The Effects of Student Loans on the Market for Higher Education

Rodrigo Azuero Melo [1] David Zarruk Valencia [2]

[1] University of Pennsylvania

[2] University of Pennsylvania

October 11, 2017

Latin American and Caribbean Economic Association Meeting

Question

- What are the general equilibrium effects of student loan programs on the market for higher education in developing economies?
  - Literature has studied either supply or demand of the market
  - Supply and demand are linked through quality
- What are the effects on quality supplied by elite vs non-elite education institutions?
  - **Quality:** composite of expenditures/student and average ability
- Optimal student loan policy

Colombia: ACCES Credits

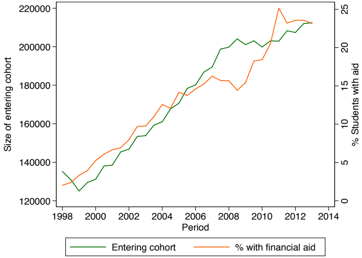

Figure: Enrollment and % of students with financial aid.

Figure: Average income and % of students with financial aid.

Colombia: Quality of Institutions

Difference between top 10 vs top 20-50 schools:

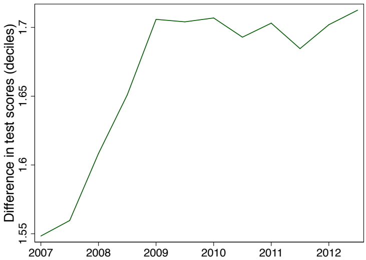

Figure: Average test scores

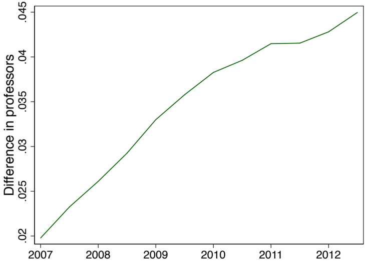

Figure: Professors per student

Our Environment

- Two tiers of institutions that differ in endowments:
  elite (top 10) vs non-elite (top 20-50) institutions
- Monopolistic competition
- Maximize quality offered subject to budget constraint
- Households maximize lifetime income, which depends on school quality

Our Hypothesis

Expansion of student loans

$\Downarrow$

Stronger demand response for elite schools

$\Downarrow$

Elite schools increase tuition and expenditures per student more

$\Downarrow$

(If expenditures and average student ability are complements)

Quality of elite schools increases more

What Do We Know?

From a partial equilibrium perspective:

- Keane and Wolpin (2001); Carneiro and Heckman (2002):

  In the U.S. borrowing constraints do not affect enrollment rates

  $\Rightarrow$ student loans have no effect on enrollment

- Attanasio and Kaufmann (2009); Kaufmann (2014); Melguizo et al. (2015):

  In developing economies, as Mexico and Colombia, borrowing constraints affect enrollment $\Rightarrow$ student loans increase enrollment

What Do We Know?

From a general equilibrium perspective:

- Epple et al. (2006); Chade et al. (2014): university sorting with fixed preferences
- William Bennett, former Secretary of Education:
  "If anything, increases in financial aid in recent years have enabled colleges [...] to raise their tuitions, confident that Federal loan subsidies would help cushion the increase"
- Gordon and Hedlund (2015):

  Student loan policies explain tuition increases

Household's Problem

- Born with innate ability and wealth $(\theta, b) \sim F(\theta, b)$
- Live for 2 periods
- In period 1:
  - Consume save at an exogenous risk free rate r
  - Study at school $j \in \{l, h\}$ and pay tuition P^j or work at market wage θw
  - Those who study and have $\theta \geq \theta_{min}$ can access student loans up to P^j at a rate $R \geq r$
  - Those who study and have $b \leq b_{max}$ at rate $R(1 - s)$
- In period 2:
  - Earn wage $w\theta(1 + z^j)$

Problem

Characterization of the Demand

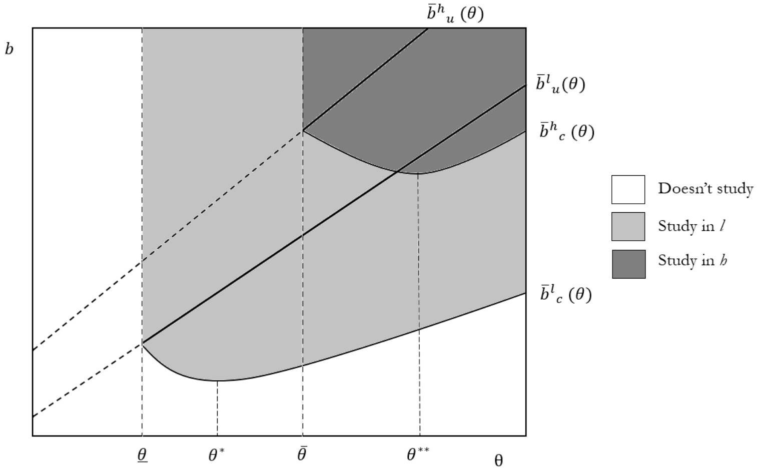

Figure: Representation of the education decisions on the state space.

