School Characteristics and the Demand for College

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Abstract

We estimate the demand for colleges in the United States by relating new applications to easily confirmable characteristics of the schools in the sample. We find that the demand for 1134 U.S. colleges in 1994 is positively related to out-of-state tuition but inversely related to in-state tuition. Further, we find those who apply to private schools are more price and income sensitive, and respond more to stronger faculty staffs. That a given state has more schools has a positive effect on the number of public-school applications and a negative impact on private-school applications. Finally, we find no correlation between state population and the number of applications to colleges in that state, suggesting that those who are willing and able to attend college are mobile.

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1 Introduction

Economists have focused considerable attention to the demand for college education.The studies can be generally divided upon two distinct questions: how do individuals decide whether to attend college, and where do they choose to attend college? These two decisions are related but are distinctly separate in their theoretical and empirical contexts. Those who investigate how individuals choose to attend college typically rely upon a qualitative variable to denote whether a particular agent demands college, and relate this measure to macro and socioeconomic variables such as the national unemployment rate, the size of the armed forces, the average income level, and the price of attendance.[1] These studies are useful in order to make inferences about the overall demand for higher education.

Several other studies relate the number of applications to a specific school with exogenous variables that characterize the population in a given geographic area. Variables such as weather, intercollegiate sports success (McCormick and Tinsley (1987), Tucker and Amato (1993) and Murphy and Trandel (1994)), and whether the institution is private or public (Tierney

[1]See, for example, Lehr and Newton (1972).

(1982)) have been used to explain the demand for a given college or university. These studies model a subsample of the general population: those who have actually revealed their desire to attend college.

These two approaches have value in that they seek to explain the demand for college on different levels. How the general population demands higher education has important implications for policy, such as student financial aid programs and human capital investment. Investigating how individuals demand education from specific schools lends insights into the decision process of those who actually decide to attend college.

Many studies have found that, within the population that decides to attend college, the demand for college education is positively related to the price of attendance (see, for example, Spence (1973)). However, other studies that model the entire population find the opposite result, i.e., higher price of attendance leads to lower numbers of people choosing to attend a college (see, for example, Lehr and Newton (1972)). The positive relationship found in the subsample approach holds for most measures used for the out-of-

pocket expense of higher education[2] and quantity demanded.[3] One appealing explanation for this relationship is that a higher tuition rate acts as a signal to potential students of the high quality of education offered by the school. A corollary to this proposition is that many colleges have a reputation of higher lifetime earnings for those completing the undergraduate curriculum. The documented positive correlation between the number of years of college education and the level of lifetime earnings of individuals[4] has motivated increasing numbers of people to seek admittance to college.[5] This in turn has placed an increasing strain on the resources available for college education.

This paper relates the number of applications to specific colleges with easily confirmable characteristics of the particular school. Thus, we model only those students who express a desire to attend college. We analyze a cross-section of 1134 U.S. colleges from 1994, and introduce several new variables that help explain the demand for college. We find that the demand

[2]Price can be measured in several ways, e.g., tuition, tuition plus room and board, foregone wages, or all dollars spent by by a full-time student on average. However, measures of expenditures on books and room and board are indexes or averages, both of which are noisy signals for the cost of attendance. We submit that the posted tuition price is the strongest determinant of student behavior in the context of cost.

[3]Several measures for the demand of higher education can be proposed, including full-time students or their equivalents and new or total applications for admission.

[4]See Becker (1964) and Gintis (1971).

[5]In 1976, 7.18 million people between the age of 18 and 24 were enrolled in college at all levels. By 1993, this number had increased to 8.19 million (U.S. Census).

for college by those who reveal they wish to attend follows economic intuition.

In particular, we find that the demand for a school's resources is positively related to the out-of-state price of attendance and negatively related to in-state price of attendance. These findings support the signaling hypothesis for out-of-state students inasmuch as these students face higher monetary and opportunity costs by attending college in another state. Further, within the population willing and able to attend college in 1994, demand was relatively income insensitive and responded positively to stronger faculty staffs.

We also investigate the demand for public and private colleges separately. We find that the population that demands private education is more price and income sensitive in the context of college demand. Also, the number of other in-state institutions has a negative impact on the demand for private colleges, suggesting substitutability, and a positive effect on public college demand, suggesting complementarity.

The paper is structured as follows. The next section describes the data used in the study and the econometric methodology employed. Section 3 reports the results for the pooled sample of schools and for two separate samples, public and private schools. The final section offers concluding remarks.

