Discussion Paper No. 11-061

University Rankings in Action? The Importance of Rankings and an Excellence Competition for University Choice of High-Ability Students

Julia Horstschräer

Zentrum für Europäische
Wirtschaftsforschung GmbH

Centre for European
Economic Research

Discussion Paper No. 11-061

University Rankings in Action? The Importance of Rankings and an Excellence Competition for University Choice of High-Ability Students

Julia Horstschräer

Download this ZEW Discussion Paper from our ftp server:

http://ftp.zew.de/pub/zew-docs/dp/dp11061.pdf

Die Discussion Papers dienen einer möglichst schnellen Verbreitung von neueren Forschungsarbeiten des ZEW. Die Beiträge liegen in alleiniger Verantwortung der Autoren und stellen nicht notwendigerweise die Meinung des ZEW dar.

Discussion Papers are intended to make results of ZEW research promptly available to other economists in order to encourage discussion and suggestions for revisions. The authors are solely responsible for the contents which do not necessarily represent the opinion of the ZEW.

Non-Technical Summary

Every year, secondary school graduates have to choose a university. This is a crucial decision for their future trajectories made under imperfect information. Therefore, quality indicators like university rankings and an excellence competition may provide valuable information for choosing a university.

This paper analyzes whether prospective students in fact use quality indicators as a source of information within the application process and whether the influence of the indicators differs with respect to various quality dimensions – e.g. research quality, mentoring, faculty infrastructure, student assessment and excellence status. Therefore, I estimate the effect of different quality indicators from a German university ranking and an excellence initiative run by the German government on the university application decision of high-ability students. As identification relies on the variation in ranking indicators and excellence status over time, I can disentangle the effect of the additional information provided by the rankings from the common knowledge regarding university quality.

This paper contributes to the existing literature by studying the influence of ranking indicators with respect to various quality dimensions, while at the same time controlling for overall university attractiveness. I use a very comprehensive, administrative data set provided by the German central agency ('ZVS') administering the application process for medical schools. The data set contains individual information on all applicants at German medical schools for the years 2002-2008.

The evaluation of the excellence initiative shows that in the course of the competition the share of applicants increased on average by 19 % at the winning universities, which are today known as "excellence universities". The results regarding the different ranking indicators suggest that the non-research dimensions "student-professor ratio", the number of "clinic beds", and the "students' satisfaction" rather than the research-related indicators influence university choice of high-ability students. This may seem counterintuitive, but is plausible as research quality seems to be common knowledge within the group of high-ability students. In this case, the research related ranking indicators do not provide any additional information. Hence, university rankings are in action if they add new information to the common knowledge of university quality. Yet, the different quality indicators influence prospective student's university choice only to a moderate extent. Distance between a student's hometown and the university remains the most powerful determinant of university choice in Germany.

Nevertheless, providing information on all quality dimensions separately instead of publishing university rankings in aggregated league tables widens the basis of information and thus supports a well-informed university choice. This in turn could reduce drop-out rates, increase human capital production and – depending on the social welfare function – may also increase overall welfare. Furthermore, multidimensional rankings also induce incentives for the top research institutes to not only invest in research but also in the non-research quality dimensions such as mentoring, faculty infrastructure and the overall satisfaction of their students.

Das Wichtigste in Kürze

Jedes Jahr müssen sich Abiturienten nicht nur für ein Studienfach, sondern auch für eine Universität entscheiden. Diese Wahl der Universität treffen sie jedoch unter unvollständiger Information bezüglich ihrer eigenen Fähigkeiten, der Qualität der Universität sowie dem jeweiligen Ertrag eines Hochschulabschlusses. Daher könnten Qualitätsindikatoren wie Hochschulrankings und Exzellenzlabels wertvolle Informationen für die Wahl der Universität liefern.

Dieses Papier analysiert, ob angehende Studierende Qualitätsindikatoren als Informationsquelle während des Bewerbungsprozesses nutzen und ob sich der Einfluss verschiedener Rankingdimensionen – z.B. Forschung, Betreuung, Infrastruktur der Fakultät sowie die Zufriedenheit der derzeitigen Studierenden – unterscheidet. Dafür wird untersucht, wie die verschiedenen Rankingindikatoren des Centrums für Hochschulentwicklung (CHE) sowie die 2006 und 2007 verliehenen Exzellenzlabels die Wahl der Universität von hochqualifizierten Bewerbern beeinflussen. Um die Bedeutung der verschiedenen Qualitätsdimensionen von der allgemeinen Attraktivität einer Universität unterscheiden zu können, nutzt die Studie die Veränderungen der Rankings und Exzellenzlabels über die Zeit.

Die Analysen ergänzen die bestehende Literatur durch die Betrachtung verschiedener Rankingdimensionen bei gleichzeitiger Berücksichtigung der allgemeinen Attraktivität einer Hochschule. Dafür wird ein umfassender, administrativer Datensatz der deutschen Zentralstelle für die Vergabe von Studienplätzen (ZVS) ausgewertet. Dieser enthält individuelle Informationen aller Bewerber für ein Medizinstudium der Jahre 2002 bis 2008.

Die Evaluation der Exzellenzinitiative zeigt, dass der Anteil der Bewerber an den "Exzellenz-Universitäten" durchschnittlich um 19% angestiegen ist. Des Weiteren scheinen die nicht forschungsbezogenen Qualitätsdimensionen wie das Betreuungsverhältnis, die Infrastruktur der Fakultät und die Zufriedenheit der Studierenden die Hochschulwahl stärker zu beeinflussen als die forschungsbezogenen Rankingindikatoren. Dieses Ergebnis mag kontraintuitiv erscheinen, ist aber durchaus plausibel. Ist die Forschungsqualität der Hochschulen allgemein bekannt und wird zu einem Großteil als über die Zeit konstant wahrgenommen, so bieten die forschungsbezogenen Indikatoren des Rankings keine zusätzlichen Informationen für die Bewerber. Qualitätsindikatoren beeinflussen die Wahl der Universität somit vor allem dann, wenn sie zusätzliche, ohne das Ranking unbekannte Informationen über die Qualität der Universitäten liefern. Insgesamt ist der Einfluss von Qualitätsindikatoren auf die Hochschulwahl jedoch moderat. Die Entfernung zur Universität bleibt in Deutschland weiterhin der stärkste Einflussfaktor für die Wahl der Hochschule.

Die Veröffentlichung von Rankings in verschiedenen Qualitätsdimensionen vergrößert aber in jedem Falle die Informationsbasis gegenüber aggregierten Hochschulrankings und unterstützt somit eine wohlüberlegte Hochschulwahl. Eine verbesserte Passung zwischen Studenten und Universität könnte wiederum zu besseren Bildungsergebnissen führen und so dem Gemeinwohl dienen. Zusätzlich könnten multidimensionale Rankings für die Top-Forschungsfakultäten auch Anreize zur Investition in die Qualitätsdimensionen Betreuung, Infrastruktur und die Zufriedenheit der Studierenden erzeugen.

University Rankings in Action? The Importance of Rankings and an Excellence Competition for University Choice of High-Ability Students

Julia Horstschräer
ZEW, Mannheim*

November 14, 2011

Abstract

This paper analyzes how high-ability students respond to different indicators of university quality when applying for a university. Are some quality dimensions of a ranking, e.g. research reputation or mentoring more important than others? I estimate a random utility model using administrative application data of all German medical schools. As identification relies on the variation in quality indicators over time, I can disentangle the response to changes in quality indicators from the common knowledge regarding the overall university attractiveness. Results show that the ranking provides more relevant information in the quality dimensions mentoring, infrastructure and students' satisfaction than with respect to research.

Keywords: higher education, university choice, college admission, conditional logit

JEL-classification: I21, I23, I28, C25

Acknowledgements: I thank the German central agency for the allocation of students to universities (ZVS - 'Zentralstelle zur Vergabe der Studienplätze') for the provision of the application data. Thanks also go to Nadja Dwenger for valuable discussions on the data and to my colleagues at ZEW (Melanie Arntz, Andrea Mühlenweg, Grit Muehler and Maresa Sprietsma) for their comments on an earlier version of this paper. The paper has benefitted from presentations at the Jahrestagung des Vereins für Socialpolitik (2011), the EALE conference (2011) and the seminars at the CReAM Centre (University College London), the University of Hannover and ZEW, Mannheim. Lennart Ziegler provided excellent research assistance. This research has been funded by the German Federal Ministry of Education and Research (reference number: 01 JG 0914). All remaining errors are my own responsibility.

*Centre for European Economic Research (ZEW), P.O. Box 103443, D-68034 Mannheim, Germany, E-mail: hortschraeer@zew.de, phone: +49-621-1235196.

