Competition in Higher Education: Sorting, Ranking and Fees

Kaiqi Liu[1] Hannes Rusch[12] Christian Seel[1] Stefan Terstiege[1]

[1]Maastricht University

[2]Max Planck Institute for the Study of Crime, Security and Law, Behavioral Economics of Crime and Conflict Group, Freiburg

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Market for Higher Education

- Billion dollar market - expected to grow even further as demand for higher education increases
- Millions of Higher education degrees every year
- The rise of private for-profit universities

This Paper

- Most of the literature focuses on U.S.-based simulations with a focus on two university types
- We incorporate private for-profit universities
- Quality of universities is endogenous
- Simpler framework to derive analytical solutions and generalizable comparative statics
- Flexible to accommodate various international contexts

Main Results

- Private non-profit and public universities compete for top students; ordering under refinements
- Private for-profit university has a subtle influence on the market
- An increase in the quota of the public university might decrease its equilibrium market share
- Private for-profit universities are the beneficiaries of a growing market for education
- Embedding different national contexts

Model - Players

A continuum of students and three types of universities: public, private non-profit, and private for-profit.

Students:

- Student mass normalized to one
- Students have types $h \in [\underline{h}, \overline{h}] \subseteq \mathbb{R}$, representing high-school grades
- Student types distribution (cdf) is called G, where G is continuous and strictly increasing on its support with $G(\underline{h}) = 0$

Model - Players

Public University:

- Quota: $0 < q_{pu} < 1$
- Graduation probability: $\phi(h)$, where ϕ is strictly increasing and continuous, with $\phi(\underline{h}) = 0$ and $\phi(\overline{h}) = 1$
- Tuition fee: 0

Private Universities:

- Non-profit university quota: $0 < q_n < 1 - q_{pu}$
- Non-profit university tuition fee: an exogenously given fee $a_n \geq 0$
- For-profit university quota: 1
- For-profit university tuition fee: $a_f \geq 0$
- Graduation probability: 1 (can be relaxed) [a]

[a] This assumption is motivated by better facilities, smaller classrooms and laxer grading standards at private universities.

Model - Payoffs

Determining the Rank of Universities:

- Based on the ranking of average ability types of students at the universities.

Student Payoff: Value of Diploma - Tuition Fee

- Diploma value tied to university rank
- University rank ($K = 1, 2, 3$) with diploma values π_1, π_2, π_3, respectively.
- Assumption: $\pi_1 > \pi_2 > \pi_3 > 0$

University Goals

- Private for-profit maximizes revenue
- Private non-profit and public are not driven by profit considerations (accept top students)

Model - Overview

The private for-profit university chooses its fee a_f.

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Every student decides at which university to apply [a].

[a] Azevedo, E. M., & Leshno, J. D. (2016). A supply and demand framework for two-sided matching markets. Journal of Political Economy, 124(5), 1235-1268.

↓

Universities admit students up to their quota.

↓

The rankings of universities and the revenue of the private for-profit university are determined.

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The payoff of students are determined.

Model - Two Versions

Two-university Models:

- Public university and private non-profit university
- Public university and private for-profit university
- Private non-profit university and private for-profit university

Three-university Model:

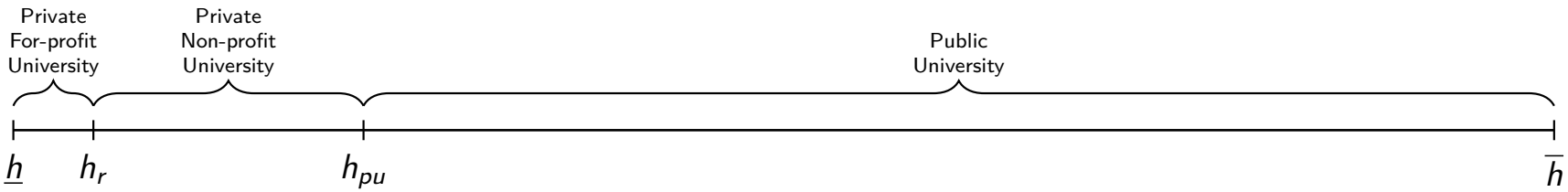
- All three types of universities

Main Results - Equilibria in Three-University model

- Four possible equilibria under restrictions:

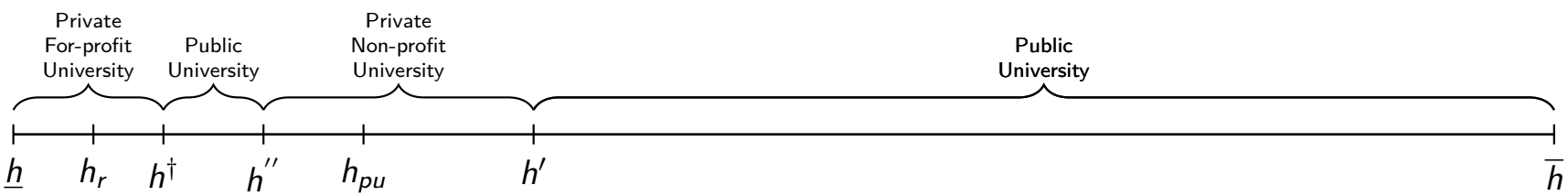
$\pi_3 - a_f \geq 0, \phi(h^\dagger)\pi_1 \geq \pi_3 - a_f$ ("=" if $h^\dagger > h_r$), and $\pi_2 - a_n > \pi_3 - a_f$

