No	No	Subj. × uni. × tariff trend	No	No
Observations	34,365	23,897	Observations	58,988	47,103
R-squared	0.034	0.192	R-squared	0.096	0.159

Robust standard errors in parentheses clustered on university
*** p<0.001, ** p<0.01, * p<0.05
Times scores are standardised to range between 0 and 1 (percentiles)
Data is in tariff x university x subject x year cells for entry in 2006-2011
All specifications include dummy variables for partly missing or imputed data

Table 8: Effects of TGUG ranking on applications, by applicant and university tariff group

	(1)	(2)	(3)	(4)
Times overall	0.166***	0.131**	0.098*	0.190***
	(0.044)	(0.040)	(0.048)	(0.037)
Times overall × applicant tariff 2	-0.033		-0.033	
	(0.045)		(0.045)	
Times overall × applicant tariff 3	0.036		0.036	
	(0.044)		(0.044)	
Times overall × applicant tariff 4	0.138*		0.136*	
	(0.054)		(0.054)	
Times overall × course tariff 2		0.026	0.026	
		(0.042)	(0.042)	
Times overall × course tariff 3		0.114**	0.113**	
		(0.035)	(0.035)	
Times overall × course tariff 4		0.034	0.033	
		(0.065)	(0.065)	
Times overall × Russell Group uni.				0.043
				(0.041)
Fixed effects:				
Subject × uni. × tariff	Yes	Yes	Yes	Yes
Subject, uni, tariff × year	Yes	Yes	Yes	Yes
Observations	46,883	46,883	46,883	46,883
R-squared	0.159	0.160	0.160	0.159

Notes as Table 4

Table 9: Effects of TGUG ranking on applications, by university market power

	Britain domiciled applicants	England domiciled applicants	Britain domiciled applicants	England domiciled	Local domiciled applicants
	All British universities	All British universities	50km market	50km market	50km market
	(1)		(2)	(3)	(4)
Times overall	0.028	0.022	0.278***	0.281***	0.236***
	(0.046)	(0.048)	(0.041)	(0.042)	(0.030)
Times overall × number of Universities offering subject	0.004***	0.004***	-	-	-
	(0.001)	(0.001)			
Times overall × share of geographical market	-		-1.249*	-1.232*	-0.130†
			(0.546)	(0.586)	(0.077)
Observations	726,001	647,279	647,799	587,483	647,799
R-squared	0.034	0.035	0.039	0.035	0.034

Robust standard errors in parentheses clustered on university
*** p<0.001, ** p<0.01, * p<0.05, †p<0.10
Dependent variable is log applications
Data is in tariff x university x subject x post-town-group year cells for entry in 2006-2011
All specifications include dummy variables for partly missing or imputed data

9 Figures

Figure 1: NSS domains and statements

22	Overall	Overall, I am satisfied with the quality of the course.
1	The teaching on my course	Staff are good at explaining things.
2		Staff have made the subject interesting.
3		Staff are enthusiastic about what they are teaching.
4		The course is intellectually stimulating.
5	Assessment and feedback	The criteria used in marking have been clear in advance.
6		Assessment arrangements and marking have been fair.
7		Feedback on my work has been prompt.
8		I have received detailed comments on my work.
9		Feedback on my work has helped me clarify things I did not understand.
10	Academic support	I have received sufficient advice and support with my studies.
11		I have been able to contact staff when I needed to.
12		Good advice was available when I needed to make study choices.
13	Organisation/ management	The timetable works efficiently as far as my activities are concerned.
14		Changes in the course or teaching have been communicated effectively.
15		The course is well organised and is running smoothly.
16	Learning resources	The library resources and services are good enough for my needs.
17		I have been able to access general IT resources when I needed to.
18		Able to access specialised equipment, facilities or room when I needed to.
19	Personal development	The course has helped me present myself with confidence.
20		My communication skills have improved.
21		As a result of the course, I feel confident in tackling unfamiliar problems.