1 Introduction

Every year, secondary school graduates that want to pursue higher education have to choose a university. This is a crucial decision for their future trajectories made under imperfect information regarding their own ability, university quality and the corresponding returns to a degree. From an economist's point of view, it is very important that prospective students apply for the universities that fit them best in order to maximize human capital production and to minimize drop-outs. Therefore, university rankings and indicators of excellence may provide valuable information for the decision of prospective students.

In this paper, I analyze whether high-ability students in fact use different university quality indicators as a source of information and whether some quality dimensions are more important for an applicant's decision than others. For this purpose, I estimate the effect of different quality indicators from a German university ranking – as well-established as the *U.S. News & World Report* ranking in the U.S. – on the university application decision of high-ability students. As an additional quality indicator, I use an excellence competition run by the German government, which declared some universities to be "excellence universities" and granted them extra money. Identification relies on the variation induced by changes in the ranking indicators over time and the introduction of the excellence status. This allows me to disentangle the response to changing quality indicators from the time-constant, common knowledge regarding the overall university attractiveness.

In contrast to the U.S. higher education system, the German system is traditionally based on public universities which were recognized as quite homogeneous with respect to their quality. During the last couple of years, however, several changes towards a more competitive market have been implemented. With the publication of university rankings in the media starting from the 1990's on, the quality of different institutions has become directly comparable for the first time. Furthermore, the European Bologna Declaration from 1999 induced a change in the German higher education system to create comparable tertiary degrees throughout Europe and to increase the international competitiveness of the European system of higher education.[1] From 2006 onwards, some German federal states introduced tuition fees,[2] and in 2006 and 2007, the German government has run an excellence initiative awarding extra funding to the universities with the best future concept for research. This said, it is very likely that university choice has recently become more important for prospective students. Especially, as Brewer et al. (1999) and Strayer (2002) show that the type of university an individual chooses significantly affects post-school earnings.

[1]For an evaluation of the German Bologna Process see Horstschräer and Sprietsma (2010).

[2]For analyses regarding the introduction of tuition fees in Germany see Dwenger et al. (2011) and Hübner (2009).

The theoretical literature characterizes the "College Admission Problem" as a two-sided market (Gale and Shapley; 1962; Roth and Sotomayor; 1989). On the one hand, prospective students decide where to apply and, once admitted, whether to accept the university's offer. On the other hand, universities (or a central authority) determine who is admitted. The admission problem can be evaluated from three different perspectives: (i) the prospective student who most likely wants to maximize his human capital, (ii) the universities which try to maximize the aggregated human capital of their graduates, and (iii) a social welfare perspective where the optimum depends on the assumed social welfare function. According to Becker (1973) and Chade et al. (2011), welfare is maximized by assigning the best students to the best universities as long as student and university quality are complements. Such a sorting of prospective students into universities exists in a two-sided market only if universities differ sufficiently in quality (Chade et al.; 2011). Along this line, a hypothesis is that publishing quality indicators may enhance human capital and – depending on the social welfare function – may also enhance a welfare maximizing assortative sorting.

An extensive empirical literature exists on the decision whether or not to attend university. However, this paper contributes to the more recent literature on *where* to attend university. Existing evidence in the field of university choice addresses both the influence of financial aid (e.g. Ehrenberg and Sherman; 1984; McPherson and Schapiro; 1991; Moore et al.; 1991; Avery and Hoxby; 2003) and non-monetary factors (e.g. Toutkoushian; 2001; Mueller and Rockerbie; 2005; Griffith and Rask; 2007; Berkowitz and Hoekstra; 2011) on the matriculation (or application) decision. For the U.S., Weiler (1996) analyzes monetary and non-monetary factors influencing the matriculation decision of high-ability students and shows that attendance costs as well as non-monetary characteristics, such as university quality and reputation, are significant factors.

The influence of rankings on university choice, is explicitly studied by Monks and Ehrenberg (1999), Mueller and Rockerbie (2005) and Griffith and Rask (2007). Monks and Ehrenberg (1999) study the influence of the *U.S. News & World Report* rankings on admission at selective private institutions. They show that low ranked universities accept a higher share of applicants, that more accepted applicants do not matriculate and that matriculated students have lower SAT scores. Using Canadian application data, Mueller and Rockerbie (2005) find that an improvement in rank, in general, has a positive influence on the aggregated number of applications. The U.S. study by Griffith and Rask (2007) on an individual level also suggests that the matriculation decision of high-ability students is influenced by changes in rank, and that rankings can affect individuals heterogeneously with respect to gender, nationality and ability. However, the Anglo-Saxon higher education system has always been more competitive than the comparatively homogeneous German higher education sector. Therefore, it is not obvious whether the international evidence is applicable to the German context.

The German studies by Büttner et al. (2003) and Helbig and Ulbricht (2010) analyze the influence of German university rankings on the number of matriculated students and the sorting of students according to ability. They show that rankings also seem to influence the matriculation decision in Germany. However, both German studies fail to disentangle the effect of the additional information provided by the rankings from the common knowledge regarding university attractiveness.

This paper contributes to the existing literature on university rankings by distinguishing the importance of different quality dimensions, while controlling for the common knowledge regarding university attractiveness. To my knowledge, this analysis is the first to provide evidence regarding the importance of different ranking dimensions. The international literature, so far, has been limited to the influence of the overall rank of an university. The German multidimensional ranking of the Center for Higher Education Development (CHE ranking), however, allows me to study several quality dimensions separately. The main quality dimensions published are research reputation, mentoring, faculty infrastructure as well as a recommendation by professors and students. An additional quality indicator studied is the excellence status awarded by the German government within an excellence competition. My results thus provide additional knowledge on which quality dimensions are (most) important for the university choice of prospective students.

A random utility model explaining the application decision by university and individual characteristics of the applicants is estimated using a conditional logit model. Due to the inclusion of university fixed effects, identification relies on the variation in rankings and excellence status over time. The estimated effects of the different quality indicators on university choice thus only comprise the response to changes in university quality as suggested by the indicators. The estimates do not reflect the time-constant, common knowledge regarding university attractiveness, which is captured by the university fixed effects.

I use a very comprehensive, administrative data set provided by the German central agency ('ZVS') administering the application process for medical schools, which is subsequently called central clearinghouse.[3] The data set contains individual information on all applicants at German medical schools for the years 2002-2008. This data set offers two important advantages for my analysis. First, I can study the application rather than the matriculation decision. This is important as the application decision is less driven

[3]In Germany, the university application process of the subjects medicine, pharmacology, veterinary medicine, dentistry, psychology and biology has been administered by a central agency called 'Zentralstelle zur Vergabe von Studienplätzen' (ZVS) during the observation period.

by supply constraints. Second, the individual nature of the data allows me to control for the distance between a student's hometown and each university in the choice set, which is shown to be a very important determinant of the application decision.

The results show that achieving excellence status increases the individual application probability by 19%. Hence, the excellence competition run by the German government significantly affects the university choice of high-ability students. Regarding the ranking indicators, a high rank with respect to students' satisfaction increases the application probability, and a low rank in mentoring, faculty infrastructure as well as in the indicator students' satisfaction lowers the probability to apply. The research oriented indicators of the German university ranking show no significant influence on the application probability. Research quality nevertheless proofs to be a very important determinant for choosing a university. However, it seems to be common knowledge and therefore part of the general attractiveness of a university. In this case, the non-research ranking indicators provide more relevant information for the university choice of high-ability students than the research-oriented indicators. Publishing multidimensional university rankings, thus, widens the basis of information for a well-informed university choice.

The remainder of the paper is structured as follows. In the next section, I give a more detailed overview on the institutional background of the German university ranking, the excellence initiative and the central admission procedure (Section 2). Subsequently, Section 3 describes the application data including first descriptive evidence, Section 4 explains the estimation strategy, and Section 5 presents the results. Section 6 concludes.

2 Institutional Background

The German higher education sector used to be quite homogeneous with respect to the quality of universities. The share of private institutions is traditionally very low. The public universities are administered and financed by the 16 German federal states. Unlike in the Anglo-Saxon system, no specific universities were considered as elite institutions, and no tuition fees existed until 2006. In general, only a registration fee of about 100 Euros had been levied each term by the universities. However, competition between universities has been encouraged lately. Besides the introduction of tuition fees and changes in the degree system due to the European homogenization, university rankings became publicly available and presumably also more important to prospective students due to encouraged competition.