2 Data and Methodology

The data used in this study comprise a cross-section of 1134 colleges in the United States from the academic year 1994-1995. The data are analyzed in a pooled sample and then separated into subsamples of private and public schools. We propose the following log-linear demand structure for college

$$\begin{aligned} lnQ_d &= \beta_0 + \beta_1 lnTUITION + \beta_2 lnOSTUIT + \beta_3 lnINCOME + \\ &\quad \beta_4 lnTOPTEN + \beta_5 lnGRADRATE + \\ &\quad \beta_6 lnFULL + \beta_7 lnASSOC + \beta_8 lnASST + \beta_9 lnDPERSTU + \\ &\quad \beta_{10} lnPOP18 + \beta_{11} lnBPOP18 + \\ &\quad \beta_{12} lnFACSTU + \beta_{13} lnSCHLS + \epsilon \end{aligned} \tag{1}$$

where Q_d is the number of applications to given school,[6] TUITION (OSTUIT) is the in-state (out-of-state) tuition price,[7] INCOME is the median

[6] While some students certainly apply to more than one school, this "double-counting" does not invalidate the findings in this study. Students who apply to more than one school still discriminate on where to apply and this is of interest in this study.

[7] Several measures for the price of attendance can be used. Lehr and Newton consider foregone wages as the largest component of the cost of higher education. However, we submit that the posted tuition rate is the most obvious measure of cost used by students *ex ante* acceptance.

income level of the state in which the school is located,[8] TOPTEN is the percentage of students who graduated in the top ten percent of their high-school classes, GRADRATE is the graduation rate of the institution, FULL, ASSOC, and ASST are the percentages of full, associate, and assistant professors in the faculty,[9] DPERSTU is the dollars spent per-student by the school, POP18 is the percentage of the institution's state population between the ages of 18 and 24 years, BPOP18 is the percentage of border-state population between 18 and 24 years of age, FACSTU is the faculty-to-student ratio, SCHLS is the number of other in-state schools, and $\epsilon \sim (0, \sigma^2)$ is a random error term.[10]

The log-linear functional form is convenient because the estimated coefficients can be interpreted as demand elasticities. These elasticities are unitless and thus can be compared across the different samples estimated. We estimate equation (1) using the entire sample and then separate the sample into

[8] TUITION, OSTUITION, and INCOME are all measured in 1994 dollars.

[9] We use the faculty and student characteristics as proxies for the quality of education received at a particular institution. Some authors, e.g., Lehr and Newton (1972), consider the quality of education a cost of attendance because higher quality may imply higher levels of work. We regard the quality of education as an enhancement to the demand for a particular school and do not expect to see a higher-quality education reduce the demand for a particular institution.

[10] All variables are school specific except for INCOME, SCHLS, and the population statistics, which are state specific.

private and public schools and reestimate. We find that in all three samples higher education is a normal good, is inversely related to in-state tuition, and is positively related to out-of-state tuition.[11] The empirical results for the pooled sample, private schools and public schools are reported in Tables 1, 2 and 3, respectively. Standard errors and their corresponding t-statistics have been corrected for mild heteroskedasticity.

3 Empirical Results and Inferences

3.1 Pooled Sample Results

The results of the pooled sample estimation are reported in Table 1. We estimate an in-state price elasticity of demand of -0.21, which is statistically significant. College education is found to be normal with an estimated in-state income elasticity of 0.55, which is weakly statistically significant. The out-of-state tuition elasticity of demand is estimated at 0.33 and is also statistically significant.

These results agree with those in other studies which find a positive rela-

[11] We drop OSTUIT when estimating the demand for private schools because these schools do not discriminate on what state the student is from.

tionship between price of attendance and the demand for college. However, we find this positive relationship only in the context of out-of-state tuition rates. This follows economic intuition in that, if a school uses tuition as a signal of quality, it will have greater success with out-of-state students. This follows because out-of-state students face higher opportunity and monetary costs in attending a school out of state. For in-state students, on the other hand, we would expect to see the opposite hold true; as the price of in-state education rises, the more attractive out-of-state resources become because of changes in relative prices.[12]

The constitution of a college's faculty has mixed effects on the demand for college resources. As would be expected, the percentage of full professors, awarded their rank based upon their teaching and research expertise, has a positive and statistically significant effect on the number of students who demand a school's resources. However, the percentage of associate professors has a neutral (i.e., not statistically different from zero) effect, and the percentage of assistant professors has a negative and statistically significant effect on the demand for a school's resources. This implies that students

[12] As in-state prices increase, we would expect to see a larger increase in the demand for educational resources in border states than in distant states. Such behavior can be explained in a spatial model.

consider the constitution of the faculty and the expected level of instruction they will receive when deciding where to attend college.[13]

The graduation rate and the percentage of students from the top ten percent of their graduating high-school classes, also have a positive and statistically significant effect on the demand for a school's resources, with the latter being larger in magnitude. A ten percent increase in the graduation rate at a college, *ceteris paribus,* will lead to an increase in the demand for that school's resources of 3.3 percent. Likewise, the higher the faculty-to-student ratio at a school and the more dollars spent per student attending the school, both of which would lead a student to expect a higher level of instruction, have a positive and statistically significant effect on the demand for college education.

