The Incidence of Student Financial Aid: Evidence from the Pell Grant Program

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Background and Motivation

- Affordability and access to higher education
  - Large private returns, positive externalities, credit constraints
  - Rationale for need-based student aid
- Federal Pell Grant Program
  - $35 billion provided to 9.5 million low-income students (2011)
- Effectiveness of need-based aid depends on whether it “sticks”
  - Tax incidence framework
- Shift in the organization of higher education
  - Growth of the for-profit sector
Overview

• Framework:
  – Schools observe students’ ability to pay and outside aid
  – Offer schedule of prices via:
    • Overall tuition
    • Individual discounts (scholarships)

• Data: National Postsecondary Student Aid Survey (NPSAS)

• Questions:
  – What is the economic incidence of need-based aid?
    • How much of every Pell $1 is passed-through to schools?
  – Does behavior vary across sectors (control, selectivity)?
    • Can we say something about schools’ objectives from their response?
Contributions

• Estimate the economic incidence of need-based aid
  – Regression discontinuity (RD) and regression kink (RK) designs
  – On average, students’ prices fall by $0.84 for every $1 of Pell Grant aid
  – $0.16 passed-through to schools

• Highlight a general vulnerability of the RD design
  – RD does not identify pass-through of outside student aid
  – “Treatment” of Pell Grant receipt is multidimensional

• Develop a combined RD/RK estimator
  – Allows for separate identification of treatment dimensions
  – Applicable in other circumstances
The Pell Grant Program

[Graph showing the maximum Pell Grant over time, with data points indicating the increase in grant amounts from 1974 to 2010.]

Maximum Pell Grant (nominal) and Maximum Pell Grant (2011$)
The Pell Grant Program

• Variation in maximum award not exogenous
  – 75% of eligible students receive less than maximum

• Statutory award for student $i$ in year $t$ depends on both her expected family contribution (EFC) and the maximum award

\[ Pell_{it} = \max\{ (\max Pell_t - EFC_{it}), 0\} \]

• Students with $Pell_{it} \in [200, 399]$ receive $400$

• EFC is a nonlinear function of dependency status, income, assets, family size, number of siblings also attending college
The Empirical Distribution of Pell Grant Aid

Distance from Pell Grant Eligibility Threshold

Average Pell Award

Schedules
The Regression Kink Design

• Analogous to RD design
  – Identification from discontinuous change in derivative (versus change in level) of endogenous regressor (Nielsen et al., 2010; Card et al., 2009)

• Identifying assumption:
  – Conditional on unobservables, density of EFC is smooth (continuously differentiable) at threshold for Pell Grant eligibility
  – Implies that individuals cannot perfectly sort
  – Encompasses identifying assumption for RD design

• Strong testable predictions:
  – Density of EFC continuous and smooth at threshold
  – Distribution of observable characteristics continuous and smooth
The Regression Kink Design

• Analogous to RD design
  – Identification from discontinuous change in derivative (versus change in level) of endogenous regressor (Nielsen et al., 2010; Card et al., 2009)

• Key identifying assumption:
  – Conditional on unobservables, density of EFC is continuously differentiable at threshold for Pell Grant eligibility
  => Individuals cannot perfectly sort
The RK Design: Testable Implications

• Density of EFC continuous and smooth at threshold
• Distribution of observable characteristics also continuous and smooth

These conditions are satisfied.
Testing Identifying Assumptions: Density of EFC
Distribution of Observable Characteristics at Cut-Off for Pell Grant Eligibility

A. Race

B. Gender

D. SAT Score

E. Age
Conceptual Framework: RD and RK Designs

Change in level = 400
Change in slope = -1

Distance from Pell Grant Eligibility Threshold

Pell Grant Aid, Institutional Aid

Pell Grant
Observed Institutional Grants
Conceptual Framework: RD and RK Designs

1. No Crowd Out

![Graph showing the relationship between Pell Grant Aid, Institutional Aid, and the distance from Pell Grant Eligibility Threshold. The graph includes lines representing 'Pell Grant' and 'Observed Institutional Grants.' The graph indicates a change in level of 400 and a change in slope of -1.](image-url)
Conceptual Framework: RD and RK Designs

1. No Crowd Out

![Graph showing change in level and slope for Pell Grant Aid and Institutional Aid.]