German university rankings have been published in the media since the 1990's. For the first time, universities and prospective students could compare the quality regarding various quality dimensions between institutions. The university ranking of the Center for

Higher Education Development (CHE ranking) is used for the analysis in this paper. It was first published in 1998 and is – similar to the *U.S. News & World Report* rankings for the U.S. – the most comprehensive and most detailed ranking of German higher education institutions. The first ranking of medical schools has been published in 2003 in the weekly magazine "Stern", and the second ranking of 2006 has been issued with the weekly newspaper "Die Zeit". Both newspapers are well known and widely recognized outlets within Germany.[4]

Unlike the well-known rankings, such as the *U.S. News & World Report* ranking in the U.S. or the world-wide "The Times Higher Education Supplement" and the "Shanghai-Ranking of World Universities", the German CHE ranking provides information on the subject level. Hence, rather university departments than universities as a whole are compared, which allows a much more detailed assessment. Another difference is that the CHE ranking does not publish league tables. The departments are instead merely sorted into a top, middle and bottom quality group. Most importantly for my analysis, the CHE ranking assesses various quality dimensions and publishes the results in all dimensions separately without aggregating them into an overall rank. This procedure avoids the controversial assignment of weighting factors to each indicator and enables prospective students to consider the quality dimensions most important to them.

All quality indicators rely either on facts collected on the university department level, on an evaluation by professors of the respective subject or on an assessment by current students. The ranking comprises all major subjects, and every subject is ranked in a three year cycle. The main indicators in the publications of medical schools rankings – which are the ones used in my analysis – are:

- professors' recommendation
- research reputation
- student-professor ratio
- number of clinic beds
- students' satsifaction

For each of these measures, the published indicators only display whether the respective university is ranked into the top, middle or bottom group and whether that position has changed since the last ranking. To construct the indicator "professors' recommendation" ("research reputation"), professors are asked to name the top five universities in their field with respect to the overall university quality (research quality). Note, profes-

[4]Other German rankings published during the observation period 2003-2008 are the ranking of the magazine "Focus" (2004,2007) and the magazine "Spiegel" (2004,2006). However, both rankings are not as comprehensive as the CHE ranking. Note also that there is a general discussion on the quality and methodology of university rankings. This paper, though, aims to assess in a first step whether quality indicators indeed influence students' application choice. In case that rankings are indeed important for university choice, a thorough analysis of the rankings methodology is necessary.

sors cannot recommend the university at which they are currently teaching. Universities named by more than a quarter of the professors are sorted into the top quality category and universities not mentioned at all form the bottom quality group. Information on the indicators "student-professor ratio" and the quantity of "clinic beds" are collected at the university department level. The "student-professor ratio" indicates the number of students per professor and the indicator "clinic beds" gives the quantity of beds per 100 students.[5] The departments are sorted into quality groups by calculating quantiles. Finally, the "students' satisfaction" regarding their current study program is evaluated. The top, middle and bottom quality groups for this indicator are constructed by calculating means and confidence intervals for the subject as a whole and for each department. If the mean of a department and the full range of its confidence interval is higher than the subjects' mean, the department is grouped into the top category. Is the departments' mean and its confidence interval below the subjects' mean, the department is assigned into the bottom quality group.

In addition to the introduction of university rankings, the excellence initiative run by the German Government in 2006 and 2007 has been another move towards competition. In principle, the initiative is a competition for extra funding between all German universities. It is not restricted to a special subject (e.g. medical studies) but addresses universities as a whole. The aim of the initiative was to strengthen German universities, to enhance their international competitiveness, and to promote the visibility of German top-level research. As part of the nationwide competition, additional funding has been given to the best proposals for (i) graduate schools promoting young academics, (ii) clusters of excellence, and (iii) institutional strategies of universities promoting top-level research. Successful graduate schools were granted approximately one million Euros per year, clusters of excellence in a specific field on average receive 6.5 million Euros per year, and universities with promising institutional strategies to promote top-level research were awarded about 21 million Euros in total. This funding is limited to a maximum of five years. Important to note is that especially the winning universities in the competition for strategies to promote excellent research have received high media attention and have been recognized as "excellence universities" since then.

Out of all 34 medical departments in Germany, six departments are located at universities which became "excellence universities". Munich was the only university with a medical department that received the excellence status in October 2006. In October 2007, the Universities of Aachen, Berlin, Freiburg, Göttingen and Heidelberg followed. As the results of the excellence competition were announced in October and the application deadline for medicine is in July, the excellence status of the University of Munich became

[5]The number of clinic beds of a medical school is relevant because it determines how much practical experience prospective students can expect.

first relevant for the applicants of the year 2007. For all other "excellence universities" only in 2008. However, in January 2006 and 2007, the committee of the excellence initiative already announced which universities had been shortlisted.

The application procedure for universities in Germany differs by subject. For most subjects, prospective students address their applications directly to the universities. However, the application process is centrally administered by the central clearinghouse for some subjects. During the years 2002 to 2008, six subjects – medicine, pharmacology, veterinary medicine, dentistry, psychology and biology – had a centralized application and admission process. Within the central application process, every applicant may indicate a preference list of up to six universities and may apply within three different selection procedures. A competition by (i) the final secondary school grade, a procedure based on (ii) the duration that an applicant already is waiting for a university assignment, and (iii) a direct assessment by the universities are applied sequentially. If an applicant cannot be placed in procedure (i), his application is transferred to procedure (ii) and, if necessary, further to procedure (iii). Since 2004 (before 2004), 20% (51%) of the places to study have been assigned by the secondary school grade, 20% (25%) by the time of waiting, and 60% (24%) of the places are allocated directly by the universities. The allocation process within these three procedures, though, has not changed over time.

Within procedure (i) the competition by secondary school grades, it is verified in a first step whether an applicant can be admitted at the university of his first preference. If there are more applicants than places to study, the secondary school grade is decisive. In case an applicant could not be placed at his first preference, the central clearinghouse examines the possibilities at the university listed as the second preference. However, all applicants who listed this university as their first preference are placed at this university first. This demonstrates the high importance of the first preference in the listing.[6] The competition by (ii) the time of waiting is very similar. Here, the time of waiting is decisive if there are more applicants than places. The criteria for (iii) the direct admission by universities differ by university, but in general, the secondary school grade is very important once again.

3 Data and Descriptives

The data set I use to assess whether the excellence initiative and the university rankings have influenced the application decision of prospective students contains all applicants at German universities in the centrally administered subjects within the years 2002 to

[6]For a more detailed description of the centrally administered application process see Braun et al. (2010) and Braun and Dwenger (2009).

2008. A major advantage of this data set is that applications rather than matriculations are observed. The revealed preferences are, thus, less likely to be biased by supply side constraints.

Although the application data include all centrally administered subjects, I restrict the sample to applicants in the field of medical studies, which is by far the subject with the most applicants. Pharmacology, dentistry and veterinary medicine are excluded from the analysis as these subjects are only offered by very few universities resulting in a very limited choice set for prospective students. In the fields of psychology and biology, Bachelor and Master degrees were introduced, and since then, the application process is no longer centrally administered. Therefore, the analysis focuses solely on applicants for medical studies.

Similar to Dwenger et al. (2011), my estimations are based on the first university preference listed in the selection procedure using the secondary school grades. This is justified as the first preference is very important for the allocation process (see Section 2 and Braun et al. (2010)). In order to rule out any strategic preference listings, I only consider high-ability students who received the best possible grade (i.e. 1.0) in the final secondary school exam. This subgroup of students is not constrained by admission thresholds, as the most restrictive threshold is having received the best final secondary school grade (1.0) and applying at the specific university with first priority. Hence, all applicants in my sample can state their true university preferences. The sample is further restricted to applications for the semester beginning in fall from 2003 to 2008 as only few universities accept applications for the semester beginning in spring and as the first ranking of medical schools has only been published in 2003. In case someone applied for two subjects at a time (only possible until 2004), I only consider the application if medical studies is the first subject preference. Repeated applications of applicants who were not assigned to a university in their first year of application are also excluded from the analysis.

Table 1 displays the average share of applications per university and the individual characteristics of the remaining 4,535 medicine applicants of the years 2003-2008. The descriptives are disaggregated by excellence status and the main quality indicators.[7] The average share of applicants is significantly higher for "excellence universities" and the top ranked departments in the category "professors' recommendation" and "research reputation". The average share of applicants at an "excellence university" amounts to 12.63%, while the average share in the non-excellence group is only 6.89%. With respect to the other quality indicators "student-professor ratio", "clinic beds" and "students' satisfaction", there is not such a clear sorting pattern. Nevertheless, the differences are also significant in a t-test. Examining the average share of female applicants in each quality group

[7] In addition, Table A.1 in the Appendix provides a comprehensive overview on all 34 medical schools and their corresponding quality indicators.

shows also heterogeneous results of the various ranking indicators. It seems that female applicants prefer universities that are highly ranked in the categories “student-professor ratio” and “students’ satisfaction”, whereas high ranks in “professors’ recommendation” and “research reputation” are more important for male applicants. These differences are significant. Statistically non-significant, however, are the deviations in the ranking indicators “excellence university” and “clinic beds”.

