Upstream and Downstream Impacts of College Merit-Based Financial Aid for Low-Income Students: *Ser Pilo Paga* in Colombia

Online Appendix

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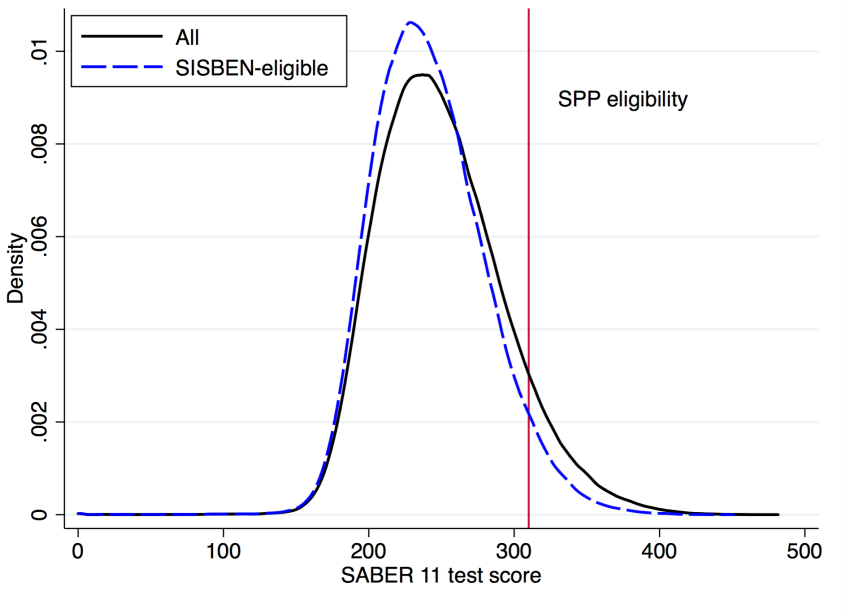
1 Figures and Tables

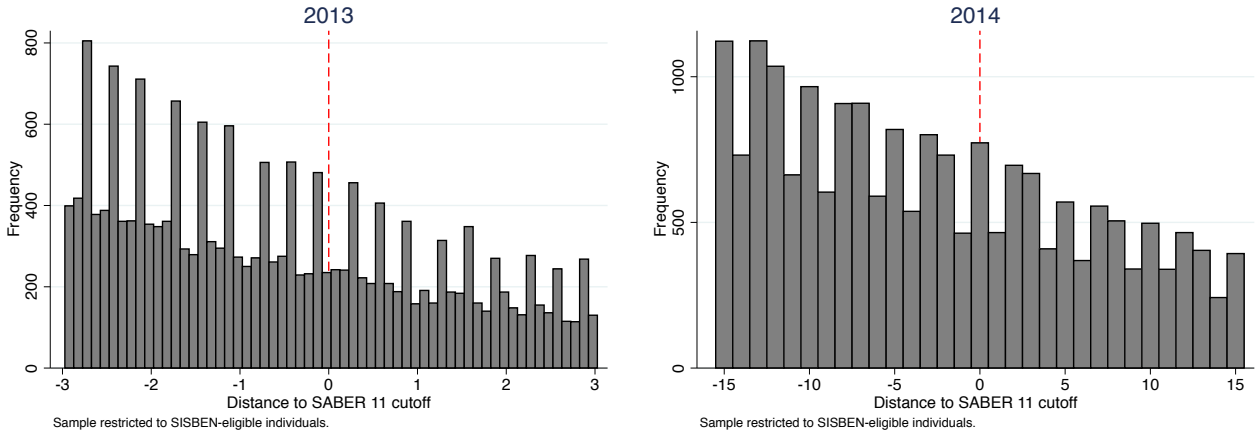
Figure A.1: Distribution of SABER 11 Scores by SISBEN-Eligibility Status



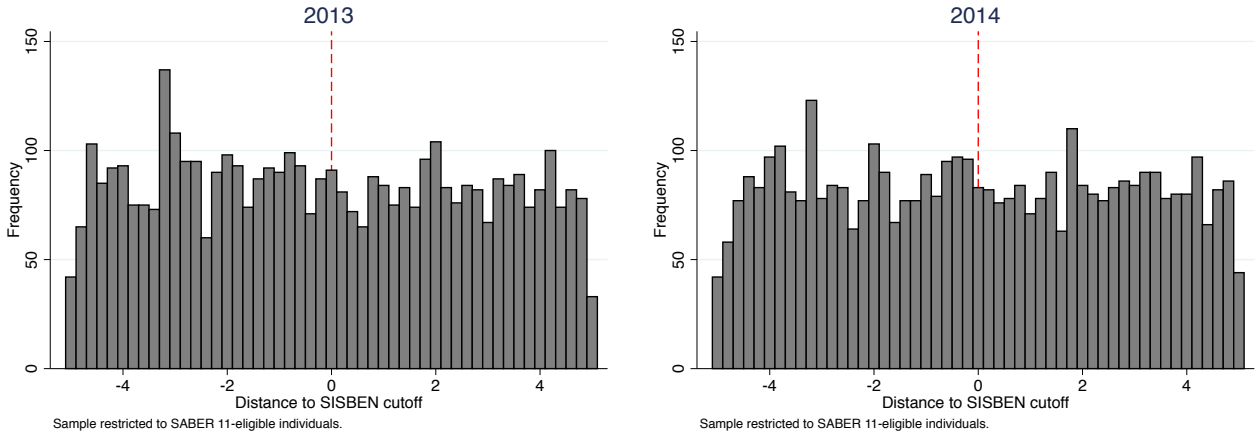
Notes: This figure plots the distribution of SABER 11 scores among Fall 2014 test-takers by SISBEN-eligibility status. The black solid line represents all test-takers, while the blue dashed line represents the subsample of test-takers that are SISBEN-eligible. The red vertical line represents the SPP eligibility cutoff. *Sources:* Authors' calculations based on ICFES, DNP, and MEN (2016).

Figure A.2: Histograms of SABER 11 and SISBEN scores in the Fall 2013 and 2014

(a) SABER 11



(b) SISBEN



Note: The SABER 11 score plotted above is the product of a linear combination of exam category sub-scores. Before Fall 2014, the formula is

$$score_i^{pre-20142} = \frac{N_{i,chem} + N_{i,bio} + N_{i,phys} + 2N_{i,sosci} + N_{i,philo} + 3N_{i,lang} + 3N_{i,math} + N_{i,eng}}{13}$$

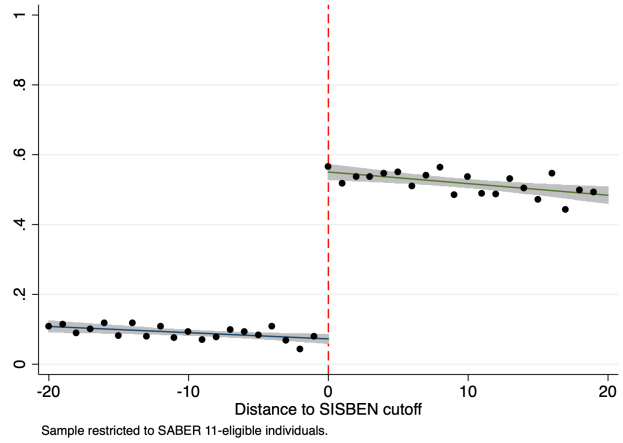
Starting Fall 2014, the formula is

$$score_i^{post-20142} = \frac{500}{1300} \times (3N_{i,reading} + 3N_{i,maths} + 3N_{i,natsci} + 3N_{i,sosci} + N_{i,eng})$$

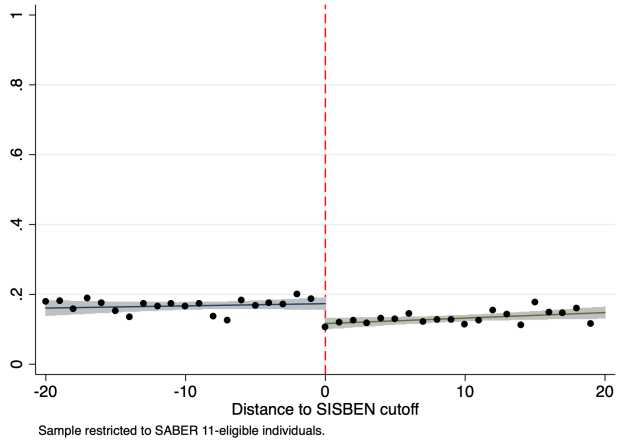
Sources: Authors' calculations based on ICFES, DNP, and MEN (2016).

Figure A.3: Immediate Postsecondary Enrollment: High- vs. Low-Quality, Private vs. Public Institutions (R_i = SISBEN wealth index)

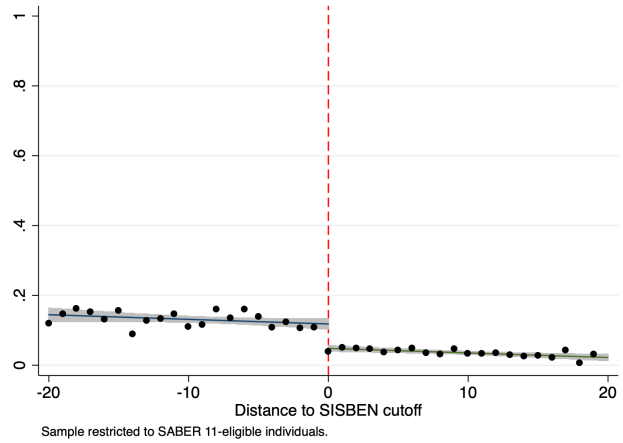
(a) Private High Quality



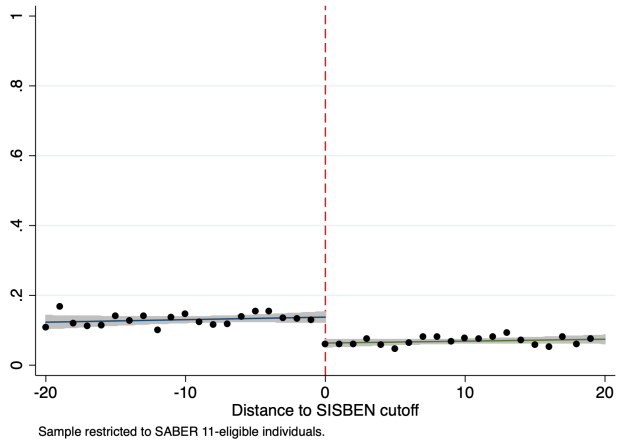
(b) Public High Quality



(c) Private Low Quality



(d) Public Low Quality

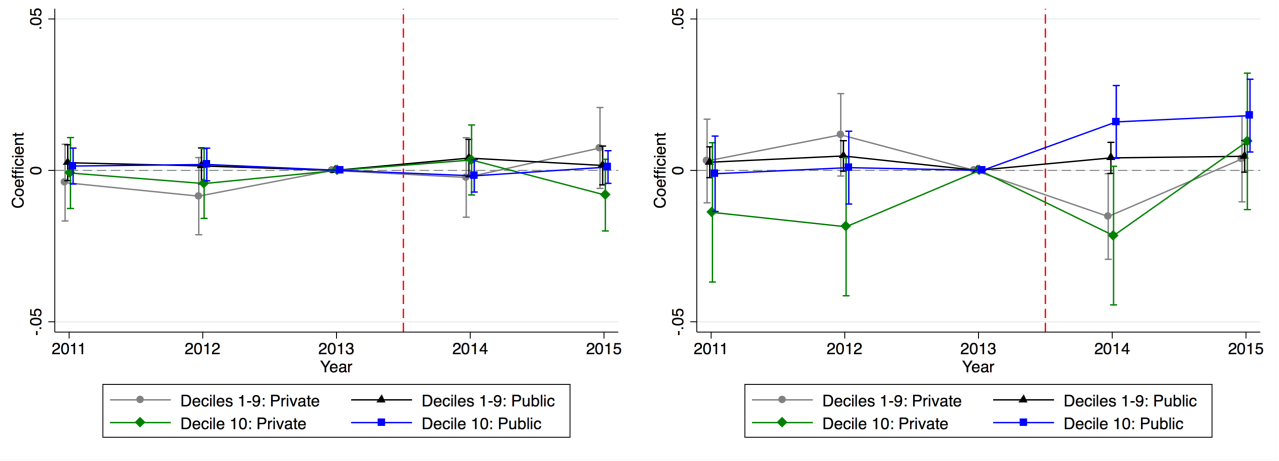


Note: The figures plot the probability of immediate enrollment in a private or public, high- or low-quality HEI as a function of the distance to the SISBEN wealth eligibility cutoff. The sample is restricted to SABER 11-eligible students. The figures suggest the likelihood of immediately attending a private, high-quality HEI rose 47.7 percentage points, while the probability of attending a public, high-quality institution decreased by 7.9 percentage points. The likelihood of attending a low-quality institution decreased by 5.2 and 7.6 percentage points for private and public institutions, respectively. See reduced-form estimates in Table 2.
Sources: Authors' calculations based on ICFES, DNP, and MEN (2016).

