Redesigning Federal Student Aid in Higher Education

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Motivation

- Direct-to-student aid comprises 20% of public higher education spending, through a combination of grants and loans [OECD, 2016].

- Scope for misuse of aid:
  - Low return on investment if school is low quality.
  - Under imperfect competition, private colleges may capture aid via markups.
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• Prior literature highlights deficiencies of U.S. aid design:
  • Largest beneficiaries (for-profit colleges) are low quality schools.
  • Aid design allows for colleges to receive more aid by increasing prices.
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  - Aid design allows for colleges to receive more aid by increasing prices.
- This paper: Evaluate alternative aid policies via a structural model of U.S higher education to improve student welfare.
Market Background

- Setting: Sub-baccalaureate (non-selective) colleges (35% of college enrollment).

• Government intervention in the U.S. sub-baccalaureate education market:
  • Means-tested student aid programs, funded by federal government. Low-income students have access to Pell grants, all students have access to subsidized federal loans. Aid increases with cost of school.
  • Community Colleges (CCs), funded by state and local governments, offer education at subsidized tuition levels.

• Private providers of education are overwhelmingly for-profit institutions (FPIs)
  • FPIs are typically smaller and specialize in vocational training programs.
  • Attract students via advertising: comprises 43.4% of total spending on student services.

• Receive 74% of revenue from federal student aid programs.
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Datasets

• **Sample**: All non-selective, sub-baccalaureate colleges in top 101 DMAs (metro areas) from 2008-2016.

• **School Characteristics/Enrollment**: IPEDS Survey. Participation mandated for all aid-eligible postsecondary schools in U.S.

• **Advertising Data**: Ad$pender dataset (DMA-level).

• **Consumer Demographics**: ACS Census Data.

• **Student Outcomes**: College Scorecard. Cohort-level earnings from IRS for federal aid recipients.
• Estimate quality as value-added in post-college earnings at each school chain.
• Assume selection on observables.
• Identify level of value-added by constructing measure of counterfactual wages if cohort only completed high school.
Model: Demand Side

- Market Definition: All working age (18-50) individuals with high-school education.
- Choice set: all sub-baccalaureate, non-selective schools in home county.
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Individual \( i \) chooses school \( j \) (or outside option) that maximizes utility

\[
 u_{i,j,t} = -\alpha_i p_{i,j,t}(\beta_i) + \lambda_i \log(a_{f(j),t} + 1) + \gamma_i \bar{X}_{j,t} + \delta_j + \xi_{j,t} + \epsilon_{i,j,t} 
\]

- Utility depends on the following school characteristics:
  - Prices: \( p_{i,j,t} \), the net price a student pays.
  - Observables: FPI TV advertising \( a_{f,t} \), student services, degree types, quality.
  - Unobservable Characteristics: \( \delta_j, \xi_{j,t}, \epsilon_{i,j,t} \).

- Preferences depend on:
  - Age, Race, Gender, Low-Income Status,
  - Random unobserved heterogeneity \( \sim N(0, \sigma_k^2) \) for each characteristic \( k \).
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- Student net price \( p_{i,j,t} \): NPV of all payments to attend college. depend on student characteristics, cost of attendance, government aid, and how students discount loans:

\[
p_{i,j,t}(\beta_i) = OOP_{i,j,t} + \beta_i L_{i,j,t}\]

- \( OOP_{i,j,t} \): out-of-pocket cost, after receiving Pell grants. Capped at \( EFC_i \).
- \( L_{i,j,t} \): loan amount+interest needed to pay cost of attendance.
- \( \beta_i \): Net discount factor \( \in [0,1] \) on 10-year loans.
Model: Supply Side

- For-Profit colleges choose tuition $p_{j,t}$ and advertising $a_{f,t}$ to maximize static chain-level profits, given constant marginal costs and linear fixed advertising costs.
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Community Colleges choose tuition $p_{j,t}$ to satisfy a budget constraint, given constant marginal costs and observed budget from state to subsidize students.
Model: Estimation Strategy

- Estimate model using GMM, with micromoments on student demographic sorting and survey data on discount rates.
- Construct 3 instruments to identify preferences for endogenous supply variables.
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- **FPI Prices**: Simulated pell grant generosity. Details
- **CC Prices**: State-level shocks to 4-year public college tuition prices. Details
- **FPI Advertising**: Political advertising. Details
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  Using dependence of CCs on state aid, estimate state-level tuition shocks for public schools in another market (selective 4-year colleges) as a measure of state policy changes towards education funding.

