Market Power and Price Discrimination in the US Market for Higher Education

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US Higher Education

- There are both public (state) and private providers.
- Public colleges enroll approximately 70% of four-year college students.
- Approximately 40% of the US college-aged population is enrolled (on a full-time equivalent basis) in four-year colleges.
- US colleges and universities are under increasing scrutiny as
  - returns to education rise
  - costs of college attendance continue to outpace inflation

- College pricing, Federal Aid, State Subdisies

- A General Equilibrium Analysis of State and Private Colleges and Access to Higher Education in the U.S. (Epple, Romano, Sarpça, Sieg, JPubE 2017)

Price Discrimination in US Higher Education

- The net tuition* paid by students in a typical classroom is often quite different

  *(posted tuition – institutional financial aid)

- Varies with student characteristics, such as ability, income, minority status.

- Some variation is efficient: pricing of externalities
- Other variation is inefficient: exercise of market power

- GOAL: To quantify the magnitudes of pricing of externalities vs. exercise of market power

- Estimate an equilibrium model of private&public college competition

- In the model (builds on ERSS, 2017) private college pricing reflects a combination of
  - Pricing of externalities
  - Exercise of market power

A Fundamental Puzzle: Pricing by Income

- Private colleges have very small market shares.
- Yet pricing by income (framed as financial aid) is the norm in private colleges.
- Competition prevents such price discrimination by small firms in other sectors of the economy.
- How does pricing by income persist in the face of competition in higher education?

Resolving the Pricing Puzzle

- We model students as having
  - preferences over observed college characteristics, and
  - idiosyncratic preferences over colleges that are known only to the student.

- We show that pricing by income then arises naturally as an equilibrium outcome within a framework of monopolistic competition.

- The model implies that this pricing by income persists even if individual colleges have negligible market shares.

- Markup does not depend on overall market share of college, but market share conditional on student characteristics

The Model

- S regions/states
- Private and State (public) universities compete for students
- Students in each state differ in income, ability, minority status
- Private universities maximize quality—an index
- State universities maximize total achievement of in-state students (but admit out-of-state too) (regulated tuitions)

Demand Side

- Student (s,m,b,y) 's utility at college j *(if admitted)*

$$U(y - [p_{sj}(m,b,y) + L - A_{sj}(y)] , a(q_j,b)) + e_j$$

- Given tuitions, qualities, non-inst. aid, chooses among colleges (that admit) & outside option to maximize utility
- Dependence on state of residence for two reasons
  - In-state tuition
  - Markup depends on a student's options

Demand Side

- Student (s,m,b,y) 's utility at college j *(if admitted)*

$$U(y - [p_{sj}(m,b,y) + L - A_{sj}(y)], a(q_j,b)) + e_j$$

- Idiosyncratic taste component e_j
  - Conditional choice probabilities—type specific demand
  - **Overlapping admissions spaces**

Private Universities

- Maximize quality

$$q_j = q(\theta_j, I_j, \Gamma_j)$$

  - Average ability, instructional expenditures, diversity

- Choose who to admit, what to charge, constrained by demand, competition, and costs

$$C(k_j, I_j) - F + V(k_j) + k_j I_j$$

- Price caps

Optimal Pricing

$$p_{sj}(m,b,y) + \frac{r_{sj}(m,b,y;\cdot)}{\partial r_{sj}(m,b,y;\cdot)/\partial p_{sj}(m,b,y)} = EMC_j(m,b)$$

$$EMC_j(m,b) \equiv V_j' + I_j + \frac{q_\theta}{q_I}(\theta_j - b) + \frac{q_\Gamma}{q_I}(\Gamma_j - m)$$

Optimal Admission

- Admit if $\min\{\bar{p}_j, p_{sj}(m,b,y)\} \geq EMC_j(m,b)$

- Admission thresholds $\bar{p}_j = EMC_j(m, b_{jm}^{min})$

Estimation

Assumption 1

a) The quality function is given by

$$q_j = \theta_j^{\gamma}\, I_j^{\omega}\, \Gamma_j^{\kappa}\, e^{u_j},\ \ \gamma, \omega, \kappa\ >\ 0 \tag{18}$$

where u_j is an unobserved exogenous characteristic.

b) The utility function is given by:

$$U_j(y - p_{sj} - L + A_{sj}, a(q_j, b)) = \alpha \ln(y - p_{sj} - L + A_{sj}) + \alpha \ln(q_j b^{\beta}) + \epsilon_j,\ \ \beta, \alpha > 0 \tag{19}$$

where α parameterizes the weight on the systematic component of utility.

c) The disturbances ε_j are independent and identically distributed with Type I Extreme Value Distribution.