Figure 2: Example layout of TGUG table for top 20 universities in 2009 tables

Economics		**Research quality**	**Entry standards**	**Student satisfaction %**	**Graduate prospects %**	**Overall rating**
1	Cambridge	5B	528		93	100
2	London School of Economics	5*A	510	74	89	97.5
3	Oxford	5B	512	84	84	97.1
4	University College London	5*A	459	72	87	93.9
5	Warwick	5*B	473	73	90	93.2
6	Durham	4B	462	79	82	90.5
7	Birmingham	4B	410	85	77	90.4
8	Nottingham	5A	453	72	81	90
9	Bristol	4A	458	73	84	89.4
10	Exeter	5B	397	81	73	88.6
11	East Anglia	4B	327	89	72	88.1
12	St Andrews	4B	430	76	80	87.2
13	York	5A	448	71	71	86.6
14	Lancaster	5*B	394	75	69	85.9
15	Bath	5B	441	70	77	85.1
16	Loughborough	3aB	374	82	72	84.4
17	Southampton	5A	399	67	75	83.9
18	Glasgow	4B	413	76	71	83.8
19	Essex	5*B	337	76	65	83
20	Leicester	5B	325	81	62	82.9

Figure 3: Timing of key events relating to publication of information, application and university entrance

Autumn t	Entry to university for t-1 applicants	
	UCAS application by year t+1 entrants	
Summer t	Publication of NSS year t results	Too late for year t entrant application
Spring t	Publication of TGUG for entry t+1, using NSS t-1	Too late for year t entrant application
Winter t	NSS year t survey	
Autumn t-1	Entry to university year t-1	
	UCAS application by year t entrants	
Summer t-1	Publication of NSS year t-1 results	Available for year t entrant application
Spring t-1	Publication of TGUG for entry t, using NSS t-2	Available for year t entrant application
Winter t-1	NSS year t-1 survey	Source data for TGUG year t+1
Autumn t-2	UCAS application by year t-1 entrants	
	Entry to university year t-2	
Summer t-2	Publication of NSS year t-2 results	Available for year t entrant application
Spring t-2	Publication of TGUG for entry t-1, using NSS t-3	Available for year t entrant application
Winter t-2	NSS year t-2 survey	Source data for TGUG year t

Figure 4: Effect of NSS scores on applications. Figure reports coefficients from first-differenced regressions with subject, uni, tariff × year fixed effects