Table 1: Mean Statistics disaggregated by Quality Indicators (2003-2008)

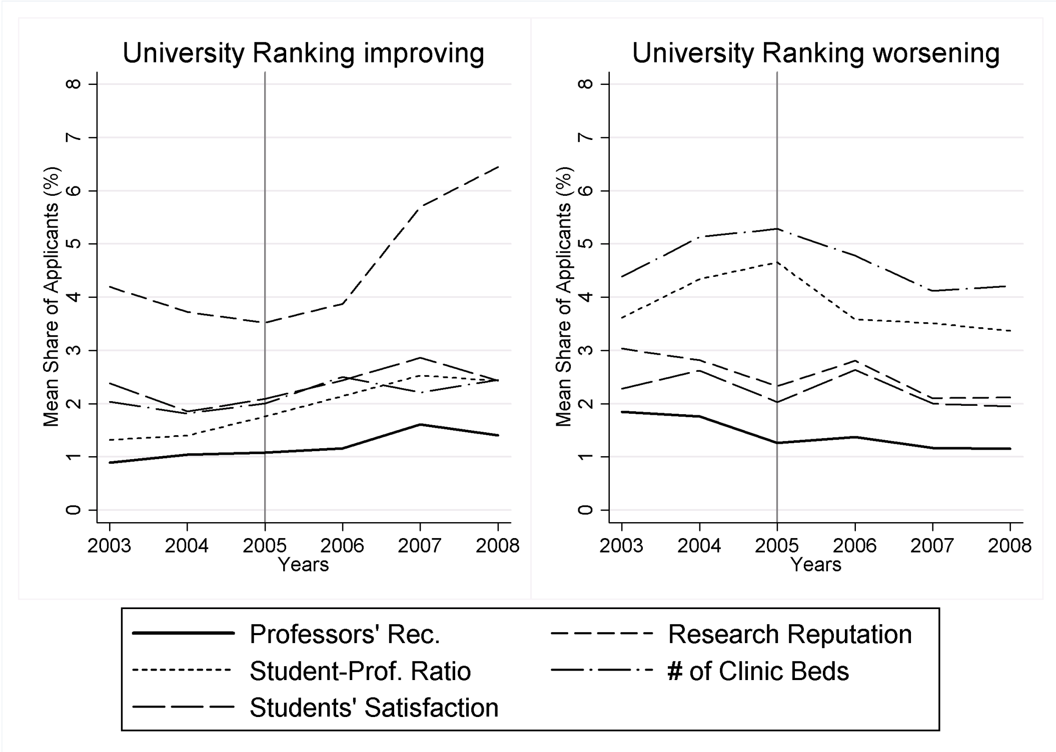
	Exc.	Prof. Rec.	Res. Rep.	Stud./Prof.	Clinic Beds	Stud. Satisf.
Top Group/Exc.						
Appl./Uni (%)	12.63	13.63	13.41	3.02	9.55	3.10
Female (%)	66.83	63.46	63.30	70.66	65.57	71.93
N	*3,920*	*1,894*	*1,951*	*1,002*	*938*	*1,001*
Middle Group/Non-Exc.						
Appl./Uni (%)	6.89	3.48	3.46	9.29	8.00	10.85
Female (%)	66.63	69.24	68.51	65.57	66.71	65.10
N	*615*	*2,565*	*2,341*	*2,533*	*2,412*	*2,682*
Bottom Group						
Appl./Uni (%)	n.a.	0.74	2.20	8.50	6.17	3.16
Female (%)	n.a.	59.21	75.72	65.35	67.39	65.91
N	n.a.	*76*	*243*	*964*	*1,012*	*792*

Data Source: ZVS Data (2003-2008), own calculations. The number of observations deviates due to missings in the ranking variables. The indicator student-professor ratio (clinic beds, students’ tip) is missing for five (one, two) universities. Appl./Uni: Average share of applicants at a university, Exc.: Excellence University, Prof. Rec.: Professors’ Recommendation, Res. Rep.: Research Reputation, Stud./Prof.: Students per Professor, Stud. Satisf.: Students’ Satisfaction.

However, whether this selection pattern is induced by the quality indicators or by other confounding factors, e.g. overall prestige of a medical school, is not clear by simply looking at descriptive evidence. A mean comparison disaggregated by excellence status and year, for example, showed that “excellence universities” already had a high share of applicants before they received the official excellence status. Therefore, the question I want to answer is whether the share of applicants has increased even further due to the excellence initiative, and whether changes in the rankings over time influence the application decision.

Figure 1, therefore, depicts the mean share of applicants over time for the universities experiencing either an improving or a worsening in ranking indicators. Comparing mean application shares after the new ranking of 2006 with respect to different quality dimensions mainly indicates small gains for universities improving in rank. The indicator “research reputation” exhibits a strong increase in the average share of applications in 2007 and 2008 but not in 2006 when the new ranking has already been available. Looking at the universities improving with respect to research in more detail, shows that this

Figure 1: Share of Applicants at Universities with a change in Ranking (2003-2008)

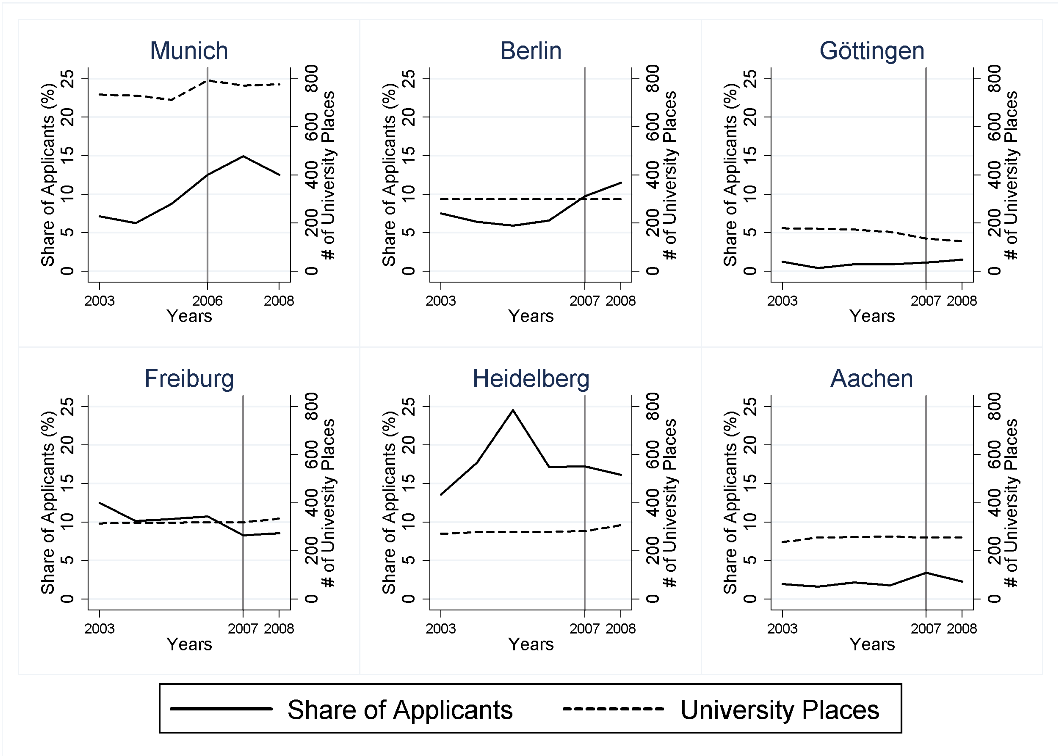


Data Source: ZVS Data 2003-2008, own calculations.

increase is mainly driven by the University of Berlin becoming "excellence university" in 2008 (see Figure 2). Downgrading a university ranking in particular seems to lower the application probability if the ranking is worsening in the dimension "student-professor ratio" or with respect to the number of "clinic beds". While the average share of applicants for universities with a decreasing rank in these dimensions increased until 2005, the share decreases after the publication of the second university ranking in 2006. Despite a worsening ranking in "research reputation" and "students' satisfaction", the average share of applicants for these universities is slightly increasing in 2006. On the one hand, this could hint at other quality dimensions being more important for university choice. On the other hand, these descriptive results could also be driven by other confounding factors. Interestingly, the indicator "professors' recommendation" is the most stable indicator. Universities improving or worsening in this dimension show the least changes in the average share of applicants.