Estimation

$$r_{sj}(m,b,y) = \frac{[(y - p_{sj}(m,b,y) - L + A_{sj}(y))\, q_j]^{\alpha}}{\sum_{k \in J_a(m,s,b)} [(y - p_{sk}(m,b,y) - L + A_{sk}(y))\, q_k]^{\alpha}}.$$

$$\begin{aligned} p_{sj}(m,b,y) &= \frac{(1 - r_{sj})\alpha}{1 + (1 - r_{sj})\alpha} \left(V_j' + I_j + \frac{\gamma I_j}{\omega \theta_j} (\theta_j - b) + \frac{\kappa I_j}{\omega \Gamma_j} (\Gamma_j - m) \right) \\ &+ \frac{1}{1 + (1 - r_{js})\alpha} \left(y - L + A_{sj}(y) \right) \end{aligned}$$

$$V_j = V'(k_j) + I_j$$

Estimation

- 2011-12 National Postsecondary Student Aid Study (NPSAS)
- We focus on ``typical" first year students, plausibly interested attending in four year schools
- Ability (predicted college GPA), income, in-state status,
- Clusters (10 private, 4+1 public)

Estimation

- Estimate conditional market shares $r_{sj}(m,b,y)$ using a logit model

- Use the estimates to predict conditional choice probabilities

Estimation

$$\tilde{p}_{sji} = \frac{(1-\hat{r}_{sj})\alpha}{1+(1-\hat{r}_{sj})\alpha}\left(V_j + I_j + \frac{\gamma I_j}{\omega\theta_j}(\theta_j - b) + \frac{\kappa I_j}{\omega\Gamma_j}(\Gamma_j - m)\right)$$
$$+ \frac{1}{1+(1-\hat{r}_{js})\alpha}\left(y - L + A_{sj}(y)\right) + v_{ji}$$

Estimate alpha, gamma/omega, kappa/omega, V_j ' s

Using subsample of students who are *not* paying the full price

Estimation

Table 4: Parameter Estimates

	(1)	(2)	(3)
Weights	No	Yes	Yes
Minority Status	No	No	Yes
α	86.56***	70.26***	72.72***
	(8.58)	(6.68)	(7.13)
$\frac{\gamma}{\omega}$	0.074***	0.0734***	0.079***
	(0.012)	(0.012)	(0.012)
$\frac{\kappa}{\omega}$			0.01***
			(0.003)
V_1	1.22***	1.21***	1.23***
	(0.07)	(0.07)	(0.07)
V_2	1.69***	1.65***	1.66***
	(0.07)	(0.07)	(0.07)
V_3	1.43***	1.40***	1.41***
	(0.08)	(0.08)	(0.08)
V_4	1.82***	1.81***	1.82***
	(0.05)	(0.05)	(0.05)
V_5	1.15***	1.14***	1.14***

Price Discrimination

the marginal effect of ability on price is approximately given by:

$$\frac{\partial p_{sj}(m,b,y)}{\partial b} \approx -\frac{(1-r_{sj})\alpha}{1+(1-r_{sj})\alpha}\frac{\gamma I_j}{\omega\theta_j} \tag{35}$$

The marginal effect of income on price is approximately:

$$\frac{\partial p_{sj}(m,b,y)}{\partial y} \approx \frac{1}{1+(1-r_{js})\alpha} \tag{36}$$

