Win, lose, or draw? Student responses to lottery scholarship eligibility rules

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Motivation

- Since 1993, 27 U.S. states have launched broad-based merit scholarship programs
  - New Mexico Legislative Lottery Scholarship (NMLLS) in 1997
- Programs generally reward in-state students with “free” college provided they meet certain eligibility criteria
  - For qualified residents only
  - Typically based on high school GPA, standardized test scores, class rank, or some combination

Motivation

- stated objectives of merit aid vary by state:
  - increase access to higher education for financially constrained students
  - Improve academic performance
  - provide incentive for students to finish high school
  - combat “brain drain”
  - incentivize good students that would have otherwise enrolled at private or out-of-state schools to enroll in-state at public institutions

Motivation

- How do students respond to scholarship eligibility rules?
  - Do students respond to minimum GPA requirements by increasing their grades?
  - Do students respond to funding caps by reducing time to degree?
  - Are recipients more likely to take the minimum number of credits in order to satisfy scholarship eligibility?
  - Is persistence increased as students put forth efforts to retain funding?

Background

- New Mexico's program (NMLLS) is the most generous, low-bar merit program in the U.S.
- Only program where eligibility based solely on college performance rather than high school performance
  - NM residency
  - Graduate from a NM high school, and enroll in one of 16 qualified public institutions in the next academic year
  - Free qualifying semester funded by the Bridge to Success Scholarship

Background

- Initial eligibility:
  - complete at least 12 hours in qualifying semester with 2.5 GPA
- Continued eligibility:
  - complete at least 12 credit hours each term, maintain 2.5 cumulative GPA
- Funding capped at 8 semesters *after* qualifying semester
- More background here; recent changes here

Background

- No requirements regarding:
  - High school GPA
  - Standardized test scores
  - Class rank
  - Community service hours
  - Citizenship
  - FAFSA-filing

Preview of Findings

- Students respond to scholarship eligibility rules
- Those just above the qualifying semester GPA requirement:
  - complete college in shorter time (i.e., before the semester cap)
  - are more likely to earn the minimum number of credits needed to maintain eligibility in the first year
  - Show no change in persistence, completion likelihood, or grades

Literature

- Much focuses on enrollments, only a handful of papers on other outcomes…
- Degree completion
  - Studies using census microdata find no effect (Sjoquist and Winters, 2012, 2015; Jia, 2018)
  - Studies using administrative data offer mixed results (Scott-Clayton, 2011; Cohodes and Goodman, 2014; Erwin and Binder, 2018)
- Generally, effects for outcomes using administrative data are dependent on the program's structure

Literature

- Contribution to literature:
  - Unique program structure: broadest, lowest-bar state merit aid program
    - Every resident “gets a shot”
    - Best proxy for recent proposals for to make college free for the vast majority of students in the U.S.
      - 2016 candidates advocated for making college free for most
      - NY Excelsior Scholarship just launched

Literature

- Contribution to literature:
  - New Mexico's lottery scholarship has very modest eligibility requirements, so some constraints (e.g., minimum cumulative GPA, "normal progress") may not be binding
  - Identification strategy estimates LATE for lower ability students that responded to the policy change
    - Other studies generally focus on higher ability students (cf. Georgia, Tennessee, Florida, Massachusetts, etc.)

Data

- Administrative data on all first-time, full-time University of New Mexico (UNM) resident students over the period 1997 – 1999

- 3,499 resident students

  - residents earning a high school equivalency in NM
  - enrolled at UNM in next regular semester
  - earned at least 12 credits during the qualifying semester
  - Meet all criteria except the 2.5 qualifying semester GPA

- Explored later cohorts (2000 – 2008), but evidence exists that bridging semester GPA began to be manipulated with launch of the Freshmen Learning Community in 2000

Table 1. Descriptive statistics, 1997-1999 cohorts

bachelor's degree within (years):	
4	.164
4.5	.288
5	.460
6	.558
credits earned by year:	
1	27.047 (4.121)
2	50.059 (13.801)
3	70.393 (24.575)
4	89.579 (36.041)
5	101.289 (42.199)
6	106.480 (44.785)
credits withdrawn in first year	1.856 (2.622)
semesters continuously enrolled	6.976 (3.318)
last observed college GPA	2.964 (.697)
obs.	3,499

Source: Freshmen Tracking System, Office of Institutional Analytics, University of New Mexico. Standard deviations are in parentheses. Descriptives are for the entire sample and are not constrained to those in the immediate neighborhood of the 2.5 qualifying semester GPA cutoff.

Table 1. Descriptive statistics, 1997-1999 cohorts (continued)

high school GPA	3.435 (.450)
composite ACT	24.002 (3.243)
required remedial coursework	.066
family income < $40,000	.176
family income < $20,000	.078
female	.553
Hispanic	.319
black	.017
American Indian	.034
Asian	.040
declined to state race-ethnicity	.014
obs.	3,499

Source: Freshmen Tracking System, Office of Institutional Analytics, University of New Mexico. Standard deviations are in parentheses. Descriptives are for the entire sample and are not constrained to those in the immediate neighborhood of the 2.5 qualifying semester GPA cutoff.