Regarding the supply and demand of university places at "excellence universities", Figure 2 depicts the share of applicants and the number of university places over time for each of the six medical schools located at "excellence universities". It provides descriptive evidence on whether the probability to apply at a university has increased in the course of the excellence initiative. The medical departments at the universities of Munich, Berlin

Figure 2: Supply and Demand at "Excellence Universities" (2003-2008)



Data Source: ZVS Data 2003-2008, own calculations.

and too a lower extend also the University of Aachen indeed experience an increase in the share of applications at the time of the excellence initiative. The share of applicants in Munich has been increasing already since 2005. The increase in Berlin and Aachen, however, sets off in 2007, which is the year they are shortlisted in the excellence initiative. The demand for the other universities seems to be stable or even decreases (University of Freiburg) in the years of the excellence initiative (2006, 2007 and 2008). The supply side, i.e. the number of university places, is constant over time for most universities. In Munich, though, the supply of university places slightly increases from 2005 to 2006. As there may also be other confounding factors – i.e. tuition fees were introduced in many federal states simultaneously to the excellence initiative – the descriptive evidence is not conclusive. Therefore, the next section explains the multivariate estimation strategy.

4 Estimation strategy

In this section, I introduce the estimation strategy to estimate the influence of university rankings and the excellence competition on the application probability in a multivariate setting. Similar to Griffith and Rask (2007), the estimations are based on a random utility model (Equation 1). The utility U_{ij} of individual i applying at university j is explained by a deterministic part of applicant-university match specific characteristics (X_{ij}), university characteristics (Z_j) as well as by an unobserved random component ϵ_{ij}. Assuming that applicants reveal their true preferences and behave rationally, the observed choice of university maximizes their utility.

$$U_{ij} = \alpha X_{ij} + \beta Z_j + \epsilon_{ij} \tag{1}$$

Following Mc Fadden (1974), I estimate the choice model using a conditional logit approach. In contrast to a multinomial logit, this allows me, to consider applicant-university match specific variables (e.g. distance from hometown). For the conditional logit model, the data needs to be in long form with j university observations for each applicant i. As there are 34 different universities offering medical studies, my data set expands from 4,535 individual observations to 154,190 applicant-university observations. Intuitively, the data set then contains the whole choice set of medical schools for each applicant. The outcome y_{ij} is a binary variable indicating the university the applicant actually has chosen to apply for. Thus, the estimation equation is specified as follows:

$$y_{ij} = \alpha_1 EXC_{ij} + \alpha_2 RANK1_{ij} + \alpha_3 RANK3_{ij} + \alpha_4 \tilde{X}_{ij} + \beta U_j + \gamma U_j \times D_{ij} + \epsilon_{ij} \tag{2}$$

The model incorporates EXC_{ij}, $RANK1_{ij}$ and $RANK3_{ij}$ as variables of interest. EXC_{ij} is a binary variable being equal to one if university j has received an excellence status at the time individual i is applying. $RANK1_{ij}$ ($RANK3_{ij}$) is a vector of ranking outcomes indicating whether university j is ranked in the top (bottom) group of a specific quality measure. Hence, the ranking indicators for being in the top (bottom) group are estimated in reference to the group of medium quality. $\tilde{X}_{ij}$ represents all applicant-university – respectively also time-university[8] – specific variables which are distance to university, distance squared, a binary variable indicating the introduction of tuition fees and the number of supplied university places. A set of dummy variables U_j controls for university characteristics which are constant over all individuals and over time – e.g. university quality that is common knowledge.[9] In other words, U_j represents university fixed effects that account for the time-constant common knowledge regarding university attractiveness. By additionally interacting the university fixed effects with the distance D_{ij} of student's i hometown to university j, I also take into account that students may be willing to move further away for some universities but not for others. Hence, the

[8]Note that variables varying over time also vary between individuals as repeated cross-sections are pooled over six years.

[9]Also city-specific characteristics, e.g. costs and quality of living, are captured by U_j, if they are constant over time.

importance of distance to university does not only differ between individuals but also between universities.

The variation used for conditional logit estimation is within a student's choice set. Hence, the estimation approach links the binary outcome variable indicating the chosen university to the university and applicant-university specific attributes and estimates the coefficients that maximize the probability for the chosen category out of the student's choice set. In order to correct for correlations between the error terms within an individual's choice set, I cluster the standard errors by individuals.

Due to the university fixed effects U_j, the identification of the variables of interest – excellence status and ranking indicators – solely relies on variation over time, i.e. the introduction of the excellence competition and changes in the ranking between 2003 and 2006. Hence, unlike Büttner et al. (2003) and Helbig and Ulbricht (2010), who estimate the effect of rankings without a university fixed effect, I can disentangle the common knowledge regarding prestige and attractiveness of a medical department from changes in the different quality indicators. Table 2 depicts the variation over time due to changes in the ranking indicators from 2003 to 2006 and the introduction of the excellence competition respectively. I observe between 2 and 10 universities out of the 34 universities (5.88% - 29.41%) for which the according ranking indicator changes between 2003 and 2006. Thus, there is reasonable variation over time that I can exploit for my identification strategy.

Table 2: Number of Universities with a Change in Excellence Status or in a CHE Ranking Indicator over Time

	Top Group / Excellence		Bottom Group	
	# Universities	%	# Universities	%
Excellence Status	6	17.65	n.a.	n.a.
Professors' Rec.	2	5.88	5	14.71
Research Reputation	5	14.71	8	23.53
Student-Prof. Ratio	7	20.59	10	29.41
# Clinic Beds	7	20.59	7	20.59
Students' Satisfaction	5	14.71	9	26.47

Data Source: CHE ranking data (2003 and 2006), own calculations.

Moreover, the quality indicators studied are most likely exogenous to the applicants' university choice. Nevertheless, endogeneity concerns could emerge with respect to the indicator "students' satisfaction". This indicator represents how satisfied current students are with their studies overall at a specific university. Peers of prospective students who study medicine already may influence the ranking indicator and, at the same time, directly the university choice of prospective students. However, endogeneity is a minor concern for the indicators evaluated by the professors ("professors' recommendation" and "research reputation") and even more so for the hard facts "student-professor ratio" and the number of "clinic beds".

A common concern when applying a conditional logit model is the independence of irrelevant alternatives (IIA) assumption. The assumption requires the relative risk of two alternatives to be unaffected by the inclusion or exclusion of other alternatives. In my case, an exclusion or change in quality of university A should not affect the relative risk of applying at university B versus applying at university C. I use a standard Hausman-type test (Hausman and McFadden; 1984) to check this assumption. The results suggest that my application of conditional logit estimation is not rejected by the Hausman test.

5 Results

This section presents the results of the conditional logit estimations that indicate if and how prospective high-ability students are influenced by different quality indicators when choosing a university. The estimated effects are displayed as odds ratios.[10] Odds ratios can be interpreted as a percentage change in the outcome variable induced by a unit change in the variable of interest holding all other variables constant. More formally, the odds ratio for variable x_{ij} is a proportional change in the odds of applicant i applying for university j for a unit increase of x_{ij} all else being equal. An effect above (below) one indicates an increase (decrease) in the odds to apply.

Table 3 depicts the odds ratios for the different quality indicators of the ranking and the excellence initiative based on different specifications. According to the final specification V, receiving excellence status increases the probability to apply by 19.3%. This translates to an increase in application share for the treated "excellence universities" by about 2.44 percentage points.[11] In specification VI, I add two variables to account for the shortlist announcement in 2006 and 2007: a binary variable being one if a university was on the shortlist in 2006 or 2007 and another binary variable indicating a failed excellence application. The indicator for being shortlisted depicts a positive significant effect suggesting an increase in the application probability by 28.9%, while the application probability for a failed university does not change significantly. Thus, I observe an announcement effect, which is a typical example of an Ashenfelter's Dip (Ashenfelter; 1978). The effect of being one of the universities on the shortlist even exceeds the estimated effect for the winners

[10] Odds ratios are calculated as $e^{\hat{\beta}}$.

[11] The effect in percentage points is calculated by multiplying the average share of applications at "excellence universities" (12.63%, see Table 1) with the percentage change indicated by the odds ratios (12.63% × 0.193% = 2.44 percentage points). This calculation corresponds to the idea of an average treatment effect on the treated.

of the excellence initiative. This seems plausible as the media attention during this phase of the initiative was at its highest.