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  - **FPI Advertising**: Political advertising

Estimate the effect of cost shock on monthly FPI advertising. Use schools’ advertising propensities in different parts of year to generate within-market variation in political ad shock exposure.
Overview: Model Results

- Students are less price elastic to tuition (-.7) than net price (-1.8).
- Less tuition elastic if passthrough from tuition to net price is low. Effect is greatest on low-income students, leading to 80% lower tuition sensitivity.
- Low average valuation of quality ($1000 increase in annual earnings = $62), high valuation of FPI advertising (10% increase = $374)
- High markups / state subsidies explain difference between CC and FPI prices.
Counterfactual Policies

- Counterfactual policies considered:
  - Bans
  - Vouchers
Counterfactual Policies

- Counterfactual policies considered:
  - **Bans**:
    1. **For-Profit Ban**: Ban for-profit education sector entirely
    2. **Gainful Employment Ban**: Ban low quality Schools ($\psi_j < 0$, 24% of schools)

Forms of both have been proposed by national policymakers. Hold government spending constant by increasing pell grant generosity.

- **Vouchers**
Counterfactual Policies

- Counterfactual policies considered:
  
  - **Bans**
  
  - **Vouchers**: Eliminate current aid system, and give low income students a cash transfer to attend a school.
    
    1. **Fixed voucher**: equal size transfer regardless of school.
    2. **Optimal Quality Voucher**: Solution to social planner problem of maximizing total value added. Give more voucher aid to schools with higher quality. Conditional on quality, give more aid to schools whose enrollment is more elastic to aid.
Counterfactual Policies

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- Evaluate alternative policies based on two metrics, capturing student taste for schooling environment and the quality of education delivered:
  - Revealed Choice Consumer Surplus: expected utility in dollars
  - Expected Value-added: expected quality for individual $i$ in market $t$. 
Counterfactual Outcomes
Conclusion

• Existing policy proposals do little to improve student outcomes.
• Vouchers increase consumer surplus and quality of education. Effect is largest for targeted students.
• Policymakers can maximize education quality by incentivizing high-quality FPIs to attract students.


Low-Income Counterfactual Outcomes

![Graph showing percent change in value added and consumer surplus for different policies. The graph compares current equilibrium, FPI ban, GE ban, fixed voucher, and optimal voucher outcomes.]
Student Loan Policy over time

 APR (%)  

Year  
Subsidized Federal Loans  
Unsubsidized Federal Loans  
Private Market Loans  

Loan Limit (2017 USD)  

Year  
Subsidized Loan Limit  
Unsubsidized Loan Limit (Dependents)  
Unsubsidized Loan Limit (Independents)
FPI tuitions tracks federal aid generosity ($\bar{\pi}_t$). Consistent with the Bennett hypothesis studied in education research [Cellini and Goldin, 2014, Turner, 2014, Lucca et al., 2018].

Note: Prices weighted by enrollment, adjusted to 2017 USD
• use a **shift-share** design with simulated instrument capturing Pell Grant generosity.

• Idea: \( E[\bar{\pi}_{i,t}|t]\) captures generosity in market \( t\), but endogenous to current labor market conditions.