Characterization of the Demand

- Unconstrained households with higher θ, ceteris paribus, choose higher education
- Constrained cut-offs are increasing in θ:
  - Individuals with higher θ will have higher lifetime income $\Rightarrow$ will consume more every period
  - To be unconstrained, they need higher b
- Among constrained individuals, there are two effects that determine the cut-off:
  - "Complementarity" effect: individuals with higher θ have incentives to choose better schools
  - "Constrainedness" effect: individuals with higher θ have higher wedges on Euler equation, so have incentives to not educate

Optimal Policy

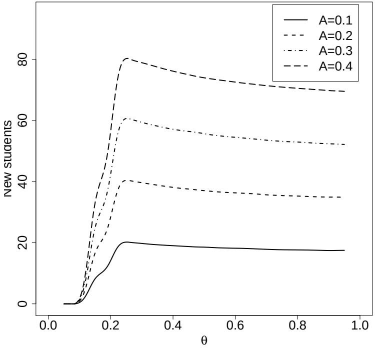

Figure: Number of students that change their study decision when borrowing constraints change from $\bar{A} = 0$ to $\bar{A}$, by ability θ.

Optimal Policy

- Two forces for constrained individuals:
  1. Studying at better schools ⇒ higher future wages (+)
  2. Studying increases wedge on the Euler equation (-)
- Decreasing marginal utility makes motive 1. stronger for low-θ individuals
- ⇒ From partial equilibrium perspective, optimal policy would lend to less able individuals

Universities' Problem

- Two universities
- Non-profit organizations
- Set tuition, ability cut-offs and investments per student to:
- Maximize composite of:
  - Quality offered
  - Income diversity of student body
- Subject to budget constraint
- Universities act simultaneously - Nash equilibrium

Problem

Optimal Policy

- Increasing proportion of low-θ individuals reduces equilibrium quality of institutions
- From supply side, optimal policy would relax borrowing constraints to high-θ individuals
- $\Rightarrow$ from a general equilibrium perspective, optimal policy will be something in between

Equilibrium

An equilibrium are tuition prices, ability cut-offs, investments per student, government policies and allocations such that:

1. Households choose optimally their education, consumption and savings
2. Universities solve their problem optimally on a Nash game, given the households' behavior
3. Government has budget balance

Target

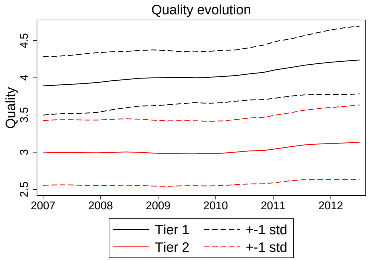

Figure: Estimated quality of tier 1 and tier 2 universities.

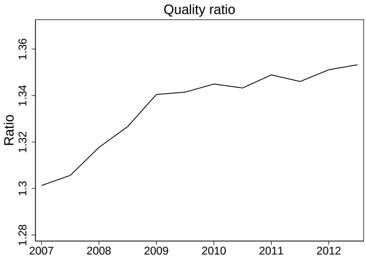

Figure: Quality ratio of tier 1 versus tier 2 universities.

Parameters

Parameter	Value	Source
Utility and discount		
β	0.97	Literature
σ	2	Literature
r	2%	Colombia
w	2	Normalization
Time parameters		
T	78	Colombia
S	5	Colombia
University parameters		
α_1	0.211	Estimation
α_2	0.358	Estimation
κ_l	1.4	Estimation
κ_h	1.2	Estimation
$E^h - C^h$	-12	Estimation
$E^l - C^l$	-7	Estimation

Table: Parameter values

Embedding Life-Cycle in 2-Period Model

- Assuming that individuals have perfect access to credit markets after they graduate from college:

$$\sum_{t=S}^{T} \beta^{t-S} u(c_t) = \Phi_S u(c_S), \qquad \sum_{t=0}^{S} \beta^{t} u(c_t) = \Phi_0 u(c_0)$$

$$\Phi_0 = \frac{1-\left(\frac{\beta}{(1+r)^{\sigma-1}}\right)^{\frac{S}{\sigma}}}{1-\left(\frac{\beta}{(1+r)^{\sigma-1}}\right)^{\frac{1}{\sigma}}}, \qquad \Phi_S = \frac{1-\left(\frac{\beta}{(1+r)^{\sigma-1}}\right)^{\frac{T-S+1}{\sigma}}}{1-\left(\frac{\beta}{(1+r)^{\sigma-1}}\right)^{\frac{1}{\sigma}}}$$

