The Out-of-State Tuition Distortion

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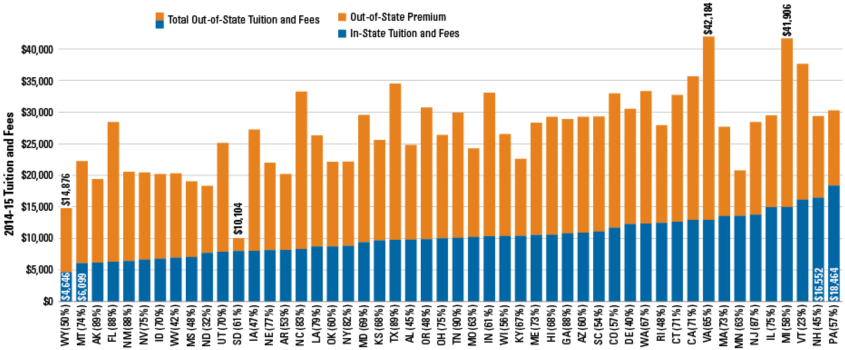
Outline

The tuition gap

- Public universities in the U.S. charge much higher tuition to non-residents.
- Flagship institutions, for example, charge \$10,000 on average for residents and \$27,000 for non-residents.

The tuition gap (flagship institutions)



The tuition gap

- Perhaps due to this tuition gap, around 75 percent of students nationwide attend in-state institutions (NCES, 2012).
- While distinguishing between residents and non-residents is consistent with state welfare maximization, it may lead to economic inefficiencies from a national perspective.

Simple hypothetical example

- Two students: one from Illinois and one from Wisconsin.
- Suppose further:
  - **preference heterogeneity**: absent tuition differences, both students prefer the out-of-state university due to "fit"
  - **price elastic**: due to the tuition gap, both students choose home-state institutions
- Pareto improvement: allow students to pay in-state tuition at the out-of-state institution.
- General point: higher out-of-state tuition may lead to inefficiencies.

Anecdotal Evidence #1 (CNN Money)

The Georgia high school senior wants to be a doctor. It's been her dream to study at the University of California in Los Angeles*, where the pre-med program, access to a great hospital, and famous doctors on teaching staff would help her on her way to medical school.* ***She got in****, but was awarded no grants, only the option of taking out $2,000 in student loans. Her parents, who are an elementary school teacher and a headmaster of a high school, would be responsible for the full* ***$58,000 in annual costs****, nearly triple what the FAFSA calculator estimated as her family contribution. She knew she couldn't take on that debt if she wanted to go on to medical school, but* ***turning down the place she worked for years to get into stung****.*

Anecdotal Evidence #2 (College Confidential)

__My dream school was University of Washington and because I live in California I have to pay so much money(50k) to attend that school__ and I only received $7252 for my financial aid. __I legit cried while talking to my mom because I couldn't afford that school__ but I really really really wanted to attend that school. My parents want me to go to UCSD which I am not interested at all (I wasn't even going to apply but my parents made me). __I honestly hate living in California because I hate the weather and its so not diverse__. So I want to ask you what I should do and what school I should go since I can't afford U-Dub considering that I want more city life and diversity and also if those listed schools have __good theater or art history program__.

Outline

- We first formalize this idea of out-of-state tuition distortions in a simple model.
- The welfare gains from reducing the tuition gap can be characterized by a sufficient statistic (Chetty, 2008) relating enrollment to tuition.
- We estimate this statistic via a border discontinuity design.

Outline

Setup

- Consider two states (s), East (E) and West (W), each with population normalized to one. Each has a public college (c).
- Student i receives the following payoff from attending c:

$$u_{ic} = \alpha q_c - t_{ic} - d_{ic} + (1/\rho)\varepsilon_{ic}$$

- where:
  - q_c represents college quality
  - t_{ic} represents tuition (r_c for residents, n_c for non-residents)
  - d_{ic} represent travel costs (0 for residents, δ for non-residents)
  - ε_{ic} is distributed type-1 extreme value
  - ρ represents the precision of preferences (i.e. $\rho = 1/\sigma$)

Enrollment Decisions

- P_s denotes the probability that a student from s attends the in-state college:

$$P_W = \frac{\exp(\alpha\rho q_W - \rho r_W)}{\exp(\alpha\rho q_W - \rho r_W) + \exp(\alpha\rho q_E - \rho n_E - \rho\delta)}$$

$$P_E = \frac{\exp(\alpha\rho q_E - \rho r_E)}{\exp(\alpha\rho q_E - \rho r_E) + \exp(\alpha\rho q_W - \rho n_W - \rho\delta)}$$

- Otherwise, students attend out-of-state institutions, with probabilities $1 - P_W$ and $1 - P_E$.

