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Student satisfaction, league tables and university applications: Evidence from Britain

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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 degrees. We show that NSS scores have a small statistically significant effect on applications at the university-subject level. This effect operates via the influence of the NSS on a university's position in separately published, subject-specific league tables, suggesting that information contained in the league table rankings is more salient. The impact of rankings is greater for more able students, for universities with entry standards in the upper-middle tier, and for subject-departments facing more competition.

JEL codes: I2, D8, H

Keywords: Student satisfaction, higher education, information, university choice

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1 Introduction

A frequently cited rationale for recent market-based reforms in higher education 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 higher education markets depends crucially 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 applications to university degree programmes respond to the signals generated 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 degrees with higher levels of student satisfaction. Indeed, given the high costs of pursuing a degree and the potentially significant benefits of making an informed choice (Dale and Krueger 2014, Broecke 2012, Hussein *et al* 2009, Black and Smith 2006, Brewer *et al* 1999), 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. First, our central focus on "user reviews" of academic and institutional quality distinguishes the present study from an existing body 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.

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. A recent exception is Alter and Reback (2014), who include indicators of student happiness and quality of life – based on the Princeton Review's *Best Colleges* guidebook– in their analysis of US college applications. However, to the best of our knowledge, ours is the first study to examine the influence of independently published data on student satisfaction with their degree programme, derived from large scale national surveys. This feedback is specific to the subject they are studying, not just the university, and the surveys are unique in the information they elicit about student views on teaching, academic support, feedback, organisation and other dimensions of academic product quality. We find that, despite the considerable cost and effort involved in administering the NSS, the additional information it provides has a small impact on the choices of students.

A second novel and important feature of our work is that we use 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). By contrast, previous studies have mainly examined the influence of quality indicators at the university level (Broecke, 2012; Meredith, 2004), or considered one or two single subject areas (Sauder and Lancaster, 2006; Soo and Elliott, 2010). One recent exception is Chevalier and Jia (2015)'s study of application decisions across UK universities. However, their work only examines 17 broad subject categories which do not closely correspond to university departments, and furthermore only investigates the impact of composite league tables. Motivating our more disaggregated unit of 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 substantial within-university variation in subject rankings (Cheng and Marsh, 2010). Even more importantly, having this

information by subject, university and year allows us to better identify the causal effects of student feedback and quality indicators on student demand, by exploiting the year-to-year shocks in the subject-by-university NSS and published quality rankings (more details below) and controlling for unobservable time varying university and subject-specific effects.

Our third contribution is to examine whether the way in which information on quality is presented to prospective university students – 'salience' effects (Chetty *et al.*, 2009) – affects application choices. To this end, we compare the direct influence of the NSS on student demand and its influence through its contribution to rankings in one of the UK's leading league tables, *The Times Good University Guide* (TGUG). The NSS might impact demand directly if prospective students respond to the constituent information published independently of third-party league tables. Alternatively, given that the satisfaction scores are now included in most of these league tables, it could be that the student satisfaction scores affect choices 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 the NSS primarily operates through league tables. The TGUG data also allow us to investigate which individual quality dimensions (student satisfaction, research quality, employability, etc.) of composite league tables have the greatest impact on demand.

A final contribution is to examine how the impact of subject-department league table rankings is conditioned by various factors, namely, prospective students' academic ability, their perceptions about the "elite" or "prestige" status of universities, and entry standards. We find that the league table rankings have the greatest effect on the most able students and for degree courses in the upper-middle entry standard tariff ("grades") group. Novel to the literature on university choice, we also 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 within settings where potential consumers find it difficult to judge quality (Daughety and Reinganum, 2008; Dranove and Jin, 2010; Nelson, 1970; Spence, 1973). 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 question 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). The present study is additionally of interest to decision-makers at both university and departmental levels who 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). In particular, by providing more refined insights into the extent to which quality metrics affect applicant numbers, our paper provides valuable information which might help managers in their resource allocation decisions.

The remainder of the paper is structured as follows. Section 2 reviews 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 estimation methods. 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 results and Section 6 concludes.