Empirical Model

- Fuzzy regression discontinuity (FRD)
  - Exploit a discontinuity in eligibility rules (minimum 2.5 cumulative GPA during the qualifying semester)
- Why not sharp RD?
  - UNM policies allowed exceptions for medical conditions and military service
  - In rare cases, students not meeting GPA requirement could petition on “special circumstances” grounds
  - NMLLS structured as a “last dollar scholarship”

Empirical Model

- 1st stage:

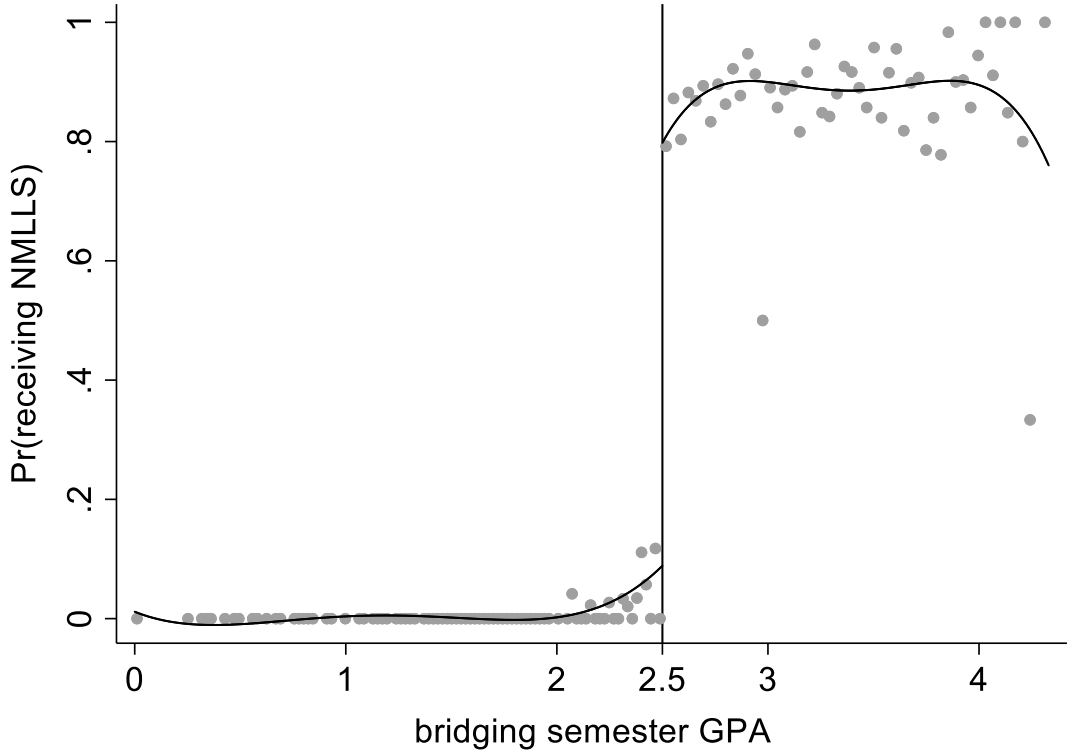
$$NMLLS_i = \alpha_0 + \alpha_1 Above_i + \alpha_2 GPAgap_i * Below_i + \alpha_3 GPAgap_i * Above_i + \boldsymbol{X\theta} + v_i$$

- 2nd stage:

$$Y_i = \pi_0 + \tau_{FRD} \widehat{NMLLS_i} + \pi_1 GPAgap_i * Below_i + \pi_2 GPAgap_i * Above_i + \boldsymbol{X\Gamma} + \varepsilon_i$$

- ***X*** includes gender, HSGPA, ACT, race-ethnicity, family income, and whether remedial coursework was required (upon admission)
- $Above_i = 1[GPA_i \geq 2.5]; Below_i = 1[GPA_i < 2.5]$