- Change in level = 400
- Change in slope = -1
- Change in level = 0
- Change in slope = 0
Conceptual Framework: RD and RK Designs

1. No Crowd Out

\[ \text{RD Estimator} = \frac{0}{400} = 0 \]

Change in level = 0
Change in slope = 0

Change in level = 400
Change in slope = -1
Conceptual Framework: RD and RK Designs

1. No Crowd Out

\[
\text{RK Estimator} = \frac{0}{-1} = 0
\]

\[
\text{RD Estimator} = \frac{0}{400} = 0
\]

Change in level = 0
Change in slope = 0
Change in level = 400
Change in slope = -1

Distance from Pell Grant Eligibility Threshold

Pell Grant Aid, Institutional Aid

- Pell Grant
- Observed Institutional Grants
Conceptual Framework: RD and RK Designs

2. Full Crowd Out

![Graph showing the relationship between Pell Grant Aid, Institutional Aid, and distance from Pell Grant Eligibility Threshold. The graph illustrates a negative slope change (-1) and a change in level (400).]
Conceptual Framework: RD and RK Designs

2. Full Crowd Out

<table>
<thead>
<tr>
<th>Change in level</th>
<th>Change in slope</th>
</tr>
</thead>
<tbody>
<tr>
<td>400</td>
<td>1</td>
</tr>
<tr>
<td>-400</td>
<td>-1</td>
</tr>
</tbody>
</table>

Distance from Pell Grant Eligibility Threshold

- Pell Grant Aid, Institutional Aid
- Change in level = 400, Change in slope = 1
- Change in level = -400, Change in slope = -1
Conceptual Framework: RD and RK Designs

2. Full Crowd Out

\[ \text{RK Estimator} = \frac{1}{-1} = -1 \]
Conceptual Framework: RD and RK Designs

2. Full Crowd Out

\[ \text{RK Estimator} = \frac{1}{-1} = -1 \]
\[ \text{RD Estimator} = \frac{-400}{400} = -1 \]
The Relationship between Institutional Aid and Pell Grants

Local linear regression
Parametric RD and RK Estimation

- **DGP:**  \( Y = f(Pell, \tau) + g(EFC) + U \)
- **Where:**  \( f(Pell, \tau) = \tau_1 Pell \)
Parametric RD and RK Estimation

• DGP: \[ Y = f(Pell, \tau) + g(EFC) + U \]
• Where: \[ f(Pell, \tau) = \tau_1 Pell \]

(First Stage)

\[ Pell_{it} = \eta \cdot 1[E\tilde{F}C_{it} < 0] + \lambda \cdot 1[E\tilde{F}C_{it} < 0] \cdot (E\tilde{F}C_{it}) + \sum_{\rho} [\psi_{\rho} \cdot (E\tilde{F}C_{it})^\rho] + \theta_j + \theta_t + \nu_{ijt} \]

(Reduced Form)

\[ y_{ijt} = \beta \cdot 1[E\tilde{F}C_{it} < 0] + \gamma \cdot 1[E\tilde{F}C_{it} < 0] \cdot (E\tilde{F}C_{it}) + \sum_{\rho} [\pi_{\rho} \cdot (E\tilde{F}C_{it})^\rho] + \delta_j + \delta_t + \varepsilon_{ijt} \]
Parametric RD and RK Estimation

- **DGP:** \( Y = f(Pell, \tau) + g(EFC) + U \)
- **Where:** \( f(Pell, \tau) = \tau_1 Pell \)

**(First Stage)**

\[
Pell_{it} = \eta \cdot 1[\widetilde{EFC}_{it} < 0] + \lambda \cdot 1[\widetilde{EFC}_{it} < 0] \cdot (\widetilde{EFC}_{it}) + \sum_{\rho} [\psi_{\rho} \cdot (\widetilde{EFC}_{it})^{\rho}] + \theta_j + \theta_t + \nu_{ijt}
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**(Reduced Form)**

\[
y_{ijt} = \beta \cdot 1[\widetilde{EFC}_{it} < 0] + \gamma \cdot 1[\widetilde{EFC}_{it} < 0] \cdot (\widetilde{EFC}_{it}) + \sum_{\rho} [\pi_{\rho} \cdot (\widetilde{EFC}_{it})^{\rho}] + \delta_j + \delta_t + \varepsilon_{ijt}
\]