Figure A.4: High-Income Students: Immediate Enrollment by Test Score Decile and HEI Type

(a) Low-Quality HEIs: Private vs Public

(b) High-Quality HEIs: Private vs Public

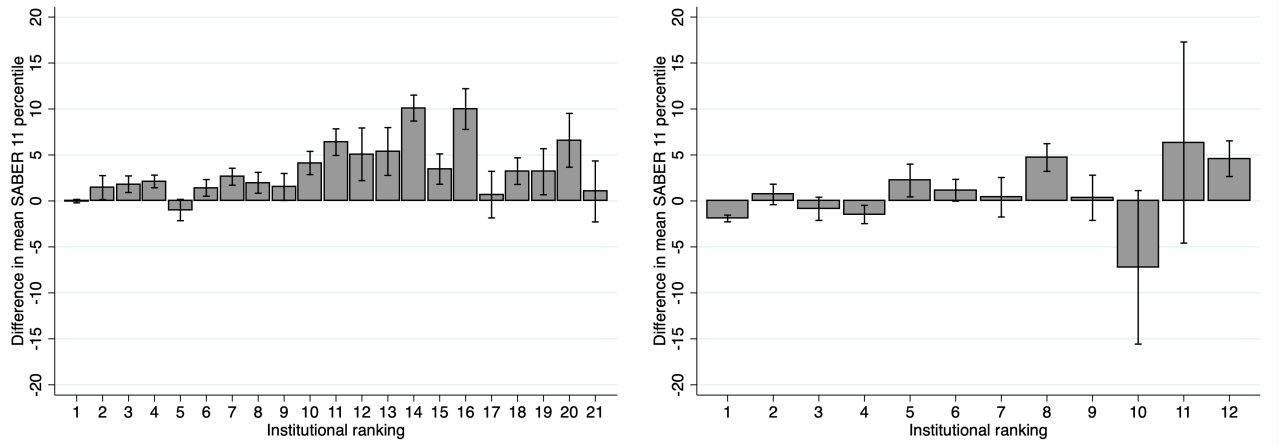


Notes: These figures plot, for high-income students (strata 4–6), the difference in immediate enrollment probabilities separately by test score decile and HEI quality between Fall (treatment) and Spring (control) test-takers before and after SPP financial aid is introduced (red vertical line) using specification (1). Beside a temporary displacement effect from private high-quality HEIs (Panel B, green line), financial aid expansion had no statistically significant effect on enrollment of high-income students. *Sources:* Authors' calculations based on ICFES, DNP, and MEN (2016).

Figure A.5: Difference in Mean Percentile of Entering Students

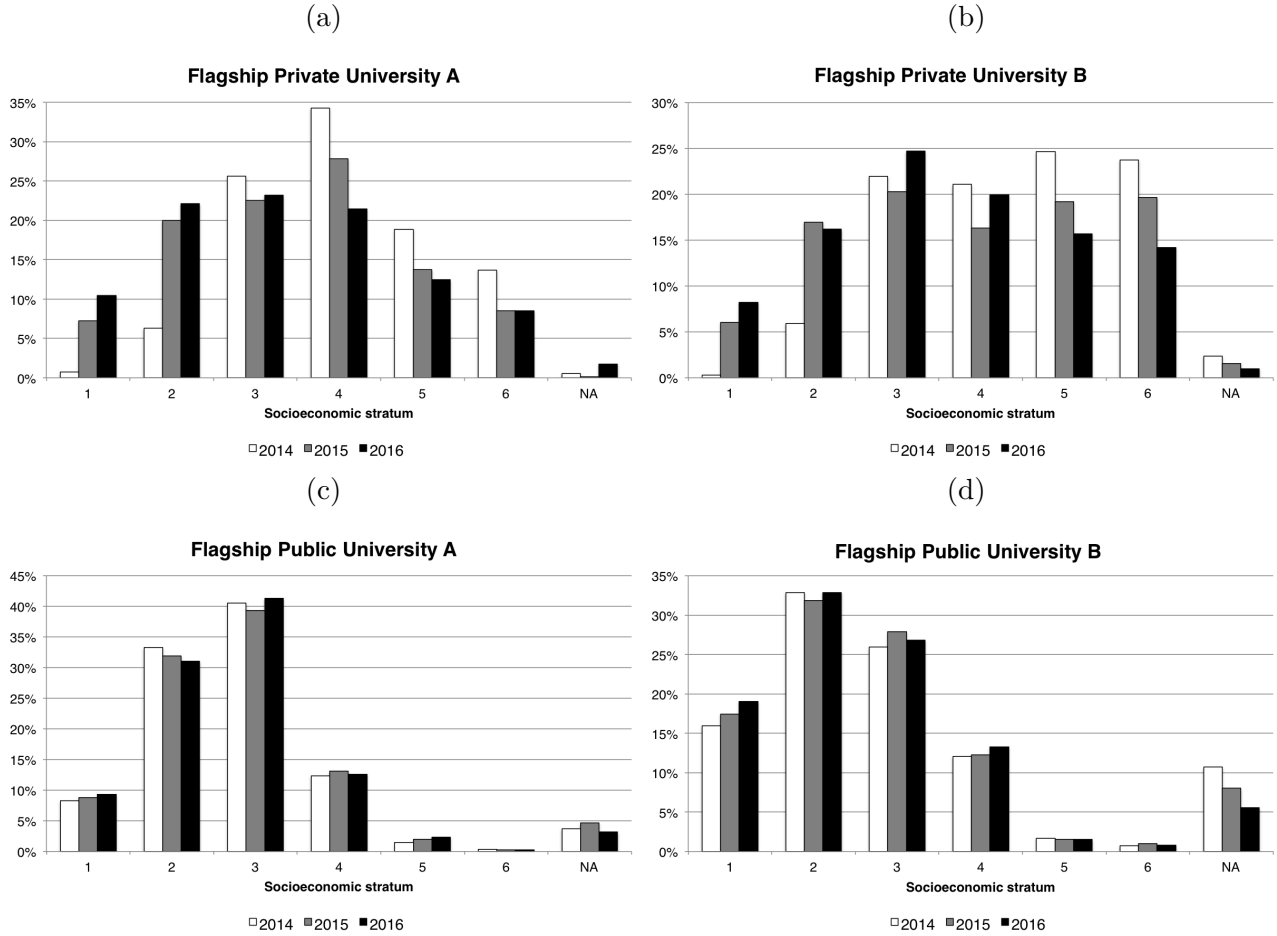
(a) Private High-Quality HEIs

(b) Public High-Quality HEIs



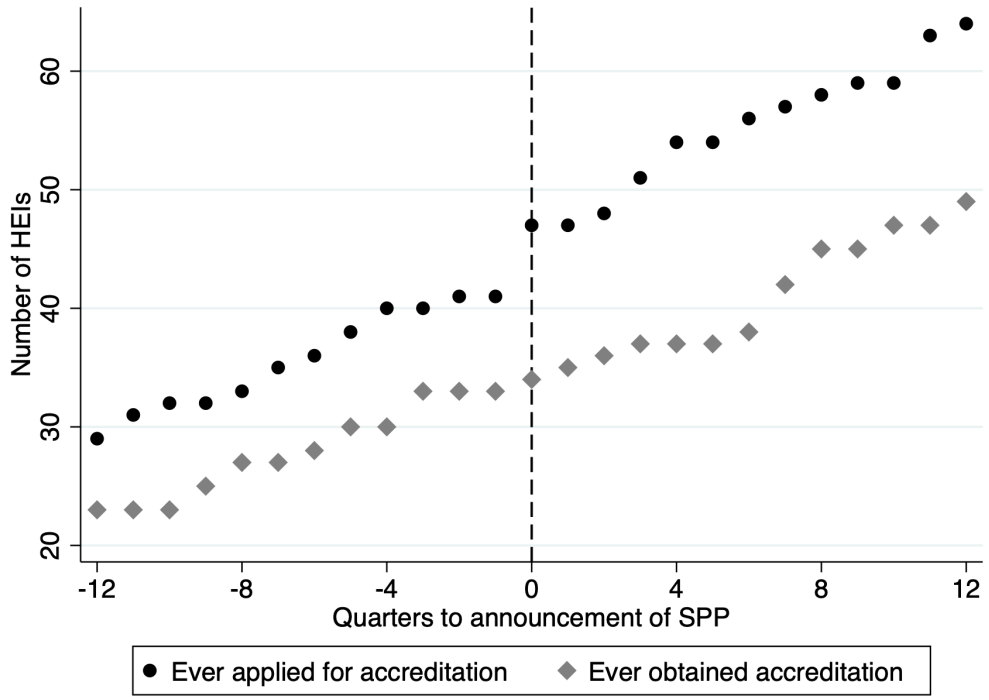
Note: This figure plots the difference in the mean SABER 11 percentile of the entering cohort for Fall 2013 and Fall 2014 test-takers, respectively. Institutions are ranked by mean SABER 11 score of Spring 2014 entering cohort (i.e., Fall 2013 test-takers). Panel A suggests that the average student quality significantly increased for most private, high-quality HEIs, with the magnitude of the impact being somewhat inversely proportional to the institutional ranking. Panel B suggests that average student quality decreased for some public, high-quality HEIs. The lines represent the 95 percent confidence intervals. *Sources:* Authors' calculations based on ICFES, DNP, MEN, and SPADIES (2016).

Figure A.6: Freshmen Socioeconomic Stratum at Selected High-Quality HEIs



Notes: These figures plot the distribution of first-semester students by socioeconomic stratum in 2014–2016 Spring semesters at selected accredited institutions. At the flagship private institution in Bogota, the share of first-semester students in the bottom two strata increased from 7.0 percent to 32.6 between 2014 and 2016 (Panel A), while the share of students from the bottom two strata decreased by 3.0 percent at a top-ranked public institution in Bogota (Panel C).
Sources: Authors' calculations based on SPADIES (2016) and administrative record from universities.

Figure A.7: Evolution of the Number of HEIs with High Quality Accreditation

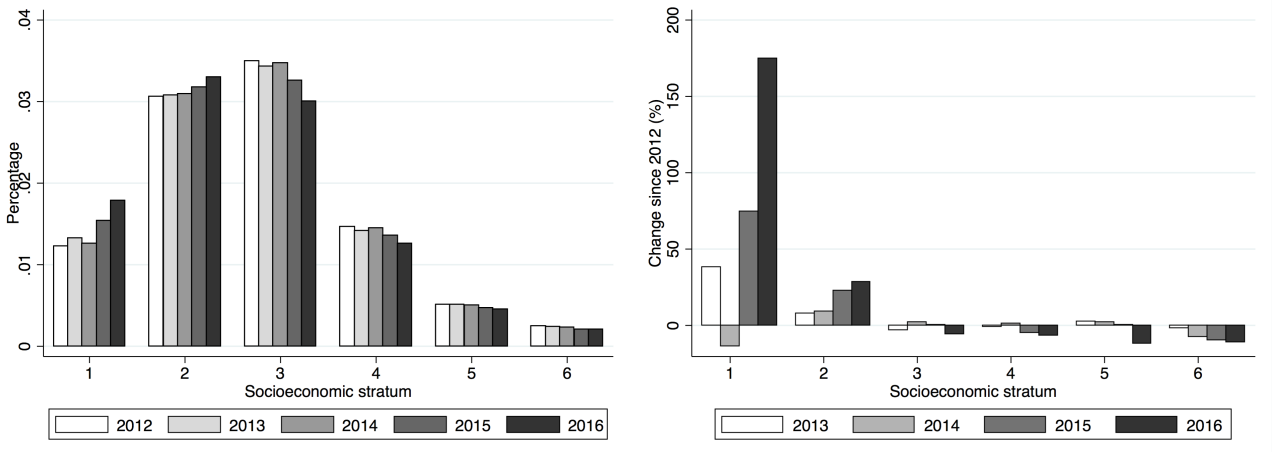


Note: The figure plots the number of HEIs ever having requested institutional *High Quality Accreditation* status (in black) and the number of HEIs ever having received this status (in gray) in Colombia. The number of HEIs requesting this status increased the moment SPP was announced, while the number of HEIs having obtained this status did not. *Sources:* Authors' calculations based on MEN and SPADIES (2016).