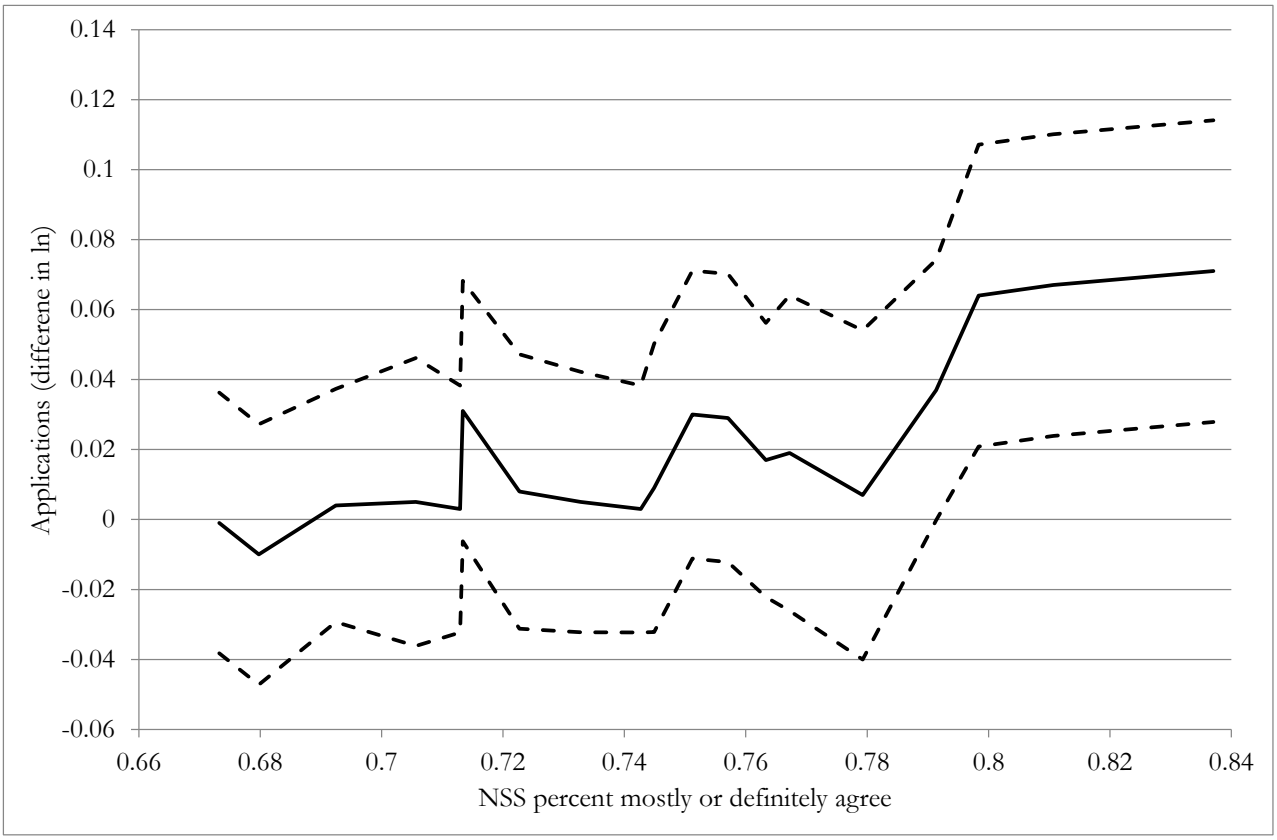


Figure 5: Effect of TGUG ranking on applications. Figure reports coefficients from first-differenced regressions with subject, uni, tariff × year fixed effects

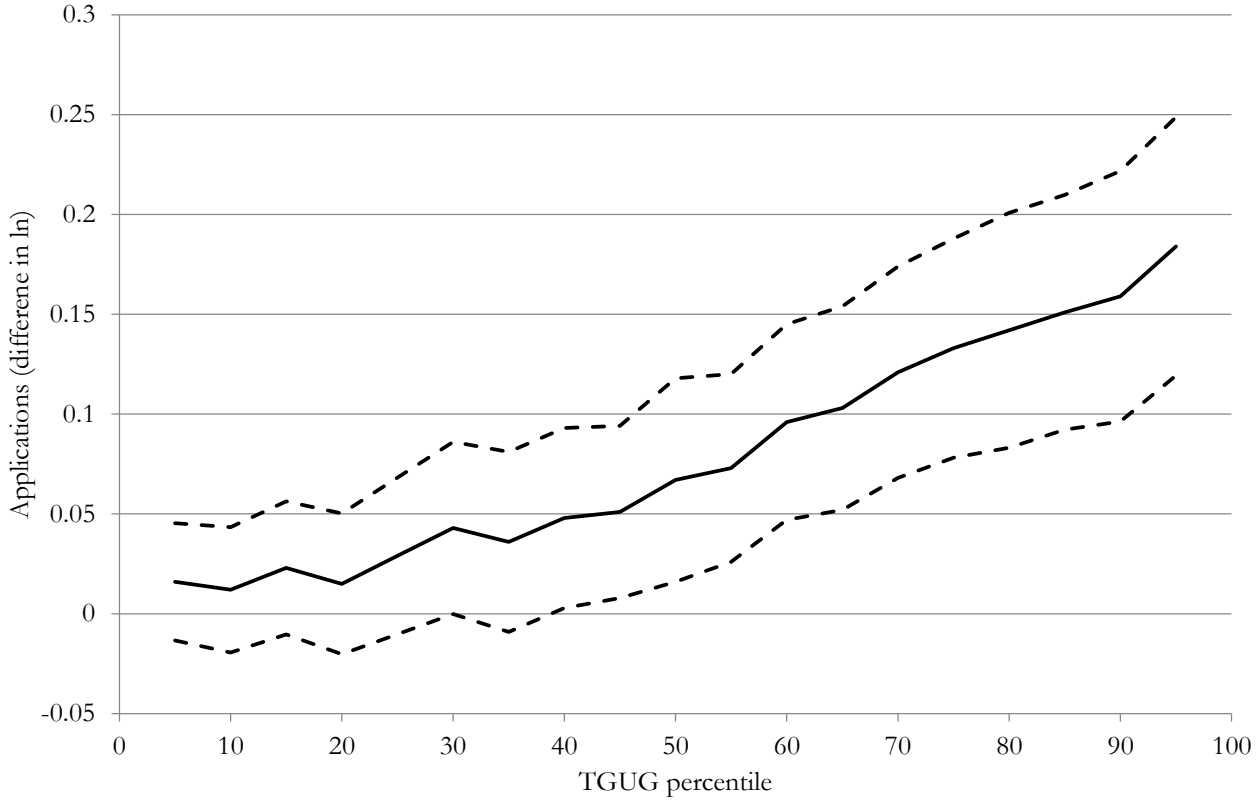
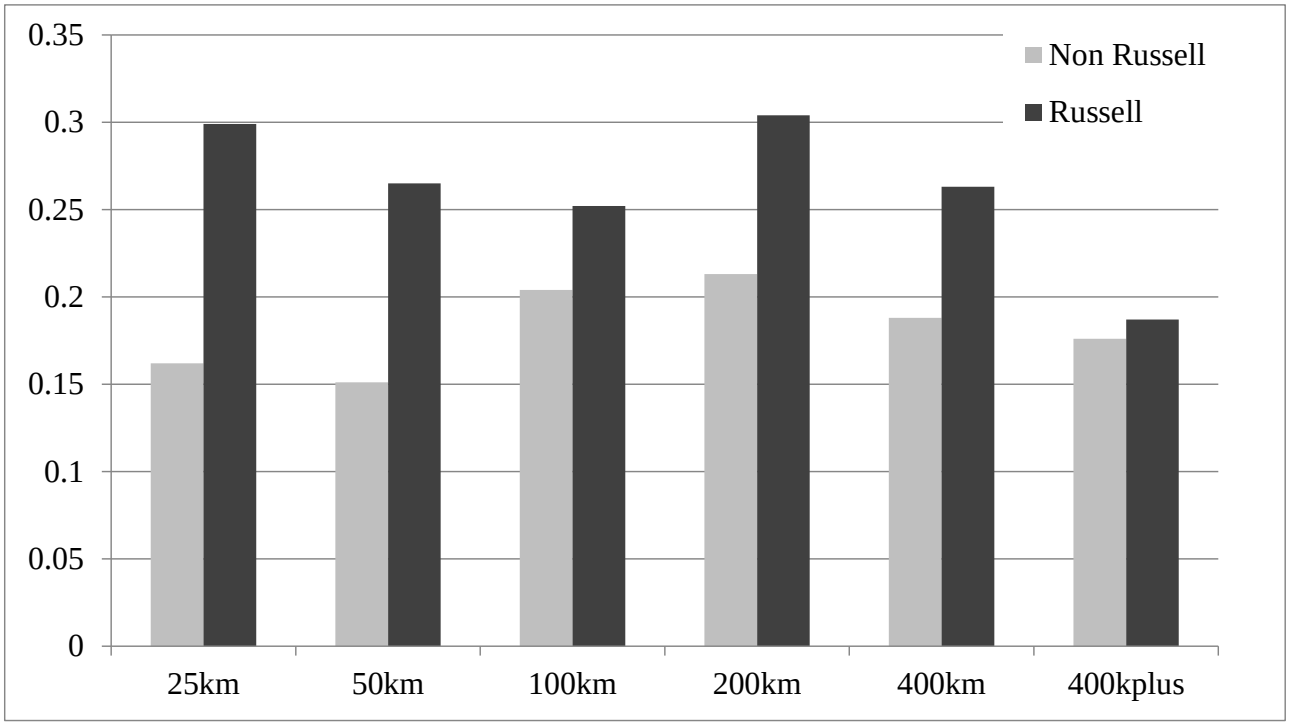