- **RK estimator:** \( \hat{\tau}_{RK} = \frac{\hat{\gamma}}{\hat{\lambda}} \)
- **RD estimator:** \( \hat{\tau}_{RD} = \frac{\hat{\beta}}{\hat{\eta}} \)
Parametric RK Estimates

\[ \hat{\gamma} = 0.15 \ (0.031) \]

\[ \hat{\lambda} = -0.70 \ (0.007) \]
Parametric RK Estimates

\[ \hat{\tau}_{RK} = -0.22 \ (0.044) \]

\[ \hat{\gamma} = 0.15 \ (0.031) \]

\[ \hat{\lambda} = -0.70 \ (0.007) \]
Parametric RD Estimates

\( \hat{\eta} = 398 \ (12.5) \)

\( \hat{\beta} = 128 \ (42.6) \)

\( \hat{\tau}_{RK} = -0.22 \ (0.044) \)
**Parametric RD Estimates**

\[ \hat{\tau}_{RK} = -0.22 (0.044) \]

\[ \hat{\tau}_{RD} = 0.32 (0.106) \]

\[ \hat{\beta} = 128 (42.6) \]

\[ \hat{\eta} = 398 (12.5) \]
What do these parameters identify?
A model of firm behavior

- Schools practice price discrimination
  - $N$ student groups with demand $Q_i(p_i)$
  - $p_i$ is price paid by students in group $i$
  - Constant marginal cost $c$
  - Subsidy $s$

- Profit maximizing monopolist solves:

$$\max_{p_1, \ldots, p_N} \pi = \sum_{i=1}^{N} Q_i(p_i)(p_i - (c - s))$$
What do these parameters identify?  
A model of firm behavior

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$$
\max_{p_1, \ldots, p_N} \pi = \sum_{i=1}^{N} Q_i(p_i)(p_i - (c - s))
$$

$$
p_i = (c - s)\mu_i \quad \text{where} \quad \mu_i = \left( \frac{e_i}{e_i + 1} \right)
$$
What do these parameters identify?

A model of firm behavior

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$$p_i = (c - s)\mu_i \text{ where } \mu_i = \left( \frac{e_i}{e_i + 1} \right)$$

$$\frac{dp_i}{ds} = -\mu_i + (c - s)\frac{d\mu_i}{ds}$$

curvature of demand
What do these parameters identify?

DGP: \( Y = f(Pell, \tau) + g(EFC) + U \)

Where: \( f(Pell, \tau) = \tau_1 Pell \)

- If changes in \( \mu_i \) are small: \( \tau_{RK} = \tau_{RD} = \tau_1 \approx \frac{dp_i}{ds} \)
- As long as there is no inflection point in log demand:
  - RD and RK should have same sign
Understanding Differences in RD and RK Estimates

• Public institution pricing inconsistent with profit-maximization
  – Unless student demand has very specific features

• Alternative framework:
  – Schools have preferences over the characteristics of students
  – Receiving a Pell Grant affects how a school treats you

• “Treatment” of Pell Grant receipt affects pricing in two ways
  – Outside aid + label
An Alternative Model of Firm Behavior

- Schools have preferences over the characteristics of students
  - Receiving a Pell Grant affects how a school treats you
  - \( \alpha_i \) is the weight given to students in group \( i \)

\[
\max_{p_1, \ldots, p_N} W = \sum_{i=1}^{N} \alpha_i(s)Q_i(p_i) \quad \text{s.t.} \quad \sum_{i=1}^{N} Q_i(p_i)(p_i - (c - s)) \geq 0
\]
An Alternative Model of Firm Behavior

- Schools have preferences over the characteristics of students
  - Receiving a Pell Grant affects how a school treats you
  - $\alpha_i$ is the weight given to students in group $i$