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. 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.[2]

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 (Griffith and Rask, 2007; Sauder and 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. Bowman and Bastedo (2009) show that the impact of moving onto (or off) the front page of the USNWR ranking is over and above the ordinal ranking of institutions. Luca and Smith (2013) show that, when presented as an ordinal ranking, 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. Alter and Reback (2014) also find evidence of salience effects, with numerical rankings primarily influencing applications to the extent that they influence whether an institution features in selective front page Princeton Review's top 20 lists.

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

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.

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 high-ability candidates more responsive to league table changes. 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). Consistent with this interpretation, Gibbons and Vignoles (2012) 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.

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). Applications from non-European Union (EU)/non-home domiciled students to business study degree courses are found to be sensitive to subject-specific rankings, but not their equivalents applying for engineering subjects. Analysing a total of 17 subject groups, Chevalier and Jia (2015) show that a one standard deviation improvement in an institution's subject ranking score increases degree applications by an average of 4.3%. Applications are found to be more sensitive to subject-specific rankings than university-wide rankings.

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[3]. 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. Alter and Reback (2014) also find that different metrics matter, with entry in some top 20 tables in the Princeton Review (e.g. for 'least desirable campus') having a bigger impact than others (e.g. for 'best overall academic experience', 'party schools', 'stone-cold sober schools' and 'jock schools').

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 the impact of

[3] 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.

online reviews for consumer goods and services (Chevalier and Mayzlin, 2006; Anderson and Magruder, 2012).

3 Research design

The primary focus of the present paper is on the causal impact of student satisfaction scores and league table rankings on undergraduate applications by home-domiciled students to British universities. Our interpretation of a 'causal' impact of these scores is the expected change in student applications for a university-subject group, arising from a change in student ("satisfaction") reviews or position in published composite league table rankings – irrespective of whether or not these metrics capture underlying quality changes. We will identify this impact from the putatively random changes in the scores that occur from year to year.

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 in Section 4.1 below. Our study nevertheless faces a number of other identification challenges.

To begin with, some components of the TGUG and other league tables are endogenous to student demand. For example, the entry 'tariff' (minimum entry qualifications) 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. High-demand, prestigious universities may also have advantages in raising research funding, allowing them to generate better research scores. Both of these factors suggest that cross-sectional correlations between TGUG scores and applications will be an upward biased estimate of the impact of the TGUG scores on applications. Also important 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).

The NSS scores are also potentially endogenous for a number of reasons. High-calibre students applying to the most sought-after institutions might have higher than average expectations about

university quality and hence provide lower than average user satisfaction ratings. Popular degree courses may suffer from congestion effects due to high student numbers which reduce student satisfaction. Courses that are popular because of kudos and good employment prospects may be more academically challenging. These institutions may also receive poor satisfaction feedback if they divert resources from the delivery of teaching and the consumption aspects of the university experience towards research. The above considerations suggest that the cross sectional correlation between NSS scores and applications will be a downward biased estimate of the causal impact of the NSS scores on applications.

Our research design, using a multi-dimensional fixed effects approach, goes a long way in tackling these challenges. We will base our estimation on a panel of university-subject-tariff group data cells, observed annually over the period 2006-2011 (based on year of applicants' potential entry). Our empirical analysis is based on estimation of β, interpreted as the causal effect of NSS scores or TGUG rankings on UCAS applications, using variants of the following regression specification:

$$\ln apps_{usat} = \beta score_{ust} + \{\mu 0_t + \mu 1_u + \mu 2_s + \mu 3_a + \mu 4_{ut} + \mu 5_{st} + \mu 6_{at} + \mu 7_{usa} + t \times \mu 8_{usa}\} + \nu_{usat} \qquad (1)$$

In (1) $\ln apps_{usat}$ is the natural log of application numbers to university *u*, in subject *s*, by applicants in tariff group *a* for entry in year *t*. Variable $score_{ust}$ is one of a number of NSS student satisfaction scores or TGUG 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). The factors inside the curly-brackets represent unobservable components, potentially correlated with $score_{ust}$, which we will control for to different degrees in different specifications using fixed effects methods, either by including dummy variables or by differencing the data over time. These factors can include: 1) year-specific effects that are invariant across universities, subjects and applicant tariff groups ($\mu 0_t$) e.g. national policy changes; 2) university effects that are fixed across subjects and applicant tariff group and time ($\mu 1_u$), e.g. university location and long-run reputation; 3) subject effects that are invariant across universities, tariff groups and time ($\mu 2_s$), e.g. the persistent status of degrees like medicine; and 4) factors shared by applicants in a tariff