College Budgets

- Let f_W denote the fraction of in-state students at college W:

$$f_W = \frac{P_W}{P_W + (1 - P_E)}$$

- Assumption: educating a student requires a constant expenditure equal to m.
- College budget constraint:

$$f_c r_c + (1 - f_c) n_c = m$$

Welfare analysis

- Utilitarian welfare: $0.5(V_W + V_E)$, where:

$$V_W = (1/\rho)\ln[\exp(\alpha\rho q_W - \rho r_W) + \exp(\alpha\rho q_E - \rho n_E - \rho\delta)]$$

$$V_E = (1/\rho)\ln[\exp(\alpha\rho q_E - \rho r_E) + \exp(\alpha\rho q_W - \rho n_W - \rho\delta)]$$

- Consider marginal reductions in non-resident tuition ($\Delta n_W = \Delta n_E = \Delta n = -1$) and budget-balancing adjustments to resident tuition.
- Consider also the symmetric case ($q_W = q_E$, $r_W = r_E = r$, and $n_W = n_E = n$). Attendance probabilities are then symmetric ($P_W = P_W = P$).

Welfare analysis

- The welfare change when reducing non-resident tuition equals:

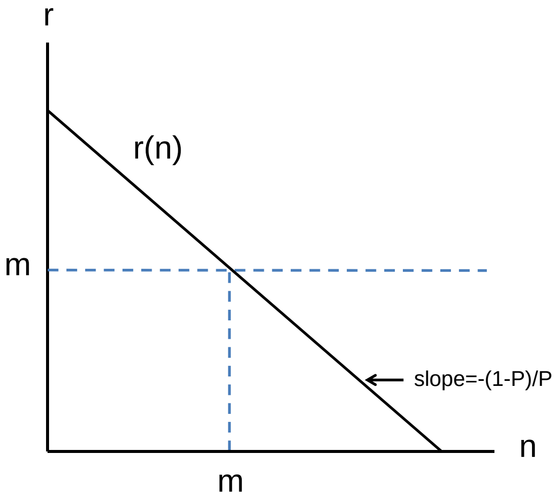
$$P\frac{\partial r}{\partial n} + (1-P)$$

- The college budget constraint implies that:

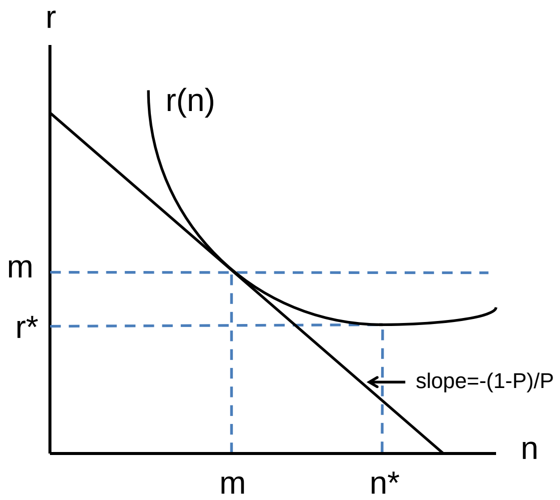
$$\frac{\partial r}{\partial n} = \frac{-(1-P) - \frac{\partial P}{\partial r}(n-r)}{P - \frac{\partial P}{\partial r}(n-r)}$$

- **Special case 1**: If $\frac{\partial P}{\partial r} = 0$, then $\frac{\partial r}{\partial n} = \frac{-(1-P)}{P}$ and no change in welfare.
- **Special case 2**: If $n = r$, then no change in welfare.
- If $\frac{\partial P}{\partial r} < 0$ and $n > r$, then $\frac{\partial r}{\partial n} > \frac{-(1-P)}{P}$, and welfare increases.