Figure A.8: Gains in Test Performance for Low-Income Students

(a) Distribution of top decile by strata

(b) Change in share of strata in top percentile



Note: Panel A plots the distribution of socioeconomic strata for the SABER 11 top 10 percent of performing students in the Fall semesters between 2012 and 2016, and suggests that the share of top performers from the bottom stratum increased by 45.8 percent between 2012 and 2016. Panel B focuses on the top percentile and plots the percentage change between in Fall 2013 through 2016, using 2012 as baseline. The sample in all figures is restricted test-takers aged 14–23. *Sources:* Authors' calculations based on ICFES (2016).

Table A.1: Manipulation Testing based on Density Discontinuity

	Running variable	
	SABER 11 (1)	SISBEN (2)
Robust Bias-Corrected p-value	0.2179786	0.4364368
Robust Bias-Corrected SE	0.0001818	0.0017997
Number of obs - left	284052	7709
Number of obs - right	15423	15423
Eff. number of obs - left	6042	2731
Eff. number of obs - right	6122	3692
Order loc. poly. (p)	2	2
Order BC (q)	3	3
Bandwidth values - left	8.705387	6.21869
Bandwidth values - right	10.00451	8.619373

Notes: This table tests for manipulation of the running variable based on density discontinuity. All results are estimated with package rddensity (Cattaneo, Jansson and Ma, 2016) using an unrestricted model and a triangular kernel function, and employ the jackknife standard errors estimator. Column (1) restricts the sample to SISBEN-eligible individuals. Column (2) restricts the sample to SABER 11-eligible individuals. The table suggests we cannot statistically detect manipulation in either variable. *Sources:* Authors' calculations based on ICFES, DNP, and MEN (2016).

Table A.2: Baseline Covariate Balance Test around SABER 11 and SISBEN Cutoffs

	Running Variable			
	SABER 11		SISBEN	
	Coef/SE	Mean Control	Coef/SE	Mean Control
	(1)	(2)	(3)	(4)
Female	-0.017	0.473	-0.004	0.442
	(0.013)		(0.026)	
Age	-0.008	16.627	0.143	16.393
	(0.051)		(0.108)	
Ethnic minority	0	0.079	-0.007	0.066
	(0.006)		(0.011)	
Employed	-0.006	0.085	-0.002	0.073
	(0.006)		(0.012)	
Family size	-0.042	4.601	-0.132	4.378
	(0.033)		(0.064)	
Mother education: Primary	-0.009	0.252	0.01	0.130
	(0.012)		(0.016)	
Mother education: Secondary	-0.011	0.504	-0.073	0.486
	(0.012)		(0.026)	
Mother education: T&T	0.001	0.134	0.005	0.178
	(0.007)		(0.019)	
Mother education: Higher	0.019	0.110	0.054	0.207
	(0.008)		(0.021)	
Father education: Primary	0	0.343	0.014	0.184
	(0.011)		(0.02)	
Father education: Secondary	-0.003	0.429	-0.052	0.444
	(0.011)		(0.022)	
Father education: T&T	0.002	0.103	-0.011	0.173
	(0.008)		(0.018)	
Father education: Higher	0.004	0.122	0.051	0.198
	(0.008)		(0.022)	
Household SES: Stratum 1	-0.002	0.343	-0.013	0.131
	(0.01)		(0.015)	
Household SES: Stratum 2	-0.013	0.459	-0.003	0.516
	(0.011)		(0.021)	
Household SES: Stratum 3	0.01	0.184	0.008	0.326
	(0.009)		(0.02)	
Household SES: Stratum 4	0.007	0.010	0.011	0.020
	(0.003)		(0.007)	
Household SES: Stratum 5	0	0.003	-0.003	0.007
	(0.001)		(0.003)	
Household SES: Stratum 6	-0.001	0.001	0	0.001
	(0.001)		(0.001)	
School hours: Full day	-0.002	0.197	0.035	0.286
	(0.009)		(0.023)	
School hours: Morning	-0.002	0.614	-0.049	0.548
	(0.011)		(0.029)	
School hours: Evening	0.003	0.009	0.001	0.006
	(0.002)		(0.003)	
School hours: Afternoon	-0.001	0.172	0.019	0.154
	(0.008)		(0.021)	
School hours: Weekends	0.003	0.008	-0.006	0.008
	(0.002)		(0.003)	
Private school	-0.002	0.172	0.067	0.301
	(0.008)		(0.025)	
Joint F-Stat (p-value, LB on bandwidth)	0.347		0.082	
Joint F-Stat (p-value, UB on bandwidth)	0.475		0.196	

Notes: This table plots the reduced-form coefficient from a RD specification where the outcome is a baseline characteristic and the running variable is either SABER 11 test scores in columns (1) and (2) or SISBEN poverty index in columns (3) and (4). The sample is restricted to SISBEN-eligible individuals in columns (1) and (2), and SABER 11-eligible individuals in columns (3) and (4). Columns (1) and (3) present conventional coefficients and standard errors in parentheses, while columns (2) and (4) present control means. The last two rows report the p-value from a joint significance test using all baseline characteristics, and small or large bandwidths ($\pm$ 20 or 40 test score units in column (1); and $\pm$ 7 or 15 household wealth units in column (3)). All results are estimated with package rdrobust (Cattaneo, Calonico and Titiunik, 2014). *Sources:* Authors' calculations based on ICFES, DNP, and MEN (2016).

Table A.3: Robustness Check: Predicted Access by Type of Postsecondary Institution

	Any	High Quality			Low Quality		
		Any	Private	Public	Any	Private	Public
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Panel A: SABER 11 as the Running Variable						
RD Coefficient	0.006	0.004	0.002	0.001	0.002	0.002	0.001
	(0.004)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)
Realized Access	0.32	0.465	0.466	0	-0.154	-0.063	-0.087
Mean Control	0.37	0.109	0.033	0.075	0.267	0.105	0.159
	Panel B: SISBEN as the Running Variable						
RD Coefficient	0.02	0.01	0.009	0.002	0.01	0.01	0
	(0.008)	(0.004)	(0.003)	(0.001)	(0.004)	(0.003)	(0.001)
Realized Access	0.274	0.396	0.477	-0.079	-0.12	-0.052	-0.076
Mean Control	0.485	0.261	0.067	0.194	0.225	0.097	0.134

Note: The table plots the reduced-form coefficient from a RD specification where the dependent variable is predicted access to postsecondary education using all 25 baseline characteristics from the universe of test-takers in Fall 2013. Panel A uses SABER 11 test scores as the running variable, while Panel B uses SISBEN wealth index as the running variable. The first row in each panel presents the RD estimate with robust standard errors. The third and forth rows reproduce the estimates and control means from Table 2. The table shows that controls cannot predict the magnitude of the effects we document of financial on immediate postsecondary enrollment. Bias-corrected RD results estimated with package rdrobust (Cattaneo, Calonico and Titiunik, 2014). Robust standard errors in parentheses.
Sources: Authors' calculations based on ICFES, DNP, and MEN (2016).

Table A.4: Immediate Postsecondary Enrollment, by Type of Institution (With and Without Controls)

	Any	High Quality			Low Quality		
		Any	Private	Public	Any	Private	Public
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Panel A: SABER 11 as the Running Variable						
RF (without controls)	0.32	0.465	0.466	0	-0.154	-0.063	-0.087
	(0.012)	(0.012)	(0.011)	(0.007)	(0.011)	(0.007)	(0.009)
RF (with controls)	0.329	0.479	0.484	-0.004	-0.155	-0.066	-0.088
	(0.012)	(0.012)	(0.012)	(0.007)	(0.011)	(0.007)	(0.008)
Mean Control	0.495	0.164	0.044	0.118	0.341	0.08	0.265
Observations	273,361	273,361	273,361	273,361	273,361	273,361	273,361
BW Loc. Poly.	28.317	24.143	22.777	27.582	26.247	30.453	27.345
Effect Obs Control	27,382	21,516	19,087	25,728	24,109	30,166	25,728
Effect Obs Treat	10,500	9,654	9,199	10,304	10,072	10,834	10,304
	Panel B: SISBEN as the Running Variable						
RF (without controls)	0.274	0.396	0.477	-0.079	-0.12	-0.052	-0.076
	(0.027)	(0.024)	(0.02)	(0.018)	(0.022)	(0.015)	(0.016)
RF (with controls)	0.253	0.392	0.479	-0.085	-0.135	-0.059	-0.082
	(0.026)	(0.025)	(0.021)	(0.019)	(0.022)	(0.015)	(0.016)
Mean Control	0.69	0.3	-0.009	0.319	0.389	0.148	0.239
Observations	21,071	21,071	21,071	21,071	21,071	21,071	21,071
BW Loc. Poly.	10.422	10.516	11.775	11.255	9.347	10.613	11.021
Effect Obs Control	4,085	4,117	4,536	4,363	3,730	4,140	4,284
Effect Obs Treat	4,116	4,154	4,612	4,417	3,708	4,182	4,339

Note: This table compares how the exclusion or inclusion of baseline covariates affects the reduced-form coefficient on the effect of financial aid eligibility on immediate postsecondary enrollment using a regression discontinuity design. The dependent variable is immediate enrollment by type of postsecondary institution (e.g., high-quality, low-quality, private, public). Panel A uses SABER 11 test score as the running variable, restricting the sample to SISBEN-eligible students. Panel B uses SISBEN wealth index as the running variable, restricting the sample to SABER 11-eligible students. The first row reproduces the main reduced-form estimates from Table 2, while the next rows include baseline covariates in the regression. Including controls, the reduced-form coefficient in Column (1) of Panel A suggests that, for individuals below a certain level of poverty, financial aid eligibility raises immediate postsecondary enrollment by 32.9 percentage points. On a basis of 49.5 percent, this implies a 66.5 percent increase in immediate enrollment. Bias-corrected RD results estimated with package rdrobust (Cattaneo, Calonico and Titiunik, 2014). Robust standard errors in parentheses. *Sources:* Authors' calculations based on ICFES, DNP, MEN, and SPADIES (2016).

Table A.5: Reason Student Chose to Attend her HEI, by Type

	Type of Postsecondary Institution		
	Any	Private	Public
It offers the major I want	58.1%	62.0%	52.4%
It's prestigious	47.4%	55.7%	36.8%
It's better academically	35.2%	42.4%	27.0%
It offers better job prospects	28.5%	36.1%	18.1%
It's public	24.1%	1.4%	62.7%
It's affordable	20.3%	9.1%	31.2%
I liked the curriculum there better	17.1%	13.5%	8.6%
It's private	6.9%	10.7%	1.1%
I have friends or relatives there	6.5%	6.3%	5.8%
It provides better contacts	5.5%	6.7%	4.5%
It's the only one that admitted me	4.5%	4.9%	3.9%
It's the only one available in my region	3.5%	3.0%	3.9%
N	1012	571	359

Note: The data is based on a survey collected from 1,487 SISBEN-eligible individuals that took SABER 11 in Fall 2015 and scored just below or above the SABER 11 eligibility cutoff. 82 observations did not match with an institution.
Source: Authors' calculations based on survey data.