Interestingly, the percentages of the population between 18 and 24 years of age in a college's home state and its border states have an insignificant effect on the demand for college. This can be explained if the population being modeled is highly mobile or if there are enough institutions in a given state to accommodate increases in a state's population. This would cause

[13]These characteristics are relatively easy for potential applicants to confirm. Resources such as school bulletins and private publications provide these facts on a regular basis. However, these data are usually presented for the previous academic year only.

the population levels used in this study to have little explanatory power in the quantity demanded of educational resources. The latter explanation is reinforced by the fact that the number of other in-state schools has an insignificant effect on the demand for a given institution's resources. A similar lack of correlation between college demand and population levels is also also found in Lehr and Newton (1972).[14]

While the pooled sample offers insights into the overall demand for individual colleges, we postulate that different populations wish to attend public and private colleges. If this is not the case, then the demand for private and public schools should be statistically identical. If the populations are different, further inferences can be drawn by separating the full sample into public and private schools. While it is possible that potential students can apply to both public and private institutions, we regard these two types of institutions as distinct in their educational mission, and thus they should attract different types of students.

[14] Alternative measures of population, including total population in the state, percentage of the country's population in the state, and the percentage of the country's population between 18 and 24 years of age in the state, do not alter the inferences found here.

3.2 Separated Sample: Private Institutions Only

The results for private colleges are reported in Table 2. We find that the demand for private institutions is different than the demand for all colleges in general. The tuition elasticity of demand is estimated at 0.21, is statistically significant, and is statistically different from that estimated in the pooled sample. This positive relationship is supported by other findings and the hypothesis that private schools may use tuition as a signal of the quality of education received at the school.

The in-state income elasticity of demand for private education is estimated at 0.55 and is weakly statistically significant. This estimate is nearly equal to that found in the pooled sample. This implies that those who reveal the desire to attend college are relatively income insensitive, regardless of where they desire to attend school.[15]

The constitution of the faculties of private institutions follows the same pattern as that of the pooled sample, suggesting that this subpopulation treats faculty constitution in the same fashion as the entire population demanding college education. The strength of the student population and the

[15] This finding is not surprising if, as recent reports indicate, private schools often subsidize attendence with financial aid.

faculty-to-student ratio also follow the same pattern as that of the pooled sample. However, the graduation rate of private schools and the dollars spent per student have greater effects on the demand for private resources than in the pooled sample.

The number of other in-state schools has a negative effect on the demand for private education. This implies that a private college finds itself easily substituted by other schools. While the estimated coefficient is only weakly significant, it does follow basic economic intuition that private schools, which are not member-institutions of large statewide systems where transfer and transiency are relatively easy, find themselves substituted on the part of current students, a fact that new applicants would be expected to take into account. Finally, as in the pooled sample, the populations of a given state and its border states do not have a statistically significant effect on the demand for private colleges.

3.3 Separated Sample: Public Institutions Only

We estimate equation (1) using the subsample of public schools and find similar results (reported in Table 3) as in the private subsample with few

exceptions. However, these differences are substantial enough to support the hypothesis that, within the population that demands higher education, there are two distinct populations of current and potential students. These two populations are divided upon institutions from which students demand resources: private or public schools.

The estimated in-state tuition elasticity of demand is -0.04 and is statistically insignificant and implies that students who demand public education resources are not very price sensitive. That students who demand public education are price insensitive follows from the availability of state and federal subsidies for the price of education.[16] The income elasticity of demand is estimated at 0.56 and is statistically insignificant, indicating that those who demand public resources are relatively unaffected by their level of income. The estimated out-of-state tuition elasticity of demand is estimated at 0.19 and is statistically significant. These results support those found in the pooled sample. The signaling hypothesis holds for those students who attend public schools in another state.

