Students' revealed preferences and ranking of school quality*

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Abstract

I present a revealed preference ranking of school quality. This is helpful to pin down between two or more schools the one that attracts high ability students at the lowest additional cost of quality. Available school rankings don't capture the heterogenous effects that an increase in school quality has on the choices of students with different characteristics. To do so, I obtain the ranking by considering schooling as a differentiated product market and for simplicity fees are regulated and admission is not selective. Then I compute the ranking by using estimates from a multinomial model of school choice. An example using a dataset of Italian college graduates suggests two findings. First the ranking I propose differs from average quality rankings because it captures average as well as marginal information that is contained in the revealed preferences of students. Second, the ranking sharply differs from rankings that newspapers publish and the maximum discrepancy in the ranking of one college is 17 positions.

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Keywords: school choice, college choice, school quality, college quality, revealed preferences, discrete choice models, product differentiation.

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1 Introduction

A Google search 'school ranking' returns 4 million hits but several of the those rankings are built arbitrarily and are easily altered by the strategic behaviour of schools and governments. This paper presents a revealed preference ranking of school quality in an educational system with regulated fees and no selective admission. The indicator that I use to construct the ranking pins down between two schools the one that attracts high ability students at the lowest additional cost of quality. The mechanism behind this is that an increase in average quality in a school is likely to alter the average ability and other characteristics of its applicants. However, students with different characteristics react differently to a quality increase. For example overall enrollment may increase if a school purchases more computers and offers basic computing skills but the average ability of students decreases if low ability students who would otherwise not go to this school choose it and high ability students perceive to benefit little from learning these skills and choose another school. I let the interaction between schools and students occur in a differentiated product market and I obtain a ranking that captures both the average and marginal information that is contained in the revealed preferences of students. I compute the ranking by estimating a multinomial model of school choice and using a dataset of Italian college graduates as an example. I observe sharp differences when I compare the rankings that I obtain to newspaper rankings. In the market I let schools be the firms, students the consumers and a diploma or degree be a differentiated good along two dimensions: the vertical one is the quality level of the school and the horizontal one its geographical location. Schools choose a costly quality level to maximise the profit they make by selling a degree and students buy the degree that maximises utility given their ability and preferences. It is rational for a school to set high quality only if the lower profit it makes per student, relative to the counterfactual event of low quality, is compensated by an increase in enrollment. Viceversa a school can set low costs of quality if the high profit per student is at most fully offset by lower enrollment.

It is little clear what exactly lies behind a school setting high quality. You only see the net effect of supply and demand and this school might attract a lot of students by investing little in the quality of the teachers and relatively more in amenities for students or viceversa. To solve this identification problem I firstly obtain an equilibrium condition for the quality level that a profit-maximising school sets. Since with this I cannot identify which school is good on average and which for example for high ability students, I obtain marginal indicators of school quality from the comparative statics so as to look at the marginal variations around the equilibrium quality. Consider a low marginal variation in quality as a result for example of a unit increase in students' ability around the equilibrium quality. I interpret it as an indicator of high marginal quality for a school as the high ability students choosing it strongly prefer it to other schools rather than being almost indifferent to another school and potentially switch to another school. I also compute a marginal indicator of quality where the variation around equilibrium is given by an increase in home-school distance and its interpretation is similar to the marginal indicator of school quality.

Using a dataset of Italian college graduates I estimate a discrete school choice model, I compute the indicators and sort them to obtain rankings of Italian colleges. Non-statistically significant rank order correlations among the rankings confirm that the rankings capture different information, e.g. average and marginal, about the behaviour of students and schools. Comparing instead the ranking I propose with one that has been available in Italy in the paper or online version of the newspaper La Repubblica since 2000 shows remarkable differences and a non-statistically significant rank order correlation confirms it. Then policy decisions that are based on easily manipulable indicators are unlikely to reflect students' preferences and set the right incentives for a sustainable management of schools. The ranking I propose offers a possible answer to the sharp increase in attention by students and policy-makers in school quality in the last 50 years as a result of an increase in compulsory schooling age and the average years of schooling worldwide over this period. This is widely documented for example in the international press by The Economist (2005) survey on colleges, by international organisations in the World Bank (2000) policy report on higher education in developing countries and in the economic literature in the Krueger and Lindahl (2001) survey.

The literature on school choice in the USA focuses on an educational system with considerable variation in fees across schools and selective admission that induce strategic interaction among students and schools. This paper instead looks at the relationship between students' demand for schooling and school quality in a school system where fees are regulated by the government and admission is non-selective. In such a system schools are driven to differentiate themselves by offering students an equilibrium quality level given

students' preferences and ability and college technology, e.g. buildings, teaching and research skills. Examples are such countries as Austria, Belgium, France, Germany, Italy, The Netherlands and Switzerland. Think of a school as a firm. As it is costly for a firm to alter the mix of labour and capital in the production process of the goods it sells, so it is for a school to alter the mix of the quantity and quality of education it sells to students. A school can invest in average quality-improving efforts by making the average student happy but by doing so it is not clear-cut whether more or fewer high ability students choose this school. Then disentangling average and marginal quality is helpful to reward differentially educational institutions and it can also offer a back-of-the envelope quality ranking of other services that different suppliers in quasi-markets or markets with some type of regulation such as hospitals and tax-advisors offer to individuals.
The rest of the paper is structured as follows: section 2 reviews the literature. Section 3 obtains a ranking from the equilibrium quality level that schools set in a stylised model of school quality. Section 4 describes the dataset. Section 5 computes the ranking for Italian colleges using a multinomial model of college choice and compares the results with average quality rankings and newspaper ones. Section 6 concludes.

http://www.bepress.com/bejeap/vol8/iss1/art14/

2 Literature

School quality has received a great deal of attention in the theoretical and empirical literature on compulsory and higher education and Behrman and Birdsall (1983) is one of the first examples of an extension of a human capital model that accounts for both quantity and quality of education. In compulsory schooling Hanushek et al. (2006) look at the effect of school quality on dropout behaviour while Hastings et al. (2006) look at school competition using the revealed preferences of students' families. Instead in higher education Black and Smith (2004) estimate the effect of college quality on students' wages and Zhe Jin and Whalley (2007) the effect of college quality on the financing of colleges. Among theory papers quality is not explicitly modelled although it is often a key-ingredient that is left in the background as for example in Epple et al. (2003) that deals with peer effects, scolarships and admission and in Gautier and Wauthy (2007) that looks at competition and efficiency in teaching and research activities.
Two main issues emerge from the debate on school quality. The first is the richness of

predictions in theoretical models. Among theory papers De Fraja and Iossa (2002) apply a model of product differentation to college choice and model as a game the interaction between students and colleges. Accurate testing of such predictions can be very beneficial to inform the choices of students and policy-makers. The second is the lack of agreement on the definition and the determinants of school quality as Heckman et al. (1995) highlights. While this is little noticeable in theoretical models, the empirical evidence on school quality is still inconclusive as the contrasting evidence of positive returns to college quality in Black and Smith (2004) and the null returns to college selectivity in Dale and Krueger (2002) suggest. On the one hand the use of publicly available indicators of school quality that governments or newspapers produce gives easily interpretable estimates for policy-makers and students. On the other hand their arbitrary nature and the lack of economic theory behind them can leave them open to manipulations by schools and governments.

Baltagi (1999), Combes (2003), Coup (2003) and Kalaitzidakis et al. (2003) offer rankings of research productivity of individual economists and economics departments in colleges worldwide and their contribution is an as unbiased as possible measure of productivity and a ranking. It is very informative to policy makers' decisions although far less to a student's one as research productivity is one of several characteristics that students look at to choose a college. Moreover, they don't support the rankings with economic theory so as to model the conditions under which for example substitutability or complementarity between teaching and research arise as it is done in Gautier and Wauthy (2007). Avery et al. (2005) instead construct a revealed preference ranking of selective colleges in the USA by using a set of rules that apply to sport tournaments and Bayesian estimation methods. Their main contribution applies to the selective college system in the USA and consists in offering a ranking that colleges cannot manipulate by acting strategically in the admission of students. They also describe the working of a model of tournament in the background although they don't explicitly model the supply of college education.