- Scenario 1: $\tilde{h}_{pu} > \tilde{h}_n$
- Equilibrium 1:



where $\phi(h_{pu})\pi_1 \geq \pi_2 - a_n > 0$

- Equilibrium 2:



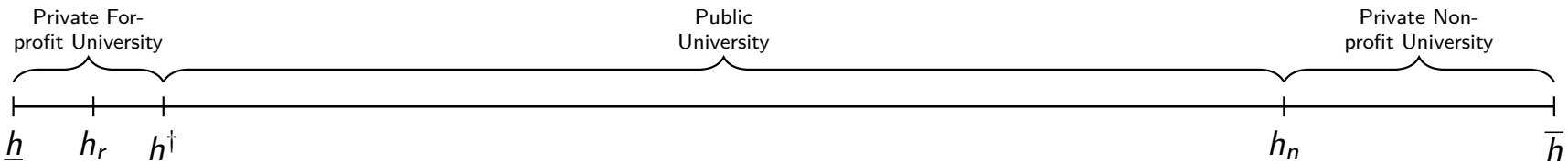
where $\phi(h')\pi_1 = \pi_2 - a_n$ with $h' \in (h_{pu}, \overline{h})$, $G(h') - G(h'') = q_n$

Main Results - Equilibria in Three-University model

- Four possible equilibria under restrictions:

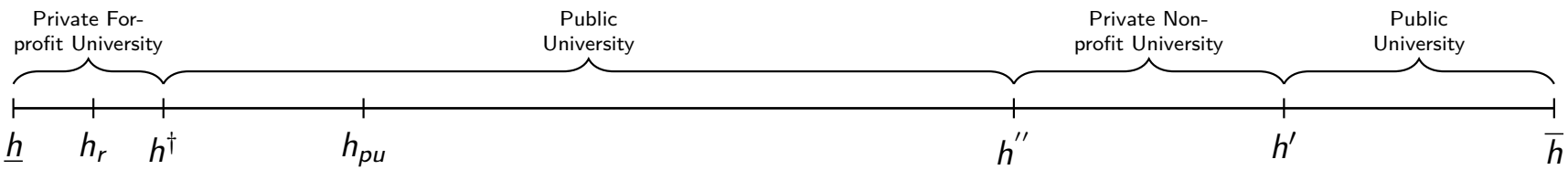
$\pi_3 - a_f \geq 0, \phi(h^\dagger)\pi_2 \geq \pi_3 - a_f$ ("=" if $h^\dagger > h_r$), and $\pi_1 - a_n > \pi_3 - a_f$

- Scenario 2: $\tilde{h}_{pu} < \tilde{h}_n$
- Equilibrium 3:



where $\pi_1 - a_n > \pi_2$

- Equilibrium 4:



where $\phi(h')\pi_2 = \pi_1 - a_n$ with $h' \in (h_{pu}, \overline{h})$, $G(h') - G(h'') = q_n$

Equilibrium Selection

- Criterion: Group Strategy-proofness
- Motivation: BarberÃ , S., Berga, D., & Moreno, B. (2016).
- Small informal networks of prospective elite students (circles of parents, elite schools, or student Olympiads)
- Small size of private non-profit universities
- Selects equilibria where private non-profit university ranks first

Optimal Fee of the Private For-Profit University

Two-University Model ($a_f \leq \pi_2$):

- Let $\tilde{q} \in (0,1)$ denote a cutoff value. The optimal fee at the private for-Profit University is:

$$a_f = \begin{cases} \pi_2 & \text{if } q_{pu} < \tilde{q} \\ \arg \max\limits_{a \in [0, \pi_2 - \phi(h_{pu})\pi_1]} G\left(\phi^{-1}\left(\frac{\pi_2 - a}{\pi_1}\right)\right) & \text{if } q_{pu} > \tilde{q} \end{cases}$$

Three-University Model with $\tilde{h}_{pu} < \tilde{h}_n$ ($a_f \leq \pi_3$):

- Let $\hat{q} \in (0,1)$ be a cutoff value. The optimal fee at the private for-Profit University is:

$$a_f = \begin{cases} \pi_3 & \text{if } q_{pu} < \hat{q} \\ \arg \max\limits_{a \in [0, \pi_3 - \phi(h_r)\pi_2]} G\left(\phi^{-1}\left(\frac{\pi_3 - a}{\pi_2}\right)\right) & \text{if } q_{pu} > \hat{q} \end{cases}$$