group that are invariant across universities, subjects and time ($\mu 3_a$) e.g. their ability. There are also potentially time varying versions of these effects ($\mu 4_{ut}, \mu 5_{st}, \mu 6_{at}$) and we will also allow for the possibility of university-subject-tariff group effects that are fixed over time ($\mu 7_{usa}$) and university-subject-tariff group trends $t \times \mu 8_{usa}$. Note that these μ terms in equation (1) are intended to represent the theoretical unobservable components that determine applications and are potentially correlated with the NSS/TGUG scores. Of course when it comes to estimation, some of these terms will be subsumed in others when they are controlled for using fixed effects methods (e.g. controlling for $\mu 7_{usa}$ also controls for $\mu 1_u$, $\mu 2_s$ and $\mu 3_a$). The term ν_{usat} represents other unobservables that are uncorrelated with the NSS/TGUG scores.

Our empirical specifications become increasingly more stringent with respect to the way we control for these unobserved university, subject, applicant tariff-group and time effects. We start with a benchmark model only controlling for year fixed effects ($\mu 0_t$) using year dummies. We then add university, subject and tariff dummy variables to control for fixed effects ($\mu 1_u, \mu 2_s, \mu 3_a$). In a third specification, we allow for unobserved university-by-subject-by-tariff fixed effects ($\mu 7_{usa}$) and wipe these out of the regression by taking first differences within university-by-subject-by-tariff categories, while controlling additionally for university-by-year, subject-by-year and tariff-group-by-year dummies.[4] That is, differencing (1) gives, where Δ is the first difference operator:

$$\Delta \ln apps_{usat} = \beta \Delta score_{ust} + \{\Delta \mu 4_{ut} + \Delta \mu 5_{st} + \Delta \mu 6_{at} + \mu 8_{usa}\} + \tilde{\nu}_{usat} \qquad (2)$$

Moving to this first-differenced specification is potentially important. It ensures that identification comes only from the association of the one-year difference in the university-subject score available for applicants for entry in years t-1 and t, with the one year difference in applications for entry in years t-1 and year t (i.e. it eliminates any correlation between score changes in one year and application changes in future or past years). In a fourth specification, we eliminate the university-by-subject-by-tariff group

[4] Note that the score variable does not vary by student tariff groups. Our purpose in keeping the data aggregated to university-by-subject-by-year-by-tariff-group cells is to allow us to include tariff-group fixed effects to control for any changes in the composition of the applicant pool to the university-subject groups (in terms of A-Level grades).

trends ($\mu 8_{usa}$) by double differencing over time, within university-by-subject-by-tariff groups, and again control for university-by year, subject-by-year and tariff-group-by-year effects using dummy variables. In this double differenced specification, identification of β comes from year-to-year changes-in-the-changes to the NSS/TGUG score variable. As shown in the results below, estimates change dramatically when moving from naïve estimation without controls for these fixed effects, to more stringent specifications. This suggests that it is very important to control for fixed institutional and subject differences, and general changes over time, in order to identify the causal impact of the information in the NSS/TGUG scores.

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 league table rankings from the TGUG. As well as allowing us to eliminate the multidimensional fixed effects discussed above, the panel structure of our data 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. Additionally, 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. 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[5] – a figure which was reduced from six from 2008 onwards. Applicants do not list their choices in any preference order, universities do not see the order in which applicants list their choices, and there is no limit to the number of offers a student can receive. Most applicants will not yet know the outcomes of their school exams, so universities usually make offers that are conditional on the applicant gaining the appropriate grades. Once an applicant receives their offer(s), they accept one as a firm first choice, and another as a backup/insurance choice in case they do not obtain the necessary grades for their first choice. Our analysis is based only on the first stage of this process, that is, the stage at which applicants make their initial choices. This means we side-step issues related to the strategic decisions students need to make when accepting offers. Even more importantly, we do not need to be concerned about the university's side of the decision process, which would lead to endogeneity issues if we looked at the impact of the TGUG/NSS scores on offers or matriculation.