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\]

\[
\frac{dp_i}{ds} = \left(-\mu_i + (c-s)\frac{d\mu_i}{ds}\right) - \left(\mu_i \frac{d\alpha_i}{ds} + \tilde{\alpha}_i(s)\frac{d\mu_i}{ds}\right)
\]

- pass-through
- willingness to pay
An Alternative Model of Firm Behavior

\[
\frac{dp_i}{ds} = \left( -\mu_i + (c-s) \frac{d\mu_i}{ds} \right) - \left( \mu_i \frac{d\tilde{\alpha}_i}{ds} + \tilde{\alpha}_i(s) \frac{d\mu_i}{ds} \right)
\]

\underbrace{\text{pass-through}} \quad \underbrace{\text{willingness to pay}}

Implications:

1. Pass-through smaller than in case of profit maximization
2. If “label” does not depend on size of Pell Grant:

\[
p_i \approx \tau_0 1[s_i > 0] + \tau_1 s_i + u_i
\]
RD Estimation with a Multidimensional Treatment

DGP: \[ Y = f(Pell, \tau) + g(EFC) + U \]

Where: \[ f(Pell, \tau) = \tau_0 1[Pell > 0] + \tau_1 Pell \]

The “treatment” of Pell Grant receipt has two dimensions:

(1) Additional dollar of outside aid (pass-through)
(2) “Pell Grant recipient” label (willingness to pay)
RD Estimation with a Multidimensional Treatment

DGP: \[ Y = f(Pell, \tau) + g(EFC) + U \]

Where: \[ f(Pell, \tau) = \tau_0 1[Pell > 0] + \tau_1 Pell \]

RD Estimator:

\[
\tau_{RD} = \frac{\lim_{\varepsilon \uparrow 0} E[Y | EFC = ef_{c_0} + \varepsilon] - \lim_{\varepsilon \downarrow 0} E[Y | EFC = ef_{c_0} + \varepsilon]}{\lim_{\varepsilon \uparrow 0} E[Pell | EFC = ef_{c_0} + \varepsilon] - \lim_{\varepsilon \downarrow 0} E[Pell | EFC = ef_{c_0} + \varepsilon]} - \frac{\tau_0}{Pell(efc_{0})}
\]
RD Estimation with a Multidimensional Treatment

DGP:
\[ Y = f(Pell, \tau) + g(EFC) + U \]

Where:
\[ f(Pell, \tau) = \tau_0 1[Pell > 0] + \tau_1 Pell \]

RK Estimator:

\[ \tau_{RK} = \frac{\lim_{\varepsilon \uparrow 0} \frac{\partial E[Y \mid EFC = efc_0 + \varepsilon]}{\partial efc} - \lim_{\varepsilon \downarrow 0} \frac{\partial E[Y \mid EFC = efc_0 + \varepsilon]}{\partial efc}}{\lim_{\varepsilon \uparrow 0} \frac{\partial E[Pell \mid EFC = efc_0 + \varepsilon]}{\partial efc} - \lim_{\varepsilon \downarrow 0} \frac{\partial E[Pell \mid EFC = efc_0 + \varepsilon]}{\partial efc}} \]

\[ \tau_{RK} = \tau_1 \]
RD Estimation with a Multidimensional Treatment

Implications:

• RD estimates “reduced form”: \( \tau_{RD} = \tau_1 + \frac{\tau_0}{Pell(efc_0)} \)

• RK estimates impact of additional dollar: \( \tau_{RK} = \tau_1 \)
RD Estimation with a Multidimensional Treatment

Implications:

- RD estimates “reduced form”: \( \tau_{RD} = \tau_1 + \frac{\tau_0}{Pell(efc_0)} \)
- RK estimates impact of additional dollar: \( \tau_{RK} = \tau_1 \)
- RD + RK allows for separate estimation of pricing response to outside aid and willingness to pay for Pell Grant recipients:

\[
\begin{align*}
\hat{\tau}_1 &= \hat{\tau}_{RK} \\
\hat{\tau}_0 &= (\hat{\tau}_{RD} - \hat{\tau}_{RK}) \cdot Pell(efc_0)
\end{align*}
\]
## Treatment Dimensions