Table 3: Effect of the Quality Indicators on the Application Probability (Odds Ratios)

	I	II	III	IV	V	VI
Excellence	1.122*	1.264***	1.329***	1.250**	1.193**	1.377***
	(.068)	(.097)	(.110)	(.111)	(.102)	(.150)
Exc. Shortlist						1.289***
						(.127)
Exc. Failure						.933
						(.164)
Top Rank						
Prof. Rec.	2.918***	3.102***	3.305***	.948	.982	.933
	(.162)	(.236)	(.254)	(.189)	(.199)	(.207)
Res. Rep.	2.537***	3.007***	2.826***	1.313**	1.178	1.128
	(.146)	(.234)	(.220)	(.164)	(.124)	(.120)
Stud./Prof.	1.130**	1.064	1.071	1.113	1.113	1.066
	(.067)	(.070)	(.072)	(.122)	(.121)	(.118)
Clinic Beds	1.194***	1.137**	1.108*	.948	.920	.959
	(.059)	(.061)	(.060)	(.085)	(.084)	(.089)
Stud. Satisf.	1.172**	1.359***	1.368***	1.362**	1.355**	1.257*
	(.085)	(.109)	(.110)	(.169)	(.170)	(.173)
Bottom Rank						
Prof. Rec.	.344***	.275***	.301***	.761	.830	.870
	(.042)	(.033)	(.036)	(.167)	(.185)	(.196)
Res. Rep.	.694***	.769***	.696***	.818	.832	.919
	(.053)	(.057)	(.054)	(.107)	(.117)	(.132)
Stud./Prof.	.863***	.628***	.649***	.702***	.698***	.674***
	(.037)	(.031)	(.034)	(.067)	(.066)	(.065)
Clinic Beds	1.410***	1.311***	1.290***	.843	.804**	.732***
	(.069)	(.073)	(.071)	(.095)	(.089)	(.084)
Stud. Satisf.	.895**	.861***	.869***	.828*	.801**	.790**
	(.039)	(.044)	(.047)	(.081)	(.076)	(.076)
Controls						
Distance		.976***	.976***	.976***	.983***	.983***
		(.000)	(.000)	(.000)	(.001)	(.001)
Distance^2		1.000***	1.000***	1.000***	1.000***	1.000***
		(.000)	(.000)	(.000)	(.000)	(.000)
Tuition Fees			.767***	.783**	.786**	.809**
			(.055)	(.076)	(.077)	(.079)
Uni Places			1.000	1.002**	1.001**	1.001**
			(.000)	(.001)	(.001)	(.001)
Uni FE				yes	yes	yes
Uni x Distance					yes	yes
Pseudo R^2	0.1145	0.4051	0.4055	0.4319	0.4477	0.4479
# Individuals			4,535			
N			154,190			

Data Source: ZVS Data (2003-2008), own calculations; additional missing dummies are included for the quality indicators students' tip, student-professor ratio and the number of clinic beds; clustered standard errors in parentheses; */**/*** indicate significance at the 10/5/1 percent level.

Regarding the different quality dimensions of the ranking, only the indicator "students' satisfaction" increases the probability to apply at a university that is highly ranked (+35.5%). The bottom rank variables for the "student-professor ratio", the number of "clinic beds" and the "students' satisfaction" suggest that prospective students try to avoid universities ranked poorly in these quality dimensions. The odds ratios manifest a significant decrease in the probability to apply by 21 % to 33 %. The ranking dimensions "professors' recommendation" and "research reputation" do not significantly influence the university choice of prospective students in the final specification. Hence, the non-research indicators mentoring, infrastructure and students' satisfaction seem to provide more important information for the prospective students.

Bearing in mind that I look at the university choice of high-ability students, this might seem counterintuitive. In fact, the mean statistics in Table 1 show a clear sorting along the indicators "professors' recommendation" and "research reputation" with higher shares of applications in the top quality group. Hence, research quality is indeed very important to the applicants. A possible explanation for the insignificant research indicator is that the information on research quality is common knowledge even without the university ranking. The publications of ranking indicators with respect to research quality then contain only little new information. Furthermore, if high-ability students only apply for the universities which are always ranked top in the research dimension, an improving research quality of another university is unlikely to affect their university choice. This interpretation is supported by the data as the significant influence of both research oriented indicators disappears when I include university fixed effects and their interaction with distance to university, which capture the commonly known and time-constant attractiveness of a university (see specifications III, IV and V).

In addition to the university fixed effects and its interactions with distance, I further control for the distance between each university and a student's hometown, the distance squared, the introduction of tuition fees from 2006 onwards and the number of university places supplied. Most importantly, the individually calculated distance to each university and its square explains the university choice to a very large extent. While the Pseudo-R^2 for specification I – containing only the university quality variables – amounts to 0.1145, adding the distance variables rises the explanatory power to 0.4051 (specification II). Hence, distance to a university overall is the most important determinant of university choice even for the high-ability students in Germany. In the main model, each kilometer a university is further apart lowers the probability to apply by 1.7 %. Considering that the average distance between the nearest and the second nearest university amounts to about 38 kilometers, German applicants are fairly immobile. As to be expected, tuition fees decrease the application probability by about 21 % and per 10 additionally provided university places the application probability rises by 1 %.

All in all, the rankings seem to provide high-ability students mainly with information concerning the non-academic quality. They use the additional information of the ranking primarily to avoid universities with the worst quality in mentoring, faculty infrastructure and the student assessment. However, receiving excellence status - which is also closely related to research quality – increases the application probability significantly. Therefore, the excellence competition may be regarded as an additional quality indicator providing new information that exceed the commonly known university quality.

Regarding the IIA assumption, I use a Hausman test to check whether the assumption holds and thus whether my application of a conditional logit model is appropriate. Excluding one university at a time while estimating the university choice model (specification V), the Hausman test mainly confirms the independence of irrelevant alternatives. The test fails for only 3 out of 33 sequentially excluded universities at a significance level of 1 %.

To analyze the results of the excellence and ranking indicators in more detail, Table 4 presents the heterogeneous effects with respect to the applicant's gender. The results for women show the same significant results as in the full sample. Achieving excellence status and a good evaluation by the current students rise the application probability, while low quality in mentoring, faculty infrastructure and the student assessment yields a decreasing application probability. For men, however, the picture is different. Their university choice does not seem to be influenced by the excellence initiative. Furthermore, I do not find a significant positive effect for any top quality ranking indicator. Similar to the estimates for women, men have a lower application probability if the university provides an unfavorable student-professor ratio or if current students evaluate it poorly. A low rank with respect to research reputation also reduces the odds to apply for men, while female students do not react to this indicator.

Table 4: Heterogeneous Effects of Quality Indicators by Gender (Odds Ratios)

	Women		Men	
Excellence	1.259**	1.553***	1.113	1.167
	(.131)	(.210)	(.163)	(.218)
Exc. Shortlist		1.420***		1.010
		(.173)		(.188)
Exc. Failure		.989		.915
		(.216)		(.274)
Top Rank				
Prof. Rec.	1.117	1.099	.751	.709
	(.276)	(.300)	(.271)	(.280)
Res. Rep.	1.128	1.061	1.315	1.291
	(.149)	(.143)	(.232)	(.230)
Stud./Prof.	1.035	.994	1.275	1.238
	(.134)	(.132)	(.262)	(.258)
Clinic Beds	.917	.968	.911	.927
	(.100)	(.107)	(.156)	(.160)
Stud. Satisf.	1.558***	1.378*	1.030	1.019
	(.232)	(.226)	(.254)	(.272)
Bottom Rank				
Prof. Rec.	.744	.808	1.159	1.170
	(.206)	(.227)	(446)	(.451)
Res. Rep.	.950	1.087	.562**	.584*
	(.158)	(.186)	(.152)	(.161)
Stud./Prof.	.768**	.737***	.583***	.574***
	(.088)	(.085)	(.101)	(.100)
Clinic Beds	.674***	.590***	1.142	1.101
	(.091)	(.083)	(.221)	(.220)
Stud. Satisf.	.844*	.831	.731*	.726**
	(.101)	(.100)	(.118)	(.118)
Pseudo R^2	0.4407	0.4411	0.4742	0.4742
# Individuals	3,023		1,512	
N	102,782		51,408	

Data Source: ZVS Data (2003-2008), own calculations; covariates: distance, distance^2, tuition fees and uni places; additional missing dummies are included for the quality indicators students' tip, student-professor ratio and the number of clinic beds; clustered standard errors in parentheses; */**/*** indicate significance at the 10/5/1 percent level.

Note that the sample of men is by half smaller than the female sample. Some estimates, thus, can also be insignificant due to the smaller sample size. Using a 50% random sample of the females for estimation, similar to the men sample only the bottom rank indicators "student-professor ratio", the number of "clinic beds" and the "students' satisfaction" remain significant (see Table A.2).