Resident and Non-resident Tuition (no behavioral response)



Resident and Non-resident Tuition (behavioral response)



Decentralization

- Under decentralization, states maximize resident welfare and compete for students.
- Equilibrium tuition is discriminatory and the tuition gap depends upon the price elasticity.
- State W maximizes "profits" on non-residents $[(n_W - m)(1 - P_E)]$ to cross-subsidizes residents.

Summary

- Reductions in non-resident tuition increase national welfare.
- The welfare gain depends upon the required change in resident tuition ($\frac{\partial r}{\partial n}$).
- This depends upon a sufficient statistic relating enrollment to tuition ($\frac{\partial P}{\partial r}$).
- We estimate this sufficient statistic via a border discontinuity design.

Outline

HERI Freshman Survey

- Our (restricted access) data are derived from a survey of freshmen at participating institutions 1997-2011.
- Key measures include:
  - zip code of permanent residence (aggregated to bins)
  - institution state
  - institution status (public or private)
  - in-state and out-of-state tuition ($1,000s)

Outline

Methods

- Recall that the goal is to estimate the responsiveness of resident enrollment to resident tuition ($\frac{\partial P}{\partial r}$).
- Key identification problem: separating tuition from geography.
- That is, do institutions disproportionately attract in-state students due to tuition discounts or a preference for proximity?

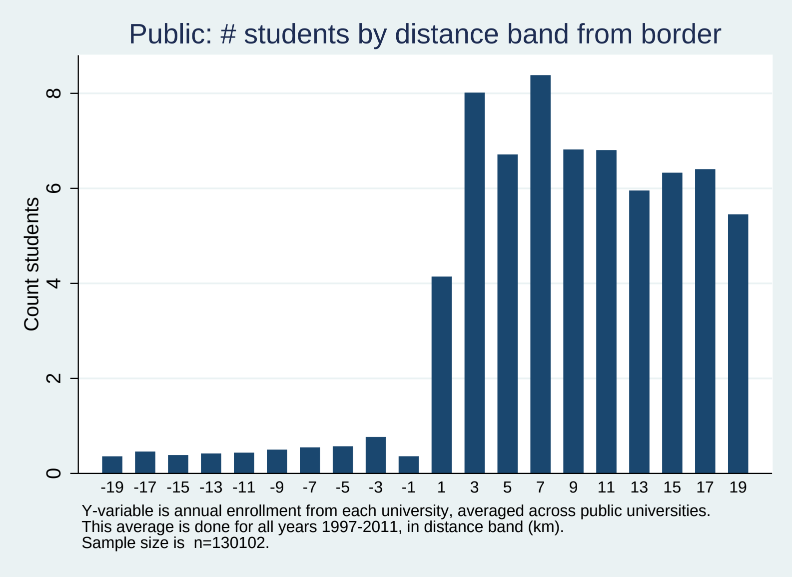
Methods

- To separate tuition and geography, we estimate the following border discontinuity (BD) regression:

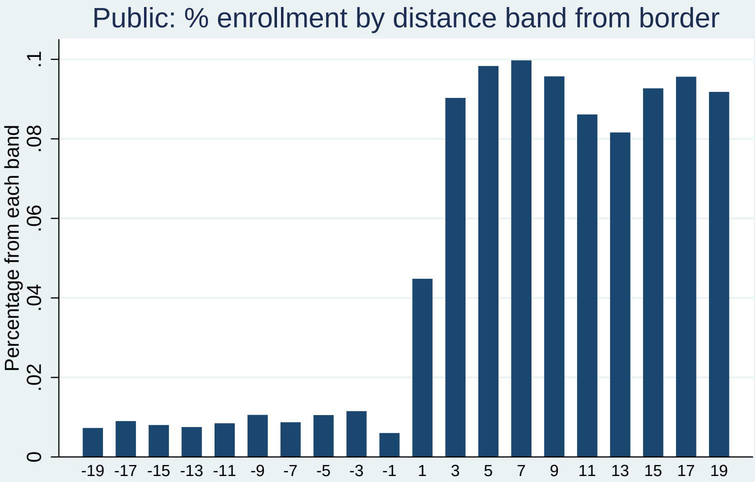
$$\ln(N_{bct}) = f(d_{bct}) + \rho^{BD} 1[d_{bct} > 0] + \theta_{bt} + \theta_{ct}$$