We acquired annual data from 2006 to 2011 from UCAS, aggregated to the university-by-subject-by-tariff group level. Tariff groups refer to entry qualifications, standardised using the UCAS tariff. This tariff is a grade point average based on school-level qualifications (mainly A-Levels, typically taken at age 17-18, for university entrants). There are four tariff groups in our UCAS data, namely up to 135, between 136 and 270, between 271 and 405 and above 406. A typical top-university tariff of three As at A-Level (on a range from E to A*) corresponds to 420 points. A tariff score below 135 points corresponds to less than two Es and a D at A-Level. Table 1 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 our study period, with the tuition regime remaining more or less constant.

5 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.

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. 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 England-domiciled students only, to confirm that these national differences and changes in fee structure do not affect our results.[6]

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[7] (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 'JACS3' level, which allows matching NSS scores with league table rankings and applications data.

6 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.

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

Note, as its name suggests, JACS is a scheme for coding subject areas. JACS3 builds on the JACS2 classification, adding further subject sub-categories and providing more refined descriptors of existing ones, yielding a more detailed and disaggregated classificatory scheme.

There are on average around 80-90 respondents in each university-subject specific group, but varying from as low as 10 to above 1200. Appendix Table A1 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 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[8]) 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

[8] 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*.

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 (1=0, 2=2, 3b=3, 3a=4, 4=5, 5*=6). From 2010 on, the TGUG uses a single numerical ranking from 0.1-6.5 at 0.1 intervals. 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 UCAS tariff points of students enrolled on courses in the subject-university category (based on data from the Higher Education Statistics Agency (HESA)). 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 these TGUG scores – the separate metrics and the overall score – into an ordinal ranking using percentiles, by year, rescaled to range between 0 and 1. This standardisation makes the different metrics comparable across years, but means that the descriptive statistics are neither especially interesting nor informative. Therefore, for illustration purposes, Figure 2 shows 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, 42 JACS codes or 106 JACS3 codes in the NSS, and 184 different UCAS codes (including joint degrees) 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 drop all joint degree applications (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. This is unlikely to have any bearing on the internal validity of the study, since we will be controlling for university and subject fixed effects, although clearly we can say nothing about whether the results are generalizable to applications to joint degree programmes.

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 Summary statistics for the NSS and TGUG score variables

As set out in Section 3, our main analysis consists of regressions of log application counts, on a score variable derived from the NSS student satisfaction ratings or the TGUG university rankings. These regressions are carried out on data aggregated to university-by-subject-by-tariff-group-by-year cells, and control for a variety of university, subject and tariff fixed effects. Construction of these score variables was described in Section 4, and Table 1 provided descriptive information regarding the applications data. Table 2 provides some descriptive statistics for the main NSS/TGUG *score* variables used in our regressions below. Since our preferred regressions will involve first or double-differencing the data within university-by-subject-by-tariff group cells, we report the means, standard deviations, maximum

and minimum for the score variables in levels, first and double-differences. This gives a sense of the amount of variation in the changes in the score variables from year to year, relative to the cross section. The figures are also useful for interpreting the scale of the effects we report below in terms of standard deviations.

The top panel of Table 2 relates to the NSS scores, and shows the figures for the mean proportion definitely or mostly agreeing with the NSS statements, and the mean proportion definitely or mostly agreeing with Q22 about overall satisfaction. The lower panel reports the statistics for the TGUG overall ranking. The proportion definitely or mostly agreeing averaged across all statements and years is 74.2%, with a standard deviation of 7%. When we first difference the data, the standard deviation reduces slightly, but there is still considerable variation in the year-to-year changes in scores, with a standard deviation of 5.7%. Double-differencing increases the variability of the NSS scores giving a standard deviation of 9.3%. A similar pattern emerges for the score relating to Q22, and for the TGUG overall ranking in the lower panel. Evidently, there is considerable variation in the NSS and TGUG scores from year-to-year, and the standard deviation of these changes is of a comparable order of magnitude to the cross sectional variation in the scores. We will use these year-to-year shocks to estimate the impacts of changes in scores on changes in applications.