• Instead: Simulate generosity from policy in year corresponding to market \( t\), given pre-period (2006) demographics in county \( c\):

\[
Z_{j,t}^\pi = E[\bar{\pi}_{i,t}|i \sim F(EFC_{c,2006}), \text{Pell Grant Policy in } t]
= \int \max(\bar{\pi}_t - EFC_i, 0) \partial F(EFC_{c,2006})
\]

• Intuition: national increases in pell grant aid induce higher FPI prices. FPIs located in historically poorer areas more likely to respond.
For-Profit College Tuition Instrument Binscatter

Residualized FPI Tuition vs. Residualized Pell Grant Generosity Instrument

\[ \beta = 1.959 \text{ (F-Stat}=141.69) \]

Note: Controls include School FE, Market Demographics, School Attributes.
• CCs receive on average 1/3 of annual revenue from state governments.
• Instrument for tuition at community colleges with state-level shocks $\nu_{s,t}$ to 4-year selective public college tuition in two steps:

\[
\text{Avg. Public 4-year College Tuition} = \beta_s \cdot \text{State Fixed Effect} + \gamma_t \cdot \text{Year Fixed Effect} + \nu_{s,t} \cdot \text{State Budget/Labor Market Controls} + \nu_{s,t} \cdot \text{State-Year Policy Shock}
\]
Community College Prices: State Tuition shocks

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$$\bar{p}_{s,t} = \beta_s + \gamma_t + \nu X_{s,t} + \nu_{s,t}$$

Avg. Public 4-year College Tuition  State Fixed Effect  Year Fixed Effect
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\(\bar{p}_{s,t}\): Avg. Public 4-year College Tuition
\(\beta_s\): State Fixed Effect
\(\gamma_t\): Year Fixed Effect
\(\nu_{s,t}\): State-Year Policy Shock

State Budget/Labor Market Controls

- Largest Tuition Shocks:
  - Louisiana 2016 ($1,300): Legislature passes policy allowing tuition hikes set by colleges without legislature approval.
Community College Tuition Instrument Binscatter

Residualized CC Tuition

Residualized 4-Year Public Tuition State-Year Shocks

$\beta = 0.198$ (F-Stat = 46.29)

Note: Controls include School FE, Market Demographics, School Attributes.
Estimate nonlinear effect $f$ of political ads on FPI ads using monthly data:

$$\log(a_{f,d,m,t} + 1) = \alpha_{f,d} + \delta_t + \beta X_{f,t,d} + f(P_{d,m,t})$$
Monthly AdShares

- High-frequency variation in monthly advertising can have heterogeneous effects on annual enrollment at schools.
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- Major driver of when firms advertise: enrollment periods.
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• Major driver of when firms advertise: enrollment periods.

• Construct “exposure” measure to political ads in month $m$ based on propensity to purchase ads in non-election years:

$$\tilde{s}_{f,d,m} = \frac{1}{T_{f,d,NE}} \sum_{t:t \in NE} \frac{a_{f,d,m,t}}{\sum_{k=1}^{12} a_{f,d,k,t}}$$

• Propensity shares creates within-market heterogeneity in effect of political advertising.
Ad Scheduling By Calendar System

- Calendar system
  - Semester (5.8%)
  - Quarter (23.5%)
  - Other academic year (10.8%)
  - Differs by program (16.9%)
  - Continuous (42.5%)
β = 2.242 (F-Stat = 10.04)

Note: Controls include School FE, Market Demographics, School Attributes.
Determinants of Value-added: Selected Coefficients

Effect on Value-Added (2017 $)

Offer Consumer Services Program
Offer Engineering Program
Offer Health Sciences Program
Offer Business Program
Offer Associate's Degree
For-Profit College

Effect on Value-Added (2017 $)

-6,000  -4,000  -2,000  0  2,000
Alternative Value-Added Measures

VA in $\Pr(\text{Employed})$

VA in $\Pr(\text{Earn} \geq \$25,000)$
School-Level Tuition Elasticities

The graph shows the distribution of supply price elasticities for different types of schools. The x-axis represents the supply price elasticity, while the y-axis shows the density of schools at each elasticity level.

Two categories are depicted:
- Community Colleges
- For-Profit Colleges

The distribution for Community Colleges is more spread out, indicating a wider range of elasticity values, whereas For-Profit Colleges have a more concentrated distribution, suggesting a narrower range of elasticity values.