- where
  - N_{bct} equals the number from bin b attending college c in year t
  - d_{bct} equals distance to the border (negative for non-residents and positive for residents)
  - θ_{bt} represents bin-by-year fixed effects
  - θ_{ct} represents college-by-year fixed effects
- Then, one can show that $\rho^{BD} = \rho(n_c - r_c)$.
- Our baseline bandwidth is 40km. For bins, we consider both "border sides" (bins of 20km) and 2km bins.

Border Discontinuity: Public Institutions



Border Discontinuity: Public Institutions



Y-variable is percentage of a university's annual border enrollment from band, averaged across public universities, all years 1997-2011, within a distance band (km). Borders with fewer than 20 distance bands scaled by band count. Sample size: n=109779.

Border Discontinuity: Public Institutions (2km bins)

Table: 2k bins specification, public institutions

	(1) enroll	(2) enroll(%)	(3) ln(enroll)
in-state	8.2553***	0.0751***	0.8603***
	(0.5536)	(0.0021)	(0.0273)
distance	-0.0350	0.0004***	0.0032***
	(0.0222)	(0.0001)	(0.0011)
Observations	130102	109779	130102
R^2	0.381	0.409	0.619

Regressions run at distance-band level for 20k range.

All specifications include university-year FE and distance band-year FE.

Sample is public universities, 1997-2011, excluding two-year colleges.

Standard errors clustered at university-band level

* p<0.1 ** p<0.05 *** p<0.01

Border Discontinuity: Public Institutions

Table: border-sides specification, public institutions

	(1) enroll	(2) enroll(%)	(3) ln(enroll)
in-state	59.9542***	0.8119***	1.7361***
	(5.8517)	(0.0077)	(0.0517)
Observations	17312	13862	17312
R^2	0.445	0.895	0.760

Regressions run at border-side level for 20k range.

Sample is public universities only, 1997-2011, excluding two-year colleges.

All specifications include univ-year and border_side-year FE.

Standard errors clustered at university-border_side level.

* $p<0.1$ ** $p<0.05$ *** $p<0.01$

Outline

Differential Admissions Standards

- Admissions standards might be lower for in-state students.
- Then, our discontinuity could reflect a change in the composition of students:
    - both low-ability and high-ability students on the in-state side
    - only high ability students on the out-of-state side
- We address this in three ways:
    - analysis of choice sets using ELS data (see paper for details)
    - high ability students (SAT/ACT scores above institution median)
    - less selective institutions (median SAT/ACT scores below sample median)

Border Discontinuity: Above median students

Table: 20k border-side specification, public, above median students

	(1) enroll	(2) enroll(%)	(3) ln(enroll)
in-state	20.6244***	0.7919***	1.2816***
	(2.2066)	(0.0091)	(0.0447)
Observations	17312	12016	17312
R^2	0.443	0.867	0.721

Regressions run at border-side level for 20k range.

Sample is limited to students above median test score in univ-year,

public universities only, 1997-2011, excluding two-year colleges.

All specifications include univ-year and border-side-year FE.

Standard errors clustered at university-border-side level.

* $p<0.1$ ** $p<0.05$ *** $p<0.01$

Border Discontinuity: Less selective institutions

Table: 20k border-side specification, less-selective public institutions

	(1) enroll	(2) enroll(%)	(3) ln(enroll)
in-state	41.1921***	0.8388***	1.4875***
	(6.2068)	(0.0091)	(0.0736)
Observations	9336	6974	9336
R^2	0.483	0.930	0.739