5.2 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), since these are the NSS scores that correspond to the TGUG league tables published in t-1 for entry in year t, and which we proceed to analyse below. The units of observation are university-by-tariff-by-subject-by-year groups and the data relates to entry years from 2007 to 2011 (NSS results from 2005 to 2009). 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. Clustering in this way corrects for the fact that we have repeat observations of the university-subject-year specific NSS scores for each tariff band, and allows 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.[9] 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[10], but is not immediately accessible in the format in which most published information is presented in league tables.

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

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. Controlling for university, subject and applicant ability effects in column 2 attenuates the coefficient of NSS scores, but it remains negative and insignificant. However, our preferred, differenced specifications are in columns 3 and 4. Controlling for fixed over-time university and course quality differences by first-differencing within university-by-tariff-group-by-

9 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.

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

subject yields a positive and statistically significant effect of changes in NSS scores on changes in applications. This evidence reinforces the arguments made in Section 3 that student feedback is endogenous to student demand in the cross section, and that cross sectional estimates yield downward biased estimates of the impact of NSS scores on applications. 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 2.5% increase in applicant numbers. Note, a ten percentage point improvement in this NSS score is a large change, corresponding to about 1.4 standard deviations of the overall distribution (see Table 2), or a move from the median to the 95th percentile across courses. The implied effect size is therefore a 1.8% increase in applications for a one standard deviation improvement in student ratings. Double differencing to remove trends, leaves the coefficients largely unchanged in column 4. We have also estimated the specification of column 3 with time invariant university, subject and tariff fixed effects and separate time dummy, with similar results. 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 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. The results remain 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 3-4 with those of columns 7-8 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 across the other NSS questions, which 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. The implication is that additional information provided by the NSS may matter mainly through its impact on the metric that appears in the published league tables, not directly through its availability in separate online tables, datasets and other formats.

5.3 Baseline regression results on league table effects on applications

Table 4 shows regression results on the effect of the TGUG rankings on student applications, for entry in 2006-2011. The structure of the table is similar to that of one of the panels of Table 3, but with the TGUG ordinal 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, where this ranking is across all subjects and institutions in a given year. 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) in the years when these are available (for entry in 2009-2011). Note, these are the same NSS scores we used in Table 3. However, the TGUG ranking also incorporates other quality metrics 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 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, research funding 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 in column 4, we still find positive significant effects, although of lower magnitude, and controlling in addition for university-subject-tariff-group trends makes only a small difference. Evidently, in contrast to the findings for the NSS scores in Table 3, the cross sectional relationships between TGUG scores

and applications are upward biased estimates of their causal impact. The point estimates are 0.17-0.2, implying that a 10 percentile improvement in the TGUG rankings increases applications by at most 2%. The standard deviation in our TGUG score is 0.28 (28 percentiles) by construction, so a one standard deviation change increases applications by less than 6%. 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. In subsequent analysis, we use first-differenced, rather than double-differenced regressions, given that double differencing makes only a marginal difference and results in the loss of a year of data.

5.4 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. Further evidence regarding the direct and indirect effects of the NSS is provided by Table 5 drawing on the timing of impacts from publication of the NSS scores. 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 but add in 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.

We subsequently 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.[11] Column 4 presents the effects from 2009 onwards. 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 that the NSS scores primarily influence applications through the league table publications, suggestive of salience effects from the way the information is organised and disseminated in the TGUG (and other) league table publications.[12]

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 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

[11] NSS scores appeared in the university level rankings, but not in the subject specific rankings, in *The Sunday Times* rankings for students entering from 2006. Any influence from these is absorbed by our university-by-year fixed effects. A subset of questions from the NSS at a more aggregated subject level (JACS2) fed into the subject rankings for *The Guardian University Guide* for students entering in 2008, but all other published league tables did not utilise NSS in subject level rankings until the publications for 2009 entry.

[12] An obvious extension to this analysis of salience would be to test for the effects of the NSS scores conditional on the TGUG scores. Unfortunately, the high correlation between the NSS and TGUG scores means that this exercise is not informative in practice. A further robustness test was to drop the Universities of Cambridge, Oxford and Warwick from our sample, since these did not participate in the NSS so have the NSS has no contribution to the TGUG rankings for these universities. The results with and without these universities are almost indistinguishable.

estimates 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 and so potentially more prescient.