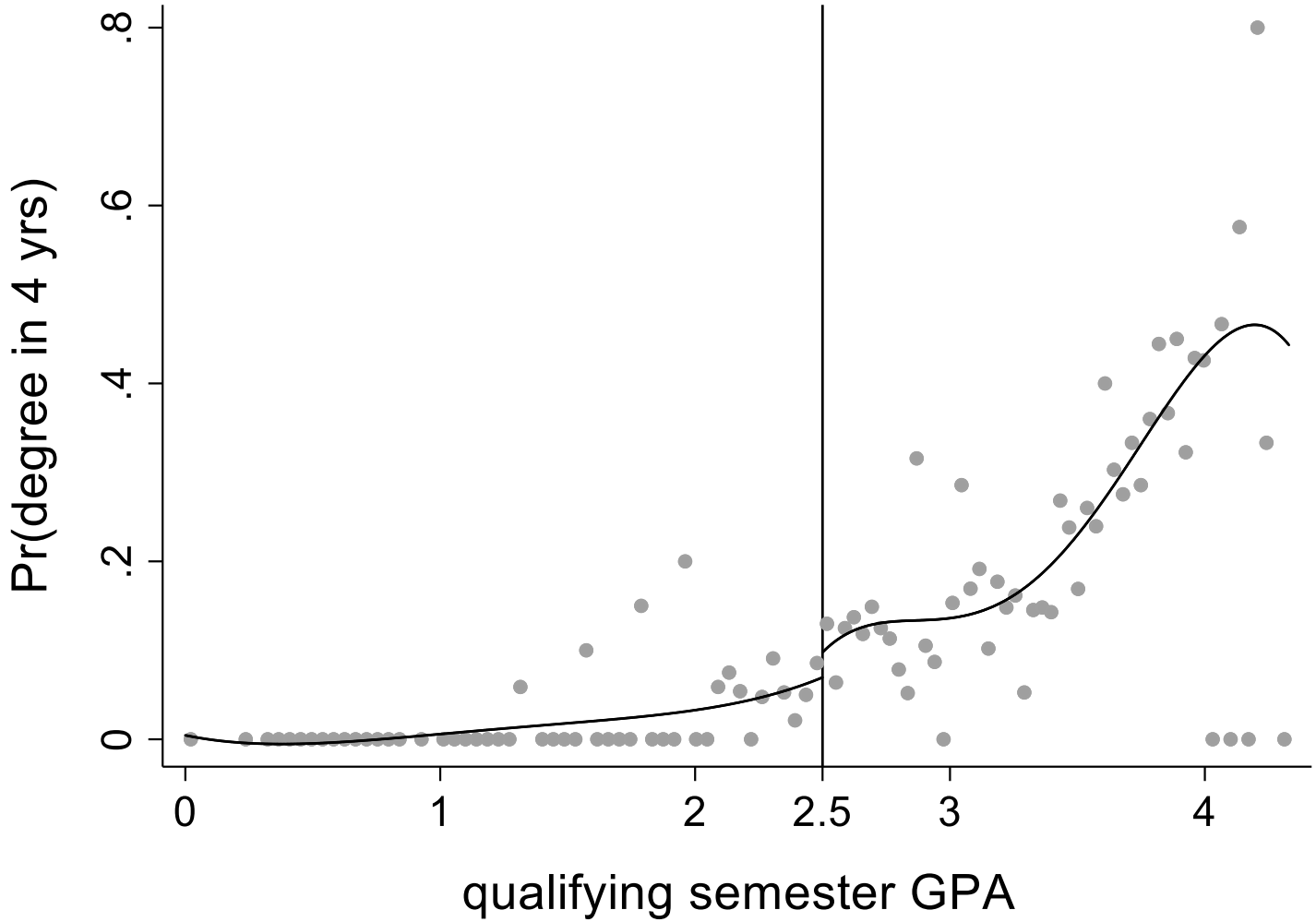
Graphical Results



Note: Points depict the within-bin sample average of NMLLS receipt probability by bridging semester GPA. A quartic fit has been added below and above the cutoff at 2.5. Binned means of bridging semester GPA with evenly spaced bins are chosen optimally to mimic the variability of the outcome variable. The triangular kernel function is used to construct global polynomial estimators. The plot provides visual evidence of the appropriateness of a fuzzy regression discontinuity approach.

Figure 2. Jump in treatment probability around the bridging semester GPA cutoff, 1997-1999 cohorts

Graphical Results



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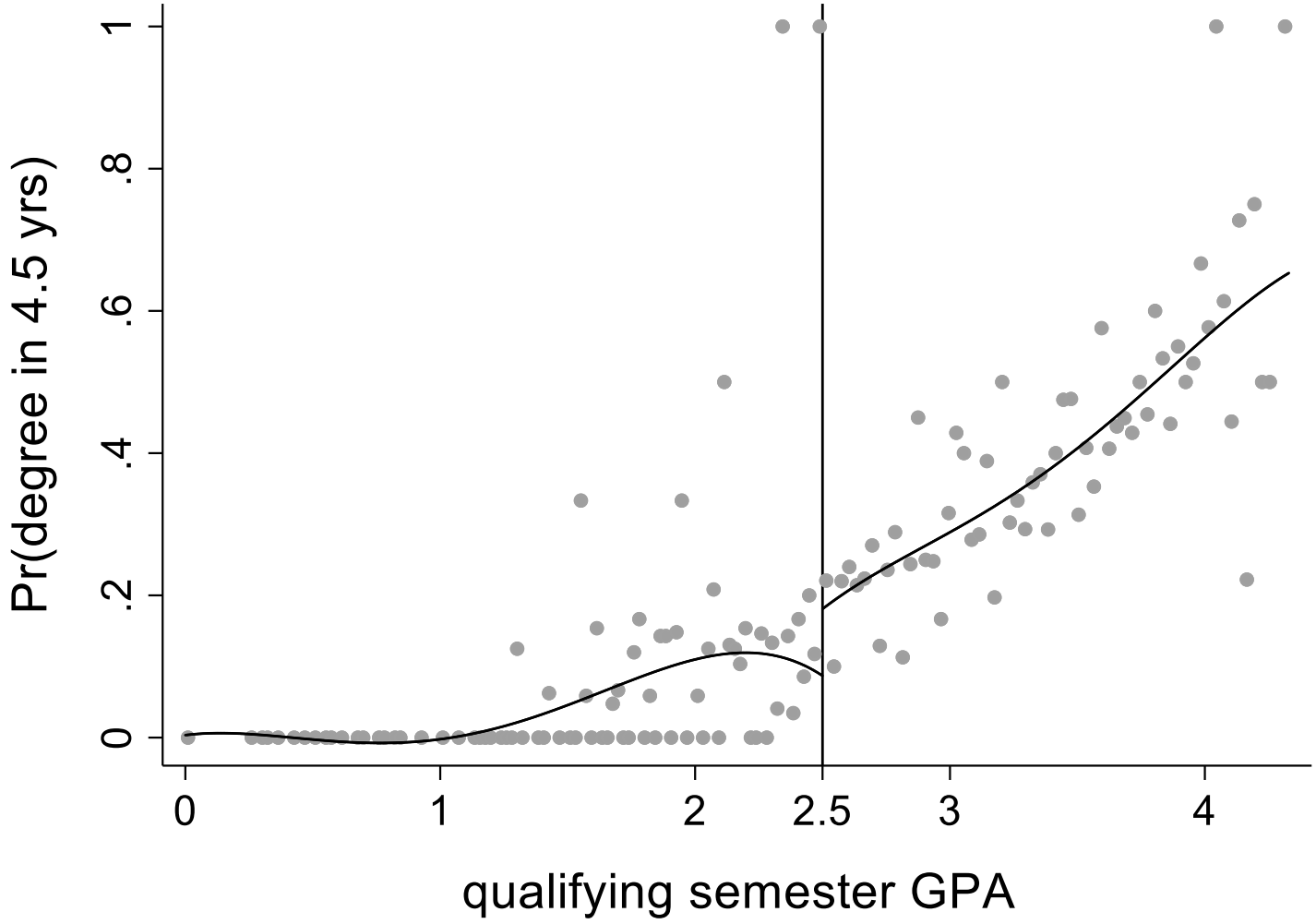
Graphical Results