Then the contribution of this paper is to fill the gap between theory and applications in the literature on school quality by offering a ranking of school quality based on students' revealed preferences in a system with regulated fees and no selection and by supporting it considering schooling as a differentiated product market. This allows to give a behavioural interpretation of the rankings as the outcome of the interaction between supply and demand for schooling quality.

3 Model

I characterise the supply of schools and their demand by students in the market for education[1] using a model of horizontal and vertical differentiation as in Anderson et al. (1992). This helps to jointly characterise the technology choice by a school over what quality level to supply and the choice by students over schools. On the demand side, students have heterogeneous ability and preferences over schools and their choice is influenced by school fees, the home-school distance, their parents' education and either further education or job opportunities that a school offers after graduation. On the supply side fees are regulated by the government and admission of students is not selective to characterise the educational system in such countries as Italy and Germany. An equilibrium is achieved by an allocation of students across universities, namely quantities, and the quality offered by universities. Then the policy variable that schools are left with is to differentiate among themselves along other dimensions than price or admission.

From now on, I focus on higher education as the greater differentiation in the demand and supply for college degrees than that for a primary school certificate helps to easily develop the intuition of the model. Several are the dimensions along which universities can look different to students' eyes. For simplicity, I consider a degree as a differentiated product along two dimensions. Vertical differentiation is given by the heterogeneity in a generic measure of college quality or desirability by students and horizontal differentiation is given instead by the variation in the geographic locations of colleges. Let colleges behave like firms that maximise the profit arising from the revenues that students' fees generate net of the costs for supplying quality. Such costs are linear in quality and let quality be the policy variable that schools use to maximise profit. Instead fees are regulated by the government and are a small percentage of the total cost to attend a year at college, in the range 15% to 25% according to a survey in La Repubblica (2003) on Italian colleges. Then I obtain the equilibrium quality level that firms set given students' demand. In the three subsections that follow I focus first on the demand by students for school quality. Then I look at the supply by schools and the equilibrium quality level that they set to maximise profit and its interpretation as a ranking of average school quality. Lastly I

[1]See Glennester (1991) on education as a quasi-market.

compute comparative statics of the equilibrium quality and interpret it as a ranking of marginal school quality.

3.1 Students' utility and demand function for colleges

Consider a continuum of universities indexed by j and arbitrarily distributed along a linear city of unit size. A generic student i has ability a_i and pre-college location z_i on the line along which she chooses a college j that maximises her utility in (1).

$$u_{ij} = \underbrace{\alpha_j + \beta_j a_i}_{H_{ij}} + \underbrace{\gamma d_{ij} + \delta_j a_i d_{ij} + \tau f_j}_{C_{ij}} + \epsilon_{ij} \tag{1}$$

$$x_{ij} = \underbrace{Pr(u_{ij} = \max_k u_{ik})}_{P_{ij}} \tag{2}$$

$$= Pr(y_i = j)$$

$$= \frac{e^{\alpha_j + \beta_j a_i + \gamma d_{ij} + \delta_j a_i d_{ij} + \tau f_j}}{\sum_k e^{\alpha_k + \beta_k a_i + \gamma d_{ik} + \delta_k a_i d_{ik} + \tau f_k}} \tag{3}$$

You can think of the student's utility[2] in (1) in a human capital framework. The human capital H_{ij} increases with the quality α_j of college j and the ability a_i of student i. The direct cost C_{ij} instead increases with the total mobility cost that I assume proportional to the home-college distance $d_{ij} = |z_i - z_j|$. Moreover I interact distance with ability as the cost varies across students with different ability. This is helpful to model the lower marginal mobility cost that high ability students face as they are more likely to get scolarships and graduate faster than their less able peers. As a consequence they pay a lower overall cost to obtain a college degree. Lastly the cost increases with the fee f_j that college j charges and I assume away for simplicity the students' foregone payoff of going to college. You can also think of a school j as offering a differentiated good, a college degree, that has two dimensions of differentiation: the vertical one is the quality α_j of the degree that the college offers. The horizontal one instead is the home-college distance d_{ij} for student i in college j. The main constraint that a school faces on the enrollment of students is its capacity to fit students in classrooms and the number of professors lecturing them. The student buys one unit of the good, i.e. one degree. The utility specification in (1) is analogous to that of the consumer's demand in a model of horizontal and vertical differentiation in Anderson et al. (1992) and other applications to higher education such as Hoxby (1997) and De Fraja and Iossa (2002). Then I characterise the demand x_{ij} in

[2] See De Fraja and Iossa (2002) for the derivation of the reduced form of the process underlying utility by using stochastic dominance.

(2) by the probability P_{ij} that student i chooses college j. By assuming that the error ϵ_{ij} follows a logistic distribution, I obtain a conditional logit model of college choice in (3). Figure 1 illustrates student i's demand function for school 1 that is located at $z_1 = 1$ on the left-hand side of the unit line. The downward-sloping and continuous line gives the demand x_{i1} for school 1 by student i as a function of home-college distance d_{i1}. The greater the distance, the more costly it is to choose college 1 and hence the lower is the probability that student i chooses it. The dashed lines instead give the change in the probability to choose school 1 given distance d_{i1} and a unit change in ability a_i. Consider two students who only differ in ability by a unit and live in the same place z_i along the line and two colleges 1 and 2 at the opposite ends of the line. The probability to choose college 1 is greater for the more talented of the two students, $\frac{\partial P_{i1}}{\partial a_i} > 0$. After interpreting the college fixed effect α_j in the next subsection, I use the average information that is contained in α_j and the marginal effect of ability on the probability to choose school j to obtain a ranking of school quality.

3.2 Colleges supply and equilibrium quality choice

Characterising the supply of college education has been widely debated in the literature on college choice.[3] While this literature mainly focuses on colleges with discretion over fees and admission rules as in Spain, the UK, the USA or Brasil, in this paper I focus instead on colleges in a country where colleges cannot set fees autonomously or have a limited degree of freedom on them as they are set by a central or local government that also transfers tax revenues to colleges for teaching and research and admission is not selective. Examples are such countries as Austria, Belgium, France Germany, Italy, Netherlands, Switzerland where the educational system can be thought of as having two main policy variables that jointly help a student to assess the quality of a college and choose one. The first is investing today the funding one school gets to increase its attractiveness tomorrow for future students. The second is some type of late selection of students at the end of the first or second year of a degree so as to compensate for the lack of selective admission upon enrollment by reallocating resources that it may have previously allocated to poorly-performing students.

[3]See Rothschild and White (1995) on competitive pricing and allocative efficiency in higher education and Winston (1999) on the limits of standard profit maximising theory for modelling education supply.

$$\max_{\alpha_j} \pi_{ij} = \underbrace{(f_j - \alpha_j)}_{p_j - c_j} \underbrace{P_{ij}}_{x_{ij}} \tag{4}$$

$$\pi'_{ij} = \frac{\partial \pi_{ij}}{\partial \alpha_j} = -P_{ij} + (f_j - \alpha_j) P_{ij}(1 - P_{ij}) = 0 \Longleftrightarrow \tag{5}$$

$$\alpha_j^* = f_j - \frac{1}{1 - P_{ij}(\alpha_j^*, a_i, d_{ij})} \ , \quad P_{ij}(\alpha_j^*, a_i, d_{ij}) = \frac{e^{\alpha_j^* + \beta_j a_i + \gamma d_{ij} + \delta_j a_i d_{ij} + \tau f_j}}{\sum_k e^{\alpha_k + \beta_k a_i + \gamma d_{ik} + \delta_k a_i d_{ik} + \tau f_k}} \tag{6}$$