<table>
<thead>
<tr>
<th></th>
<th>Pass-Through</th>
<th>Willingness to Pay</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. All institutions</td>
<td>-0.219</td>
<td>260.5</td>
</tr>
<tr>
<td></td>
<td>(0.044)**</td>
<td>(50.06)**</td>
</tr>
<tr>
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<td></td>
<td>133,270</td>
</tr>
</tbody>
</table>

Notes: Each column within a panel represents a separate regression. Standard errors clustered at institution level in parentheses; ** p<0.01, * p<0.05, + p<0.1.
Heterogeneity by Sector: Public Institutions

- Pell Grants
- Institutional Grants

Distance from Pell Grant Eligibility Threshold

Institutional Grants (Residual)

Pell Grants (Residual)
Heterogeneity by Sector: Nonselective Private Institutions

![Graph showing the relationship between institutional grants, pell grants, and distance from pell grant eligibility threshold.]

- Pell Grants
- Institutional Grants

Distance from Pell Grant Eligibility Threshold vs. Institutional Grants, Pell Grants (Residual)
Heterogeneity by Sector: Selective Nonprofits

Distance from Pell Grant Eligibility Threshold

Institutional Grants, Pell Grants (Residual)

Pell Grants

Institutional Grants
### Heterogeneity by Sector: Treatment Dimensions

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</tr>
<tr>
<td><strong>B. By sector</strong></td>
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<tr>
<td>Public Nonselective</td>
<td>-0.179</td>
<td>318.3</td>
</tr>
<tr>
<td></td>
<td>(0.017)**</td>
<td>(63.31)**</td>
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<tr>
<td>Public Selective</td>
<td>-0.173</td>
<td>618.9</td>
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<tr>
<td></td>
<td>(0.032)**</td>
<td>(101.5)**</td>
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<tr>
<td>Nonprofit Nonselective</td>
<td>-0.154</td>
<td>-193.3</td>
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<tr>
<td></td>
<td>(0.060)*</td>
<td>(216.6)</td>
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<tr>
<td>Nonprofit Selective</td>
<td>-0.687</td>
<td>97.23</td>
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<td></td>
<td>(0.101)**</td>
<td>(248.3)</td>
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<tr>
<td>For-profit</td>
<td>-0.133</td>
<td>84.67</td>
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<td></td>
<td>(0.029)**</td>
<td>(80.84)</td>
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<td><strong>Observations</strong></td>
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<td>133,270</td>
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Alternative Explanations

• Quality upgrading?
  – No discontinuities in revenue/FTE, expenditures/FTE on instruction, institutional aid, student services, Federal student loan default rates
Alternative Explanations

- **Quality upgrading?**
  - No discontinuities in revenue/FTE, expenditures/FTE on instruction, institutional aid, student services, Federal student loan default rates

- **Mechanical relationship?**
  - Over 90 percent of students have unmet need
  - $10,000 on average; $20,000 for selective nonprofit students
Alternative Explanations

• Quality upgrading?
  – No discontinuities in revenue/FTE, expenditures/FTE on instruction, institutional aid, student services, Federal student loan default rates

• Mechanical relationship?
  – Over 90 percent of students have unmet need
  – $10,000 on average; $20,000 for selective nonprofit students

• Heterogeneous treatment effects?
  – Eligibility threshold moves as maximum Pell Grant increases
  – Estimated crowd-out and willingness to pay consistent across years
Estimating Total Crowd-Out

Distance from Pell Grant Eligibility Threshold

Pell Grant Aid, Institutional Aid

- **Pell Grant**
- **Observed Institutional Grants**
Estimating Total Crowd-Out

Total Pell

Distance from Pell Grant Eligibility Threshold

Pell Grant Aid, Institutional Aid

- Pell Grant
- Observed Institutional Grants
Estimating Total Crowd-Out
Estimating Total Crowd-Out

Distance from Pell Grant Eligibility Threshold

- Pell Grant
- Observed Institutional Grants
Estimating Total Crowd-Out
Estimating Total Crowd-Out