Table A.6: Difference-in-Differences Outcomes by Type of Institution

	Any	High Quality			Low Quality		
		Any	Private	Public	Any	Private	Public
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Panel A: *Enrollment by Socioeconomic Strata and Test Score Decile*						
	Panel A.1: Strata 1–3 Only						
All Deciles							
DiD	0.0384	0.0232	0.0171	0.0061	0.0152	0.0089	0.0063
	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Mean Control	0.1789	0.0556	0.0194	0.0363	0.1233	0.073	0.0503
Deciles 1-9							
DiD	0.0237	0.0061	0.0026	0.0035	0.0176	0.0098	0.0078
	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Mean Control	0.1688	0.0452	0.0157	0.0295	0.1236	0.0741	0.0495
Decile 10							
DiD	0.1819	0.1983	0.1573	0.041	-0.0164	-0.0049	-0.0115
	(0.007)	(0.007)	(0.004)	(0.006)	(0.005)	(0.003)	(0.004)
Mean Control	0.4182	0.2748	0.1022	0.1725	0.1435	0.056	0.0875
	Panel A.2: Strata 4–6 Only						
All Deciles							
DiD	0.0036	-0.0016	-0.009	0.0074	0.0051	0.0045	0.0007
	(0.005)	(0.004)	(0.004)	(0.002)	(0.003)	(0.003)	(0.001)
Mean Control	0.4201	0.3135	0.2723	0.0413	0.1065	0.0862	0.0203
Deciles 1-9							
DiD	-0.0009	-0.009	-0.0109	0.0019	0.008	0.0065	0.0015
	(0.006)	(0.005)	(0.005)	(0.002)	(0.005)	(0.004)	(0.002)
Mean Control	0.3413	0.2023	0.1792	0.0232	0.139	0.113	0.026
Decile 10							
DiD	0.0188	0.0214	0.0046	0.0168	-0.0026	-0.0011	-0.0015
	(0.008)	(0.008)	(0.007)	(0.004)	(0.004)	(0.004)	(0.002)
Mean Control	0.5481	0.4948	0.4206	0.0742	0.0533	0.043	0.0103
	Panel B: *Share of Entering Students Scoring in Top Decile*						
DiD	-0.0057	0.0762	0.1268	0.0057	-0.0424	-0.0295	-0.0662
	(0.009)	(0.019)	(0.021)	(0.016)	(0.006)	(0.005)	(0.012)
Mean Control	0.1443	0.3627	0.39	0.3242	0.0438	0.0442	0.0426
	Panel C: *Share of Entering Students From Strata 1–3*						
DiD	0.0313	0.0904	0.1367	-0.0031	0.005	0.0082	0.0012
	(0.008)	(0.018)	(0.019)	(0.008)	(0.004)	(0.006)	(0.004)
Mean Control	0.7393	0.5258	0.2987	0.8395	0.8724	0.8328	0.9388

Note: This table presents the difference-in-differences coefficients on a series of outcomes. Panel A plots the results from specification (1) while Panels B and C plot the results from specification (2). Robust standard errors in parentheses. These regressions exclude baseline covariates. *Sources:* Authors' calculations based on ICFES, DNP, MEN, and SPADIES (2016).

2 Alternative Measures of College Quality

This section investigates how the RD results presented and discussed in Section 4.2 compare when using other metrics of college quality. This helps further understand how financial aid, by shifting students to HEIs with "high-quality" accreditation, affects the peer composition and institutional resources students are exposed to. For this purpose, we use alternative measures of resource and quality differences across universities.

Specifically, we use six proxies of institutional quality in 2014 (i.e., before SPP was introduced):

1. *Mean SABER 11 scores*: Mean standardized high school exit scores of first-year students enrolling in that university for the first time in Spring 2014.
2. *Mean SABER PRO scores*: Mean standardized score in the national college exit exam, SABER PRO, of students taking that exam in Spring 2014. Since 2009, all college students are required to present this test to graduate from an undergraduate program in Colombia. This allows us to compare the value added of colleges in terms of student performance at the time of graduation.
3. *Graduation Rate*: Percentage of students graduating from that HEI within 14 semesters from initial enrollment.
4. *Faculty with a Doctorate*: Percentage of faculty members with a doctoral degree.
5. *Log Spending per Student*: Logarithm of total operating expenses divided by the number of undergraduate students enrolled.
6. *Log Research Spending per Faculty*: Logarithm of the ratio of operating expenses assigned to research and the number of faculty members.

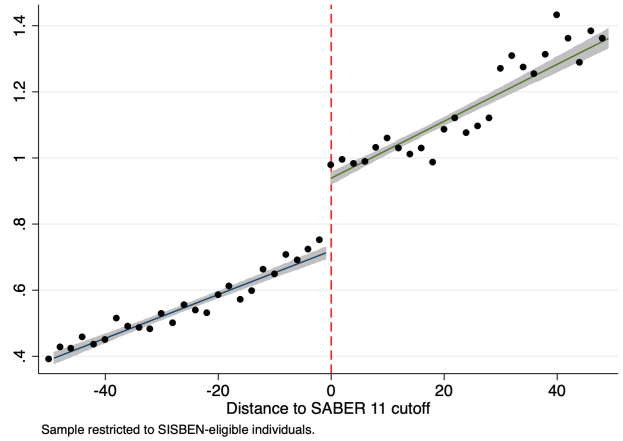
We restrict the RD estimation sample to Fall 2014 test-takers who immediately enroll in any university after having taken SABER 11 exam. Hence, we are interested in the impact of financial aid on HEI quality along the *intensive* margin, comparing different metrics of institutional quality. As always, we present results for the two populations of compliers separately. Figure B.1 and Panel A in Table B.1 use SABER 11 as the running variable, while Figure B.2 and Panel B in Table B.1 use SISBEN as the running variable.

Using SABER 11 as the running variable, the results suggest financial aid significantly improved the average quality of the HEI attended by high school seniors immediately after graduation, as measured through our six indicators above described. The results are large and precisely estimated (Table B.1, Panel A). Financial aid eligibility raised peer quality (mean high school test scores), college quality (college exit test scores, graduation rate, faculty with a doctorate), and the resources students are exposed to (spending per student, research spending per faculty member).

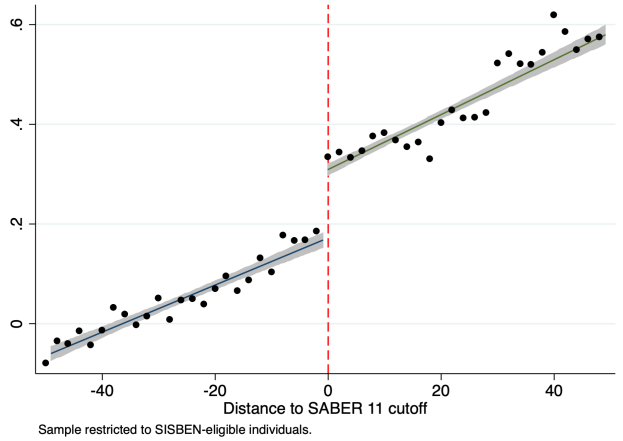
The results are qualitatively similar, although at times less precisely estimated, using SISBEN as the running variable. Figure B.2 and Panel B in Table B.1 show that, among attendees, the quality of the university they attend is falling as the SISBEN score approaches the eligibility cutoff: students are progressively poorer and thus enroll in worse-quality universities. Aid eligibility increases enrollment in higher-quality universities. Aid eligibility improved access to universities with higher peer quality, measured by mean SABER 11 scores, as well as the graduation rate. However, financial aid had no statistically significant impact on the quality of universities attended measured through resources available to students (columns 4–6).

Figure B.1: Alternative Measures of University Quality (R_i = SABER 11 test score)

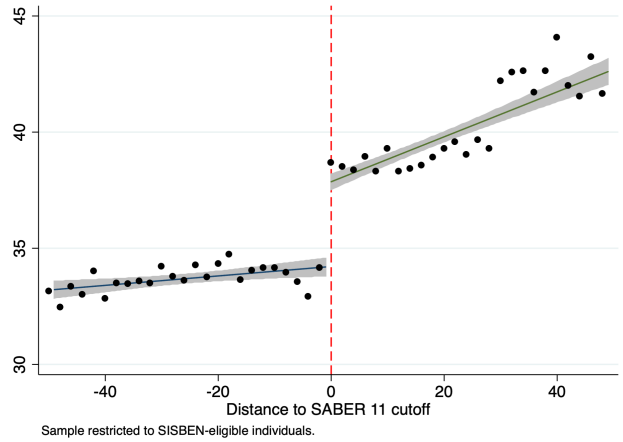
(a) Mean (Standardized) SABER 11 scores



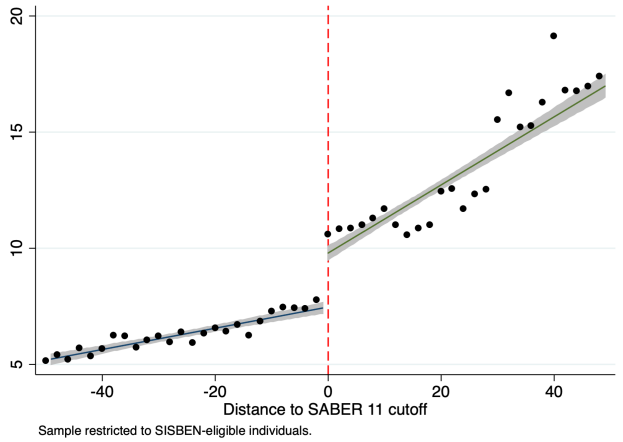
(b) Mean (Standardized) SABER PRO scores



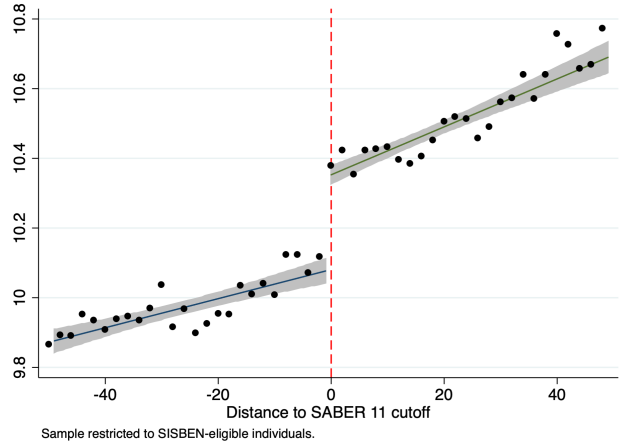
(c) Graduation Rate (%)



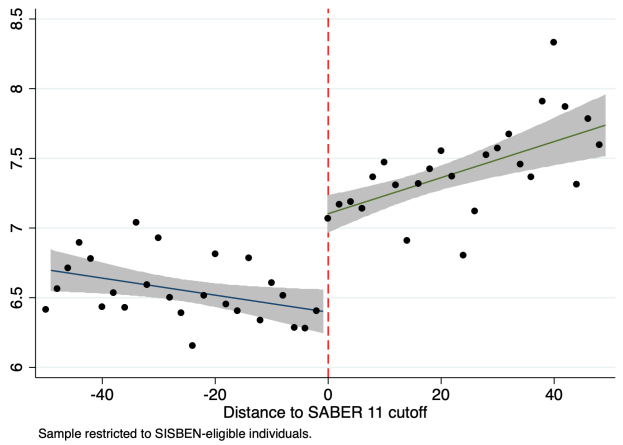
(d) Faculty with a Doctorate (%)



(e) Log Spending per Student



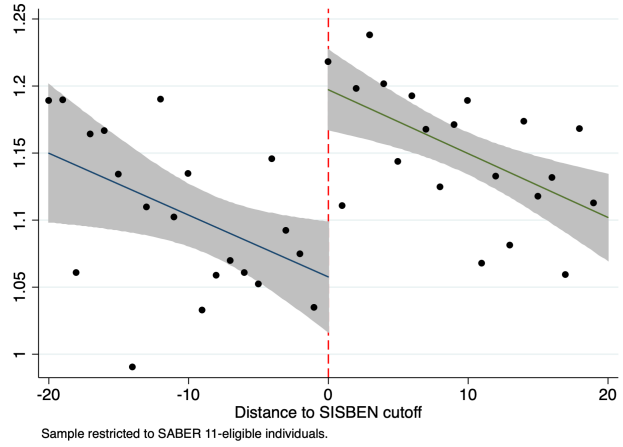
(f) Log Research Spending per Faculty



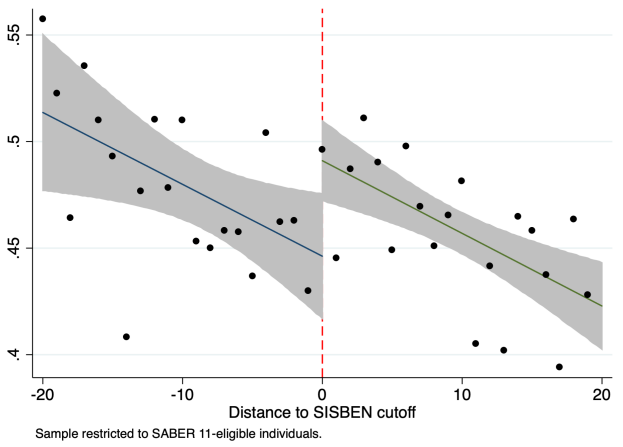
Note: The figures plot six different measures of the quality of the college students attend as a function of the distance to SABER 11 SPP eligibility cutoffs. The sample is restricted to Fall 2014 test-takers who immediately enrolled in a university the semester after having taken SABER 11 exam and are SISBEN-eligible. See reduced-form estimates in Table B.1. *Sources:* Authors' calculations based on ICFES, DNP, and MEN (2016).