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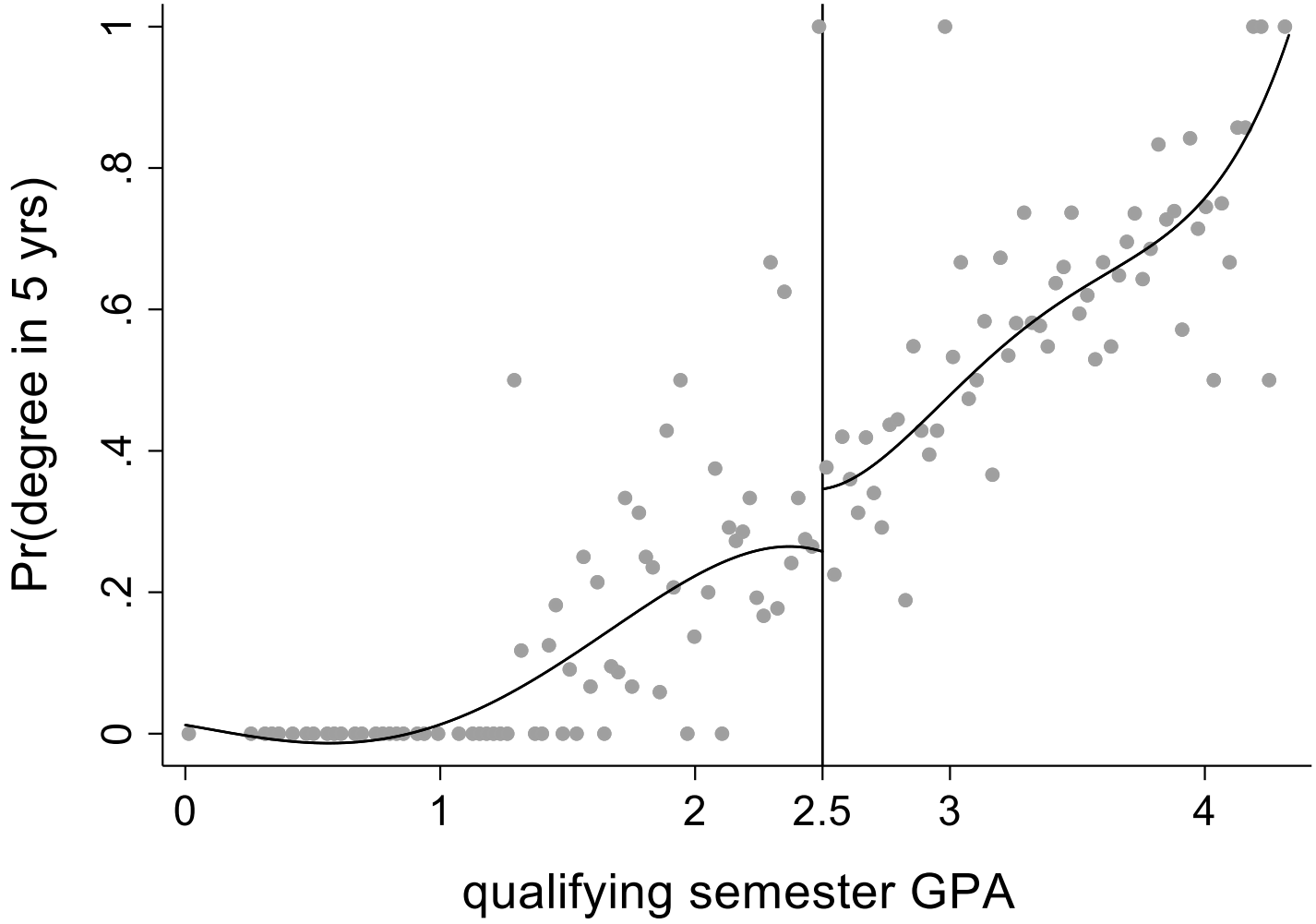