- Pell Grant Aid, Institutional Aid
- Distance from Pell Grant Eligibility Threshold
- Pell Grant Observed Institutional Grants
<table>
<thead>
<tr>
<th>Institution Type</th>
<th>Pass-through</th>
<th>95% CI</th>
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</thead>
<tbody>
<tr>
<td>All Institutions</td>
<td>0.163</td>
<td>[0.114, 0.212]</td>
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<tr>
<td>Public Institutions</td>
<td>0.031</td>
<td>[0.002, 0.060]</td>
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<tr>
<td>Nonselective Private Institutions</td>
<td>0.176</td>
<td>[0.062, 0.290]</td>
</tr>
<tr>
<td>Selective Nonprofit Institutions</td>
<td>0.787</td>
<td>[0.563, 1.011]</td>
</tr>
</tbody>
</table>
Remaining Questions

• Where does the money go?
  – Public schools redistribute among Pell Grant eligible
  – Suggestive evidence that for-profits retain as profits

• How to value “product”?
  – No large impacts on probability of attending college
  – Small degree of upgrading for marginally eligible students

• What happens in the long-run?
  – Estimates represent short-run incidence of Pell Grant aid
  – Supply of public, selective nonprofit institutions relatively fixed
  – Cellini (2010) shows for-profit entry responds to Pell Grant generosity
  – In long-run, will increased entry drive rents lower?
Conclusions

• Two dimensions to treatment
  – “Pell Grant recipient” label, extra dollar of outside aid
  – Willingness to pay, pass-through

• RD estimates represent “reduced form”

• Combined RD/RK to separately identify dimensions
  – Insight into industrial organization of higher education
  – Methods can be used in other circumstances
Conclusions

- Differences in objectives across sectors
  - Public schools value Pell Grant status
  - For-profit schools behave no differently than nonselective nonprofits
- Differences in market power
  - Pass-through significantly higher in selective nonprofit sector
- Students’ prices fall by $0.84 for every $1 in Pell Grant aid
  - In 2011, $35 billion in Pell Grant subsidies
  - $5 to $6 billion passed-through to institutions via price discrimination
Additional Slides
The Pell Grant Program

Year


Maximum Pell Grant (2011$)

3000 3500 4000 4500 5000 5500 6000

Pct of COA

1980: Max Pell = $4950 (58% of COA)

2009: Max Pell = $5015 (27% of COA)
Calculating Dependent Students’ EFC
The Pell Grant Program

Pell award amounts in nominal dollars
The Relationship between Institutional Aid and Pell Grants
# RD & RK Estimates: Varying Windows and Polynomials

<table>
<thead>
<tr>
<th>Polynomial of IV (Order)</th>
<th>IV (RK) (1)</th>
<th>IV (RD) (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. (EFC - k_t) in [-4100,10000]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>One</td>
<td>-0.294</td>
<td>0.298</td>
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<tr>
<td></td>
<td>(0.024)**</td>
<td>(0.109)**</td>
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<tr>
<td>Two</td>
<td>-0.219</td>
<td>0.323</td>
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<tr>
<td></td>
<td>(0.044)**</td>
<td>(0.106)**</td>
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<tr>
<td>Three</td>
<td>-0.028</td>
<td>0.315</td>
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<tr>
<td></td>
<td>(0.070)</td>
<td>(0.174)+</td>
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<tr>
<td>Optimal Degree</td>
<td>2</td>
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<td>Observations</td>
<td>133,270</td>
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<tr>
<td>B. (EFC-k_t) in [-4000,4000]</td>
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<td>One</td>
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<td>Two</td>
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<td></td>
<td>(0.107)</td>
<td>(0.209)</td>
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<tr>
<td>Three</td>
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<td></td>
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<td>(0.475)</td>
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<td>Optimal Degree</td>
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**Notes:** Each cell represents a separate regression. Standard errors clustered at institution level in parentheses; ** p<0.01, * p<0.05, + p<0.1.
## Treatment Dimensions by Sector and Year