Figure B.2: Alternative Measures of University Quality (R_i = SISBEN score)

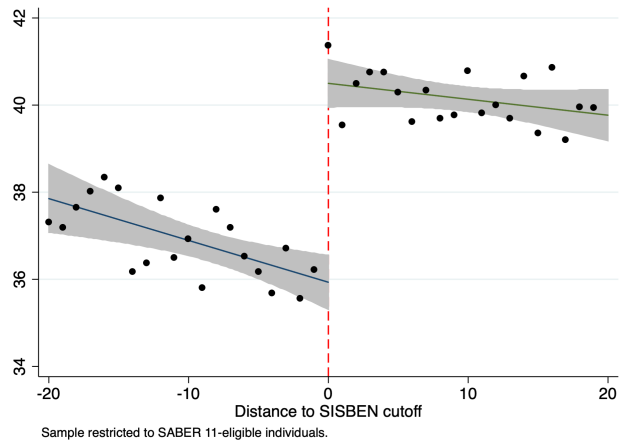
(a) Mean (Standardized) SABER 11 scores



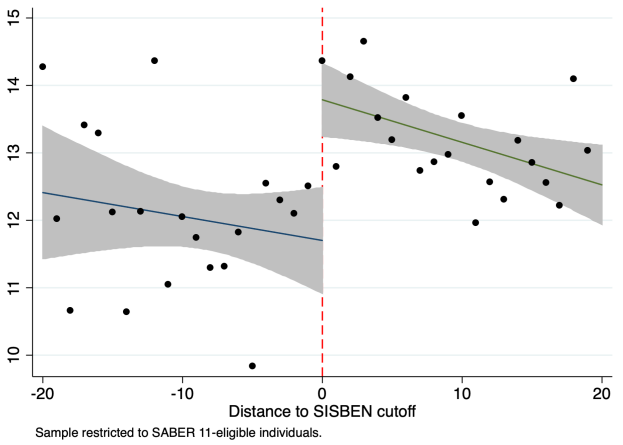
(b) Mean (Standardized) SABER PRO scores



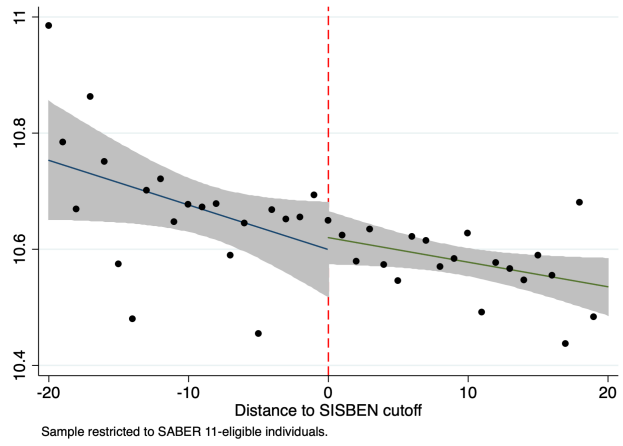
(c) Graduation Rate (%)



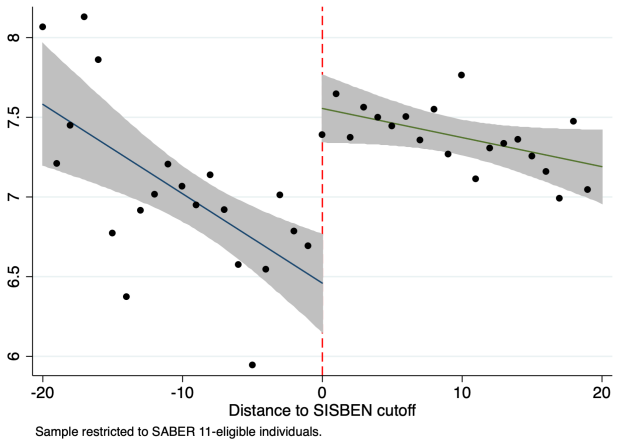
(d) Faculty with a Doctorate (%)



(e) Log Spending per Student



(f) Log Research Spending per Faculty



Note: The figures plot six different measures of the quality of the college students attend as a function of the distance to SISBEN SPP eligibility cutoffs. The sample is restricted to Fall 2014 test-takers who immediately enrolled in a university the semester after having taken SABER 11 exam and are SABER 11-eligible. See reduced-form estimates in Table B.1. *Sources:* Authors' calculations based on ICFES, DNP, and MEN (2016).

Table B.1: The Impact of Financial Aid on University Quality, by Measure of Quality

	Mean SABER 11 scores (1)	Mean SABER PRO scores (2)	Graduation Rate (%) (3)	Faculty with a Doctorate (%) (4)	Log Spending per Student (5)	Log Research Spending per Faculty (6)
	Panel A: SABER 11 as the Running Variable					
ITT	0.222	0.136	5.211	2.893	0.24	0.776
	(0.025)	(0.018)	(0.535)	(0.364)	(0.04)	(0.178)
LATE	0.273	0.167	6.433	3.562	0.294	0.954
	(0.03)	(0.022)	(0.656)	(0.445)	(0.05)	(0.22)
Mean Control	0.765	0.204	33.454	7.918	10.156	6.36
First Stage	0.813	0.814	0.81	0.812	0.814	0.814
	(0.01)	(0.01)	(0.011)	(0.01)	(0.01)	(0.009)
Observations	30,373	30,373	30,373	30,373	30,373	30,373
BW Loc. Poly.	22.549	23.402	17.397	21.129	26.688	29.829
Effect Obs Control	4,589	4,876	3,409	4,309	5,527	6,286
Effect Obs Treat	6,928	7,165	5,943	6,695	7,651	8,085
	Panel B: SISBEN as the Running Variable					
ITT	0.118	0.029	4.981	0.847	-0.047	0.662
	(0.047)	(0.035)	(0.794)	(1.034)	(0.078)	(0.367)
LATE	0.144	0.036	6.154	1.049	-0.057	0.817
	(0.057)	(0.043)	(0.967)	(1.269)	(0.096)	(0.449)
Mean Control	1.07	0.448	35.906	12.954	10.675	6.77
First Stage	0.814	0.81	0.809	0.809	0.822	0.811
	(0.018)	(0.02)	(0.02)	(0.021)	(0.017)	(0.019)
Observations	14,418	14,418	14,418	14,418	14,418	14,418
BW Loc. Poly.	10.241	9.002	8.736	7.374	12.068	8.958
Effect Obs Control	1,885	1,668	1,632	1,401	2,157	1,663
Effect Obs Treat	3,262	2,889	2,791	2,319	3,796	2,871

Note: This table presents the effect of financial aid on six different measures of the quality of the university students attend using a RD design. Panel A uses SABER 11 test score as the running variable, restricting the sample to SISBEN-eligible students. Panel B uses SISBEN wealth index as the running variable, restricting the sample to SABER 11-eligible students. No controls are included in these regressions. The LATE estimates scale the ITT estimates by the first stage. In the absence of always-takers, the LATE is equal to the TOT. Bias-corrected RD results estimated with package rdrobust (Cattaneo, Calonico and Titiunik, 2014). Robust standard errors in parentheses. *Sources:* Authors' calculations based on ICFES, DNP, MEN, and SPADIES (2016).

3 Medium-Term Enrollment, Persistence, and Academic Performance

This section analyzes the effect of financial aid on medium-term postsecondary enrollment, persistence, and performance.

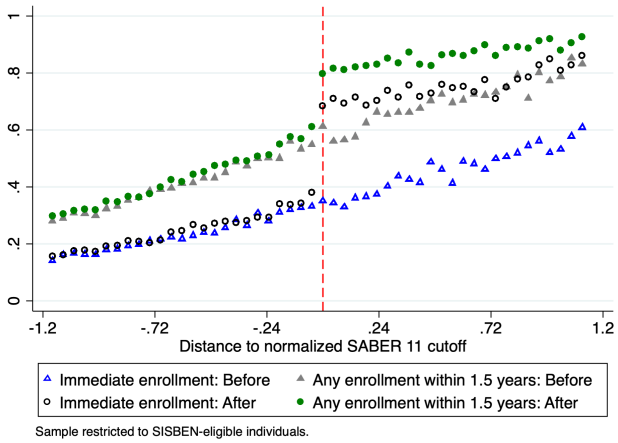
Figure C.1 compares immediate and medium-term enrollment probabilities before and after SPP. Specifically, the figure compares (i) immediate enrollment and (ii) any enrollment within 1.5 years from taking SABER 11 as a function of the distance to the normalized SABER 11 (Panel A) and

SISBEN (Panel B) SPP eligibility cutoffs for Fall 2013 test-takers ("Before") and Fall 2014 test-takers ("After"). Three lessons emerge from this figure. First, as shown in Section 4.2, financial aid significantly improved immediate enrollment: while this probability is the same before SPP (in blue), it increases significantly above the eligibility cutoff after SPP (in black). Second, any enrollment within 1.5 years increases for eligible students after SPP is rolled out (in green). Third, given control students have somewhat caught up over time (although not disproportionately more than before SPP, in gray), the magnitude of the enrollment gains within 1.5 years diminishes relative to the large immediate enrollment result.

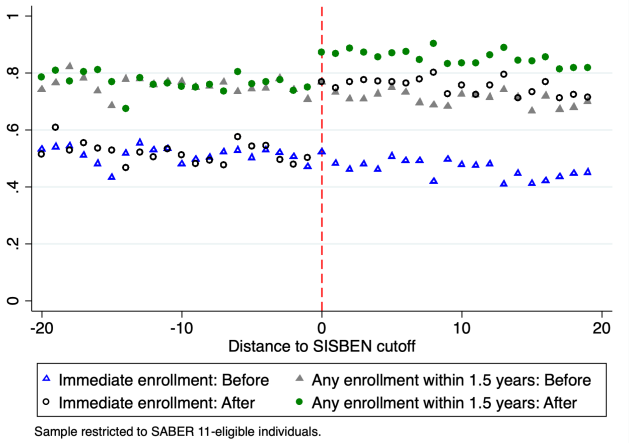
Column (1) in Table C.1 presents the reduced-form estimates on any enrollment within 1.5 years using the regression discontinuity design. The table shows that this probability increases by 19.1 percentage points or 31 percent at the SABER 11 cutoff (Panel A) and by 12.9 percentage points or 17.3 percent at the SISBEN cutoff (Panel B). While these coefficients are smaller than those on immediate enrollment from Table 2, the results are consistent with enrollment effects of aid remaining positive and significant even over a longer time horizon.

Figure C.1: Immediate Enrollment and Any Enrollment 1.5 Years After Taking SABER 11

(a) R_i = SABER 11 test score



(b) R_i = SISBEN wealth index



Note: This figure compares immediate enrollment and any enrollment within 1.5 years from taking SABER 11 as a function of the distance to the normalized SABER 11 (Panel A) and SISBEN (Panel B) SPP eligibility cutoffs for Fall 2013 test-takers ("Before") and Fall 2014 test-takers ("After"). The likelihood of any postsecondary enrollment within 1.5 years increases by 19.1 percentage points (31 percent) using SABER 11 as the running variable (Panel A) and by 12.9 percentage points (17.3 percent) using SISBEN as the running variable (Panel B). See reduced-form estimates in Table C.1, Column (1). *Sources:* Authors' calculations based on ICFES, DNP, and MEN (2016).