5.5 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 TGUG 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. These are first differenced specifications like column 3 of Table 3 and Table 4. Amongst the NSS scores, 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 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 a 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. That the research ranking of universities has no statistically significant effect is not surprising as there is hardly any over-time variation in this variable.

5.6 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, moreover, 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.

Some types of student may be more responsive to new information from league tables than others, while applications to some types of university may be more sensitive than others. In particular, we would expect applicants with higher 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 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 the response is constant across the lowest three

tariff groups at around 1.7% for a 10 percentile increase in the rankings. However this rises to around 3% 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). 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. 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. Column 3 considers heterogeneity along these two dimensions in a single regression, although this does not change the general picture.[13]

The greater sensitivity to rankings amongst higher-tariff applicants and greater sensitivity amongst middle-tariff university-subject groups may appear inconsistent. However it should be remembered that we are looking at first stage applications and students can and do apply for courses for which they end up overqualified (or underqualified). There is therefore not a simple correspondence between the response of applications to universities in a given tariff group, and the response of applications by students in this tariff group. A potential explanation for the finding of a greater elasticity of demand with respect to information signals amongst middle-tier universities, relative to upper tier universities, is that the demand for elite universities is persistent and driven by pre-existing reputational cues. At the same time, demand for low ranked universities is driven mainly by factors unrelated to quality, like accessibility. In contrast, demand for middle-ranking universities responds to the TGUG rankings because prospective students have less well-developed prior assumptions about the respective strengths

[13] We also estimated models with interactions between applicant and university tariff groups, but these were uninformative due to co-linearity issues. We also looked for interactions between the TGUG ranking with an indicator of university membership of the 24 leading universities which comprise the 'Russell Group', but found no evidence that applications to these universities is more or less sensitive to changes in rankings. Similarly, we included an interaction between TGUG scores and an indicator that a university is in the top 10 institutions based on the TGUG tables published in 2005. The point estimate is slightly higher for the top 10 institutions, but not significantly so.

of these institutions, may have little other information to distinguish between these university courses and so look to more to league tables to inform their choices.[14]

5.7 The availability of alternatives and university market power

Standard models of competition in public services with product differentiation predict that, providing there is some degree of product differentiation, 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). Applied in the present context of differentiated education markets, this would suggest that the effect of rankings on applications to a particular university might increase with the number of universities operating in its own market. In Table 9, we investigate this prediction, exploring variations in the sensitivity of applications to quality signals across universities with different degrees of market power.

To define 'markets', we proceed in two ways. In column 1, we first 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

[14] We carried out additional analyses on other aspects of heterogeneity and non-linearity. We looked for variation across broad subject groups (physical and technical, medical and biological, languages and arts, and social, legal and business), differences by applicant-university distance, and also before and after 2008 when the number of choices that students could make on their UCAS forms was reduced from 6 to 5. There were no interesting findings of significant heterogeneity on these dimensions. We further checked for non-linearities in the response of applications to NSS and TGUG scores, by regressing applications on a set of score dummies, one for each semi-decile in the score distribution. We did not find statistically significant departures from linearity, although in both cases the point estimates suggest that the marginal effect of an improvement in the score is higher at the top of the distribution than the bottom.

interaction terms is positive and highly statistically significant. The magnitude of the coefficients implies that a ten percentile increase in the TGUG rankings in a subject offered by 10 universities increases applications by 0.7%, whereas the effect in a subject offered by 100 universities is over six times higher at 4.4%. Column 2 repeats this analysis, but restricts the sample to England-domiciled applicants, 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. This definition makes sense given the mobility constraint on university choice imposed by distance (c.f. Gibbons and Vignoles, 2012). Our data allow us to do this because they record the post-town of the applicant, aggregated into 40 groups, as noted in section 4.1. The distances are straight line distances between the university and the centroid of the postal zone from which the application is made – but are only approximate given the geographical resolution of the data. 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. We similarly find strong evidence that applications are much more responsive 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, a ten percentile change in the TGUG ranking increases applications by 2.8% (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 1.4% (exp{0.1*(0.28-1.25*0.11}). Column 4 again tests the robustness of these competition results when we exclude Welsh and Scottish applicants. Column 5 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 of a ten percentile increase in rankings in competitive markets is 2.4%, 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 to 1.8%.