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
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<tbody>
<tr>
<td><strong>Public</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Pass-through</td>
<td>-0.088</td>
<td>-0.016</td>
<td>-0.066</td>
<td>-0.115</td>
</tr>
<tr>
<td></td>
<td>(0.051)+</td>
<td>(0.027)</td>
<td>(0.023)**</td>
<td>(0.019)**</td>
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<td>Willingness to pay</td>
<td>688.5</td>
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<td>(355.9)+</td>
<td>(142.4)</td>
<td>(408.9)</td>
<td>(141.7)**</td>
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<tr>
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<tr>
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<td>-0.245</td>
<td>-0.124</td>
<td>-0.117</td>
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<tr>
<td></td>
<td>(0.053)*</td>
<td>(0.107)+</td>
<td>(0.064)+</td>
<td>(0.061)**</td>
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<tr>
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<td>(353.0)</td>
<td>(722.0)</td>
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<tr>
<td><strong>Nonprofit Selective</strong></td>
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<td></td>
<td></td>
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<tr>
<td>Pass-through</td>
<td>-1.893</td>
<td>-1.041</td>
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<tr>
<td></td>
<td>(0.606)**</td>
<td>(0.241)**</td>
<td>(0.178)**</td>
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<td>(932.4)+</td>
<td>(675.1)</td>
<td>(1248)</td>
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<td>21,630</td>
<td>22,760</td>
<td>37,550</td>
<td>51,330</td>
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</table>

**Notes:** Each column represents a separate regression. Standard errors clustered at institution level in parentheses; ** p<0.01, * p<0.05, + p<0.1.
## Heterogeneity by Sector and Student Characteristics

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<tr>
<th></th>
<th>Nonwhite (1)</th>
<th>White (2)</th>
<th>Independent (3)</th>
<th>Dependent (4)</th>
<th>Female (5)</th>
<th>Male (6)</th>
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<tbody>
<tr>
<td><strong>Public</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Pass-through</td>
<td>-0.207</td>
<td>-0.183</td>
<td>-0.073</td>
<td>-0.232</td>
<td>-0.208</td>
<td>-0.195</td>
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<tr>
<td></td>
<td>(0.031)**</td>
<td>(0.021)**</td>
<td>(0.013)**</td>
<td>(0.024)**</td>
<td>(0.021)**</td>
<td>(0.027)**</td>
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<td>Willingness to pay</td>
<td>670.6</td>
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<td>471.5</td>
<td>452.7</td>
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<tr>
<td></td>
<td>(115.9)**</td>
<td>(50.19)**</td>
<td>(88.61)**</td>
<td>(74.89)**</td>
<td>(61.01)**</td>
<td>(79.16)**</td>
</tr>
<tr>
<td><strong>Private Nonselective</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Pass-through</td>
<td>-0.134</td>
<td>-0.150</td>
<td>-0.009</td>
<td>-0.171</td>
<td>-0.145</td>
<td>-0.165</td>
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<tr>
<td></td>
<td>(0.047)**</td>
<td>(0.0500)**</td>
<td>(0.030)</td>
<td>(0.053)**</td>
<td>(0.044)**</td>
<td>(0.049)**</td>
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<td></td>
<td>(159.0)</td>
<td>(142.0)</td>
<td>(116.5)</td>
<td>(196.2)</td>
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<td>(164.6)</td>
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<tr>
<td><strong>Nonprofit Selective</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pass-through</td>
<td>-0.438</td>
<td>-0.982</td>
<td>0.144</td>
<td>-0.609</td>
<td>-0.665</td>
<td>-0.716</td>
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<tr>
<td></td>
<td>(0.163)**</td>
<td>(0.138)**</td>
<td>(0.128)</td>
<td>(0.115)**</td>
<td>(0.131)**</td>
<td>(0.146)**</td>
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<tr>
<td>Willingness to pay</td>
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<td>-505.2</td>
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<tr>
<td></td>
<td>(704.6)</td>
<td>(256.6)+</td>
<td>(375.6)</td>
<td>(309.7)</td>
<td>(339.6)</td>
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<td>59,090</td>
<td>74,180</td>
<td>78,140</td>
<td>55,130</td>
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</tbody>
</table>