We compute the "mark-up" as the difference between price and effective marginal cost:

$$\text{mark-up}_j(s,m,b,y) = p_{sj}(m,b,y) \; - \; EMC_j(m,b). \tag{37}$$

Table 5: Pricing by Ability and Income

	(1)	(2)	(3)
Weights	No	Yes	Yes
Minority Status	No	No	Yes
Structural Estimates of Pricing by Ability and Income			
$\frac{\partial p}{\partial b}$	-0.095***	-0.105***	-0.112***
$\frac{\partial p}{\partial y}$	0.013***	0.015***	0.014***
Reduced Form Estimates of Pricing by Ability and Income			
$\frac{\partial p}{\partial b}$	-0.113***	-0.112***	-0.121***
$\frac{\partial p}{\partial y}$	0.017***	0.016***	0.016***
Note *p<0.1; **p<0.05; ***p<0.01			
OLS estimates account for cluster fixed effects			

Table 6: Predicted Mark-ups and Pricing by Income, Ability, and Minority Status

	(1)	(2)	(3)	(4)	(5)
markup	13.16	13.22	5.30	4.11	4.05
ability	-1.80	-0.92	-1.11	-1.12	-0.94
income	0.03	0.03	0.02	0.02	0.03
minority status	-5.75	-3.08	-4.23	-1.60	-0.58
	(6)	(7)	(8)	(9)	(10)
markup	2.66	3.09	2.86	0.75	2.77
ability	-1.06	-1.06	-1.14	-1.09	-1.96
income	0.05	0.04	0.04	0.05	0.03
minority status	-0.51	-0.50	-0.33	-0.27	-0.11

Note: Markups include pricing by minority status. Figures (in $1,000) calculated using full sample, not just those observed to receive aid.

Table 7: Local Market Shares in Clusters 1 and 2

	income percentile									
ability	10	20	30	40	50	60	70	80	90	100
10	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.02	0.00
20	0.01	0.02	0.00	0.00	0.00	0.03	0.01	0.02	0.03	0.06
30	0.01	0.00	0.00	0.00	0.02	0.05	0.00	0.04	0.03	0.05
40	0.03	0.02	0.01	0.01	0.04	0.01	0.01	0.00	0.04	0.02
50	0.02	0.01	0.00	0.02	0.02	0.06	0.03	0.04	0.09	0.11
60	0.00	0.02	0.01	0.00	0.02	0.04	0.08	0.05	0.04	0.05
70	0.00	0.01	0.01	0.02	0.06	0.05	0.03	0.10	0.08	0.08
80	0.04	0.08	0.05	0.07	0.07	0.11	0.04	0.05	0.07	0.24
90	0.08	0.07	0.04	0.07	0.13	0.20	0.10	0.07	0.20	0.23
100	0.22	0.28	0.37	0.18	0.29	0.28	0.38	0.31	0.41	0.53

Note: Table gives proportion of each income-ability percentile combination attending colleges in Cluster 1 or 2. Proportions are unweighted.

Unconditional market share is about 0.08

Table 8: Predicted Mark-ups by Ability and Income Quintile, Clusters 1 and 2

	Mark-ups over Effective Marginal Cost				
ability\income	0%-20%	20%-40%	40%-60%	60%-80%	80%-100%
0%-20%	-	0.22	0.63	1.15	17.99
20%-40%	-	0.23	0.64	1.16	17.56
40%-60%	-	0.24	0.65	1.17	15.56
60%-80%	-	0.25	0.66	1.18	12.66
80%-100%	0	0.26	0.68	1.20	9.15
	Mark-ups over Marginal Resource Cost				
ability\income	0%-20%	20%-40%	40%-60%	60%-80%	80%-100%
0%-20%	-	2.50	2.92	3.44	20.28
20%-40%	-	1.89	2.30	2.82	19.22
40%-60%	-	1.32	1.73	2.25	16.64
60%-80%	-	0.68	1.09	1.61	13.10
80%-100%	-0.92	-0.60	-0.19	0.33	8.28

Main Findings

$10,000 increase in income increases tuition by $210 to $510

A one standard to deviation in ability decreases tuition by $920 to $1960

Minority discounts $110 to $5750

Markups range between 3.5% to 33.5% ($750 to $13,000)

Varies substantially within colleges, larger markups occur for some student types

Policy Experiment

- Moving students from a state with low quality public universities to a state with a diversified public university system

- Benefits to having a diversified set of public universities
  - Direct effects
  - Indirect effects to students who choose private schools