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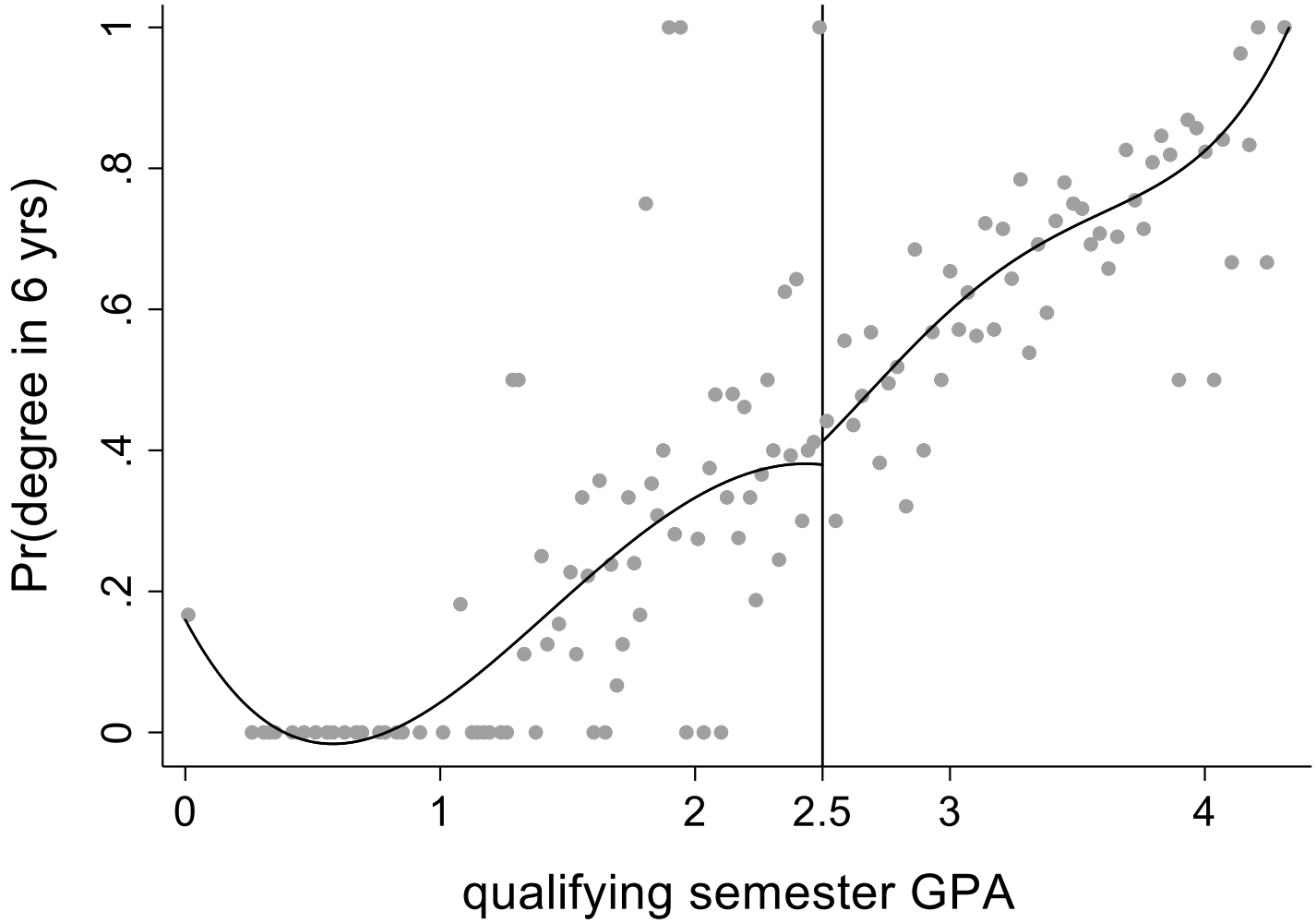
Graphical Results



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Graphical Results

- Other plots not shown for brevity
  - credits after one year here
  - credits after two years here
  - credits after three years here
  - credits after four years here
  - credits after five years here
  - credits after six years here
  - credits withdrawn in first year here
  - semesters continuously enrolled here
  - last observed college GPA here

Table 2. Estimated local average treatment effects of the NMLLS on degree completion