Then I jointly consider the allocation of funds and the selection after one-two years from enrollment as a quality parameter α_j that school j sets as a policy variable to maximise profit π that is proportional to students' enrollment over the whole length of the school degree similarly to a logit oligopoly model with quality choice in Anderson et al. (1992). As a simplifying assumption, consider the profit π_{ij} that school j gets per student i choosing to go there.[4] The choice of students over schools is characterised in (2) as the probability to choose one. Then the per student profit function in (4) is the product of the per student profit school j gets times the probability P_{ij} that student i chooses school j. Schools get fees f_j and pay a marginal cost of quality $c(\alpha_j) = \alpha_j$ by assuming that it is linear in quality.[5] I motivate this by thinking that hiring two extra professors costs twice as much as hiring one and discounts to build two extra classrooms rather than 1 or purchasing 200 new pcs rather than 100 are negligible. From the first order condition I obtain an implicit expression for the equilibrium quality level α_j^* in (6).[6]

The joint decrease in profit per student and increase in probability of enrollment by a student that an increase in quality α_j produces characterises the tradeoff that a college j faces and it is illustrated in Figure 2.[7] By setting high average quality, a school incurs high costs and obtains a low profit per student, likely high demand level and an ability distribution of students with low mean. Setting instead low costs the school gets a high profit per student but makes a little quality-appealing offer to the average student that impacts the probability of enrollment and the ability distribution of students with high mean. It is helpful to interpret with two examples what α_j^* captures by considering (6)

[4] The overall profit of school j can be obtained by integrating (4) over the joint distribution of students' location and ability on the line; also assuming in the short-run that all school face only marginal costs and no fixed costs does not alter the results.

[5] You can easily allow the revenues per student that a school obtains to be made up of fees and government subsidies per student enrolled.

[6] You can also obtain the equilibrium quality by using an implicit functional form $c(\alpha_j)$ for the cost of quality; however the benefit of no dependence on functional form comes at the cost of a complex and little easily interpretable expression for the equilibrium quality α_j^*.

[7] The sufficient conditions confirm that α_j^* is a global maximum under plausible assumptions on the objective function of the school.

where α_j^* appears on the left- and right-hand side.[8] First, if you let school j increase equilibrium average quality α_j^* by a unit, the left-hand side of (6) increases while the right-hand side decreases. Then you need a decrease in either ability a_i or home-school distance d_{ij} or a combination of them for the equilibrium condition in (6) to still hold. I interpret this as a crowding out effect of the additional quality that school j offers to each additional student choosing j on high ability student as the purchase of new sport facilities rather than the hire of talented professors can increase the popularity of the school among students living away from it but it can also reduce the average ability of students choosing j. Second if you let ability a_i increase by a unit either the right-hand side of (6) decreases and so does α_j^* on the left-hand side or for α_j^* to be unchanged, it must be compensated by a decrease in the level of other individual characteristics such as home-school distance. Then you need a decrease in α_j^* for the equilibrium condition to hold. I interpret this as a crowding in effect of ability that can be the result of a lower average perception of quality by students but this can arise for example from more stringent exam rules, the switch of a school from little to more profitable research projects and fields in related degrees for example from qualitative business studies to industrial organisation. To sum up α_j helps to link the supply and the demand side of school quality and its interpretation offers an intuition of what information it captures if you estimate it as fixed effect of school j in a multinomial model of school choice. By considering the two examples above, I am unable to say whether an increase in α_j arises from a school hiring for example a Nobel Prize-winning professor or from the construction of a new football pitch. Avery et al. (2005) suggest a fix to the problem of identifying school quality by estimating P_{ij} with both individual- and alternative-specific information as regressors and interpreting the choice-specific constant as individual preferences. In section 5 I estimate (3) using a multinomial model and data on Italian college students, I compute predicted values P_{ij} and sort their values in descending order to offer an overall or average ranking of school quality similarly to Avery et al. (2005). However, this does not fully solve the problem as $\hat{P}$ gives an estimate of the average school quality under which different individual characteristics are at work in influencing school choice. Then in the next subsection I propose an indicator of school quality that tries to help an econometrician to set apart the effect of a college purchasing a football pitch from that of hiring a Nobel prize-winning

[8] You need to characterise the interaction among schools and students in a game-theoretic framework to obtain an explicit expression of either a symmetric or asymmetric equilibrium.

professor on students' choices.

3.3 Change in college equilibrium quality with students' characteristics and college rankings

I differentiate the equilibrium college quality α_j^* in (6) with respect to characteristics of schools or students using the Implicit Function theorem to account for the implicit expression of equilibrium quality.

$$\alpha_{j_d}^{*\prime} = \frac{\partial \alpha_j^*}{\partial d_{ij}} = -\underbrace{\frac{\frac{\partial P_{ij}(\alpha_j^*, a_i, d_{ij})}{\partial d_{ij}}}{\frac{\partial P_{ij}(\alpha_j^*, a_i, d_{ij})}{\partial \alpha_j^*}}}_{MQ_d} \underbrace{\frac{\left[1 + \alpha_j^*(1 - 2P_{ij}(\alpha_j^*, a_i, d_{ij}))\right]}{\left[1 + \frac{1}{\alpha_j^*} + \alpha_j^*(1 - 2P_{ij}(\alpha_j^*, a_i, d_{ij}))\right]}}_{AQ} \tag{7}$$

$$\alpha_{j_a}^{*\prime} = \frac{\partial \alpha_j^*}{\partial a_i} = -\underbrace{\frac{\frac{\partial P_{ij}(\alpha_j^*, a_i, d_{ij})}{\partial a_{ij}}}{\frac{\partial P_{ij}(\alpha_j^*, a_i, d_{ij})}{\partial \alpha_j^*}}}_{MQ_a} \underbrace{\frac{\left[1 + \alpha_j^*(1 - 2P_{ij}(\alpha_j^*, a_i, d_{ij}))\right]}{\left[1 + \frac{1}{\alpha_j^*} + \alpha_j^*(1 - 2P_{ij}(\alpha_j^*, a_i, d_{ij}))\right]}}_{AQ} \tag{8}$$

I obtatin the marginal change in equilibrium quality per unit change in home-school distance d_{ij} in (7) and students' ability a_i in (8). I propose this as an indicator of school quality because by construction it weighs the factors inducing for example high ability students to choose a college with respect to the factors driving the average student. The more similar are the factors driving high ability and average students, then the less informative is the indicator I propose and the more similar its value is likely to be to the overall indicator of school quality that I describe in section 3.2 and obtain in (6). (8) is a measure of the change in marginal quality due to a unit increase in ability and I consider it as the product of the ratios MQ_a and AQ to simplify its interpretation. MQ_a is the ratio of the marginal effect (MFX) of ability over the marginal effect of average college quality and I interpret it as the weight that the marginal effect of ability has on a student's choice with respect to the marginal effect of average quality α_j on choice. AQ instead is a rectangular hyperbola[9] in the equilibrium average quality indicator α_j^* and the probability P_{ij} that student i chooses college j. Overall I interpret $\alpha_{j_a}^*$ as an indicator of the marginal quality from ability, MQ_a, that is weighted by a function AQ of equilibrium average quality. In other words it is the additional average quality that students who have greater ability by a unit than their peers need to be compensated with to be equally willing to choose college j than their less able peers. Then the smaller $\alpha_{j_a}^*$ is, the greater

[9] Its asymptotic behaviour is not problematic for low values of P_{ij}, e.g. $P_{ij} < 0.5$ as it is reasonable in educational systems in which schools supply is regulated but no single school has a sizable market power.

is the marginal quality of college j as lower has to be the marginal effort the college does to adjust to for example lecture more able students. I interpret this for example as peer effects working out as a substitute for quality at the margin among high ability students that already are in college j and those choosing it.