The strength of the student population, measured by those who gradu-

[16] We included dummy variables for states that dedicate lottery funds for post-secondary education scholarships. However, the coefficients on these dummy variables were insignificant, and did not alter the other inferences found here.

ated in the top ten percent of their high-school classes and the graduation rate at the school, both have a positive effect on the demand for public schools, with only the former being statistically significant. The constitution of the faculty affects the demand of public institutions differently than that of private schools. The percentages of both full and associate professors have a positive and statistically significant effect on the demand for resources, while the percentage of assistant professors has a negative and statistically insignificant impact on demand.[17]

The number of other in-state schools, unlike in the sample of private institutions, has a positive and statistically significant effect on the demand for a public college. The intuition is that public schools in a given state are normally members of at least one system of schools. These alliances make it easier for students to attend a satellite school and transfer credits to a "flagship" school or to attend satellite schools on a transient basis. This result implies that there is an advantage to being a member of a system of schools where each is viewed as a complement to the other allied schools.

[17] This can be explained by the fact that small satellite schools typically have fewer full professors than major "flagship" schools. The positive coefficient on the percentage of associate professors may stem, in part, from the complementarity of satellite schools to large state universities.

The remaining estimates yield the same inferences as in the pooled and private samples. Thus, these variables explain the demand for college resources in similar ways regardless of the type of institution (student) being modeled.

4 Conclusions

In this paper we analyze the demand for college resources based upon the characteristics of the schools which are easily confirmable by potential students. We analyze the demand for a cross-section of 1134 U.S. schools from the academic year 1994-1995 in a pooled sample and in two separated samples, private and public colleges. We find a positive relationship between the number of applications and out-of-state tuition, whereas in-state tuition is inversely related to the number of applications.

This study also reveals that the number of in-state schools has a positive effect on the demand for public resources, suggesting that these schools are treated as possible complements by potential students. The reverse is true for private schools in that they are treated as possible substitutes by applicants. However, the strength of the student population has a greater effect on the

demand for private schools.

We postulate and test the hypothesis that different populations demand public and private education by separating the samples into public and private schools. We find that the populations that demand public and private resources are distinctly different in how sensitive they are to price and income changes, and in how they react to the constitution of a school's faculty. The demand for private colleges is more price and income sensitive than that of public schools, and the demand for private schools is enhanced only by an increase in the percentage of established, full professors, whereas that of public schools is enhanced by higher percentages of both full and associate professors.

The major result of this paper is the positive (negative) relationship between the number of applications and the price of out-of-state (in-state) tuition. Higher out-of-state tuition rates may signal a higher-quality education at a particular school. On the other hand, as in-state tuition rates increase, other schools become more appealing to in-state students because of changes in relative prices.

5 References

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6 Tables

Table 1: Pooled Data (Both Private and Public Schools)

Variable	Coefficient	t-Statistic
Constant	-4.257	-1.506
TUITION	-0.217	-6.226*
OSTUIT	0.3312	7.176*
INCOME	0.5543	1.758**
FULL	0.4530	5.847*
ASSOC	0.0167	0.175
ASST	-0.4969	-4.676*
TOPTEN	0.1879	4.882*
GRADRATE	0.3325	3.347*
DPER	0.1418	5.832*
SCHLS	-0.0213	-0.445
STUFAC	1.0488	9.651*
POP18	-0.1954	-0.285
BPOP18	-0.3205	-1.621

* (**) denotes significance at the 95% (90%) level.

Table 2: Separated Sample (Private Schools Only)

Variable	Coefficient	t-Statistic
Constant	-3.6239	-1.162
TUITION	0.2108	5.125*
INCOME	0.5504	1.555
FULL	0.2860	4.001*
ASSOC	-0.1056	-1.171
ASST	-0.3351	-3.216*
TOPTEN	0.2578	5.282*
GRADRATE	0.6922	5.464*
DPER	0.1245	4.988*
SCHLS	-0.0834	-1.595
STUFAC	0.3463	2.850*
POP18	-0.1729	-0.220
BPOP18	-0.5781	-1.560

* (**) denotes significance at the 95% (90%) level.

Table 3: Separated Sample (Public Schools Only)

Variable	Coefficient	t-statistic
Constant	-1.2827	-0.281
TUITION	-0.0419	-0.906
OSTUIT	0.1975	3.418*
INCOME	0.5662	1.175
FULL	0.7777	3.632*
ASSOC	0.7816	3.385*
ASST	-0.2006	-0.833
TOPTEN	0.1340	2.395*
GRADRATE	0.2953	1.911**
DPER	0.1541	3.271*
SCHLS	0.1956	2.509*
STUFAC	1.4452	7.197*
POP18	0.9843	0.949
BPOP18	-0.0978	-0.397

* (**) denotes significance at the 95% (90%) level.