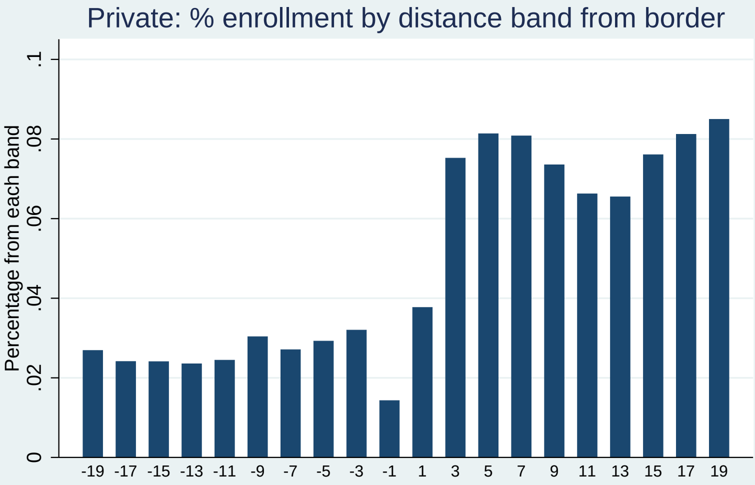
Regressions run at border_side level for 20k range.
Sample is less-selective public universities, 1997-2011, excl. 2yr colleges.
All specifications include univ-year and border_side-year FE.
Standard errors clustered at university-border_side level.
* p<0.1 ** p<0.05 *** p<0.01

Endogenous sorting

- Geographic fixed effects control for bin attributes, such as the number of HS students, that are common across institutions.
- However, border discontinuity designs are invalidated when families sort around the border according to preferences [Bayer, Ferreira, and McMillian (2007)].
- We do not see any bunching of students just inside the border.
- Also that, given one-year residency requirements, sorting would need to occur in advance of college admissions season.

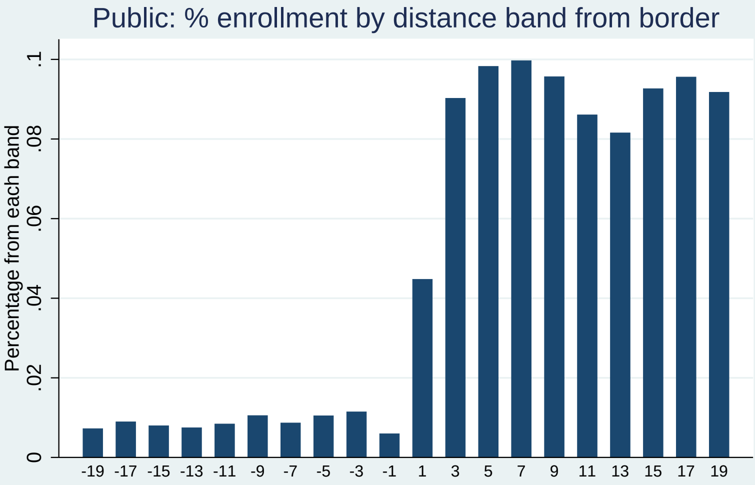
Outline

Border Discontinuity: Private Institutions



Y-variable is percentage of a university's annual border enrollment from band, averaged across private universities, all years 1997-2011, within a distance band (km). Borders with fewer than 20 distance bands scaled by band count. Sample size: n=317146.

Border Discontinuity: Public Institutions



Y-variable is percentage of a university's annual border enrollment from band, averaged across public universities, all years 1997-2011, within a distance band (km). Borders with fewer than 20 distance bands scaled by band count. Sample size: n=109779.

Border Discontinuity for Private Institutions

- While smaller than public, this discontinuity for private institutions is surprising.
- In the paper, we document:
  - **financial advantages** for residents at private institutions (NPSAS data)
  - **admissions advantages** for residents at private institutions (ELS data)

Outline

Methods

- We next consider a tuition discontinuity (TD) design:

$$\ln(N_{bct}) = f(d_{bct}) - \rho^{TD}\tau_{bct} + \theta_{ct} + \theta_{bt}$$

- where $\tau_{bct} = n_{ct}1[d_{bct} < 0] + r_{ct}1[d_{bct} > 0]$ represents tuition for students from bin b attending college c in year t.
- Then, one can show that $\rho^{TD} = \rho$.