Consider two examples. First think of a school that scores high in the equilibrium quality ranking, e.g. α_j^* with big absolute value and positive sign and AQ with absolute value greater than one and positive sign thanks to an efficient management. However, only by attracting over time students overall, i.e. $\frac{\partial P_{ij}}{\partial \alpha_j} > 0$, and high ability ones at the margin, i.e. $\frac{\partial P_{ij}}{\partial a_i} > 0$, will this school obtain a sizable and negative score in the ability ranking, i.e. $\alpha_{ja}^{*'} < 0$. Second think of a recently established school that is new on the market. So as to score high in the ability ranking it has to compensate for the lack of past experience that results in a low score in the equilibrium quality ranking, i.e. low values of and α_j^* and AQ, by scoring higher than older schools in attracting high ability students at the margin, i.e. $\frac{\partial P_{ij}}{\partial a_i} > 0$ and a positive and sizable MQ_a. The same interpretation applies to the change in equilibrium school quality given a unit-change in home-school distance. Likewise for the quality indicator α_j^*, I compute $\alpha_{ja}^{*'}$ and $\alpha_{jd}^{*'}$ that I interpret as indicators of the attractiveness of college j among high ability students and those choosing a college away from home[10] in section 5 using a dataset of Italian college graduates and estimates of multinomial models.

4 Data

I use a repeated cross-section of administrative data on approximately 70% of Italian college graduates in the years 2000-2003 that Almalaurea[11] collects. The dataset includes the college choice of students, information on high school as well as on their socio-economic background and the precise geographical location of their parents' house given by the postcode. A reasonable assumption is that students live with their parents up to graduation from high school since census data and casual evidence suggest that the geographical mobility at high school is negligible. Table 1 reports the names of the variables and their summary statistics. High school final grade is in the range 36-60/60 and I consider it as a measure of observable ability. Male indicates that there is 47% of male students in the

[10]Modelling the interaction between quality, ability and distance and obtaining from it an empirically tractable counterpart such as their joint distribution is left for future work.

[11]A research consortium that is affiliated to the University of Bologna and the Italian Ministry of University and Research, see http://www.almalaurea.it

sample. The mean birth year is 1974, the mean graduation year 2002 and both show a low standard deviation that suggests the absence in the sample of mature students who may study part-time and have a job. The home-school distance measures the distance in kilometers between a student's family house and the college and I compute it using geocoded information.[12] Pre-college geographic area of residence is a dummy indicating a student's family residence before college in one of the three areas North, Center and South as defined by the Italian National Statistical Office. High school type is a dummy taking 5 different values. Lastly, mother's education level is a dummy taking values in the range 1 for no education to 5 for college degree. All polychotomous dummies are reported as binary ones.

The total sample size is 135000 and I carry out the estimation in the next section separately for each of the four most numerous among the Italian university departments whose names and sample size are reported in Table 2. Tables 4-7 report the names of the colleges by department, the estimates of the multinomial model and the college rankings. Data are not available yet on schools in Milano, Roma and Napoli. Then the rankings in the next section offer an example as in Avery et al. (2005) that use a sample of high ability students to obtain a ranking of selective colleges in the USA.

I compare the ranking that I propose with the ranking that the Italian newspaper La Repubblica publishes yearly, see for example La Repubblica (2003), to inform students' college choice. It is constructed as a weighted average of several indicators of college characteristics such as the number of desks and professors per student.[13]. I choose the overall indicator and ranking among 6 that are available as the newspaper points at it as the ranking that students schould look at. Moreover, rank order correlation shows a high and statistically significant correlation among the different rankings that La Repubblica publishes.

5 Estimation

In this section I obtain estimates of the multinomial choice model in (3) to construct the indicators $\hat{\alpha}_d^{*\prime}$ and $\hat{\alpha}_a^{*\prime}$ of college quality respectively in (7) and (8) and I omit the

[12] Classification error may arise for students whose families migrate more than once but this is very unlikely according to census data. Moreover, a student moving at high school to a different city than the one where the family lives still incurs mobility costs for travelling back home and overall accomodation costs.

[13] The methodology for the construction of the indicator is available in La Repubblica website.

subscript j from now on for simplicity. By sorting the indicators I obtain and interpret the rankings.

5.1 Methodology

I jointly estimate the effects of school- and individual-specific characteristics on school choice using a conditional logit model. The dependent variable y_i equals the school choice j by student i and students have the same choice set that consists of all the colleges that offer a degree type, for example Economics, and it is the same that the newspaper college guide La Repubblica reports.[14] A drawback of discrete choice models is the inability to identify the choice-specific constants α_j and the standard approach to deal with it is to fix a base category b and identify the difference $\alpha_j - \alpha_b$.[15] However doing so would hamper the interpretation of the college ranking as the choice of the base category college is arbitrary. To avoid this I construct a synthetic college by randomly assigning to it from the pool of students who choose for example Economics a number of students equal to the mean number of student in Economics. Then I use the synthetic college as the baseline category in the multinomial model of college choice. The regressors are specified in (2). They are a constant whose associated parameter α gives the mean contribution of college-specific characteristic to students' choices and is interpreted as average college quality similarly to Avery et al. (2005), a measure of student's ability a_i is given by the high school final grade and a measure of mobility costs by the home-college distance d_i in kilometers.[16] Tuition fees f decrease students' utility in (1), they increase the per student profit in (4) and also decrease the equilibrium quality in (6). Data on fees for each college is unavailable. The newspaper La Repubblica (2003) survey estimates that they range from 15% of total yearly cost for undergraduate students who choose a university far away from the family house to 25% otherwise. Moreover according to casual evidence

[14] I assume throughout that students choose first the degree type and then the college for two reasons. First the departments in the dataset are the four greatest and account for 70% of Italian students graduating in 2000-2003. Second there are minimum 30 and maximum 50 colleges distributed North to South in Italy per each department.

[15] I do not consider the utside option of no college for high school graduates who enter the labour market due to lack of data but it could be a helpful extension to reestimate the model with no college as a base category.

[16] The presence of α on the left- and right-hand side of (3) raises a similar problem to the computation of marginal effects of regressors on the probability to choose one among the alternatives available in the choice set in a multinomial choice model; This is dealt with by assuming that the parameter on the right-hand side of (3) carries information about college quality that lie in students' revealed preferences today and the one on the left-hand side information about the equilibrium quality a college should set up tomorrow given students' preferences today.

fees show very low variation among colleges that offer the same degree, e.g. Economics. Then omitting fees from the construction of the indicators but using home-college distance as a proxy for mobility costs is unlikely to alter estimates and rankings. I also include as controls in the regression dummies for gender, year of birth, the type of high school attended, the education of the student's mother as a proxy for the education and income of parents and the three macro-geographical areas Italy: North, Center and South, to indicate the capture regional effects in the student's pre-college residence.

5.2 Results

I obtain estimates and rankings by sorting the indicators separately for Economics, Engineering, Law and Literature and Philosophy departments as the contents of the degrees are homogeneous by field and report them in Tables 4-7. I sort data in each table in descending order of the estimated predicted value $\hat{P}_j$ of the probability to choose school j and that is proportional to the equilibrium average quality indicator in (6). Consider for example Table 4 on school choice in Economics: in column (1) you read the names of the schools and in column (11) the number of students who choose each school. I divide the remaining columns (2-10) in three subsets each of which reports the ranking of a quality indicator by college. Columns (2-4) report the equilibrium average quality ranking by sorting the $\hat{P}_j$s, columns (5-7) the distance-based ranking and columns (8-10) the ability-based one that I respectively obtain by sorting the values $\hat{\alpha_d^{*\prime}}$ and $\hat{\alpha_a^{*\prime}}$ in ascending order. As a term of comparison, I report each indicator along with on its right hand-side a column labelled "LR ranking" that the Italian newspaper La Repubblica publishes yearly to inform the choices of students enrolling in college. An overall view of the rankings in Tables 4-7 suggests two main findings. First, the correlation among the ranking I propose and the average quality one is not statistically significant as you can see from the p-values of the rank order correlation test for Economics in Table 3. Therefore I cannot reject the hypothesis that for example the equilibrium quality and distance ranking pick different information that are contained in students' revealed preferences. Secondly the comparison between any of the ranking I propose and the newspaper one show sizable differences with a maximum difference in a ranking by 17 positions and this is confirmed by non-statistically significant rank order correlation.