The graph visually compares the tuition elasticities between community and for-profit colleges, highlighting differences in how changes in supply price affect tuition decisions.
For-Profit College Bans

- National policymakers have proposed barring federal aid for FPI firms, or their advertising efforts.
- Consider an equilibrium where FPIs are removed from choice set, or required to set $a_{f,t} = 0$. 
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• Return government savings in the form of increasing the generosity $g$ of the pell grant program

$$\pi_{t,p} = g_p \times \pi_t$$
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- Benchmark for evaluating existing policy proposals to improve welfare/quality in the sector.
Voucher Policies

- 99% of federal aid in-sample is spent on low-income (pell-eligible) students. Focus on voucher policies servicing these individuals.

\[
\tau_{i,j,t} = \begin{cases} 
\tau_{j,t} & \text{if } EFC_i \leq EFC_t \\
0 & \text{if } EFC_i > EFC_t 
\end{cases}
\]

- **Voucher Design 1**: \( \tau_{j,t} = g \). Deliver equal amount of aid to students regardless of cost, eliminating increased aid to higher priced schools.

- **Voucher Design 2**: \( \tau_{j,t} = g \times \psi_j \times \frac{\varepsilon_j}{\varepsilon_j+1} \). Give students more aid for attending higher quality institutions that are elastic to voucher subsidy.
Social planner chooses policy $\mathcal{P}$ to maximize quality provision to low-income students $L$ of the sector. Restrict $\mathcal{P}$ to be a set of school-specific vouchers $\{\tau_{j,t}\}$ for each school:

$$\begin{align*}
\max_{\mathcal{P} = \{\tau_{j,t}\}} & \sum_m M_{t,L} \sum_{j \in \mathcal{J}_t} s_{j,t,L}(\vec{\tau}) \times \psi_j \\
\text{s.t.} & \sum_m M_{m,L} \sum_{j \in \mathcal{J}_m} s_{j,t,L}(\vec{\tau}) \times \tau_{j,t} \leq G
\end{align*}$$
Optimal Voucher

- Simplified solution to social planner problem:

\[
\tau_{j,t}^* = \frac{1}{\lambda} \times \frac{\varepsilon_{j,j,t}}{1 + \varepsilon_{j,j,t}} \times \psi_j
\]  

1. Shadow Price of Budget Constraint
2. Voucher Elasticity Distortion Term
3. Quality

Schools receive more aid if voucher elasticity \(\varepsilon_{j,j,t}\) (change in enrollment from more voucher aid) is higher. Depends on price sensitivity of demand side and price/advertising response from supply side.
Optimal Voucher

• Simplified solution to social planner problem:

\[ \tau_{j,t}^* = \frac{1}{\lambda} \times \frac{\varepsilon_{j,j,t}^T}{(1 + \varepsilon_{j,j,t})^T} \times \psi_j \]  

(2)

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Proposition 1
Suppose the social planner optimizes Equation 1. The optimal voucher in market $m$ is:

$$\vec{\tau}^*_m = (I + E_m)^{-1}E_m \times \frac{1}{\lambda} \times \vec{\psi}_m$$

(3)

where $E_m$ is a $J_m \times J_m$ matrix with elements:

$$E_{m,k,j} = \varepsilon_{k,j,t} \times \frac{S_{k,L}}{S_{j,L}}$$
Distribution of Voucher Distortion Term

Distribution of Voucher Distortion

Distortion Term \( \epsilon/(\epsilon+1) \)

- Community Colleges
- Non-Advertising For-Profits
- Advertising For-Profits
Binscatter of Enrollment Change Under Optimal Voucher

![Graph showing change in log enrollment against value-added with data points for CCs (Bins=16) and FPIs (Bins=24).]
Binscatter of Supply Repsonse Under Optimal Voucher

Change in Log(Tuition)

Value-Added

CCs (Bins=12)  FPIs (Bins=23)

Change in Log(TV Ads+1)

Value-Added

Advertising FPIs (Bins=24)