6 Concluding discussion

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. 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. The NSS is a significant undertaking, costing over £2 million annually to administer, as well as demanding considerable effort on the part of students and universities. Yet, while we find that the NSS has a statistically significant impact on applications, these effects are relatively small. A ten percentage point improvement in the proportion of students 'mostly' or 'definitely' agreeing with positive NSS statements about their university course (1.5 standard deviations) boosts applications by around 2.5%.

An important finding is that the influence of these satisfaction ratings primarily operates through their influence on composite league tables which are published subsequent to the first release of the NSS results. These tables are represented by the Times Good University Guide (TGUG) in our analysis, but we would expect similar results from other published league tables since these all use variants of the same information. In short, 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. Even so, the response to the TGUG league tables is not large: A ten percentile move up the table rankings (7-8 places in economics, or 0.3 standard deviations) increases demand by around 2%. 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. Another is that quality is only one of a large number of factors influencing university choice.

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 or geographical 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 4.4% 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. High-ability candidates are also 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, relative to those at the bottom and the top, again possibly reflecting the high degree of competition for students within this tier.

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 student satisfaction ratings 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 UCAS data on applicants by tariff group in each year by university-subject, 2006-2011. Numbers are counts of applicants.

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

Data in university x subject x tariff x year cells
Tariff1 = up to 135 UCAS points ; Tariff2= 136-270 UCAS points; Tariff3= 271-405 UCAS points; and Tariff4 = above 406 UCAS points, where UCAS points are calculated on the basis of post-General Certificate in Secondary Education (GCSE) (age-16) qualifications.

Table 2: Descriptive statistics levels, first-differences and double-differences of NSS and TGUG scores

	Obs	Mean	Std. Dev.	Min	Max
NSS, for entry 2005-2010					
Definitely or mostly agree - mean across domains	34365	0.742	0.070	0.440	0.965
First-differenced	23967	0.009	0.057	-0.324	0.287
Double-differenced	15785	-0.004	0.093	-0.530	0.470
Definitely or mostly agree Q22	34365	0.825	0.109	0.250	1
First-differenced	23967	0.0012	0.096	-0.710	0.667
Double-differenced	15785	-0.004	0.158	-0.897	0.960
Times Good University Guide, for entry 2006-2010					
TGUG overall ranking	58988	0.507	0.282875	0.010	1
First-differenced	46883	0.003	0.129493	-0.670	0.710
Double-differenced	35853	-0.003	0.189587	-1.100	1.070

Table reports summary statistics for the main score variables use in the analysis, in levels, first-differences and double-differences

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

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

Data is in tariff x university x subject x year cells for entry in 2007-2011

All specifications include dummy variables for partly missing or imputed data

FD: first differenced, DD double differenced, within university-by-subject-by-tariff groups. R-squared declines from columns 2 to 3 and 7 to 8 due to first differencing

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

	(1)	(2)	(3)	(4)
TGUG Overall ranking	0.279*	0.439***	0.200***	0.170***
	(0.113)	(0.062)	(0.031)	(0.038)
Fixed effects:				
Year	Yes	Yes	No	No
Subject + uni. + tariff	No	Yes	No	No
Subject × uni. × tariff	No	No	Yes	Yes
Subject, uni, tariff × year	No	No	Yes	Yes
Subject × uni. × tariff trend	No	No	No	Yes
Observations	58,988	58,988	46,883	35,853
R-squared	0.080	0.429	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
TGUG overall ranking is an ordinal ranking by year, standardised to range between 0 and 1 (based on percentiles/100)
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)
Definitely or mostly agree mean, t	-0.042	-	-	-
	(0.090)			
Definitely or mostly agree mean, t-1	-0.158	0.040	-	-
	(0.103)	(0.092)		
Definitely or mostly agree mean, t-2	0.206*	0.231*	0.104	0.339***
	(0.100)	(0.105)	(0.121)	(0.093)
Definitely or mostly agree mean, t-3	-	0.110	-	-
	-	(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
Sample years change between columns due to the different structure of lags and leads.