Look now at examples based on the comparison between pairs of colleges to strengthen the intuition of the two main and aforementioned findings. Consider two colleges in Economics in Table 4: $\hat{P}$ equals 0.047 for Catania and 0.086 for Messina, two colleges in the same region, Sicily. Then Messina scores higher than Catania in the equilibrium average quality ranking. The interpretation is that on average the revelead preferences of students are greater for Messina than for Catania. However if you also look at the marginal rankings in columns (5) and (8), Catania scores higher than Messina in both. I interpret this finding as Messina attracting a high percentage of Sicilian students choosing Economics. However, by doing so, a crowding out effect may occur and at the margin high ability students and those living far away from it may opt for Catania.

Now look at Engineering in Table 5: Torino and Piemonte Orientale are two colleges in the same region, Piemonte, the first is an old Engineering school scoring high in average quality and low at the margin and viceversa for Piemonte Orientale. Then on the demand-side a high percentage of students in Engineering choose Torino. On the supply-side instead Torino is a long-established college with a high perceived equilibrium quality by students and hence it may work less to attract able students at the margin. The opposite applies to Parma with a relatively young and small college and Engineering department, hence with lower equilibrium quality but more careful at attracting marginal students with its quality-improving efforts. Moreover, Engineering has roughly the same number of students as Law or Literature and Philosophy as Table 2 reports but they are spreadout on 15 departments rather than 20 in the other departments. If you compare the predicted values, the three colleges with top score in the equilibrium quality ranking have greater predicted values in column (4) than the top three departments in other degrees. For the same colleges, the magnitudes of the marginal effects in columns (7) and (10) is smaller in Engineering than in other departments with the same position in the ranking. This suggests a correlation between the lower number of colleges in Engineering than in other departments, the greater weight of the average quality as given by the equilibrium ranking and the lower marginal one as given by the distance and ability rankings. Further research may uncover additional findings on the impact of competition on the variation in quality among departments

Lastly focus on Law in Table 6. Compare Genova and other colleges to spot a potential issue of horizontal differentiation. Genova scores at mid-ranking on equilibrium quality and in the bottom 25% on the distance and the ability ones. This is correlated with the low geographical competition among Law schools in Liguria as Genova is the only Law school in this region. Bologna instead competes for law students with Ferrara, Modena-Reggio Emilia and Parma. This adds up to 4 law schools in the same region and by looking at the ranking I propose you notice that competition for college students results in Bologna scoring high on average quality and at mid-ranking at the margin. Instead Ferrara, Modena-Reggio Emilia and Parma score low on average ability and on average similarly to Bologna at the margin.

6 Conclusion

In the paper I offer a ranking of school quality that awards as top quality the school that attracts high ability students with the least effort in quality. I characterise the demand and supply of schools in countries with a mainly public educational system in which fees are regulated and admission is not selective. I consider schooling as a differentiated product market and the dimensions of differentiation are the quality of colleges and their geographical location. I focus on two types of quality indicators to rank schools in the same field. I obtain the first by considering the equilibrium conditions from the profit maximisation problem of schools and I interpret it as average quality. I instead obtain the other type by comparative statics of the equilibrium and I interpret it as the marginal attractiveness of colleges for able students and for those living away from a college. By using a dataset of Italian college students I compute rankings for Italian colleges that offer degrees in Economics, Engineering, Law and Literature and Philosophy. The ranking offers a methodology to evaluate and pin down best and worst colleges in a field by setting apart average and marginal information that is contained in the revealed preferences of students.

Two main policy recommendations follow from the discussion on the rankings of Italian colleges in section 5. The first is to use in the allocation of funds to schools the indicators of quality that capture the preferences of students as well as the optimising behaviour of schools over the financial resources they get. Indicators that miss such characteristics and only offer arbitrarily weighted averages of schools statistics may fail to capture the rational behaviour of students and schools. Then it would be hard to set the right incentives for the allocative efficiency of financial resources within and between schools at the compulsory or higher education level. This can be done with the publication by a government of the quality ranking of schools that I propose rather than just aggregate statistics as it still occurs for example in Germany or Italy. The ranking can be very helpful to inform the choices of both students over what school to enroll in and policy-makers over school financing. The second recommendation is the joint use of the indicators to rank schools by average quality using the equilibrium ranking and by marginal quality using the ability ranking. This helps to account for the heterogeneity in the size and the age of schools as well as the geographical density, the level of economic development and the mean level of schooling across geographic areas. Doing so, you can award differentially a long established school from a recently established one and help to set the right incentives for the allocative efficiency of financial resources schools get.

References

[1] Anderson, S. and de Palma A. and Thisse, J. (1992) *Discrete choice theory of product differentiation* Cambridge, Mass. : MIT Press

[2] Avery, C. and Glickman, M. and Hoxby, C. (2004) *A revealed preference rankings of U.S. colleges and universities*, NBER Working Paper 10803

[3] Baltagi, B. (1999) *Applied Econometrics Rankings:1989-1995*, Journal of Applied Econometrics 14, 423-441

[4] Black, D. and Smith J. (2004) *How Robust is the Evidence on the Effects of College Quality: Evidence from Matching*, Journal of Econometrics 121, 99-124

[5] Coup, T. (2003) *Revealed Performances : Worldwide Rankings of Economists and Economics Departments, 1990-2000*, Journal of the European Economic Association 1, 13091345

[6] Combes, P. and Linnemer, L. (2003) *Where are the Economists who Publish? Publication Concentration and Stock Rankings in Europe*, Journal of the European Economic Association, 1, 1250-1308

[7] Dale, S. and Krueger, A. (2002) *Estimating the Payoff to Attending A More Selective College: An Application of Selection on Observables and Unobservables*, Quarterly Journal of Economics 117, 1491-1527

[8] De Fraja, G. and Iossa (2002) *Competition among Universities and the Emergence of the Elite Institution*, Bulletin of Economic Research 54, 275-93

[9] Epple, D. et Romano, R. and Sieg, H. (2003) *Peer Effects, Financial Aid, and Selection of Students into Colleges and Universities: An Empirical Analysis*, Journal of Applied Econometrics 18, 501-526

[10] Gautier and Wauthy (2007) *Teaching versus research: A multi-tasking approach to multi-department universities*, European Economic Review 51, 273-295

[11] Glennerster, H. (1991) *Quasi-Markets for Education?* Economic Journal 101, 1268-1276

[12] Hanushek, E. and Lavy, V. and Hitomi, K. (2006) *Do Students Care about School Quality? Determinants of Dropout Behavior in Developing Countries*, NBER Working Paper 12737

[13] Hastings, J. and Kane, T. and Staiger, D. (2007) *Parental preferences and school competition: evidence from a public school choice program*, NBER Working Paper 11805

[14] Heckman, J. and Layne-Farrar, A. and Todd, P. (1995) *Does Measured School Quality Really Matter? An Examination of the Earnings-Quality Relationship*, NBER Working Paper 5274

[15] Hoxby, C. (1997) *How the Changing Market Structure of U.S. Higher Education Explains College Tuition*, NBER Working Paper 6323

[16] La Repubblica (2003) *Guida all'universitá*

[17] Kalaitzidakis, P. and Mamuneas, T. and Stengos, T. (2003) *Rankings of Academic Journals and Institutions in Economics*, Journal of the European Economic Association 1, 1346-1366

[18] Krueger, A. and Lindahl, M. (2001) *Education for Growth: Why and for Whom?* Journal of Economic Literature 39, 1101-1136

[19] Rothschild, M. and White, L. (1995) *Some Simple Analytics of the Pricing of Higher Education*, Journal of Political Economy 103, 573-586

[20] The Economist (2005) *Survey on higher education*, September 10th-16th

[21] Winston, G. (1999) *Subsidies, Hierarchy, and Peers: the awkward economics of higher education*, Journal of Economic Perspectives 13, 13-36

[22] World Bank (2000) *Higher Education in Developing Countries: Peril and Promise*

[23] Zhe Jin, G. and Whalley, A. (2007) *The power of information: how do U.S. news rankings affect the financial resources of public colleges?*, NBER Working Paper 12941

Figure 1: Illustration of demand x_{i1} for university 1 by student i on a linear city of unit size when home-college distance d_{i1} and student's ability a_i vary