As a robustness check, I estimate a pseudo introduction of the excellence competition in 2004 and 2005 and a pseudo change in the university ranking in 2005 (see Table 5). If the applied university choice model is appropriate, the quality indicators should not affect the applicants' decision at a point in time before the indicators became public. Therefore, I create a dummy variable indicating that the "excellence universities" received the excellence status already in 2004 and 2005 respectively, and I assign the ranking indicators of the second ranking, published in 2006, already to the corresponding universities in the year 2005.

Restricting the observation period to the years 2003 - 2005 and estimating the main models (specifations V and VI in Table 3) yields mainly non-significant results for the achieving excellence status as well as for being shortlisted or having failed to obtain excellence status. In the full sample, only the bottom rank indicator for the number of clinic beds is negatively related to the application probability. This effect is only significant at the 10 % level. Compared to the main estimations in Table 3, the effect lost significance.

Estimations on the female sample yield the same weakly significant correlation between poor infrastructural quality and the application probability. The specification incorporating only the main excellence indicator also shows a significant increase in the probability to apply for "excellence universities" although the status "excellence university" has not been awarded at this point in time. However, the effect loses its significance in the specification incorporating dummy variables for the universities being shortlisted and having failed within the excellence initiative. Estimations using the sample of men do not show any significant results. As mentioned above, smaller sample sizes may be partly responsible for the less significant results. These pseudo estimations are only a crude check of robustness as they are based on only one post-reform year of observation. Nevertheless and despite the few remaining significant effects, the robustness check in general supports my results and suggests that my estimates indeed reflect the influence of changes in quality indicators on the university choice of high-ability students.

Table 5: Pseudo Introduction of Excellence Competition and Change in Rankings (Odds Ratios)

	Full Sample		Women		Men	
Excellence	1.266	1.129	1.481**	1.286	.999	.825
	(.192)	(.388)	(.292)	(.557)	(.245)	(.479)
Exc. Shortlist		.886		.859		.818
		(.290)		(.356)		(.451)
Exc. Failure		.783		.674		.887
		(.288)		(.312)		(.572)
Top Rank						
Prof. Rec.	1.306	1.267	1.189	1.112	1.504	1.540
	(.381)	(.379)	(.427)	(.415)	(.779)	(.802)
Res. Rep.	.875	.871	.845	.839	.943	.943
	(.137)	(.137)	(.168)	(.166)	(.253)	(.253)
Stud./Prof.	1.199	1.177	1.137	1.093	1.188	1.199
	(.213)	(.210)	(.246)	(.239)	(.395)	(.400)
Clinic Beds	.874	.891	.940	.977	.746	.749
	(.128)	(.134)	(.169)	(.181)	(.195)	(.198)
Stud. Satisf.	.997	1.000	.964	.975	1.133	1.112
	(.204)	(.206)	(.242)	(.246)	(.434)	(.428)
Bottom Rank						
Prof. Rec.	1.063	1.109	1.388	1.509	.529	.530
	(.370)	(.393)	(.588)	(.661)	(.361)	(.364)
Res. Rep.	.704	.713	.765	.789	.678	.680
	(.157)	(.160)	(.210)	(.218)	(.269)	(.270)
Stud./Prof.	1.040	1.043	.963	.968	1.211	1.214
	(.137)	(.138)	(.155)	(.156)	(.299)	(.300)
Clinic Beds	.734*	.727*	.687*	.673*	.691	.690
	(.121)	(.120)	(.150)	(.147)	(.191)	(.192)
Stud. Satisf.	.903	.913	.826	.843	.981	.983
	(.135)	(.136)	(.158)	(.161)	(.246)	(.247)
Pseudo R^2	0.4812	0.4812	0.4828	0.4829	0.5007	0.5007
# Individuals	1,969		1,266		703	
N	66,946		43,044		23,902	

Data Source: ZVS Data (2003-2008), own calculations; covariates: distance, distance^2, tuition fees and uni places; additional missing dummies are included for the quality indicators students' tip, student-professor ratio and the number of clinic beds; clustered standard errors in parentheses; */**/*** indicate significance at the 10/5/1 percent level.

6 Conclusion

In this paper, I distinguish the importance of different university ranking dimensions for the university choice of high-ability students. Quality indicators considered are the "professors' recommendation', "research reputation", "student-professor ratio", the number of "clinic beds" and "students' satisfaction". Furthermore, I provide an evaluation of an excellence competition run by the German government awarding universities with an outstanding future concept for top-level research. Using administrative application data for all German medical schools, I estimate a random utility model of the high-ability students' application choice in a conditional logit setting. Identification relies on the variation over time induced by changes in the ranking indicators between the first publication in 2003 and the second in 2006 as well as by the introduction of the excellence initiative in 2006 and 2007. This allows me to distinguish the effect of changes in the different quality indicators from the general attractiveness of a university.

The evaluation of the excellence initiative shows that in course of the competition the share of applicants increased at the winning universities, which are today known as "excellence universities". On average, achieving excellence status increases the application probability by 19%, which relates for the "excellence universities" to an increase in applications of about 2.44 percentage points. Hence, the excellence competition and the accompanying media attention provide additional information that exceeds the common knowledge on university attractiveness and thus affect the university choice of high-ability students.

The results regarding the different ranking indicators suggest that the non-research dimensions "student-professor ratio", the number of "clinic beds" and the "students' satisfaction" rather than the research-oriented indicators widen the basis of information for choosing a university. This does not by any means suggest that high-ability students in Germany do not care about research quality. In fact, research quality affects their university choice significantly. However, the research quality of German medical schools is rather recognized as part of the common knowledge regarding university attractiveness and, as such, is captured by the incorporated university fixed effects. Hence, the research dimension of the ranking does not provide the high-ability applicants with any new information, while the indicators regarding mentoring, faculty infrastructure and the student assessment do. The ranking indicators are thus, especially in the non-research dimensions, in action where they add new information to the common knowledge of universities' research reputation.

Providing information on all quality dimensions separately instead of publishing university rankings in aggregated league tables can thus be useful to support a well-informed university choice. This in turn could reduce drop-out rates, increase human capital production and – depending on the social welfare function – also increase overall welfare. An important prerequisite for the ranking to improve the applicant-university match, though, is that the quality indicators reflect real quality differences. Therefore, the discussions about ranking methodology are important for assessing the benefits of university rankings (e.g. see Cremonini et al.; 2008).

Another positive aspect of publishing multidimensional rankings is that the universities well-known for their top level research also need to guarantee a good standard with respect to the non-research ranking indicators if they want to attract high-ability students.

Top research institutes, therefore, cannot completely specialize in research and fully neglect e.g. mentoring quality as a low rank in the non-research indicators also lowers the application probability of high-ability students. Hence, multidimensional rankings could induce incentives for the top research institutes also to invest in the non-research quality dimensions.

When interpreting my results, it is important to keep in mind that the distance between a student's hometown and the university remains the most powerful determinant of university choice in Germany. Quality indicators, as shown affect university choice, especially if they add new information to the common knowledge of universities' research reputation, but due to the immobility of students only to a moderate extend. Either German students are simply reluctant to move far away from their hometown, even if they benefitted from attending a high-quality university, or they still recognize the German medical schools as a group of homogeneous quality such that there is no need for them to apply at universities further away from their hometown.

A factor limiting the generalization of my analysis is that I focus on the university decision of high-ability students. High-ability students are probably intrinsically motivated to a high degree and, therefore, are personally very interested in attending one of the best universities. Moreover, students with the best grade in their final secondary school exam are not constrained by admission thresholds. Therefore, the influence of the different ranking indicators on average students can differ from my results. The dimensions not related to research could be even more important for average students as they, for example, might expect to need more and better mentoring.

Another concern is that medical students could be different from students of other subjects. In that case, it is unclear whether the effects of the different quality indicators can be translated to the behavior of university applicants in general. This is even more so as the German job market in the field of medicine is not as competitive as in other fields. To signal ones quality on the labor market by the quality of the attended university, therefore, could be even more important in other fields than medicine.

Overall, analyzing the importance of different quality indicators for choosing a university, I show not only that university rankings do affect high-ability students in the application process but also that the influence of the ranking indicators differ with respect to the quality dimensions. Therefore, publishing multidimensional university rankings widens the basis of information for prospective students. University applicants can decide which quality dimensions are most important to them and, subsequently, may apply with a higher probability at the university that fits them best.

References

Ashenfelter, O. (1978). Estimating the effect of training programs on earnings, *Review of Economics and Statistics* **60**: 47–57.

Avery, C. and Hoxby, C. M. (2003). Do and Should Financial Aid Packages Affect Students' College Choices, *in* C. Hoxby (ed.), *College Choices: The Economics of Where to Go, When to Go, and How to Pay For It*, University of Chicago Press, Chicago, pp. 239 – 301.