- Life-cycle problem can be embedded in 2-period model by:

$$\tilde{\beta} = \frac{\beta^S \Phi_S}{\Phi_0}$$

Computation

- Given $P^j, \underline{\theta}^j, I^j$, compute the fixed point z^l, z^h in household's and firm's problem:
  - Start with a guess for z^l, z^h
  - Solve household's problem and aggregate students attending each school
  - Compute the quality supplied by schools using the aggregates
  - If z^l, z^h are close to the qualities supplied, stop. Otherwise, try new guess
- For each j, solve the university's problem given $P^i, \underline{\theta}^i, I^i, z^l, z^h$.
- If optimal $P^j, \underline{\theta}^j, I^j$ are close to initial guess, stop. Otherwise, try new guess

Preliminary Results

Reform: increase borrowing limit from $\bar{A} = 0$ to $\bar{A} > 0$:

Table: Equilibrum computations

		Pre-reform	Post-reform
Elite institutions	Students attending	0.29	0.47
	Average ability of student body	0.48	0.64
	Quality offered	1.01	1.19
Non-elite institutions	Students attending	0.35	0.34
	Average ability of student body	0.41	0.38
	Quality offered	0.53	0.42

Conclusions

- We characterize the market for higher education when there are two tiers of schools
- Quality is an endogenous link between supply and demand
- We study general equilibrium effects of student loan policies on quality supplied by colleges
- Student loan policies have secondary pervasive effects that the literature has not studied: tuition prices and quality offered

Bibliography

Attanasio, O. P. and Kaufmann, K. M. (2009). Educational choices, subjective expectations and credit constraints. *NBER Working Papers*.

Carneiro, P. and Heckman, J. J. (2002). The evidence on credit constraints in post-secondary schooling. *The Economic Journal*.

Chade, H., Lewis, G., and Smith, L. (2014). Student portfolios and the college admissions problem. *Review of Economic Studies*.

Epple, D., Romano, R., and Sieg, H. (2006). Admission, tuition and financial aid policies in the market for higher education. *Econometrica*.

Gordon, G. and Hedlund, A. (2015). Accounting for the rise in college tuition. *NBER Chapters*.

Kaufmann, K. M. (2014). Understanding the income gradient in college attendance in mexico: the role of heterogeneity in expected returns. *Quantitative Economics*.

Keane, M. P. and Wolpin, K. (2001). The effect of parental transfers and borrowing constraints on educational attainment. *International*

Household's Problem

$$V^j(\theta, b) = \max_{c,a} \quad u(c) + \beta u(c'), \quad \text{s.t.}$$

$$c + a + P^j = b \cdot (1 - \tau)$$

$$c' = a(1 + r) \cdot 1_{\{a \geq 0\}} + a(1 + \tilde{R}) \cdot 1_{\{a < 0\}} + w\theta(1 + z^j)$$

$$\tilde{R} = \begin{cases} R(1 - s) & \text{if } b \leq b_{max} \\ R & \text{if } b > b_{max} \end{cases}$$

$$a \geq -1_{\{\theta \geq \theta_{min}\}} \cdot P^j, \quad c \geq 0, \quad c' \geq 0$$

$$V^N(\theta, b) = \max_{c,a} \quad u(c) + \beta u(c'), \quad \text{s.t.}$$

$$c + a = b \cdot (1 - \tau) + w\theta$$

$$c' = a(1 + r) + w\theta$$

$$a \geq 0, \quad c \geq 0, \quad c' \geq 0$$

Household's Problem

$$V(\theta, b) = \begin{cases} \max\{V^h(\theta, b), V^l(\theta, b), V^N(\theta, b)\} \text{ if } \theta \geq \max\{\underline{\theta}^h, \underline{\theta}^l\} \\ \max\{V^j(\theta, b), V^N(\theta, b)\} \text{ if } \underline{\theta}^{-j} > \theta \geq \underline{\theta}^j \\ V^N(\theta, b)\} \text{ if } \theta < \min\{\underline{\theta}^h, \underline{\theta}^l\} \end{cases}$$

Go back

Universities' Problem

$$\max_{P^j,\underline{\theta}^j} \quad \left(z^j\right)^{\alpha} \left(\sigma_b^j\right)^{1-\alpha} \qquad \text{subject to:}$$

$$z^j = \tilde{\theta}^{j\,\alpha_1} (I^j)^{\alpha_2}$$

$$\tilde{\theta}^j = \int_{\Theta \times B} \theta \cdot e^j(\theta, b) dF(\theta, b)$$

$$I^j \cdot N^j + V^j(N^j) + C^j = P^j \cdot N^j + E^j$$

$$N^j = \int_{\Theta \times B} s^j(\theta, b) dF(\theta, b)$$

- Investments per student: I^j
- Minimum ability cut-off: $\underline{\theta}^j$
- Tuition: P^j

Go back