The Effects of Student Loans on the Market for Higher Education

Rodrigo Azuero Melo ¹  David Zarruk Valencia ²

¹University of Pennsylvania
²University of Pennsylvania

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**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*
Question

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- What are the effects on quality supplied by elite vs non-elite education institutions?
  - **Quality**: composite of expenditures/student and average ability
Question

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  - 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
Our Hypothesis

Expansion of student loans

⇒

Stronger demand response for elite schools
Our Hypothesis

Expansion of student loans

⇓

Stronger demand response for elite schools

⇓

Elite schools increase tuition and expenditures per student more
Our Hypothesis

Expansion of student loans

⇓

Stronger demand response for elite schools

⇓

Elite schools increase tuition and expenditures per student more

⇓

(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
⇒ 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 ⇒ 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
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Household’s Problem

- Born with innate ability and wealth $(\theta, b) \sim F(\theta, b)$
Household’s Problem

- Born with innate ability and wealth \((\theta, b) \sim F(\theta, b)\)
- Live for 2 periods
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 \(\theta w\)
  - 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 \(R(1 - s)\)
Household’s Problem

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▪ In period 2:
  ▪ Earn wage \(w\theta(1 + z^j)\)
Characterization of the Demand

**Figure:** Representation of the education decisions on the state space.
Characterization of the Demand

- Unconstrained households with higher $\theta$, ceteris paribus, choose higher education
- Constrained cut-offs are increasing in $\theta$:
  - Individuals with higher $\theta$ 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 $\theta$ have incentives to choose better schools
  - “Constrainedness” effect: individuals with higher $\theta$ have higher wedges on Euler equation, so have incentives to not educate
Figure: Number of students that change their study decision when borrowing constraints change from $\bar{A} = 0$ to $\bar{A}$, by ability $\theta$. 
Optimal Policy

- Two forces for constrained individuals:
  1. Studying at better schools $\Rightarrow$ higher future wages (+)
  2. Studying increases wedge on the Euler equation (-)

- Decreasing marginal utility makes motive 1. stronger for low-$\theta$ individuals

- $\Rightarrow$ 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
Optimal Policy

- Increasing proportion of low-$$\theta$$ individuals reduces equilibrium quality of institutions

- From supply side, optimal policy would relax borrowing constraints to high-$$\theta$$ 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
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FIGURE: Estimated quality of tier 1 and tier 2 universities.

FIGURE: Quality ratio of tier 1 versus tier 2 universities.
# Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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**Table:** Parameter values
Assuming that individuals have perfect access to credit markets after they graduate from college:

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

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

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

\[
\tilde{\beta} = \frac{\beta^S \Phi_S}{\Phi_0}
\]
**Computation**

- Given $P^j, \theta^j, I^j$, 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 $P^i, \theta^i, I^i, z^l, z^h$.
  - If optimal $P^j, \theta^j, I^j$ 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: Equilibrium computations

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<th>Pre-reform</th>
<th>Post-reform</th>
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<td>Quality offered</td>
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<tr>
<td>Non-elite institutions</td>
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<td></td>
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<tr>
<td>Students attending</td>
<td>0.35</td>
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<tr>
<td>Average ability of student body</td>
<td>0.41</td>
<td>0.38</td>
</tr>
<tr>
<td>Quality offered</td>
<td>0.53</td>
<td>0.42</td>
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</tbody>
</table>
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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.
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\[ V^j(\theta, b) = \max_{c, a} \quad u(c) + \beta u(c'), \quad \text{s.t.} \]
\[ c + a + P^j = b \cdot (1 - \tau) \]
\[ c' = a(1 + r) \cdot 1_{\{a \geq 0\}} + a(1 + \tilde{R}) \cdot 1_{\{a < 0\}} + w\theta(1 + z^j) \]
\[ \tilde{R} = \begin{cases} 
R(1 - s) & \text{if } b \leq b_{\text{max}} \\
R & \text{if } b > b_{\text{max}} 
\end{cases} \]
\[ a \geq -1_{\{\theta \geq \theta_{\text{min}}\}} \cdot P^j, \quad c \geq 0, \quad c' \geq 0 \]

\[ V^N(\theta, b) = \max_{c, a} \quad u(c) + \beta u(c'), \quad \text{s.t.} \]
\[ c + a = b \cdot (1 - \tau) + w\theta \]
\[ c' = a(1 + r) + w\theta \]
\[ a \geq 0, \quad c \geq 0, \quad c' \geq 0 \]
Household’s Problem

\[ V(\theta, b) = \begin{cases} 
\max\{V^h(\theta, b), V^l(\theta, b), V^N(\theta, b)\} & \text{if } \theta \geq \max\{\theta^h, \theta^l\} \\
\max\{V^j(\theta, b), V^N(\theta, b)\} & \text{if } \theta^{-j} > \theta \geq \theta^j \\
V^N(\theta, b) & \text{if } \theta < \min\{\theta^h, \theta^l\} 
\end{cases} \]
Universities’ Problem

\[
\begin{align*}
\max_{P^j, \tilde{\theta}^j} & \quad (z^j)^\alpha \left( \sigma_b^j \right)^{1-\alpha} \\
\text{subject to:} & \\
& z^j = \tilde{\theta}^j \cdot \alpha_1 (l^j)^{\alpha_2} \\
& \tilde{\theta}^j = \int_{\Theta \times B} \theta \cdot e^j(\theta, b) dF(\theta, b) \\
& l^j \cdot N^j + V^j(N^j) + C^j = P^j \cdot N^j + E^j \\
& N^j = \int_{\Theta \times B} s^j(\theta, b) dF(\theta, b)
\end{align*}
\]

- Investments per student: \( l^j \)
- Minimum ability cut-off: \( \theta^j \)
- Tuition: \( P^j \)