

Price Discounting at U.S. Land Grant Universities: A Supply-Demand Analysis

Prasenjit N. Ghosh, Henry W. Kinnucan, and Patricia A. Duffy
(Auburn University)

Prepared for the ASSA 2021 Virtual Annual Meeting, January 3-5, 2021

Motivation

- Why Do U.S. News University Rankings Matter?
 - ✓ Front page news in national news media, institutional websites, and alumni publications
 - ✓ Public research universities and their rankings receive astonishing amount of public attention every year
 - ✓ University administrators believe that revenue is linked to USNWR rankings and act accordingly



Motivation (*Contd.*)

2

- Why 1862 Land Grant Universities?
 - ✓ The first set of the national universities established “to promote the liberal and practical education of the industrial classes in the several pursuits and professions in life” (Title-7 U.S. Code § 304)
 - ✓ By providing major educational resources to the American society these universities play an important role in the U.S. educational system
 - ✓ No empirical work has been done to understand the relationship between an improvement in the USNWR rankings and pricing policies of these institutions

Research Question

3

- Do the research universities that do better in USNWR rankings really have the ability to charge higher tuition and offer less financial aid than institutions that do less well in the rankings?

Literature Review

4

- **Monks and Ehrenberg (1999)**: Analyze USNWR ranking's effects on institutions' pricing policies
- **Meredith (2004)**: Expanded **Monks and Ehrenberg (1999)** by using FE approach on a larger sample-233 public and private schools classified as national doctoral universities
- **Bastedo and Bowman (2011)**: How USNWR rankings affect financial indicators in public universities

Supply-Demand Framework

5

- We develop an Equilibrium Displacement Model (EDM)
- The structural model:
 - (1) $Q_S = S(P_G, \bar{C})$ (Supply of education services)
 - (2) $Q_D = D(P_N, \bar{Y})$ (Demand for education services)
 - (3) $P_G = P_N + AID$ (Gross price)
 - (4) $AID = f(P_G, \bar{Y}, \bar{N})$ (Student aid)
 - (5) $Q_S = Q_D \equiv Q$ (Market clearing)
- Endogenous variables- Q , gross tuition (P_G), net tuition (P_N), and financial aid (AID)
- Overbar ($\bar{\quad}$) indicates exogenous variables (e.g., \bar{Y} is a vector of demand shifters, including USNWR ranking)

Supply-Demand Framework (*Contd.*)

6

- **The Equilibrium Displacement Model (EDM):** Taking total derivatives the structural model can be expressed as:

$$(1') \quad Q_S^* = \varepsilon P_G^* + \varepsilon_{\bar{C}} \bar{C}^*$$

$$(2') \quad Q_D^* = \eta P_N^* + \eta_{\bar{Y}} \bar{Y}^*$$

$$(3') \quad P_G^* = K_{P_N} P_N^* + K_{AID} AID^*$$

$$(4') \quad AID^* = \alpha_{P_G} P_G^* + \alpha_{\bar{Y}} \bar{Y}^* + \alpha_{\bar{N}} \bar{N}^*$$

$$(5') \quad Q_S^* = Q_D^* = Q^*$$

- Asterisk indicates relative change (e.g., $Q_D^* = dQ_D/Q_D$).
- Greek letters represent either partial elasticities or structural elasticities

Supply-Demand Framework (*Contd.*)

7

Table 1. Definitions and Signs of the Partial Elasticities

Partial and Structural Elasticity	Definition	Sign
(1)	(2)	(3)
η	$\frac{\partial Q_D}{\partial P_N} \frac{P_N}{Q_D}$	< 0
η_Y	$\left(\frac{\partial Q_D}{\partial \bar{Y}} \frac{\bar{Y}}{Q_D} \right)$	> 0
ε	$\left(\frac{\partial Q_S}{\partial P_G} \frac{P_G}{Q_S} \right)$	> 0
ε_C	$\left(\frac{\partial Q_S}{\partial \bar{C}} \frac{\bar{C}}{Q_S} \right)$	< 0
α_{P_G}	$\left(\frac{\partial AID}{\partial P_G} \frac{P_G}{AID} \right)$	> 0
α_Y	$\left(\frac{\partial AID}{\partial \bar{Y}} \frac{\bar{Y}}{AID} \right)$	< 0
α_N	$\left(\frac{\partial AID}{\partial \bar{N}} \frac{\bar{N}}{AID} \right)$	> 0

Supply-Demand Framework (*Contd.*)

8

- **Reduced Form of the EDM:** Solving equations (1')- (5') simultaneously for three endogenous variables of our interest we obtain three reduced form equations.