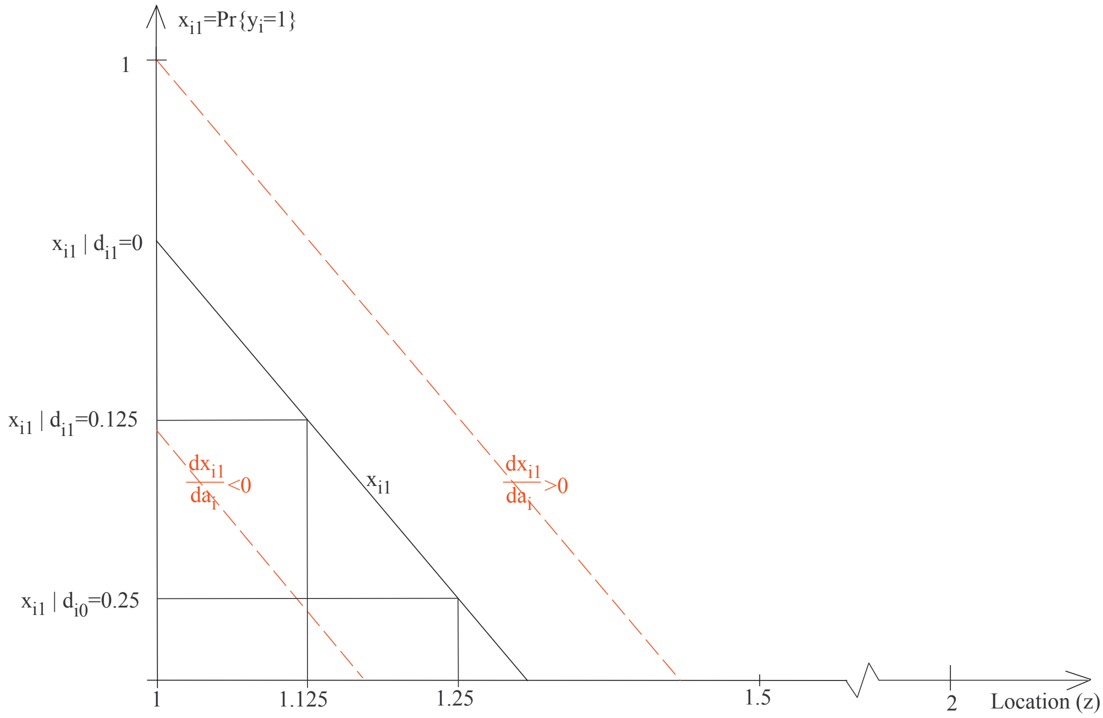

Table 1: Summary statistics of variables from 4 biggest departments by number of graduates among Italian universities in 2000-2003

Variable	Mean	Standard deviation	Min	Max
High school final grade	48.93	7.23	36	60
Male	0.47		0	1
Year of birth	1974	4	1923	1982
Graduation calendar year	2002	2	2000	2003
Home-college distance	159.33	245.58	0	1118.42
Pre-college geographic area of residence				
North	0.57		0	1
Center	0.18		0	1
South	0.25		0	1
High school type				
Gymnasium	0.565		0	1
Teaching	0.036		0	1
Languages	0.044		0	1
Technical	0.302		0	1
Vocational	0.029		0	1
Other	0.024		0	1
Mother's education				
No schooling	0.01		0	1
Primary school	0.209		0	1
Junior high school	0.271		0	1
High school	0.335		0	1
College degree	0.173		0	1

Source: Almalaurea dataset of Italian college graduates in years 2000-2003

Table 2: Summary statistics of the 4 biggest departments by number of graduates across Italian universities in 2000-2003

Department	Enrollment	
	number of students	percentage of the total population of students
Economics	43,324	14.87
Engineering	34,658	11.90
Law	37,785	12.97
Literature and Philosophy	35,083	12.05

Source: Almalaurea dataset of Italian college graduates in years 2000-2003

Figure 2: Illustration of the profit π of university j as a function of average quality α_j

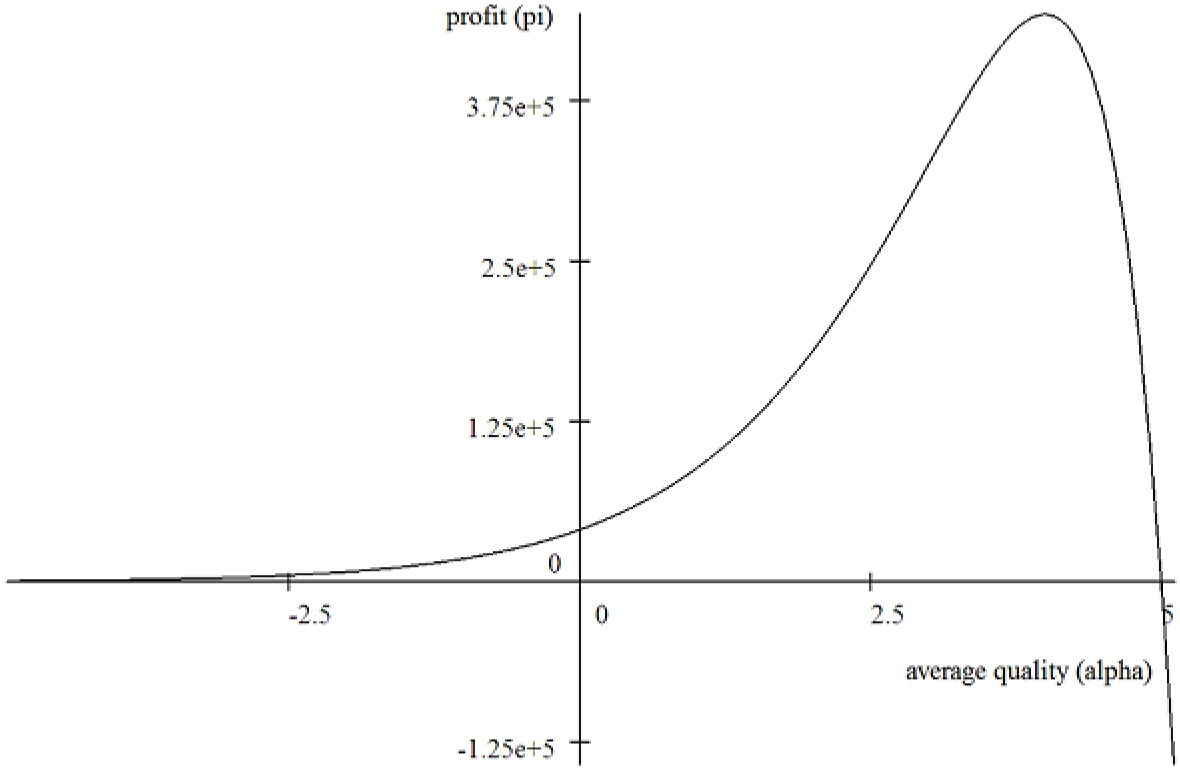

Table 3: Kendall-tau rank order correlation of college rankings in Economics

(1)	(2) La Repubblica ranking	(3) Equilibrium ranking $\hat{P}_j$	(4) Distance ranking $\hat{\alpha}^{*\prime}_d$	(5) Ability ranking $\hat{\alpha}^{*\prime}_a$
La Repubblica ranking	1			
Equilibrium ranking $\hat{P}_j$	0.300	1		
	0.069			
Distance ranking $\hat{\alpha}^*_j$	0.279	0.358	1	
	0.091	*0.030*		
Ability ranking $\hat{\alpha}^*_j$	-0.200	-0.142	0.100	1
	0.229	*0.398*	*0.559*	

Source: Almalaurea dataset of Italian college graduates in years 2000-2003 and La Repubblica (2003) survey.
Notes: *i*) The table reports in *Italic* p-values at 1% significance level of each correlation.
ii) Rank order correlations of degrees in other departments are not statisticaly significant either and are not reported.
iii) The ranking offers only an example as it is constructed using estimates of 70% of Italian college graduates in 2000-03 and schools from Milano, Roma and Napoli are missing.