Becker, G. S. (1973). A Theory of Mariage: Part I, *Journal of Political Economy* **81**: 813–846.

Berkowitz, D. and Hoekstra, M. (2011). Does High School Quality Matter? Evidence from Admissions Data, *Economics of Education Review* . forthcoming.

Braun, S. and Dwenger, N. (2009). Success in the University Admission Process in Germany: Regional Provenance Matters, *Higher Education* **58**: 71–80.

Braun, S., Dwenger, N. and Kübler, D. (2010). Telling the Truth May Not Pay Off: An Empirical Study of Centralised University Admissions in Germany, *The B.E. Journal of Economic Analysis & Policy* **10**(1).

Brewer, D., Eide, E. and Ehrenberg, R. (1999). Does it Pay to Attend an Elite Private College? Cross-Cohort Evidence on the Effects of College Type on Earnings, *The Journal of Human Resources* **34**(1).

Büttner, T., Kraus, M. and Rincke, J. (2003). Hochschulranglisten als Qualitätsindikatoren im Wettbewerb der Hochschulen, *Vierteljahreshefte zur Wirtschaftsforschung* **2**: 252–270.

Chade, H., Lewis, G. and Smith, L. (2011). Student Portfolios and the College Admission Problem, Working Paper: Version February 2011.

Cremonini, L., Westerheijden, D. and Enders, J. (2008). Disseminating the right information to the right audience: cultural determinants in the use (and misuse) of rankings, *Higher Education* **55**: 373–385.

Dwenger, N., Storck, J. and Wrohlich, K. (2011). Do Tuition Fees Affect the Mobility of University Applicants? Evidence from a Natural Experiment, *Economics of Education Review* (forthcoming).

Ehrenberg, R. and Sherman, D. R. (1984). Optimal Financial Aid Policies for a Selective University, *Journal of Human Resources* **12**(2).

Gale, D. and Shapley, L. S. (1962). College Admissions and the Stability of Marriage, *The American Mathematical Monthly* **69**(1).

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

Hausman, J. and McFadden, D. (1984). Specification Tests for the Multinomial Logit Model, *Econometrica* **52**(5).

Hübner, M. (2009). Do Tuition Fees Affect Enrollment Behavior? Evidence from a 'Natural Experiment' in Germany, Discussion Paper No. 69, CDSE University of Mannheim.

Helbig, M. and Ulbricht, L. (2010). Perfekte Passung - Finden die besten Hochschulen die besten Studenten?, *in* S. Trepte and M. Verbeet (eds), *Allgemeinbildung in Deutschland*, VS-Verlag für Sozialwissenschaften, Wiesbaden, pp. 107–118.

Horstschräer, J. and Sprietsma, M. (2010). The Effects of the Bologna Process on College Enrollment and Drop-out Rates, Discussion Paper No. 10-018, ZEW Mannheim.

Mc Fadden, D. (1974). Conditional Logit Analysis of Qualitative Choice Behaviour, *in* P. Zarembka (ed.), *Frontiers in Econometrics*, Academic Press, New York, pp. 105–142.

McPherson, M. and Schapiro, M. O. (1991). Does Student Aid Affect College Enrollment? New Evidence on a Persistent Controversy, *The American Economic Review* **81**: 309–318.

Monks, J. and Ehrenberg, R. G. (1999). The Impact of *U.S. News & World Report* College Rankings on Admissions Outcomes and Pricing Policies at Selective Private Institutions, NBER Working Paper 7227.

Moore, R., Studenmund, A. H. and Slobko, T. (1991). The Effect of the Financial Aid Package on the Choice of a Selective College, *Economics of Education Review* **10**: 311–321.

Mueller, R. and Rockerbie, D. (2005). Determining demand for university education in Ontario by type of student, *Economics of Education Review* **24**: 469 – 483.

Roth, A. E. and Sotomayor, M. (1989). The College Admission Problem Revisited, *Econometrica* **57**(3).

Strayer, W. (2002). The Returns to School Quality: College Choice and Earnings, *Journal of Labor Economics* **20**(3): 475–503.

Toutkoushian, R. K. (2001). Do parental income and educational attainment affect the initial choices of New Hampshire´s college-bound students?, *Economics of Education Review* **20**: 245–262.

Weiler, W. (1996). Factors Influencing the Matriculation Choices of High Ability Students, *Economics of Education Review* **15**: 22–36.

A Appendix

Table A.1: Excellence Status and Ranking Indicators by University (Ranking 2003 vs. 2006)

University of ...	Exc.	Prof. Rec.		Res. Rep.		Stud./Prof.		Clinic Beds		Stud. Satisf.	
		2003	2006	2003	2006	2003	2006	2003	2006	2003	2006
Aachen	2007	2	2	2	2	3	1	2	2	2	1
Berlin	2007	2	2	2	1	2	2	3	3	2	2
Bochum	no	2	3	2	3	3	3	x	1	3	3
Bonn	no	2	2	2	2	2	3	2	2	3	3
Dresden	no	2	2	2	2	1	2	1	2	1	2
Düsseldorf	no	2	2	2	2	2	3	2	3	x	3
Erlangen-Nürnb.	no	2	2	2	2	1	1	2	x	2	2
Essen	no	2	3	2	2	2	1	2	2	2	1
Frankfurt/Main	no	2	2	2	2	2	3	2	2	3	2
Freiburg	2007	1	1	1	2	2	2	2	3	2	2
Gießen	no	2	3	2	3	2	2	3	2	2	2
Göttingen	2007	2	2	2	2	3	3	3	3	2	3
Greifswald	no	2	2	2	3	1	1	1	1	1	1
Halle	no	2	2	2	3	1	1	1	2	1	1
Hamburg	no	2	2	2	2	1	3	x	x	3	3
Hannover	no	2	2	2	2	2	3	3	3	3	2
Heidelberg	2007	1	1	1	1	2	3	1	2	2	2
Heidelb.-Mannh.	no	2	1	2	1	3	x	2	2	2	x
Jena	no	2	2	2	3	1	1	1	2	1	1
Kiel	no	2	3	2	3	2	2	2	3	3	2
Cologne	no	2	2	2	2	3	3	3	2	3	3
Leipzig	no	2	2	2	2	2	2	3	3	2	2
Lübeck	no	2	2	2	2	3	1	2	1	1	1
Magdeburg	no	2	2	2	2	1	1	1	1	1	1
Mainz	no	2	2	2	2	3	3	2	2	3	3
Marburg	no	2	2	2	2	2	2	2	x	3	2
Munich	2006	1	1	1	1	2	2	2	2	3	2
Münster	no	2	2	2	2	3	1	3	2	1	1
Regensburg	no	2	2	2	2	1	1	1	2	1	1
Rostock	no	2	2	2	3	2	2	1	1	1	2
Saarbrücken	no	2	3	2	3	3	2	x	1	2	3
Tübingen	no	1	2	1	2	2	2	2	2	2	3
Ulm	no	2	2	2	2	2	2	2	3	3	2
Würzburg	no	2	2	1	2	1	2	2	1	2	1

1(2,3): top (middle, bottom) ranking group; x: indicator missing; Exc.: Excellence status; Prof. Rec.: Professors' Recommendation; Res. Rep.: Research Reputation evaluated by Professors; Stud./Prof.: Student-Professor ratio; Clinic Beds: Number of clinic beds; Stud. Satisf.: Students' Satisfaction.

Table A.2: Heterogeneous Effects using a 50 % Random Sample of Females (Odds Ratios)

	Women	
Excellence	1.261	1.449*
	(.188)	(.280)
Exc. Shortlist		1.278
		(.218)
Exc. Failure		.911
		(.295)
Top Rank		
Prof. Rec.	1.113	1.046
	(.388)	(.404)
Res. Rep.	.953	.914
	(.171)	(.166)
Stud./Prof.	1.047	1.009
	(.193)	(.195)
Clinic Beds	.831	.868
	(.129)	(.136)
Stud. Satisf.	1.297	1.197
	(.273)	(.282)
Bottom Rank		
Prof. Rec.	.659	.704
	(.261)	(.281)
Res. Rep.	1.102	1.222
	(.258)	(.298)
Stud./Prof.	.745*	.722**
	(.120)	(.118)
Clinic Beds	.669**	.609***
	(.125)	(.117)
Stud. Satisf.	.650**	.639***
	(.110)	(.110)
Pseudo R^2	0.4460	0.4463
# Individuals	3,023	
N	102,782	

Data Source: ZVS Data (2003-2008), own calculations; covariates: distance, distance^2, tuition fees and uni places; additional missing dummies are included for the quality signals students' tip, student-professor ratio and the number of clinic beds; clustered standard errors in parentheses; */**/*** indicate significance at the 10/5/1 percent level.