$$(1) \quad P_G^* = \left[\frac{K_{PN} \eta_{\bar{Y}} - K_{AID} \alpha_{\bar{Y}} \eta}{\mathcal{D}} \right] \bar{Y}^* - \left[\frac{K_{AID} \alpha_{\bar{N}} \eta}{\mathcal{D}} \right] \bar{N}^* - \left[\frac{K_{PN} \varepsilon_{\bar{C}}}{\mathcal{D}} \right] \bar{C}^*$$

$$(2) \quad P_N^* = \left[\frac{\eta_{\bar{Y}} (1 - K_{AID} \alpha_{P_G}) - K_{AID} \alpha_{\bar{Y}} \varepsilon}{\mathcal{D}} \right] \bar{Y}^* - \left[\frac{K_{AID} \alpha_{\bar{N}} \varepsilon}{\mathcal{D}} \right] \bar{N}^* - \left[\frac{\varepsilon_{\bar{C}} (1 - K_{AID} \alpha_{P_G})}{\mathcal{D}} \right] \bar{C}^*$$

$$(3) \quad AID^* = \left[\frac{K_{PN} \alpha_{P_G} \eta_{\bar{Y}} + \alpha_{\bar{Y}} (K_{PN} \varepsilon - \eta)}{\mathcal{D}} \right] \bar{Y}^* + \left[\frac{\alpha_{\bar{N}} (K_{PN} \varepsilon - \eta)}{\mathcal{D}} \right] \bar{N}^* - \left[\frac{K_{PN} \alpha_{P_G} \varepsilon_{\bar{C}}}{\mathcal{D}} \right] \bar{C}^*$$

where $\mathcal{D} = [K_{PN} \varepsilon - \eta (1 - K_{AID} \alpha_{P_G})] > 0$

Hypotheses

9

□ We test the following hypotheses:

$$1. \frac{P_G^*}{\bar{Y}^*} > 0$$

$$2. \frac{P_N^*}{\bar{Y}^*} > 0$$

$$3. \frac{AID^*}{\bar{Y}^*} > 0$$

Empirical Approach

10

- The system of three equations can be written as:

$$Y_{it} = \alpha_i + \beta_i X_{it} + u_{it}$$

- OLS, Fixed effects (FE)
- Generalized Linear Model (GLM) with robust standard errors
- Did not test for endogeneity

Data Sources

11

- Integrated Postsecondary Education Data Systems (IPEDS)
- The USNWR's Annual Reports: "Best Colleges"
- The U.S. Census Bureau
- The U.S. Bureau of Labor Statistics

Results

12

Table 2: Estimation Results for OLS and Fixed Effect (FE) Regression Models.

Variable	Log In-State Tuition		Log Out-of-State Tuition		Log Average Financial Aid	
	OLS	FE	OLS	FE	OLS	FE
	(1)	(2)	(3)	(4)	(5)	(6)
Negative of <i>USNWR</i> National Ranking	-0.0019 (0.0013)	-0.0047** (0.0021)	0.00028 (0.0008)	-0.0030** (0.0013)	0.0009 (0.0011)	-0.0035 (0.0025)
Negative of <i>Shanghai</i> World Ranking	-0.0009*** (0.0002)	-0.001*** (0.0003)	-0.0006*** (0.00017)	-0.0008*** (0.0002)	-0.0013*** (0.0002)	-0.0003 (0.0004)
Log of Total UG Enrollment	0.529*** (0.098)	0.560*** (0.137)	0.363*** (0.0759)	0.509*** (0.095)	0.279** (0.121)	1.449*** (0.313)
Log of Endowment/Student	0.373*** (0.127)	0.390** (0.164)	0.214*** (0.071)	0.314*** (0.113)	0.229** (0.109)	0.851*** (0.304)
Log of Median Household Income	-0.187 (0.133)	-0.531*** (0.162)	0.129 (0.124)	-0.216 (0.168)	0.395*** (0.147)	-0.367 (0.238)
Unemployment Rate	0.0326*** (0.003)	0.027*** (0.0027)	0.029*** (0.003)	0.020*** (0.002)	0.108*** (0.007)	0.0829*** (0.007)
Intercept	1.182 (2.428)	4.211 (3.482)	2.388 (1.795)	3.329 (2.994)	-1.662 (2.20)	-11.882* (5.922)

Notes: Robust standard errors are shown in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Results (*Contd.*)

13

Table 3: Generalized Linear Model (GLM) Estimates

Variable	Log In-State Tuition (1)	Log Out- Of-State Tuition (2)	Log Avg. Financial Aid (3)
Negative of <i>USNWR</i> National Ranking	0.0033*** (0.0005)	0.0035*** (0.0004)	0.0033*** (0.0005)
Negative of <i>Shanghai</i> World Ranking	-0.00048*** (0.0001)	0.0002* (0.0001)	-0.00065*** (0.0001)
Log of UG Enrollment	-0.058 (0.059)	-0.190*** (0.043)	-0.158 (0.066)
Log of Endowment per Student	0.079** (0.038)	-0.062** (0.028)	0.042 (0.054)
Log of Median Household Income	0.727*** (0.092)	0.319*** (0.061)	0.424*** (0.096)
Unemployment Rate	0.059*** (0.006)	0.052*** (0.003)	0.107*** (0.006)
Intercept	0.683 (1.480)	9.185*** (1.012)	4.778** (1.583)

Notes: Robust standard errors are shown in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Conclusions

14

- Results affirm the importance of college rankings on tuition and financial aid across 1862 land grant universities

- One unit improvement in national ranking (say, from 4th to 3rd) is associated with an increase in
 - (a) inflation adjusted in-state sticker price by 0.33% to entering undergraduates
 - (b) inflation adjusted out-of-state sticker price by 0.35% to entering undergraduates
 - (c) inflation adjusted financial aid per undergraduate student by 0.33%

Thank You!

Contact Information:

Prasenjit N. Ghosh
png0005@auburn.edu