Table 4: College choice in Economics: revealed preferences and La Repubblica (LR) rankings and multinomial logit model estimates (continued on the next page)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
College	Equilibrium			Distance (d)			Ability (a)			Observations
	ranking		predicted	ranking		MFX	ranking		MFX	
	$\hat{P}$	LR	value $\hat{P}$	$\hat{\alpha_d^{*\prime}}$	LR		$\hat{\alpha_a^{*\prime}}$	LR		
Bologna	1	1	0.165	6	1	-0.090*	9	1	0.004*	5462
						(0.050)			(0.003)	
Torino	2	7	0.097	2	7	-0.052*	17	7	0.040	2876
						(0.050)			(0.051)	
Messina	3	16	0.086	17	16	-0.048	16	16	-0.006	2855
						(0.050)			(0.008)	
Parma	4	9	0.069	4	9	-0.045*	15	9	0.011*	2191
						(0.027)			(0.007)	
Firenze	5	12	0.063	16	12	-0.039*	11	12	-0.003*	2040
						(0.036)			(0.003)	
Bari	6	11	0.061	10	11	-0.036***	8	11	-0.003*	2046
						(0.004)			(0.001)	
Siena	7	5	0.058	8	5	-0.038*	7	5	-0.005*	1868
						(0.023)			(0.003)	
Trento	8	2	0.054	1	2	-0.033*	19	2	0.015	1808
						(0.033)			(0.021)	
Modena-Reggio Emilia	9	10	0.050	13	10	-0.033*	3	10	0.012*	1640
						(0.024)			(0.010)	
Catania	10	14	0.047	12	14	-0.028	10	14	0.001*	1563
						(0.040)			(0.001)	

Table 4 continues on the next page

Table 4 (continued from the previous page)

(1) College	(2) Equilibrium ranking	(3)	(4) predicted value $\hat{P}$	(5) Distance (d) ranking	(6)	(7) Distance (d) MFX	(8) Ability (a) ranking	(9)	(10) Ability (a) MFX	(11) Observations
	$\hat{P}$	LR		$\hat{\alpha_d^{*\prime}}$	LR		$\hat{\alpha_a^{*\prime}}$	LR		
Genova	11	3	0.043	11	3	-0.028*	12	3	-0.023	1310
						(0.028)			(0.028)	
Chieti	12	15	0.042	3	15	-0.024	3	15	-0.002	1172
						(0.039)			(0.005)	
Udine	13	13	0.028	14	13	-0.018	2	13	0.011	897
						(0.026)			(0.019)	
Trieste	14	6	0.027	7	6	-0.017	10	6	0.006	894
						(0.025)			(0.011)	
Padova	15	19	0.023	19	19	-0.015	18	18	-0.003*	756
						(0.019)			(0.003)	
Molise	16	4	0.021	9	4	-0.014	6	4	-0.001	686
						(0.023)			(0.002)	
Piemonte Orientale	17	18	0.017	5	18	-0.012*	1	18	0.007*	501
						(0.011)			(0.007)	
Sassari	18	17	0.014	15	17	-0.007	1	17	0.005	488
						(0.022)			(0.022)	
Cassino	19	8	0.035	20	8	-0.022	20	8	0.050**	1094
						(0.033)			(0.020)	
Ferrara	19	20	0.005	18	20	-0.003*	14	20	-0.0001*	152
						(0.003)			(0.0001)	

Source: Almalaurea dataset of Italian college graduates in years 2000-2003.

Notes: *i*) The estimated conditional logit model on the choice of college j by student i is derived from the utility specification in (1) $u_{ij} = \alpha_j + \beta_j a_i + \gamma d_{ij} + \delta_j a_i d_{ij} + \tau f_j$.

ii) The estimated model includes regressors to control for a student's gender, type of high school attended and year of birth, the education level of a student's mother and the geographical area where the student's family lives.

iii) The colleges in the table are ranked by the value of the equilibrium ranking $\hat{\alpha_j}$ in column (2).

iv) The table reports standard errors in parentheses and significance levels using *** for 1%, ** for 5% and * for 10%.

v) The ranking offers only an example as it is constructed using estimates of 70% of Italian college graduates in 2000-03 and schools from Milano, Roma and Napoli are missing.

Table 5: College choice in Engineering: revealed preferences and La Repubblica (LR) rankings and multinomial logit model estimates (continued on the next page)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
College	Equilibrium			Distance (d)			Ability (a)			Observations
	ranking		predicted	ranking		MFX	ranking		MFX	
	$\hat{P}$	LR	value $\hat{P}$	$\hat{\alpha}_d^{*\prime}$	LR		$\hat{\alpha}_a^{*\prime}$	LR		
Torino	1	1	0.224	4	1	-0.091*	14	1	-0.014*	5090
						(0.054)			(0.014)	
Bologna	2	6	0.200	8	6	-0.107**	11	6	-0.001*	4811
						(0.050)			(0.001)	
Padova	3	4	0.155	13	4	-0.074*	13	4	-0.002*	3405
						(0.059)			(0.002)	
Firenze	4	5	0.068	9	5	-0.042*	4	5	0.001*	1589
						(0.041)			(0.001)	
Genova	5	2	0.063	2	2	-0.040*	2	2	0.002*	1395
						(0.039)			(0.002)	
Catania	6	12	0.059	10	12	-0.028	1	12	0.002	1364
						(0.051)			(0.005)	
Modena-Reggio Emilia	7	14	0.044	6	14	-0.030*	5	14	0.001*	1062
						(0.026)			(0.001)	
Parma	8	9	0.040	1	9	-0.027*	3	9	0.001*	927
						(0.021)			(0.001)	

Table 5 continues on the next page

Table 5 (continued from the previous page)

(1) College	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11) Observations
	Equilibrium			Distance (d)			Ability (a)			
	ranking		predicted	ranking		MFX	ranking		MFX	
	$\hat{P}$	LR	value $\hat{P}$	$\hat{\alpha_d^{*\prime}}$	LR		$\hat{\alpha_a^{*\prime}}$	LR		
Trento	9	3	0.036	11	3	-0.024	7	3	0.0006	841
						(0.026)			(0.0007)	
Udine	10	10	0.031	12	10	-0.021	10	10	-0.0003*	681
						(0.028)			(0.0003)	
Ferrara	11	11	0.027	7	11	-0.019*	6	11	0.001*	639
						(0.015)			(0.001)	
Messina	12	15	0.019	14	15	-0.013	12	15	-0.002*	442
						(0.024)			(0.002)	
Piemonte Orientale	13	8	0.012	3	8	-0.009*	8	8	0.0003*	277
						(0.009)			(0.0003)	
Siena	14	7	0.008	5	7	-0.006	9	7	0.001***	192
						(0.009)			(0.0002)	
Cassino	15	13	0.015	15	13	-0.010	15	13	0.003**	365
						(0.025)			(0.001)	

Source: Almalaurea dataset of Italian college graduates in years 2000-2003.

Notes: i) The estimated conditional logit model on the choice of college j by student i is derived from the utility specification in (1) $u_{ij} = \alpha_j + \beta_j a_i + \gamma d_{ij} + \delta_j a_i d_{ij} + \tau f_j$.

ii) The estimated model includes regressors to control for a student's gender, type of high school attended and year of birth, the education level of a student's mother and the geographical area where the student's family lives.

iii) The colleges in the table are ranked by the value of the equilibrium ranking $\hat{\alpha_j}$ in column (2).

iv) The table reports standard errors in parentheses and significance levels using *** for 1%, ** for 5% and * for 10%.

v) The ranking offers only an example as it is constructed using estimates of 70% of Italian college graduates in 2000-03 and schools from Milano, Roma and Napoli are missing.

