College Pricing

Ben Johnson

April 30, 2012

Abstract

Colleges in the United States price discriminate based on student characteristics such as ability and income. This paper develops a model of college pricing in which colleges maximize their prestige. Several policy experiments are considered in which the college loses the ability to price discriminate at all or to price discriminate with respect to income.

Part I

Introduction

This paper investigates the pricing decisions of colleges. The college pricing decision is different from other pricing decisions because most students do not pay the full tuition price. Colleges price discriminate, attempting to figure out how much each particular student would be willing to pay, and charging that rate. College financial aid offices meet the difference between the full tuition rate and what the student is deemed able to pay with institutional loans, government-subsidized loans, and grants. This type of aid is based on financial need. Colleges also sometimes offer aid based on merit to provide an incentive for talented students to attend the institution. Financial aid is the vehicle through which colleges are able to use

price discrimination.

Winston (1999) explains the most important characteristics of higher education and how decisions differ for a non-profit institution of higher education and a for-profit business. Universities get revenue from both students paying tuition and alumni making donations. This arrangement allows the university to subsidize their customers and charge a tuition price that is below its cost. Another unique aspect of higher education is that customers are also inputs in the other customers' education. In other words, high quality students learn from each other.

Rothschild and White (1995) develop an economic model for services like higher education that rely on customers as inputs. They assume that universities are profit maximizers and that they were constrained by a necessity for tuition revenue to be high enough to cover costs. Colleges compete for students through price and non-price means.

Epple, Romano and Sieg (2003) assume the schools maximize their quality. The schools face a constraint where tuition and other income like endowment revenue and state subsidies must be sufficient to cover costs. In Epple, Romano and Sieg (2006), educational quality depends on ability and average income of the student body and on instructional expenditures per student. They find that low- and medium-quality colleges have limited market power and admissions decisions are mostly driven by the effective marginal cost of educating students of various abilities and incomes.

The remainder of the paper is organized as follows. Part II introduces the model. Part III discusses the data used for estimation of the model. Part IV explains various policy experiments the model could be used to run. Part V puts forth ideas for future research.

Part II

Model

The objective of this study is to investigate how changes in pricing schemes for schools change the welfare of the school and students. Previous models of the college pricing decision like Epple, Romano and Sieg (2006) assumed the objective of the college is to maximize the quality of education it provides. In this model, college j maximizes its prestige P_j, which is a function of student ability, student diversity, selectivity, and college wealth. The objective function is

$$\max_{p_j^{max}, f_{ij}} P_j, \tag{1}$$

where $P_j = \alpha_1 \bar{a}_j + \alpha_2 d_j + \alpha_3 s_j + \alpha_4 w_j$, where $\bar{a}$ represents the mean ability of the enrolled students, d represents student diversity (the number of first-generation college attendees on campus), s represents the selectivity of the school (percentage of applicants accepted), and w represents the school's wealth. The coefficients α represent the relative weight placed on each component of prestige and will be estimated. Wealth is represented as $w_j = \bar{p_j} n_j + e_j$, where $\bar{p_j}$ represents the average price students pay for tuition, n_j is the number of students enrolled, e_j is other income the school receives (endowment funds, for example). Schools will choose p_j^{max}, their maximum ("sticker") tuition price f_{ij} (financial aid to student i, explained below) to maximize P_j. Changes in p_j^{max} and f_{ij} will affect $\bar{p_j}$, which in turn will affect w_j in the prestige equation. In addition, price and financial aid changes will affect the types of students who are willing to attend school j, which impacts $\bar{a}$, d, and s. It would be possible to assume a different functional form for P_j, or even to estimate the functional form, but the linear form will be assumed here. Each school also has a budget constraint

$$w_j \geq c_j, \tag{2}$$

where c_j is the cost of running the school.

There are a few notable differences in the objective function in this paper compared to the objective function in Epple, Romano and Sieg (2006). In this paper, prestige is affected by student diversity. In Epple, Romano and Sieg (2006) quality is affected by average student income. Schools place a high weight on diversity of their student body, often publishing the number of first-generation college students in their incoming classes and taking pride in admitting and helping to finance the attendance of lower-income students. The college prestige is a function of college wealth, where educational quality is a function of educational expenditures. Colleges care more about their total wealth than their educational expenditures because they can buy buildings, amenities, and more employees with their wealth. Total wealth is a more broad measure of how much money a school has than educational expenditures.

Colleges are able to use tuition pricing and admissions policies to select students who will help them maximize their prestige. Students differ across four dimensions: income y_i, ability a_i, diversity status d_i, and random taste for a particular college j, ϵ_{ij}. Income, ability, and diversity status are observable to the college. Taste for a particular college is not observed and might include factors like location or campus amenities. Student i's utility from choosing to go to school j is

$$U_{ij} = [y_i - p_{ij}(a_i, y_i, d_i)] + \beta P_j + \epsilon_{ij}, \tag{3}$$

where p_{ij} is the price of attending college j and P_j is the utility the student gets from attending a school of prestige P. β, the utility weight of prestige, will be estimated. The weight on income net of tuition is normalized to one. The function for the price the student pays, $p_{ij}(a_i, y_i, d_i)$, is decreasing in d_i, weakly decreasing in ability and weakly increasing in income. The student will choose to go to the school that presents him with the highest utility, so $U_i = \max \{U_{ij}\}_{j \in A_i}$, where the set A_i represents the schools into which student i has gained admission.