**Notes:** Each column represents a separate regression. Standard errors clustered at institution level in parentheses; ** p<0.01, * p<0.05, + p<0.1.
### No Evidence of Quality Upgrading

<table>
<thead>
<tr>
<th>Tuition/FTE</th>
<th>Revenue/FTE</th>
<th>Institutional Expenditures/FTE on:</th>
<th>CDR</th>
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<tbody>
<tr>
<td></td>
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<td>Grants</td>
<td>Instruction</td>
</tr>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
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</tbody>
</table>

**A. All Sectors**

<table>
<thead>
<tr>
<th>Mean of depvar</th>
<th>* Pell Grant Aid</th>
<th>Observations</th>
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<tbody>
<tr>
<td>$10,619</td>
<td>-0.027</td>
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<td>$19,038</td>
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<tr>
<td>$1,061</td>
<td>0.004</td>
<td>66,940</td>
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<td>$6,214</td>
<td>-0.035</td>
<td>83,810</td>
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<td>$5,748</td>
<td>0.008</td>
<td>84,630</td>
</tr>
<tr>
<td>6.55</td>
<td>0.0003</td>
<td>128,800</td>
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</table>

* Pell Grant Aid (0.142) (0.198) (0.015) (0.060) (0.072) (0.0001)***

**Notes:** Each column within a panel represents a separate regression. Standard errors clustered at institution level in parentheses; ** p<0.01, * p<0.05, + p<0.1.
## No Evidence of Quality Upgrading

<table>
<thead>
<tr>
<th></th>
<th>Tuition/FTE</th>
<th>Revenue/FTE</th>
<th>Institutional Expenditures/FTE on:</th>
<th>CDR</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>Grants (3)</td>
<td>Instruction (4)</td>
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<tr>
<td>B. By Sector</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Nonselective Public</td>
<td></td>
<td></td>
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<tr>
<td>Mean of depvar</td>
<td>$5,160</td>
<td>$13,629</td>
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<tr>
<td>* Pell Grant Aid</td>
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<td></td>
<td>(0.040)*</td>
<td>(0.074)*</td>
<td>(0.008)+</td>
<td>(0.024)</td>
</tr>
<tr>
<td>Selective Public</td>
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<td>0.139</td>
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<tr>
<td></td>
<td>(0.059)</td>
<td>(0.170)</td>
<td>(0.013)+</td>
<td>(0.064)*</td>
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<tr>
<td>Nonselective Nonprofit</td>
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<tr>
<td>Mean of depvar</td>
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<td>$6,138</td>
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<tr>
<td>* Pell Grant Aid</td>
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<td>0.120</td>
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<td>(0.259)</td>
<td>(0.030)</td>
<td>(0.088)</td>
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<td></td>
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<td>Mean of depvar</td>
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<td>(0.097)</td>
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<td>Mean of depvar</td>
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<tr>
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<td>0.022</td>
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<td>(0.133)+</td>
<td>(0.161)+</td>
<td>(0.013)</td>
<td>(0.057)</td>
</tr>
<tr>
<td>Observations</td>
<td>66,950</td>
<td>77,470</td>
<td>66,940</td>
<td>83,810</td>
</tr>
</tbody>
</table>

**Notes:** Each column within a panel represents a separate regression. Standard errors clustered at institution level in parentheses; ** p<0.01, * p<0.05, + p<0.1.
Any Unmet Need

- A. Nonselective Public
- B. Selective Public
- C. Nonselective Nonprofit
- D. Selective Nonprofit
- E. For-profit
- F. All Sectors

Distance from Pell Grant Eligibility Threshold

Percentage

-4000 -2000 0 2000 4000 6000 8000 10000

-4000 -2000 0 2000 4000 6000 8000 10000

-4000 -2000 0 2000 4000 6000 8000 10000
Total Unmet Need

A. Nonselective Public

B. Selective Public

C. Nonselective Nonprofit

D. Selective Nonprofit

E. For-profit

F. All Sectors

Distance from Pell Grant Eligibility Threshold

Average Unmet Need

Back