	(1)	(2)	(4)	(5)
	linear model	quadratic model	c = 2.3	c = 2.7
first stage: NMLLS eligibility	**.716*** **	**.686*** **	**-.181*** **	**-.075**
robust p-value	< .001	< .001	< .001	.170
degree within four years	**.074** **	**.080**	**.448**	**.883**
robust p-value	.031	.236	.662	.170
$N_W^- \mid N_W^+$	499 | 1085	545 | 1244	421 | 1021	474 | 608
h	.583	.688	.679	.359
degree in 4.5 years	**.127***	**.109**	**-.035**	**-3.449**
robust p-value	.081	.275	.964	.783
$N_W^- \mid N_W^+$	518 | 1152	545 | 1244	336 | 714	345 | 337
h	.647	.681	.497	.210
degree within five years	**.091**	**.100**	**.129**	**.591**
robust p-value	.315	.415	.812	.417
$N_W^- \mid N_W^+$	580 | 1400	630 | 1595	258 | 428	630 | 952
h	.759	.874	.333	.512
degree within six years	**.040**	**-.0004**	**-.113**	**3.228**
robust p-value	.508	.996	.753	.474
$N_W^- \mid N_W^+$	499 | 1085	583 | 1432	205 | 319	437 | 601
h	.583	.778	.254	.301

Note: estimates are based on fuzzy regression discontinuity models using the 2.5 GPA cutoff during the student's first semester (i.e., qualifying semester). A triangular kernel is used to construct local polynomial estimators. Common mean squared error-optimal bandwidths, h, determine the neighborhood of the GPA cutoff examined. Local linear regression is used to construct point estimators. Robust standard errors are clustered at the cohort-level. *, **, and *** denote statistical significance at the ten, five, and one percent-levels, respectively. First-stage results are from models using four-year completion rates.

Table 4. Estimated local average treatment effects of the NMLLS on course taking behavior

	(1)	(2)	(4)	(5)
	linear model	quadratic model	c = 2.3	c = 2.7
first stage: NMLLS eligibility	**.669*** **	**.657*** **	**-.171*** **	**-.149** **
robust p-value	< .001	< .001	< .001	.017
credits after one year	**-1.873***	**-2.852*** **	**2.712**	**-.906**
robust p-value	.062	.006	.620	.824
$N_W^- \mid N_W^+$	270 | 484	416 | 810	255 | 397	560 | 790
h	.285	.467	.319	.434
credits after two years	**1.617**	**-3.540**	**5.100**	**10.077**
robust p-value	.438	.322	.852	.543
$N_W^- \mid N_W^+$	255 | 438	273 | 505	205 | 319	599 | 839
h	.267	.290	.256	.467
credits after three years	**-.986**	**-11.053**	**10.568**	**119.390**
robust p-value	.816	.186	.753	.278
$N_W^- \mid N_W^+$	212 | 354	255 | 438	207 | 333	466 | 605
h	.211	.268	.280	.321
credits after four years	**.263**	**-10.330**	**-5.580**	**197.590**
robust p-value	.964	.223	.911	.282
$N_W^- \mid N_W^+$	213 | 358	270 | 484	205 | 319	466 | 605
h	.227	.286	.256	.321
credits after five years	**-1.401**	**-5.780**	**-13.373**	**131.790**
robust p-value	.831	.376	.857	.127
$N_W^- \mid N_W^+$	213 | 358	355 | 699	197 | 286	523 | 741
h	.229	.382	.239	.382
credits after six years	**-2.928**	**-7.454**	**-10.756**	**167.760**
robust p-value	.547	.182	.818	.149
$N_W^- \mid N_W^+$	179 | 307	270 | 484	207 | 326	474 | 608
h	.187	.286	.266	.358
withdrawals during first year	**1.317** **	**1.707** **	**1.997**	**-3.357**
robust p-value	.024	.014	.713	.920
$N_W^- \mid N_W^+$	270 | 484	467 | 951	258 | 428	345 | 420
h	.284	.537	.335	.224

Note: estimates are based on fuzzy regression discontinuity models using the 2.5 GPA cutoff during the student's first semester at UNM (i.e., qualifying semester). A triangular kernel is used to construct local polynomial estimators. Common mean squared error-optimal bandwidths, h, determine the neighborhood of the GPA cutoff examined. Local linear regression is used to construct point estimators. Robust standard errors are clustered at the cohort-level. *, **, and *** denote statistical significance at the ten, five, and one percent-levels, respectively. $N_W^- = \sum_{i=1}^{n} 1(\bar{r} - h \leq R_i < \bar{r})$, $N_W^+ = \sum_{i=1}^{n} 1(\bar{r} \leq R_i \leq \bar{r} + h)$.

Table 5. Estimated local average treatment effects of the NMLLS on academic performance

	(1)	(2)	(4)	(5)
	linear model	quadratic model	c = 2.3	c = 2.7
first stage: NMLLS eligibility	**.702*** **	**.673*** **	**-.162**	**-.068**
robust p-value	< .001	< .001	.159	.311
last observed GPA	**.121**	**.114**	**-.220**	**2.974**
robust p-value	.151	.406	.735	.233
$N_W^- \mid N_W^+$	414 | 810	518 | 1152	295 | 553	466 | 607
h	.454	.641	.398	.334
semesters continuously enrolled	**.551**	**.455**	**1.422**	**39.136**
robust p-value	.103	.396	.498	.483
$N_W^- \mid N_W^+$	218 | 378	354 | 661	260 | 440	419 | 468
h	.241	.370	.348	.286

Note: estimates are based on fuzzy regression discontinuity models using the 2.5 GPA cutoff during the student's first semester at UNM (i.e., qualifying semester). A triangular kernel is used to construct local polynomial estimators. Common mean squared error-optimal bandwidths, h, determine the neighborhood of the GPA cutoff examined. Local linear regression is used to construct point estimators. Robust standard errors are clustered at the cohort-level. *, **, and *** denote statistical significance at the ten, five, and one percent-levels, respectively. $N_W^- = \sum_{i=1}^{n} 1(\bar{r} - h \leq R_i < \bar{r})$, $N_W^+ = \sum_{i=1}^{n} 1(\bar{r} \leq R_i \leq \bar{r} + h)$.