The first cohort of SPP recipients (i.e., Fall 2014 test-takers) began their undergraduate studies in Spring 2015. The average length of a program being 4.5 years, degree completion outcomes will only become available once they begin graduating, around 2021–2022. Instead, we observe two shorter-run measures of academic performance and persistence: the cumulative fraction of courses passed by Spring 2016 (included), and whether the student dropped out by that term. It should be noted that persistence during the first year is a strong predictor of completion: one in two college dropouts does so during freshman year in university (MEN, 2016).

We use two empirical strategies to compare college persistence between financial aid recipients and non-recipients. First, we use a RD design where the outcome is a dummy for being enrolled in a HEI in Spring 2016, i.e., 1.5 years after taking the high school exit exam. Columns (2) through (8) in Table C.1 present these results by type of HEI. Panel A uses SABER 11 test score as the running variable, while Panel B uses SISBEN wealth index as the running variable. The reduced-form estimate

in Column (2) suggests the likelihood of being enrolled in any HEI in Spring 2016 increased by 15.3 percentage points. On a base of 54.2 percent, this implies an increase of 28.2 percent. That is, the effects of financial aid on enrollment 1.5 years after taking SABER 11 are roughly a third of the immediate enrollment results documented in Table 2. This is in large part because barely-ineligible students have somewhat caught up, as discussed above. However, enrollment at high-quality HEIs remains 38.5 percentage points (227.8 percent) higher.

Table C.1: Medium-Term Enrollment in Postsecondary Education, by Type of Institution

	Any	*In Spring 2016*					
		Any	High Quality			Low Quality	
			Any	Private	Public	Any	Private	Public
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Panel A: SABER 11 as the Running Variable							
RF	0.191	0.153	0.385	0.406	-0.027	-0.231	-0.094	-0.131
	(0.012)	(0.015)	(0.012)	(0.012)	(0.008)	(0.014)	(0.009)	(0.01)
Mean Control	0.609	0.542	0.169	0.049	0.123	0.372	0.147	0.22
Observations	299,475	299,475	299,475	299,475	299,475	299,475	299,475	299,475
BW Loc. Poly.	25.31	19.778	25.457	20.771	28.761	17.782	21.235	23.777
Effect Obs Control	25,256	16,955	25,256	18,379	29,988	14,717	19,382	22,473
Effect Obs Treat	10,927	9,280	10,927	9,632	11,581	8,724	9,808	10,442
	Panel B: SISBEN as the Running Variable							
RF	0.129	0.117	0.311	0.438	-0.127	-0.191	-0.074	-0.117
	(0.023)	(0.022)	(0.026)	(0.019)	(0.021)	(0.022)	(0.017)	(0.017)
Mean Control	0.745	0.688	0.344	0.08	0.267	0.342	0.147	0.195
Observations	23,132	23,132	23,132	23,132	23,132	23,132	23,132	23,132
BW Loc. Poly.	9.063	12.549	10.77	14.382	10.636	10.568	9.257	12.145
Effect Obs Control	3,883	5,133	4,526	5,644	4,490	4,469	4,001	5,025
Effect Obs Treat	3,918	5,320	4,638	5,984	4,573	4,548	4,011	5,195

Note: This table presents the effect of financial aid on medium-term postsecondary enrollment using a regression discontinuity design. The dependent variable is any postsecondary enrollment by Spring 2016—1.5 years having taken SABER 11—in Column (1). Columns (2)–(8) restrict attending to enrollment in the Spring 2016 term. Their dependent variable is enrollment by type of postsecondary institution (e.g., high-quality, low-quality, private, public) in Spring 2016. Panel A uses SABER 11 test score as the running variable restricts, restricting the sample to SISBEN-eligible students. Panel B uses SISBEN wealth index as the running variable, restricting the sample to SABER 11-eligible students. The RF coefficient in Column (1) of Panel A suggests that, for individuals below a certain level of poverty, financial aid eligibility raises any postsecondary enrollment 1.5 years after graduating high school by 19.1 percentage points. On a base of 60.9 percent, this implies a 31.4 percent increase in any postsecondary enrollment with 1.5 years. No controls are included in these regressions. Bias-corrected RD results estimated with package rdrobust (Cattaneo, Calonico and Titiunik, 2014). Robust standard errors in parentheses. *Sources:* Authors' calculations based on ICFES, DNP, MEN, and SPADIES (2016).

The results from Table C.1 conflate persistence with the positive enrollment results and a shift in the quality of institutions attended. For this reason, it is worth comparing persistence and other academic outcomes across financial aid recipients and their classmates using the following OLS regression,

controlling for a set of relevant observables. Our second empirical strategy is as follows:

$$y_{imj} = \alpha + \beta 1(\text{SPP recipient})_i + \delta_{mj} + \boldsymbol{X}'_{imj}\Gamma + \varepsilon_{imj} \quad (1)$$

where y_{imj} is outcome y for student i in major m in postsecondary institution j, 1(SPP recipient) is a dummy variable that turns 1 if a student is SPP beneficiary and 0 otherwise, δ_{mj} are major-by-institution fixed effects, $\boldsymbol{X}_{imj}$ is a vector of 25 baseline characteristics, and ε_{imj} is a student-specific error term. Standard errors are clustered at the institution-by-major level.

Columns (1)–(4) in Table C.2 show that, on average 22.6 percent of students who enrolled in Spring 2015 are absent by Spring 2016.[1] SPP recipients are 12.1 percentage points less likely to be absent than their classmates (Column 1). Because retention rates are higher in high-quality HEIs attended by SPP recipients, Column 2 includes major-by-institution fixed effects. This reduces the magnitude of the coefficient, but not its statistical significance. Since dropout rates tend to decrease with pre-collegiate ability, controlling for SABER 11 score further reduces the magnitude of the coefficient (Column 3). Finally, including baseline covariates—our preferred specification—suggests SPP recipients are 3.8 percentage points less likely to drop out than their classmates (Column 4). On a mean of 22.1 percent, SPP recipients are 17.2 percent (3.8/22.1) less likely to drop out. This is partly a result of the program design, which requires beneficiaries to graduate from their program for the loan to become forgivable.

Columns (5)–(8) in Table C.2 use as dependent variable the cumulative share of courses passed by Spring 2016 (inclusive). On average, students passed 85.2 percent of their courses in their first three semesters in college. This share is 0.6 percentage points higher for SPP recipients than for their classmates (Column 5). Including major-by-college fixed effects reduces the magnitude of this coefficient (Column 6). Further, controlling for SABER 11 makes this coefficient switch sign and become significant (Column 7). Including a rich set of baseline controls suggests SPP recipients are 1.9 percentage points more likely to fail a course during their freshman year (Column 8). On a base of 85.3 percent, this implies a 2.2 percent drop in performance.

The second row in Table C.2 treats SPP recipiency status as endogenous and instruments it using program eligibility (i.e., scoring above 310/500 in SABER 11 and having a SISBEN score below the cutoff). The resulting 2SLS estimates suggest that selection on unobservables does not drive our main results, namely that SPP recipients are less likely to drop out but more likely to fail courses. However, by construction, we observe course-passing information only for retained students. The differential non-random attrition from postsecondary education documented in Columns (1)–(4) may thus compromise the course-passing comparability of SPP recipients and non-recipients, possibly generating selection bias.

To deal with this issue, we follow Abdulkadiroglu, Pathak and Walters (2018) and formally assess the robustness of our results to selected attrition by constructing non-parametric bounds on the 2SLS estimate under a monotonicity assumption on the attrition process, in the spirit of Lee (2009).[2] This monotonicity assumption in response to SPP eligibility is as follows:

$$D_i(1) \neq D_i(0) \implies D_i(1) = 1$$

[1] The first-year retention rate in Colombia varies significantly by type of HEI, and is lower than the average retention rate in the United States. In 2015, data from SPADIES shows the percentage of first-time, degree-seeking undergraduates retained was 77.1 percent at 4-year institutions in Colombia, 82.2 percent at high-quality institutions, 75.4 percent at low-quality institutions, 84.5 percent at private, high-quality institutions, and 78.6 percent at public, high-quality institutions. In the U.S., data from the U.S. Department of Education suggest the percentage of first-time, full-time degree-seeking undergraduates retained at 4-year institutions was 80 percent from 2013 to 2014. For selective institutions (i.e., acceptance rate of 25 percent or below), this share is 96 percent at both public and private non-profit institutions.

[2] We thank Christopher Walters for sharing the Stata code to perform this estimation.

This restriction implies that any student who changes behavior in response to SPP eligibility does so to receive financial aid. That is, no student declines SPP in response to eligibility, and no one drops out of college (and hence exits our estimation sample) in response to SPP eligibility. Intuitively, if SPP eligibility reduces the likelihood of dropping out for students, the usual LATE framework must be augmented with a set of "at risk" compliers who drop out of college (exit the sample) when ineligible for financial aid: $D_i(1) = 1, D_i(0) = a$, where a represents attrition from the sample. This prevents identification of the mean treated outcome for the subgroup of compliers who remain in the sample, but these means can be bounded using observed response probabilities and quantiles of the outcome distribution.[3] We then obtain standard errors by conducting 100 bootstrap replications of the entire procedure. In practice, risk set indicators and baseline covariates are included in all regressions used to estimate group shares, CDFs, and mean potential outcomes.

The third row in Table C.2 displays estimated bounds on 2SLS estimates for compliers. These bounds are tight around 2SLS estimates and suggest that adjustments for differential attrition do not overturn the conclusion that SPP recipients are 2 percent more likely to fail courses in their first year of college. The seemingly contradicting evidence on performance outcomes is likely also a result of program design. As mentioned above, SPP requires beneficiaries to graduate from their undergraduate program for the loan to become forgivable. SPP does not, however, provide achievement incentives; beneficiaries are not required to maintain a minimum grade point average in college. This partly explains why SPP recipients are slightly more likely to fail courses than counterfactual students. Ultimately, while this small negative effect on performance may potentially affect time to degree, we interpret the generally positive results displayed in Table C.2 as evidence against mismatch documented in other settings (Cohodes and Goodman, 2014; Dillon and Smith, 2017; Goodman, Hurwitz and Smith, 2017; Hoxby and Avery, 2013).

Table C.2: Persistence and Performance by Spring 2016: Cumulative Dropout and Course-Rassing Rates

	Dependent variable							
	Absent by Spring 2016				Cumulative share of courses passed by Spring 2016			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
OLS	-0.121	-0.049	-0.019	-0.038	0.006	0.002	-0.017	-0.019
	(0.018)	(0.005)	(0.005)	(0.006)	(0.011)	(0.003)	(0.002)	(0.003)
2SLS	-0.139	-0.060	-0.007	-0.035	0.014	0.013	-0.020	-0.023
	(0.019)	(0.007)	(0.006)	(0.007)	(0.011)	(0.003)	(0.003)	(0.003)
Bounds (LB; UB)					-0.052 0.015	0.003 0.013	-0.020 -0.020	-0.023 -0.023
					(0.004) (0.003)	(0.004) (0.002)	(0.003) (0.002)	(0.003) (0.003)
Major-by-college FE		Yes	Yes	Yes		Yes	Yes	Yes
SABER 11 score			Yes	Yes			Yes	Yes
Other controls				Yes				Yes
N	109,735	109,595	109,595	101,157	84,654	84,451	84,451	78,368
R2	0.006	0.208	0.224	0.239	0.000	0.492	0.524	0.535
Dep Mean	0.226	0.226	0.226	0.221	0.852	0.852	0.852	0.853
Dep SD	0.418	0.418	0.418	0.415	0.199	0.199	0.199	0.198

Note: Sample restricted to Fall 2014 SABER 11 test-takers who immediately enrolled in any postsecondary institution in Spring 2015. The dependent variable in Columns (1)–(4) is a dummy for whether a student registered in Spring 2015 is absent by Spring 2016, and in Columns (5)–(8) it is the cumulative share of courses passed by Spring 2016. Each row represents a separate regression. Robust standard errors in parentheses clustered at the first major-by-college pair in rows 1 and 2. Because the share of courses passed are observed for retained students, we assess the robustness of our results in row 2 to selective attrition by constructing non-parametric bounds on local average treatment effects under a monotonicity assumption on the attrition process, in the spirit of Abdulkadiroglu, Pathak and Walters (2018) and Lee (2009). Row 3 reports these non-parametric bounds and standard errors using 100 bootstrap replications of the entire procedure. Controls include 25 baseline characteristics. $*p < 0.1, **p < 0.05, ***p < 0.01$.
Sources: Authors' calculations based on ICFES, DNP, MEN, and SPADIES (2016).