Figure 6: Effects of TGUG ranking on applications by residence-university distance



10 Appendix Tables

Table 10: Effects of TGUG ranking on applications, by subject group

	(3)	(4)
Times overall	0.196***	0.158**
	(0.037)	(0.055)
Times overall _physical	0.012	
	(0.059)	
Times overall _phys_tech		0.098
		(0.076)
Times overall _medic_biol		-0.012
		(0.090)
Times overall _lang_arts		0.076
		(0.072)
Observations	46,883	46,883
R-squared	0.159	0.159

Notes as Table 4
Baseline subject is social, legal, business, language, creative, arts and humanities in Column 2
Baseline subject is social legal and business in Column 3

Table 11: Times scores, distance and Russell Group status

	(1)	(2)
Times overall	0.198***	0.162***
	(-0.03)	(0.034)
Times overall _distance_50k	-0.021	-0.011
	(0.035)	(0.044)
Times overall _distance_100k	0.017	0.042
	(0.031)	(0.035)
Times overall _distance_200k	0.040	0.051
	(0.030)	(0.035)
Times overall _distance_400k	0.013	0.026
	(0.028)	(0.035)
Times overall _distance_400kp	-0.020	0.014
	(0.034)	(0.046)
Times overall _russel		0.137**
		(0.045)
Times overall _distance_50k_russell		-0.023
		(0.058)
Times overall _distance_100k_russell		-0.089
		(0.063)
Times overall _distance_200k_russell		-0.046
		(0.058)
Times overall _distance_400k_russell		-0.062
		(0.052)
Times overall _distance_400kp_russell		-0.126*
		(0.063)
Observations	726,001	726,001
R-squared	0.034	0.034

Notes as Table 4. Distance bands in km.