Tuition Discontinuity Design

Table: 20k border-side tuition specification, public institutions

	(1) enroll	(2) enroll(%)	(3) ln(enroll)
tuition	-6.2595***	-0.0813***	-0.1856***
	(0.5735)	(0.0016)	(0.0055)
Observations	17152	13745	17152
R^2	0.438	0.805	0.745

Regressions run at border_side level for 20k range.

Sample is public universities only, 1997-2011, excluding two-year colleges.

All specifications include univ-year and border_side-year FE.

Standard errors clustered at university-border_side level.

* $p<0.1$ ** $p<0.05$ *** $p<0.01$

Outline

Methods

- Consider finally a hybrid discontinuity design:

$$\ln(N_{bct}) = f(d_{bct}) - \rho^{TD} t_{bct} + \rho^{BD} 1[d_{bct} > 0] + \theta_{ct} + \theta_{bt}$$

- Compares enrollment discontinuities between along borders with large and small tuition gaps.

Hybrid Discontinuity Design

Table: 20k border-side hybrid specification, public institutions

	(1) enroll	(2) enroll(%)	(3) ln(enroll)
in-state	49.7362***	0.7483***	1.2608***
	(9.3996)	(0.0203)	(0.1004)
tuition	-1.3432*	-0.0083***	-0.0610***
	(0.7595)	(0.0022)	(0.0098)
Observations	17152	13745	17152
R^2	0.447	0.901	0.765

Regressions run at border_side level for 20k range.

Sample is public universities only, 1997-2011, excluding two-year colleges.

All specifications include univ-year and border_side-year FE.

Standard errors clustered at university-border_side level.

* p<0.1 ** p<0.05 *** p<0.01

Outline

Measuring Welfare

- Given a one-dollar reduction in non-resident tuition, recall that the change in welfare equals:

$$P\frac{\partial r}{\partial n} + (1 - P)$$

- where the required change in resident tuition equals:

$$\frac{\partial r}{\partial n} = \frac{-(1-P) - \frac{\partial P}{\partial r}(n-r)}{P - \frac{\partial P}{\partial r}(n-r)}$$

- Note that $\frac{\partial P}{\partial r} = -\rho P(1-P)$. The required change in resident tuition then equals:

$$\frac{\partial r}{\partial n} = \frac{-(1-P) + \rho(n-r)P(1-P)}{P + \rho(n-r)P(1-P)}$$

- We assume $P = 0.75$ and (based upon analysis of NPSAS data), $n - r = \$6,416$.

Welfare Calculations

tuition discontinuity	-0.1856	-0.0610
effects on non-residents		
change in tuition	-\$1.00	-\$1.00
welfare change	\$0.25	\$0.25
no behavioral response		
change in resident tuition	\$0.33	\$0.33
resident welfare change	-\$0.25	-\$0.25
combined welfare change	\$0.00	\$0.00
with behavioral response		
change in resident tuition	\$0.03	\$0.21
resident welfare change	-\$0.02	-\$0.16
combined welfare change	\$0.23	\$0.09

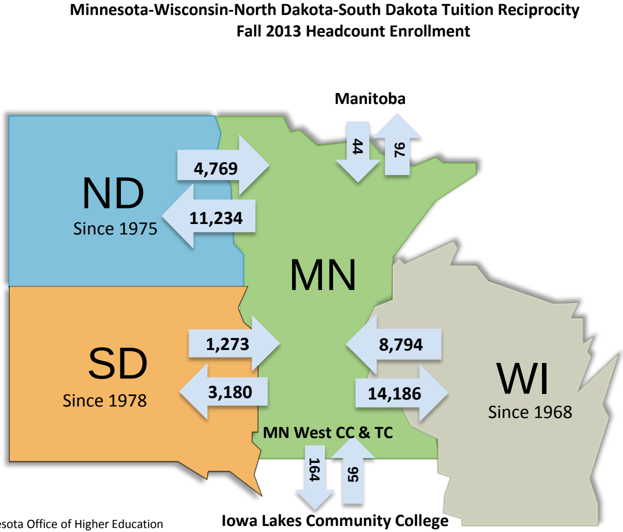
Corrective Policies

1. Federal intervention
2. Residence-based vouchers: state E could provide out-of-state tuition vouchers to their residents in an amount equal to $n_W - r_E$.
    - Potential problem: state W may optimally respond by further increasing tuition by the amount the voucher.
3. State reciprocity programs