Table 6: Timing of TGUG effects on applications

		Pre-2009	2009-on
	(1)	(2)	(3)
TGUG overall, t	0.065	-	-
	(0.037)		
TGUG overall, t-1	0.224***	0.214***	0.190***
	(0.033)	(0.048)	(0.037)
TGUG 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)	TGUG criteria	(2)
Teaching	0.054	Satisfaction (2009 on)	0.087***
	(0.076)		(0.019)
Feedback	0.030	Teaching quality (teaching	0.075*
	(0.058)	degrees only > 2006)	(0.030)
Support	0.049	Employment prospects	0.079***
	(0.067)		(0.021)
Organisation	-0.024	Entry standards (Tariff)	0.027
	(0.053)		(0.022)
Resources	0.023	Research	0.041
	(0.049)		(0.024)
Personal development	0.154*		
	(0.059)		
Fixed effects:		Fixed effects:	
Year	No	Year	No
Subj. + uni. + tariff	No	Subj. + uni. + tariff	No
Subj.× uni. × tariff	Yes	Subj.× uni. × tariff	Yes
Subj., uni, tariff × year	Yes	Subj., uni, tariff × year	Yes
Subj. × uni. × tariff trend	No	Subj. × uni. × tariff trend	No
Observations	23,897	Observations	47,103
R-squared	0.192	R-squared	0.159

Robust standard errors in parentheses clustered on university
*** p<0.001, ** p<0.01, * p<0.05
TGUG overall ranking is an ordinal ranking by year, standardised to range between 0 and 1 (based on percentiles/100)
Data is in tariff x university x subject x year cells for entry in 2007-2011 (column 1) or 2006-2011 (column 2)
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)
TGUG overall	0.166***	0.131**	0.098*
	(0.044)	(0.040)	(0.048)
TGUG overall × applicant tariff 2	-0.033		-0.033
	(0.045)		(0.045)
TGUG overall × applicant tariff 3	0.036		0.036
	(0.044)		(0.044)
TGUG overall × applicant tariff 4	0.138*		0.136*
	(0.054)		(0.054)
TGUG overall × course tariff 2		0.026	0.026
		(0.042)	(0.042)
TGUG overall × course tariff 3		0.114**	0.113**
		(0.035)	(0.035)
TGUG overall × course tariff 4		0.034	0.033
		(0.065)	(0.065)
Fixed effects:			
Subject × uni. × tariff	Yes	Yes	Yes
Subject, uni, tariff × year	Yes	Yes	Yes
Observations	46,883	46,883	46,883
R-squared	0.159	0.160	0.160

Notes as Table 4
Tariff group thresholds are described in Table 1

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

	Britain domiciled applicants All British universities	England domiciled applicants All British universities	Britain domiciled applicants 50km market	England domiciled 50km market	Local domiciled applicants 50km market
	(1)	(2)	(3)	(4)	(5)
TGUG overall	0.028	0.022	0.278***	0.281***	0.236***
	(0.046)	(0.048)	(0.041)	(0.042)	(0.030)
TGUG overall × number of universities offering subject	0.004***	0.004***	-	-	-
	(0.001)	(0.001)			
TGUG 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

Question	Domain	Statement
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

	t-2				t-1				t			
	Winter	**Spring**	**Summer**	**Autumn**	**Winter**	**Spring**	**Summer**	**Autumn**	**Winter**	**Spring**	**Summer**	**Autumn**
t-1 entry cohort				Apply to UCAS				Entry to Uni.				
t entry cohort								Apply to UCAS				Entry to Uni.
NSS	Survey NSS t-2		Publish NSS t-2 *		Survey NSS t-1		Publish NSS t-1		Survey NSS t		Publish NSS t	
TGUG		Publish TGUG t-2 using NSS t-3				Publish TGUG t-1 using NSS t-2 *				Publish TGUG t using NSS t-1		

Note: Events and information sources available to applicants for entry in year t are shown shaded
Information sources used in the baseline results in Table 3 and Table 4 are marked with an asterisk *
The cover of the TGUG books published in year t-1 is labelled with the year of entry t. We refer to the TGUG books by their actual year of publication not the cover year.

Appendix

Table A1: Descriptive statistics for overall satisfaction score (Q22) in the NSS response data, 2005-2010

	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

Columns 2-6 show the relative shares of respondents who answered within one of five Likert scale categories to the statement, 'overall I am satisfied with the quality of my course' (question 22 of the NSS)