Table 6: College choice in Law: revealed preferences and La Repubblica (LR) rankings and multinomial logit model estimates (continued on the next page)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
College	Equilibrium			Distance (d)			Ability (a)			Observations
	ranking		predicted	ranking		MFX	ranking		MFX	
	$\hat{P}$	LR	value $\hat{P}$	$\hat{\alpha_d^{*\prime}}$	LR		$\hat{\alpha_a^{*\prime}}$	LR		
Bologna	1	2	0.168	10	2	-0.135*	14	2	-0.024*	6062
						(0.086)			(0.015)	
Parma	2	10	0.093	18	10	-0.082*	12	10	-0.002*	3360
						(0.070)			(0.002)	
Bari	3	3	0.089	5	3	-0.048	3	3	0.003	3201
						(0.085)			(0.007)	
Torino	4	4	0.082	8	4	-0.035	16	4	-0.011	3042
						(0.071)			(0.028)	
Catania	5	11	0.068	3	11	-0.037	10	11	-0.004	2491
						(0.080)			(0.011)	
Firenze	6	7	0.064	9	7	-0.058	7	7	0.001*	2284
						(0.067)			(0.001)	
Messina	7	15	0.057	2	15	-0.050	8	15	-0.003	2025
						(0.070)			(0.005)	
Siena	8	6	0.048	14	6	-0.048*	2	6	0.001*	1696
						(0.041)			(0.001)	
Genova	9	1	0.047	16	1	-0.025	18	1	-0.006	1686
						(0.063)			(0.016)	
Modena-Reggio Emilia	10	9	0.042	15	9	-0.042*	17	9	-0.010*	1520
						(0.039)			(0.010)	

Table 6 continues on the next page

Table 6 (continued from the previous page)

(1) College	(2) Equilibrium ranking $\hat{P}$	(3) Equilibrium ranking LR	(4) Equilibrium predicted value $\hat{P}$	(5) Distance (d) ranking $\hat{\alpha}^{*\prime}_d$	(6) Distance (d) ranking LR	(7) Distance (d) MFX	(8) Ability (a) ranking $\hat{\alpha}^{*\prime}_a$	(9) Ability (a) ranking LR	(10) Ability (a) MFX	(11) Observations
Ferrara	11	13	0.042	12	13	-0.041*	4	13	0.001*	1518
						(0.040)			(0.001)	
Trento	12	5	0.041	6	5	-0.030	15	5	-0.010	1518
						(0.063)			(0.027)	
Molise	13	14	0.037	11	14	-0.025	5	14	0.001	1255
						(0.064)			(0.003)	
Padova	14	12	0.033	4	12	-0.033	6	12	0.004	1193
						(0.041)			(0.006)	
Trieste	15	8	0.027	7	8	-0.018	13	8	-0.004	980
						(0.050)			(0.014)	
Sassari	16	16	0.024	17	16	-0.005	9	16	0.001	873
						(0.023)			(0.007)	
Catanzaro	17	19	0.017	1	19	-0.016	8	19	0.001*	636
						(0.042)			(0.001)	
Cassino	18	17	0.006	13	17	-0.006**	11	17	0.023*	193
						(0.003)			(0.015)	
Piemonte Orientale	19	18	0.017	3	18	-0.016	19	18	-0.004*	632
						(0.040)			(0.001)	

Source: Almalaurea dataset of Italian college graduates in years 2000-2003.
Notes: *i*) The estimated conditional logit model on the choice of college j by student i is derived from the utility specification in (1) $u_{ij} = \alpha_j + \beta_j a_i + \gamma d_{ij} + \delta_j a_i d_{ij} + \tau f_j$.
ii) The estimated model includes regressors to control for a student's gender, type of high school attended and year of birth, the education level of a student's mother and the geographical area where the student's family lives.
iii) The colleges in the table are ranked by the value of the equilibrium ranking $\hat{\alpha_j}$ in column (2).
iv) The table reports standard errors in parentheses and significance levels using *** for 1%, ** for 5% and * for 10%.
v) The ranking offers only an example as it is constructed using estimates of 70% of Italian college graduates in 2000-03 and schools from Milano, Roma and Napoli are missing.

Table 7: College choice in Literature and Philosophy: revealed preferences and La Repubblica (LR) rankings and multinomial logit model estimates (continued on the next page)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
College	Equilibrium			Distance (d)			Ability (a)			Observations
	ranking		predicted	ranking		MFX	ranking		MFX	
	$\hat{P}$	LR	value $\hat{P}$	$\hat{\alpha}_d^{*\prime}$	LR		$\hat{\alpha}_a^{*\prime}$	LR		
Bologna	1	4	0.195	4	4	-0.108**	6	4	-0.064*	5408
						(0.047)			(0.039)	
Torino	2	5	0.114	10	5	-0.058*	3	5	0.044	2860
						(0.057)			(0.061)	
Firenze	3	3	0.084	11	3	-0.054*	12	3	-0.016*	2295
						(0.038)			(0.013)	
Padova	4	7	0.078	8	7	-0.050*	11	7	-0.022*	2239
						(0.042)			(0.022)	
Parma	5	14	0.073	9	14	-0.048*	8	14	-0.011*	1963
						(0.033)			(0.009)	
Siena	6	2	0.069	14	2	-0.045*	16	2	-0.015*	1868
						(0.035)			(0.014)	
Messina	7	16	0.055	15	16	-0.034	15	16	-0.009	1495
						(0.044)			(0.014)	
Catania	8	1	0.047	13	1	-0.027	14	1	-0.009	1274
						(0.044)			(0.018)	
Bari	9	12	0.041	6	12	-0.025	7	12	-0.007	1119
						(0.041)			(0.012)	
Genova	10	10	0.035	5	10	-0.024*	5	10	0.029	893
						(0.024)			(0.036)	

Table 7 continues on the next page

Table 7 (continued from the previous page)

(1) College	(2) Equilibrium ranking $\hat{P}$	(3) Equilibrium ranking LR	(4) Equilibrium predicted value $\hat{P}$	(5) Distance (d) ranking $\hat{\alpha_d^{*\prime}}$	(6) Distance (d) ranking LR	(7) Distance (d) MFX	(8) Ability (a) ranking $\hat{\alpha_a^{*\prime}}$	(9) Ability (a) ranking LR	(10) Ability (a) MFX	(11) Observations
Trieste	11	9	0.029	2	9	-0.019	10	9	0.003	866
						(0.029)			(0.005)	
Trento	12	8	0.028	7	8	-0.019	9	8	-0.008	790
						(0.024)			(0.012)	
Chieti	13	15	0.028	3	15	-0.018	4	15	-0.005	717
						(0.032)			(0.010)	
Sassari	14	11	0.023	17	11	-0.013	1	11	0.011	645
						(0.026)			(0.036)	
Ferrara	15	13	0.022	12	13	-0.016*	13	13	-0.004*	616
						(0.016)			(0.004)	
Udine	16	17	0.017	1	17	-0.012	17	17	0.014	481
						(0.019)			(0.028)	
Piemonte Orientale	17	19	0.014	16	19	-0.011*	2	19	0.007	350
						(0.011)			(0.007)	
Cassino	18	6	0.041	19	6	-0.023	19	6	0.001*	1095
						(0.041)			(0.001)	
Modena-Reggio Emilia	19	18	0.010	18	18	-0.007*	18	18	-0.002*	269
						(0.007)			(0.002)	

Source: Almalaurea dataset of Italian college graduates in years 2000-2003.

Notes: *i*) The estimated conditional logit model on the choice of college j by student i is derived from the utility specification in (1) $u_{ij} = \alpha_j + \beta_j a_i + \gamma d_{ij} + \delta_j a_i d_{ij} + \tau f_j$.

ii) The estimated model includes regressors to control for a student's gender, type of high school attended and year of birth, the education level of a student's mother and the geographical area where the student's family lives.

iii) The colleges in the table are ranked by the value of the equilibrium ranking $\hat{\alpha_j}$ in column (2).

iv) The table reports standard errors in parentheses and significance levels using *** for 1%, ** for 5% and * for 10%.

v) The ranking offers only an example as it is constructed using estimates of 70% of Italian college graduates in 2000-03 and schools from Milano, Roma and Napoli are missing.