[3] A full description of the methods for bounding local average treatment effects in the presence of differential attrition is available in Abdulkadiroglu, Pathak and Walters (2018), Appendix A.2.

4 The Second Cohort of SPP Recipients

Having documented the enrollment effects of financial aid on the first cohort of SPP beneficiaries (henceforth SPP1), this section estimates these effects for the second cohort of students (henceforth SPP2). Unlike SPP1, students from SPP2 were high school juniors when the government announced SPP. They therefore had one year to prepare their college application. Expecting an increasing take-up of SPP over time, the government raised the SABER 11 eligibility cutoff from 310 to 318 for SPP2, while keeping the SISBEN cutoff unchanged (see Figure D.1). Therefore, relative to SPP1, SPP2 beneficiaries will be more selected on ability (top 8 percent versus top 9 percent of test scores), but a priori equally wealthy. As before, we exploit the SABER 11 and SISBEN eligibility cutoffs using a RD design separately for the two population of compliers.

First, we test whether the key identification assumptions required in a RD strategy still hold for this second cohort. We find that 77 students received SPP without having the required SISBEN score in SPP2. That is, unlike in SPP1, there are some always-takers in SPP2. As discussed in Section 4.1, students from cohorts 2 and above reacted to the expansion of financial aid by requesting an evaluation from local authorities to be included in SISBEN. They also reacted by requesting a SISBEN re-evaluation, in the hopes that their new score would fall below the eligibility cutoff. This generates a concern that, unlike SPP1, there might be some manipulation of SISBEN scores around the cutoffs in this second cohort (and those that followed). While we do not detect any imbalance in baseline covariates across the SABER 11 cutoff for SISBEN-eligible students, we do detect some small differences among SABER 11-eligible students around the SISBEN cutoff (Table D.1). Specifically, merit-eligible students who are barely need-eligible are more likely to be female, low-income, and have more educated fathers than barely ineligible students. For narrow bandwidths, we can reject the joint null hypothesis of balance across all baseline covariates for this population of compliers.

Consistent with SPP becoming more well-known and students having more time to prepare their college application, a higher fraction of eligible students were able to receive the scholarship-loan in SPP2 than in SPP1. The take-up rate of SPP increased by 12.3 percentage points for this second cohort, from 59.4 percent in SPP1 to 71.7 percent in SPP2.

Third, when compared with SPP1 outcomes, SPP2 enrollment impacts vary depending on the population of compliers one observes. Figure D.2 plots immediate enrollment probabilities Fall 2014 test-takers (SPP1) and Fall 2015 test-takers (SPP2) as a function of the two running variables. Raising the SABER 11 cutoff improved enrollment for those above the new threshold; but not those below it. The reduced-form coefficient for SPP2 (Table D.2) is 0.308 and thus very similar to the 0.32 coefficient for SPP1 (Table 2). For individuals below the poverty cutoff, aid eligibility raises immediate enrollment by 30.8 percentage points in SPP2 versus 32.0 percentage points in SPP1. Critically, however, raising the SABER 11 cutoff also raised the control mean for SPP2 (45.6 percent) relative to SPP1 (37 percent). This implies that the enrollment effect in percentage terms falls from 86.5 percent in SPP1 to 67.5 percent in SPP2.

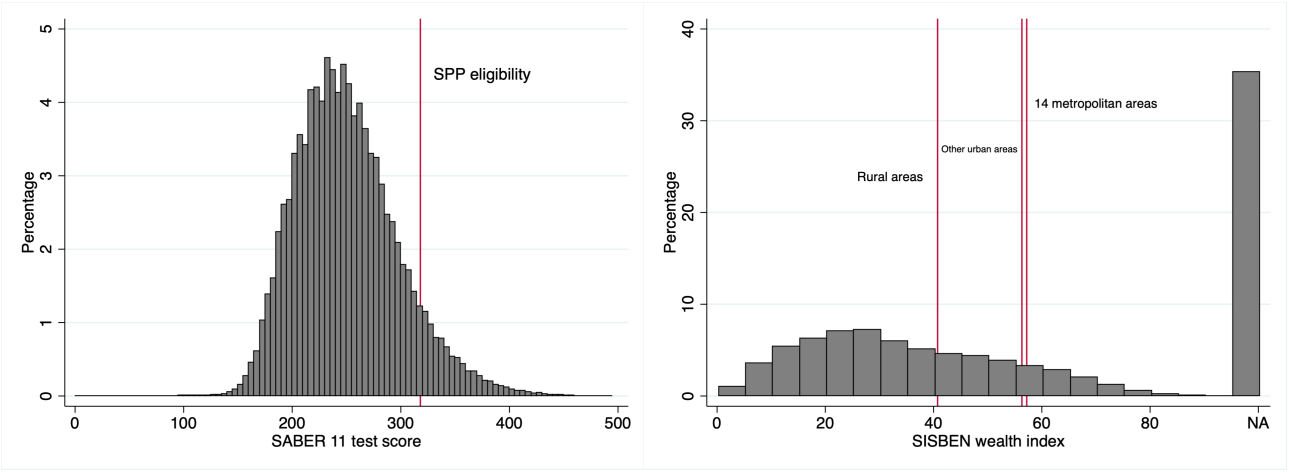
In contrast, we much smaller differences in enrollment outcomes between SPP1 and SPP2 using SISBEN as the running variable. For individuals scoring above the test score threshold, aid eligibility raises immediate enrollment by 24.5 percentage points in SPP2 versus 27.4 percentage points in SPP1. Given the control mean increased from 48.5 percent to 56.8 percent, the enrollment effect falls from 56.5 percent in SPP1 to 43.1 percent in SPP2.

Finally, students eligible for SPP2 shifted away from public, high-quality HEIs—a result that is statistically significant and large in percentage terms (29.5 to 34.7 percent) for both populations of compliers. The shift away from low-quality HEIs is somewhat less accentuated in SPP2 relative to SPP1: negative 42–51 percent versus negative 53–58 percent, respectively. This is both a result of a lower reduced-form coefficient using SISBEN as the running variable as well as a higher control means in both comparisons in SPP2 relative to SPP1.

A mixture of demand and supply responses to financial aid expansion are potentially at play in producing these positive results for control students, as discussed in Section 5.1. It is worth noting that, in May 2015, the Colombian government implemented a separate student loan program called "Tú Eliges." The objective of this loan program was to expand financial aid to low- and middle-income (albeit lower-performing) students.[4] As a result, loans were often awarded to lower-performing, middle-income students, which might drive part of the positive low-quality enrollment effects for documented in Table D.2. Although these loans could explain part of the increase in immediate enrollment for the control population in SPP2, they cannot explain most of the large enrollment gains among students barely ineligible for SPP: Section 5.1 documented that low-income, lower-performing Fall 2014 already had large enrollment gains relative to Spring 2014 test-takers (the control group in the difference-in-differences approach) before "Tú Eliges" was introduced.

Figure D.1: SPP Eligibility Conditions for the Second Cohort of SPP

(a) Merit: SABER 11 test score $\geq$ 318/500 (b) Need: SISBEN wealth index $<$ threshold

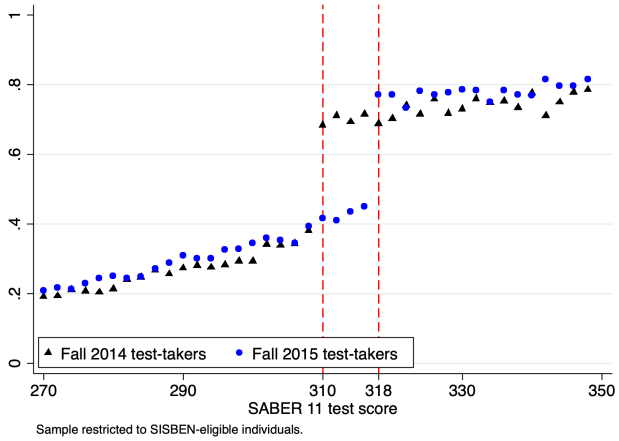


Notes: These figures show the distribution of SABER 11 test scores (Panel A) and SISBEN poverty index (Panel B) for Fall 2015 test-takers. The red vertical lines represent the SPP eligibility cutoffs. The figures suggest both variables are distributed smoothly around the eligibility cutoffs. In Panel B, the SISBEN eligibility cutoff varies by the applicant's geographic location. Test-takers not included in SISBEN (e.g., individuals that do not receive welfare) do not have a SISBEN score and appear in Panel B as "N/A".
Sources: Authors' calculations based on ICFES, DNP, and MEN (2016).

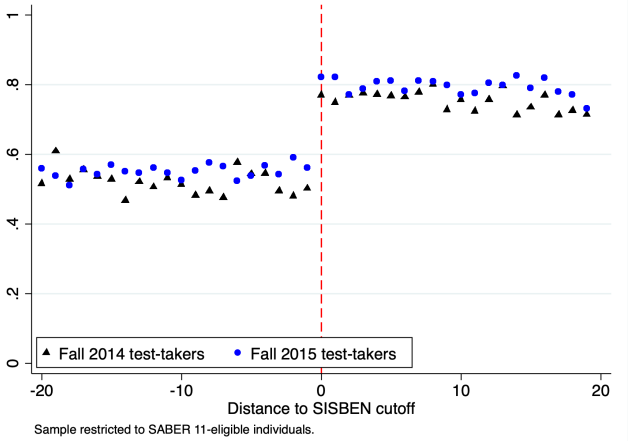
[4]Unlike SPP2, loans from "Tú Eliges" (1) were not forgivable upon graduation, requiring beneficiaries to pay back the full amount of the loan; (2) did not require beneficiaries to graduate from high school by a specific date; (3) could be used to attend both low- and high- quality HEIs; and (4) were less restrictive in their eligibility criteria than SPP2.

Figure D.2: Immediate Postsecondary Enrollment: SPP1 versus SPP2

(a) R_i = SABER 11 test score



(b) R_i = SISBEN wealth index



Note: These figures plot the probability of immediately accessing any postsecondary institution for test-takers in Fall 2014 (SPP1, in black) and Fall 2015 (SPP2, in blue) as a function of the SABER 11 score (Panel A) and SISBEN (Panel B) eligibility cutoffs. The SABER 11 cutoff increased from 310 to 318 for SPP2 (i.e., from top 9 percent to top 8 percent of test scores), while the SISBEN cutoff remained the same. *Sources:* Authors' calculations based on ICFES, DNP, and MEN (2016).