Results

- Empirical results confirm significant jump in treatment likelihood of 70% around GPA cutoff
- 7.4 percentage points (45%) and 12.7 percentage points (44%) more likely to graduate within 4 and 4.5 years, respectively
  - Suggests shorter time to degree but no overall change in completion
- Recipients take 1.9 (7%) fewer credits in the first year, explained by 1.3 (71%) more credits withdrawals
- No impact on grades, persistence, overall credit completion, or overall degree completion

Falsification Tests

- Three different types:

1. Estimate models using *faux*-cutoffs of 2.3 and 2.7
   - There should be no discontinuities in the running variable other than at the known cutoff
   - No significant effects using these cutoffs
2. Use predetermined control variables as outcomes
   - *A priori* knowledge there shouldn't be any significance
   - "placebo treatment effects"

Table 7. Testing for placebo treatment effects using predetermined covariates

covariate	1997-1999
high school GPA	**-.101**
robust p-value	.462
$N_W^- \mid N_W^+$	315 | 588
h	.342
composite ACT	**-1.179**
robust p-value	.109
$N_W^- \mid N_W^+$	331 | 612
h	.356
required remedial coursework	**.042**
robust p-value	.270
$N_W^- \mid N_W^+$	416 | 810
h	.463
family income < $40,000	**-.026**
robust p-value	.783
$N_W^- \mid N_W^+$	287 | 539
h	.322
family income < $20,000	**.009**
robust p-value	.763
$N_W^- \mid N_W^+$	354 | 661
h	.376
female	**-.113**
robust p-value	.594
$N_W^- \mid N_W^+$	130 | 233
h	.153
observations	3499

Note: estimates are based on fuzzy regression discontinuity models using the 2.5 GPA cutoff during the student's first semester at UNM (i.e., qualifying semester). A triangular kernel is used to construct local polynomial estimators. Common mean squared error-optimal bandwidths, h, determine the neighborhood of the GPA cutoff examined. Local linear regression is used to construct point estimators. Robust standard errors are clustered at the cohort-level. *, **, and *** denote statistical significance at the ten, five, and one percent-levels, respectively.

Table 7. Testing for placebo treatment effects using predetermined covariates (continued)

covariate	1997-1999
Hispanic	**-.052**
robust p-value	.736
$N_W^- \mid N_W^+$	216 | 375
h	.234
black	**-.003**
robust p-value	.672
$N_W^- \mid N_W^+$	254 | 435
h	.256
Asian	**.004**
robust p-value	.728
$N_W^- \mid N_W^+$	416 | 812
h	.473
American Indian	**-.007**
robust p-value	.746
$N_W^- \mid N_W^+$	565 | 1333
h	.731
declined to state race-ethnicity	**.002**
robust p-value	.741
$N_W^- \mid N_W^+$	287 | 539
h	.327
observations	3499

Note: estimates are based on fuzzy regression discontinuity models using the 2.5 GPA cutoff during the student's first semester at UNM (i.e., qualifying semester). A triangular kernel is used to construct local polynomial estimators. Common mean squared error-optimal bandwidths, h, determine the neighborhood of the GPA cutoff examined. Local linear regression is used to construct point estimators. Robust standard errors are clustered at the cohort-level. *, **, and *** denote statistical significance at the ten, five, and one percent-levels, respectively.

Falsification Tests

3. Falsification tests of manipulability in the running variable conducted following McCrary (2008)

   – Tests for nonrandom sorting of individuals into treatment (a.k.a. “bunching”)

   – Null hypothesis is continuity in the running variable, here qualifying semester GPA