Anecdotal Evidence #3 (US News and World Report)

Jessica Torch thought she ***wanted to major in Jewish studies****, even before she started applying to colleges. She had attended Jewish schools all her life and actively participated in the Jewish community in the Sandy Springs suburb of her native Atlanta.* ***None of Georgia's state schools, however, offered Jewish studies, and her parents weren't eager to pay out-of-state tuition for the University of Maryland-College Park****, where Jessica badly wanted to go. She had almost given up hope of ever studying her dream major at her dream school, when* ***she and her family discovered a practical solution: the Academic Common Market, ...a reciprocity agreement among 16 southern states*** *that allows undergraduate and graduate students to enroll at a university in another state while paying in-state tuition.*

Minnesota Tuition Reciprocity



Source: Minesota Office of Higher Education

Outline

Summary

- We consider out-of-state tuition in the context of a simple discrete choice model.
- The welfare gain from reducing the tuition gap depends upon a sufficient statistic relating enrollment to tuition.
- We estimate this sufficient statistic using a border discontinuity design.
- Back-of-the envelope calculations suggest substantial welfare gains from reducing the tuition gap.

Outline

Alternative bandwidths: Public Institutions

Table: 10k border-sides specification, public institutions

	(1)	(2)	(3)
	enroll	enroll(%)	ln(enroll)
in-state	32.9971***	0.7964***	1.4545***
	(3.1806)	(0.0085)	(0.0498)
Observations	16550	12094	16550
R^2	0.444	0.873	0.734

Regressions run at border-side level for 10k range.

Sample is public universities only, 1997-2011, excluding two-year colleges.

All specifications include univ-year and border-side-year FE.

Standard errors clustered at university-border-side level.

* p<0.1 ** p<0.05 *** p<0.01

Alternative bandwidths: Public Institutions

Table: 30k border-side specification, public institutions

	(1)	(2)	(3)
	enroll	enroll(%)	ln(enroll)
in-state	78.6061***	0.8222***	1.9129***
	(6.9741)	(0.0074)	(0.0531)
Observations	17482	14616	17482
R^2	0.460	0.907	0.770

Regressions run at border-side level for 30k range.

Sample is public universities only, 1997-2011, excluding two-year colleges.

All specifications include univ-year and border-side-year FE.

Standard errors clustered at university-border-side level.

* p<0.1 ** p<0.05 *** p<0.01

Related Literature

- **Out-of-state tuition**: Groat (1964), Morgan (1983), Noorbakhsh and Culp (2002), Kane (2007), Abraham and Clark (2006), Cohodes and Goodman (2014), Groen and White (2004) and Epple et. al. (2013).
- **Tuition and financial aid policy**: Avery and Hoxby (2004) and Dynarski (2003).
- **Pre-college and post-college migration**: Kennan (2015), Bound et. al. (2004).
- **Border discontinuity designs in education**: Black (1999), Bayer, Ferreira, and McMillian (2007).
- **Federalism**: Oates (1972), Oates (1999), Inman and Rubinfeld (1997), Besley and Coate (2003), Knight (2013).

Choice Set Data

- As a complementary analysis, we next compare students with similar choice sets (Avery et. al., 2013).
- Choice sets are constructed using ELS 2002-2006 survey questions:
  - set of college applications
  - set of acceptances (choice set)
  - choice
- While sample sizes are too small for a border discontinuity, we measure distance between students and institutions.
- We also use measures of tuition, separately for residents and non-residents.
- We estimate alternative-specific multinomial logit models, which include institution fixed effects.

Analysis of Choice Sets (ASC logit models)

	(1) enroll	(2) enroll	(3) enroll
in-state	0.3763***		0.1972
	(0.1048)		(0.1380)
tuition		-0.0360***	-0.0326**
		(0.0121)	(0.0164)
distance	-0.5226***	-0.4961***	-0.5234***
	(0.1482)	(0.1340)	(0.1486)
distance	0.1092***	0.0957***	0.1088***
squared	(0.0363)	(0.0333)	(0.0364)
cases	8,300	8,300	8,300
students	2,690	2,690	2,690