The timing of the model is as follows. First, each of the I students in the population will

realize his income y_i, ability a_i, diversity status d_i, and taste for each particular college j, ϵ_{ij}. Income, ability, and the unobserved taste are drawn independently from a distribution that for simplicity will be assumed to be normal. Diversity status, a binary variable with value one if the student is the first in his family to go to college, is one with an assumed probability p^d and zero with probability $1 - p^d$. Since there are only I students in the model and their characteristics are drawn randomly, there are a limited number of high-quality students. Schools will bid for these students by discounting the price, which will lead to different levels of prestige for different schools.

Second, each school will choose a maximum price p_j^{max} and choose which students to admit. Each school will admit x_{jt} students, where x_{jt} is observed in the data. Each school j will rank the students based on how much prestige they will contribute to the school and accept the top x_{jt} students. Schools will offer each student a financial aid package $f_{ij} = m_{ij}(a_i, y_i, d_i)$, where the function m determines how much aid a student with a particular ability, income, and diversity status will receive. For simplicity in estimation, one could assume a linear functional form for m_{ij}. The final price student i would pay at school j will be $p_{ij}(a_i, y_i, d_i) = \min\left\{p_j^{max}, p_j^{max} - f_{ij}\right\}$.

Third, students will compare the utility they can receive from each school to which they were admitted, A_i, and choose to go to the school which gives them the highest utility value. Schools will realize their prestige values.

Part III

Data

The National Center for Education Statistics (NCES) collects data about educational institutions and the students who attend them. Integrated Postsecondary Education Data System (IPEDS) contains information about the institutional characteristics, prices, enroll-

ment, financial aid, degrees conferred, student persistence, and institutional resources. The data on tuition pricing and financial aid would be necessary for the estimation of the model specified above. IPEDS collects the average amount of financial aid received by students and the average net price for each institution. IPEDS will be used in the estimation procedure for data on average net price paid, $\bar{p}_{jt}$, by students at each school. IPEDS's variable that records the number of first-generation college students enrolled will be used as a proxy for d_{jt}, student diversity.

National Postsecondary Student Aid Survey (NPSAS) contains student-level data on financial aid. The dataset holds information about student demographic information that shapes how much colleges expect them to pay, the loans and grants colleges offer, and how much money the student pays for school. In the model outlined above, the student side of the market was simulated. Using NPSAS data instead of simulated data for students as specified above would be an option in a future study.

Part IV

Policy Experiments

The model written above can be used to run several policy experiments. It would be interesting to see how college prestige and student utility would change if colleges were no longer able to price discriminate. If the college could not price discriminate, it would set only one price that all students would have to pay. This single price would be lower than p^{max} above. It would be interesting to see how the prestige of each college would change and whether the total welfare for students would increase or decrease. It is likely that welfare for wealthier students would increase because they would be paying less for tuition and the welfare for poorer students would fall. A scheme with no price discrimination would likely lead to more sorting of higher-income students into the more prestigious schools.

Another policy experiment of interest would be to disallow price discrimination based on income only and still allow price discrimination based on ability. Such a scheme would make the price a student paid a function of ability. Schools would likely be more generous in their merit scholarships than in the base case of price discrimination based on income and ability. This would likely allow more high-ability students to go to high-prestige schools. Fewer low-ability, high-income students would choose to go to the high-prestige schools.

The outcome of these policy experiments would be of interest to the government. The government currently does not interfere with the price discrimination practiced by institutions. If the above policy experiments concluded that the total welfare of students is lower under price discrimination than under a regime where all students must pay the same price, it would be evidence that the government should intervene and restrict the practice of price discrimination.

Colleges argue that charging a different price for all students allows greater access to better schools for low-income students. This model would allow a researcher to check whether this argument holds true by seeing if fewer low-income students choose to go to high-prestige schools after the elimination of price discrimination. Comparing the welfare of lower-income students under different pricing schemes would be another worthwhile endeavor.

An extension to the model could make feasible an policy experiment that allows colleges to choose their own pricing scheme. Perhaps some colleges would choose to charge a single price to all students, some might choose only to offer merit-based scholarships, and others could could offer both merit-based and need-based financial aid. Checking if schools of a similar prestige level choose the same pricing schemes would be interesting. Looking at how different types of students sort into schools based on their pricing behaviors could be another area of research.

Part V

Avenues for Future Research

Future researchers could add borrowing to the model. The model specified above does not allow students to take out loans to finance their education. In reality, many students rely on loans to pay for school. Allowing for borrowing would also make predictions about financial aid more reliable because the model above assumed that the entire financial aid package is composed of grants. Allowing for loans as part of financial aid would add more differentiation to financial aid offers. Another possible way to change the model would be to make it dynamic. The objective of schools would be to maximize their prestige over time. Finally, adding a time cost for applying to a school in the students' utility function in order to limit the number of schools to which a student can apply would also make the model more realistic.

References

Epple, Dennis, Richard Romano, and Holger Sieg. 2003. "Peer Effects, Financial Aid and Selection of Students into Colleges and Universities: An Empirical Analysis." *Journal of Applied Econometrics*, 18(5): pp. 501–525.

Epple, Dennis, Richard Romano, and Holger Sieg. 2006. "Admission, Tuition, and Financial Aid Policies in the Market for Higher Education." *Econometrica*, 74(4): pp. 885–928.

Rothschild, Michael, and Lawrence J. White. 1995. "The Analytics of the Pricing of Higher Education and Other Services in Which the Customers Are Inputs." *Journal of Political Economy*, 103(3): pp. 573–586.

Winston, Gordon C. 1999. "Subsidies, Hierarchy and Peers: The Awkward Economics of Higher Education." *The Journal of Economic Perspectives*, 13(1): pp. 13–36.