Main Results - Implications of Capacity Choice at the Public University

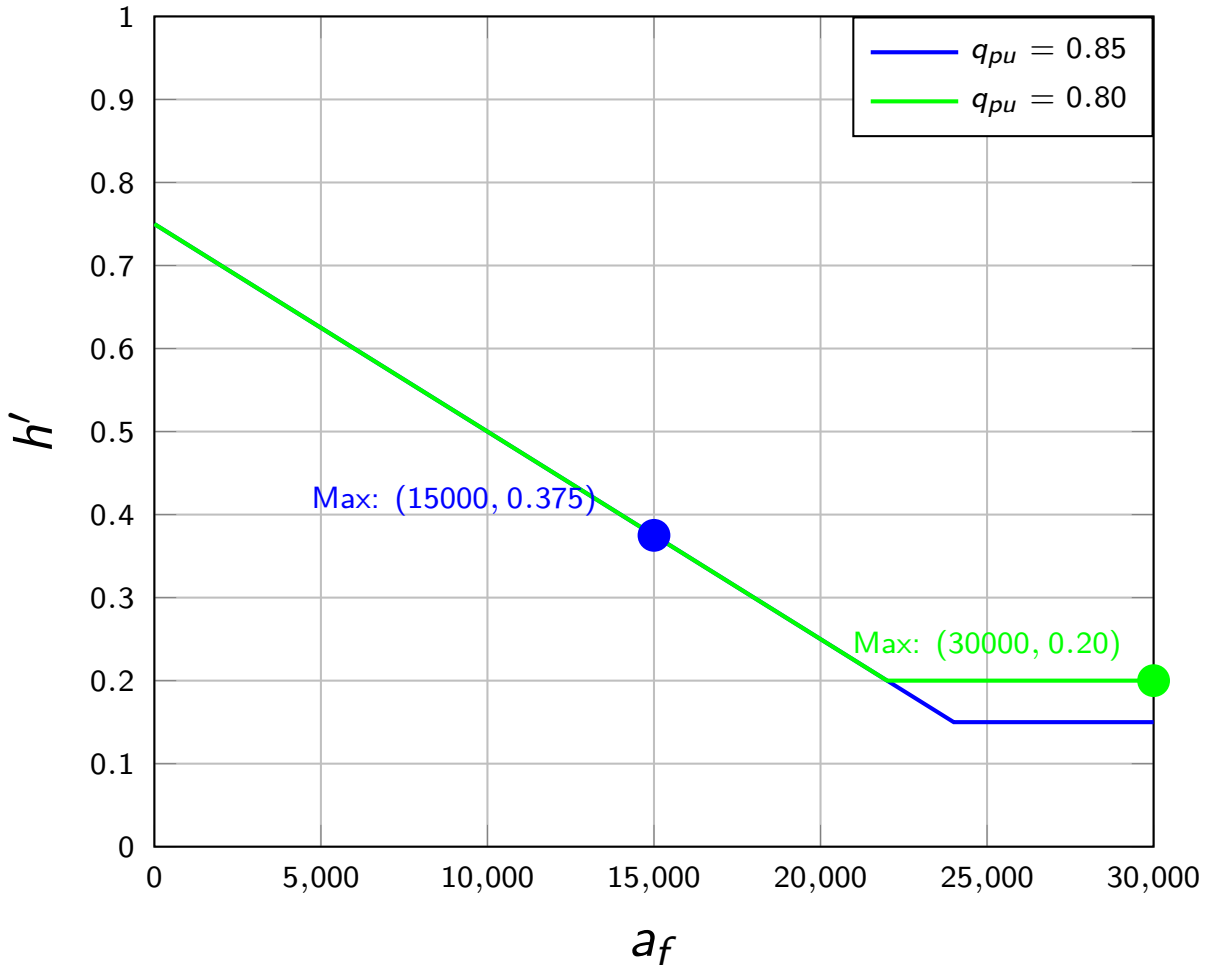


Figure: The market share of the for-profit university as a function of its tuition fee a_f for $G(h) = \phi(h) \sim \text{UNI}_{[0,1]}$ and $q_{pu} = 0.8$ (green) and $q_{pu} = 0.85$ (blue). $\tilde{q} = \frac{13}{16}$ in this case.

Main Results - Growing Student Numbers

Theorem

- Suppose the ability distribution $G(h)$ first-order stochastically dominates the new ability distribution $G^n(h)$. Then the private for-profit university makes a (weakly) higher equilibrium profit under $G^n(h)$.

Theorem

- Suppose $\phi(h) \sim UNI_{[0,1]}$ and $G(h) \sim UNI_{[\hat{h},1]}$ with $\hat{h} \geq 0$. Then a lower student quality leads to a (weakly) higher market share of the private for-profit university.

Further Results

- A higher capacity at the public university might decrease its equilibrium market share
- Allowing private for-profit universities help to satisfy market demand at low cost to the government; does not give up control of the intellectual elite
- Allowing private non-profit universities is likely to give up control of the intellectual elite
- Potential explanation for observed systems in China and the U.S.

Conclusion

- In every equilibrium, the private for-profit university attracts the least able students.
- Under group strategy-proofness, the private non-profit university attracts the top students.
- Increased capacity of the public university may lead to unused capacity at the public university, but have the unexpected benefit of a decreased study fee at the private for-profit university.
- The private for-profit university benefits from an increased enrollment in higher education.

Thank you for your attention!