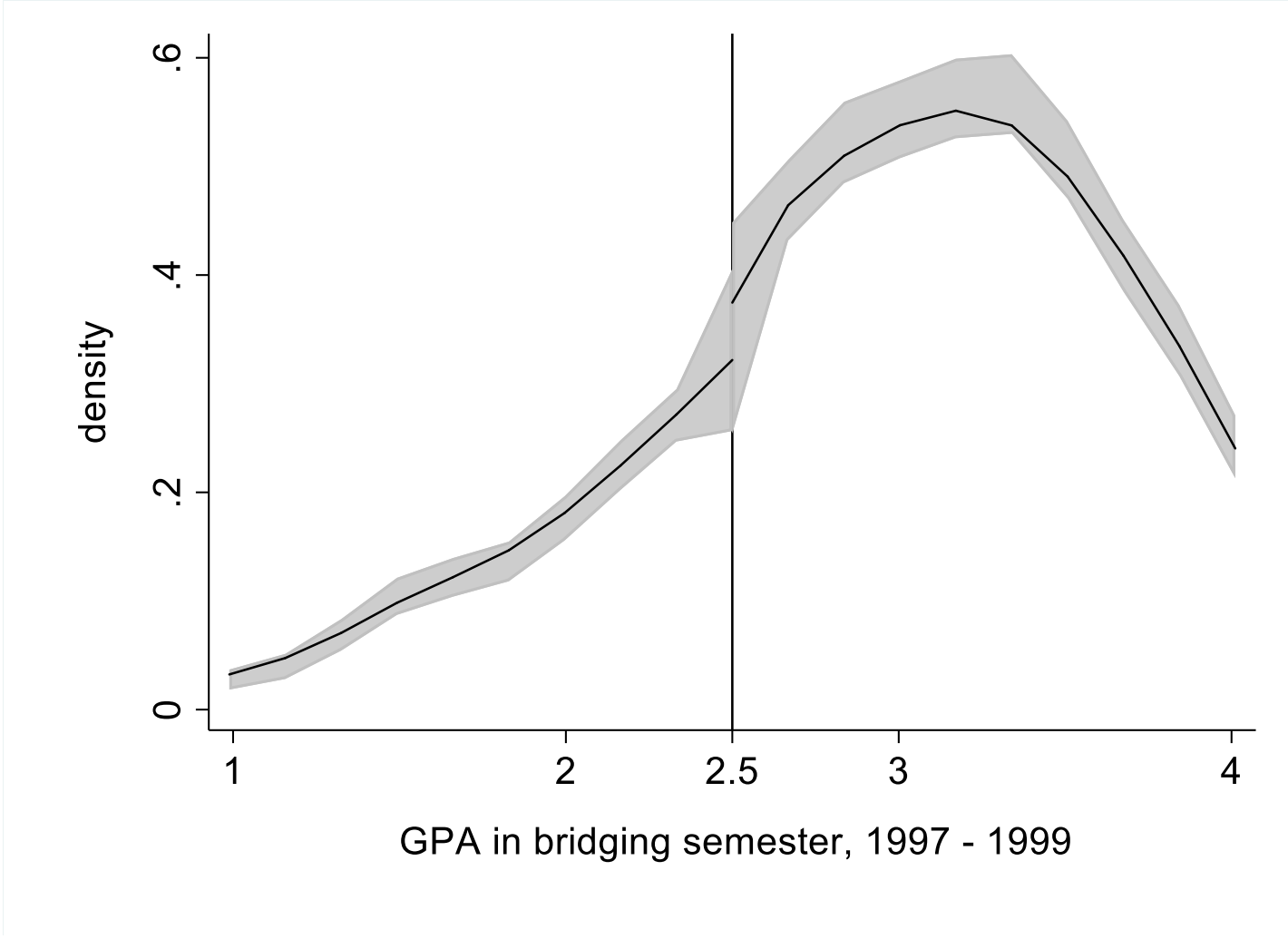
Falsification Tests

Table 2. Testing for manipulation of the bridging semester GPA cutoff for NMLLS eligibility, 1997 to 1999 cohorts

	bandwidths		effective obs.		conv. test		robust test	
$h_- \neq h_+$	left	right	left	right	T	p-value	T	p-value
$T_2(\hat{h}_1)$	.605	.557	504	952	1.168	.243	.107	.915
$T_3(\hat{h}_2)$	1.088	.887	697	1632	.598	.550	.208	.836
$T_4(\hat{h}_3)$	1.151	1.109	736	2040	.541	.589	.090	.928
$h_- = h_+$								
$T_2(\hat{h}_1)$	.504	.504	467	945	.813	.416	.247	.805
$T_3(\hat{h}_2)$	.887	.887	643	1632	.747	.455	.150	.881
$T_4(\hat{h}_3)$	1.109	1.109	730	2040	.569	.569	.054	.957

Note: results from manipulation tests following McCrary (2008) and Cattaneo, Jansson, and Ma (2017) examining 1997 – 1999 cohorts at UNM. $T_p(h)$ is the manipulation test statistic using the p-th order density estimators with bandwidth h. $\hat{h}_p$ denotes the MSE-optimal bandwidths for the p-th order density estimator. A triangular kernel is used to construct local polynomial estimators. Tests are performed with identical and different data-driven bandwidths. Conventional and robust test statistics examine the null hypothesis of continuity in the bridging semester GPA around the NMLLS eligibility cutoff.

Falsification Tests



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Conclusions

- Eligibility rules matter
  - funding caps may serve as an effective policy lever when trying to incentivize students to complete college in a timely manner
  - Students may take the minimum number of hours during a qualifying period when program eligibility is based on college performance
- Future proposals should be cautious and intentional in setting initial eligibility and renewal rules
  - Eligibility rules should directly reflect policy goals of the program (e.g., timely degree completion, high academic achievement, continuous full-time enrollment, etc.)

Conclusions

- Low-bar merit aid programs not likely to positively impact college persistence, grades, or completion likelihood

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- Thank you for your time
- Questions?
- Contact the author at:
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