Table D.1: Baseline Covariate Balance Test for the Second Cohort of SPP

	Running Variable			
	SABER 11		SISBEN	
	Coef/SE	Mean Control	Coef/SE	Mean Control
	(1)	(2)	(3)	(4)
Female	0.004	0.452	0.053	0.386
	(0.011)		(0.027)	
Age	-0.005	16.631	0.082	16.543
	(0.047)		(0.104)	
Ethnic minority	0.001	0.009	-0.003	0.006
	(0.002)		(0.003)	
Employed	0.007	0.094	-0.013	0.089
	(0.007)		(0.015)	
Family size	0.023	4.476	0.018	4.326
	(0.037)		(0.071)	
Mother education: Primary	-0.004	0.226	-0.003	0.138
	(0.009)		(0.018)	
Mother education: Secondary	-0.002	0.484	0.027	0.414
	(0.011)		(0.029)	
Mother education: T&T	0.002	0.148	-0.009	0.191
	(0.007)		(0.019)	
Mother education: Higher	0.007	0.138	-0.001	0.249
	(0.007)		(0.024)	
Father education: Primary	0.007	0.303	0.016	0.176
	(0.009)		(0.018)	
Father education: Secondary	-0.015	0.444	-0.075	0.469
	(0.011)		(0.026)	
Father education: T&T	0.001	0.113	0.009	0.148
	(0.007)		(0.018)	
Father education: Higher	0.012	0.134	0.046	0.210
	(0.008)		(0.022)	
Household SES: Stratum 1	-0.012	0.361	0.006	0.119
	(0.011)		(0.015)	
Household SES: Stratum 2	0.006	0.448	0.039	0.492
	(0.011)		(0.025)	
Household SES: Stratum 3	0.007	0.171	-0.052	0.343
	(0.008)		(0.025)	
Household SES: Stratum 4	0	0.017	0.006	0.037
	(0.003)		(0.01)	
Household SES: Stratum 5	-0.001	0.002	-0.003	0.010
	(0.001)		(0.004)	
Household SES: Stratum 6	-0.001	0.001	0	0.000
	(0.001)		(0)	
School hours: Full day	-0.01	0.207	-0.005	0.350
	(0.01)		(0.023)	
School hours: Morning	0.002	0.620	0.019	0.496
	(0.011)		(0.027)	
School hours: Evening	0	0.007	0.002	0.006
	(0.002)		(0.004)	
School hours: Afternoon	0.009	0.159	-0.033	0.146
	(0.007)		(0.019)	
School hours: Weekends	-0.001	0.007	0.003	0.004
	(0.002)		(0.003)	
Private school	-0.003	0.190	-0.018	0.351
	(0.009)		(0.022)	
Joint F-Stat (p-value, LB on bandwidth)	0.247		0	
Joint F-Stat (p-value, UB on bandwidth)	0.699		0.184	

Notes: This table plots the reduced-form coefficient from a RD specification where the outcome is a baseline characteristic and the running variable is either SABER 11 test scores in columns (1) and (2) or SISBEN poverty index in columns (3) and (4). The sample is restricted to Fall 2015 test-takers who are SISBEN-eligible in columns (1) and (2), or SABER 11-eligible in columns (3) and (4). Columns (1) and (3) present conventional coefficients and standard errors in parentheses, while columns (2) and (4) present control means. There is no statistically significant imbalance in Column (1), and we cannot reject the joint null hypothesis. There is imbalance in 5 of 25 covariates in Column (3) and, while imbalance in these observable characteristics using SISBEN as the running variable are relatively small, we can reject the joint null hypothesis for small bandwidths. All results are estimated with package rdrobust (Cattaneo, Calonico and Titiunik, 2014). *Sources:* Authors' calculations based on ICFES, DNP, and MEN (2016).

Table D.2: Immediate Postsecondary Enrollment for the Second Cohort of SPP, by Type of Institution

	Any	High Quality			Low Quality		
		Any	Private	Public	Any	Private	Public
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Panel A: SABER 11 as the Running Variable						
RF	0.308	0.444	0.473	-0.028	-0.129	-0.02	-0.108
	(0.013)	(0.013)	(0.012)	(0.008)	(0.01)	(0.007)	(0.008)
Mean Control	0.456	0.15	0.055	0.095	0.304	0.129	0.172
Observations	312,863	312,863	312,863	312,863	312,863	312,863	312,863
BW Loc. Poly.	28.578	27.713	26.655	26.442	38.145	44.042	38.615
Effect Obs Control	25,378	23,874	22,943	22,943	40,952	51,629	40,952
Effect Obs Treat	10,841	10,678	10,408	10,408	12,769	13,584	12,769
	Panel B: SISBEN as the Running Variable						
RF	0.245	0.397	0.451	-0.06	-0.151	-0.06	-0.086
	(0.024)	(0.032)	(0.024)	(0.023)	(0.028)	(0.02)	(0.02)
Mean Control	0.568	0.278	0.106	0.173	0.297	0.144	0.146
Observations	23,135	23,135	23,135	23,135	23,135	23,135	23,135
BW Loc. Poly.	12.917	7.321	11.667	8.224	7.011	9.594	7.877
Effect Obs Control	4,459	2,650	4,111	2,977	2,546	3,443	2,831
Effect Obs Treat	4,804	2,720	4,342	3,104	2,588	3,618	2,960

Note: This table presents the effect of financial aid on immediate postsecondary enrollment for the second cohort of SPP using a regression discontinuity design. The dependent variable is immediate enrollment by type of postsecondary institution (e.g., high-quality, low-quality, private, public). Panel A uses SABER 11 test score as the running variable restricts, restricting the sample to SISBEN-eligible students. Panel B uses SISBEN wealth index as the running variable, restricting the sample to SABER 11-eligible students. No controls are included in these regressions. The reduced-form coefficient in Column (1) of Panel A suggests that, for individuals below a certain level of poverty, financial aid eligibility raises immediate postsecondary enrollment by 30.8 percentage points, which is very similar to 32.0 result from Table 2 from the first cohort of SPP. Critically, however, the basis for this second cohort of SPP has increased substantially, from 37 percent to 45.6 percent. This implies that the enrollment effect in percentage terms falls from 86.5 percent to 67.5 percent. Bias-corrected RD results estimated with package rdrobust (Cattaneo, Calonico and Titiunik, 2014). Robust standard errors in parentheses. *Sources:* Authors' calculations based on ICFES, DNP, MEN, and SPADIES (2016).

5 Where Did Displaced Applicants Enroll?

The greater entry competition at elite private universities induced by financial aid may have displaced some applicants from attending top schools. This section uses admission records microdata from one of the country's top-ranked universities to identify and characterize displaced applicants, and track them to the colleges where they end up enrolling around the country.

In this top-ranked university, 900 SPP-*in*eligible applicants whose test scores would have granted them

admission in Spring 2014 were rejected the following year as a result of the more selective cutoffs.[5] Figure E.2 tracks where these displaced students enrolled in Spring 2015, i.e., the semester immediately after presenting SABER 11. Panel A shows that around 42 percent of displaced students did not immediately enroll in any HEI in Colombia, with the remainder enrolling at institutions with significantly lower-quality students, according to their mean SABER 11 score before SPP.[6] Specifically, 22 percent of displaced students attended Bogota's second-best private HEI, whose mean normalized SABER 11 score is 1.94 (i.e., a loss in peer quality of 1.1 points). Roughly 9.3 percent of displaced students attended an institution with a score of 1.54 (i.e., a loss in peer quality of 1.5 points). One-third of all displaced students belong to relatively wealthy households, i.e., strata 4, 5, or 6. Panel B restricts the sample to these relatively wealthy students and shows that one-third of them opted not to immediately enroll in any HEI in Colombia, while 26.7 percent opted for the 8th ranked institution in the country; a private, high-quality college in Bogota.

How does this compare to successful applicants who would not have been admitted the following year due to the increase in cutoffs, that is, the would-be marginal applicants? Indeed, comparing the two cohorts is important because not all those who are admitted enroll. Specifically, Londoño-Vélez (2016) suggests that on average roughly 30 percent of admitted applicants enrolled at this elite private university before SPP, and that those from strata 4–6 were twice as likely to enroll as those from strata 1–3. Thus, Figure E.3 presents the difference in the frequency of marginal and would-be marginal applicants enrolled at each institution before and after SPP.[7] The figure suggests an increase in the number of students that did not immediately enroll in any HEI and that enrolled in lower-ranked institutions.[8]

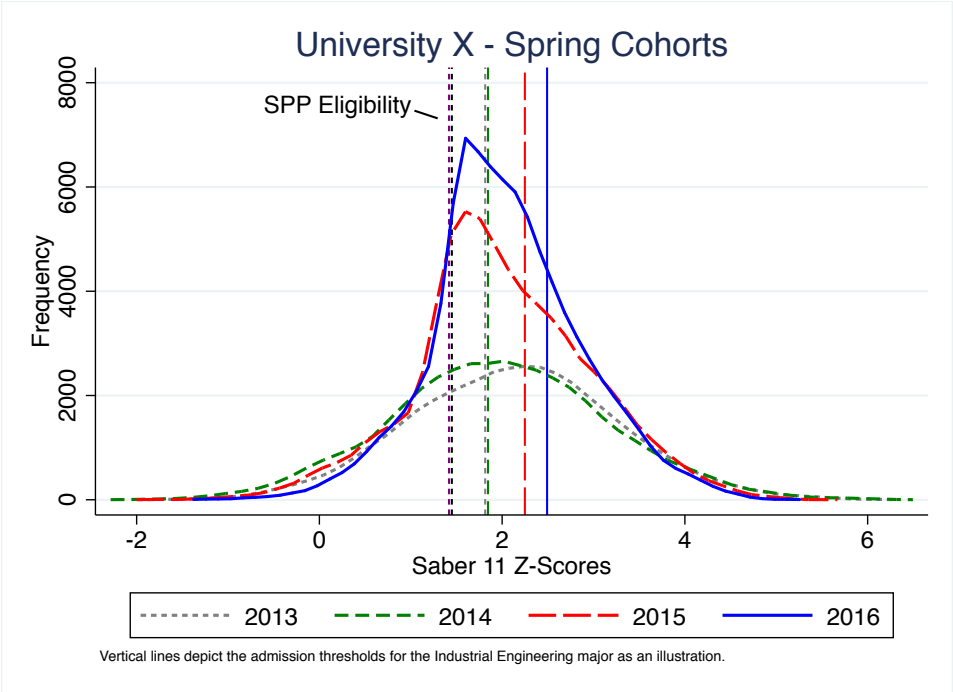
[5] Figure E.1 illustrates the rightward shift in admission cutoffs at this institution produced by SPP.

[6] Roughly one-third of those (immediately) crowded out from higher education re-applied to this same university to no avail. By Fall 2016 (i.e., 1.5 years later), 70 percent were attending higher education.

[7] There are 317 such would-be marginal applicants in Spring 2014.

[8] Note that almost 42 percent of would-be marginal applicants come from relatively wealthy households (i.e., strata 4-6).

Figure E.1: SPP displaced students from an elite private university

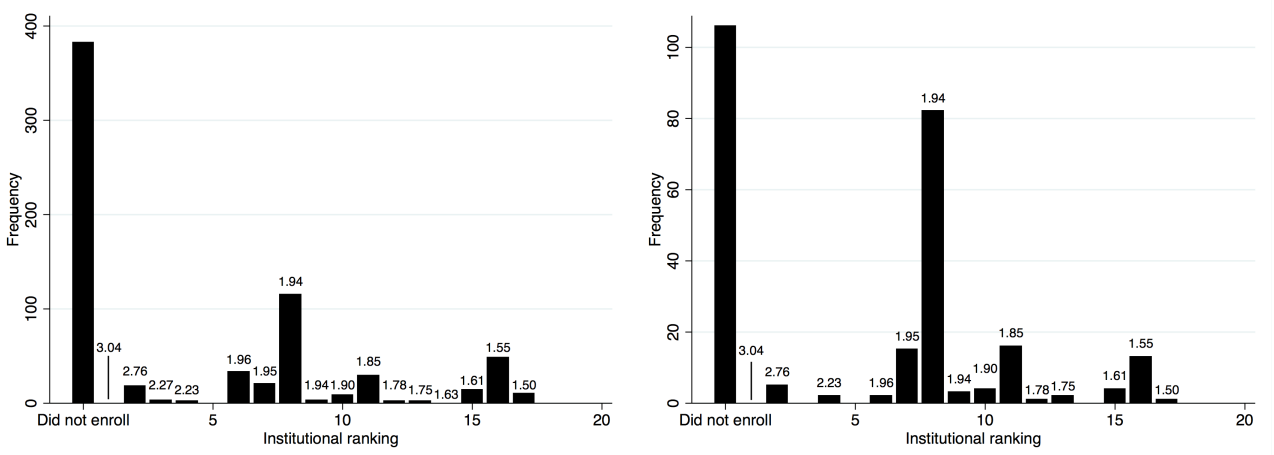


Notes: This figure plots the distribution of SABER 11 scores among applicants wishing to enroll in an elite private university in Bogota in the Spring semesters of 2013, 2014, 2015, and 2016. The vertical lines depict the admission cutoffs for a representative undergraduate program (Industrial Engineering). The figure shows that the increase in the number of applicants following the announcement of SPP induced a rightward shift in the admission threshold, thus raising admission selectivity. *Source:* Londoño-Vélez (2016).

Figure E.2: Institutions where displaced applicants immediately enrolled

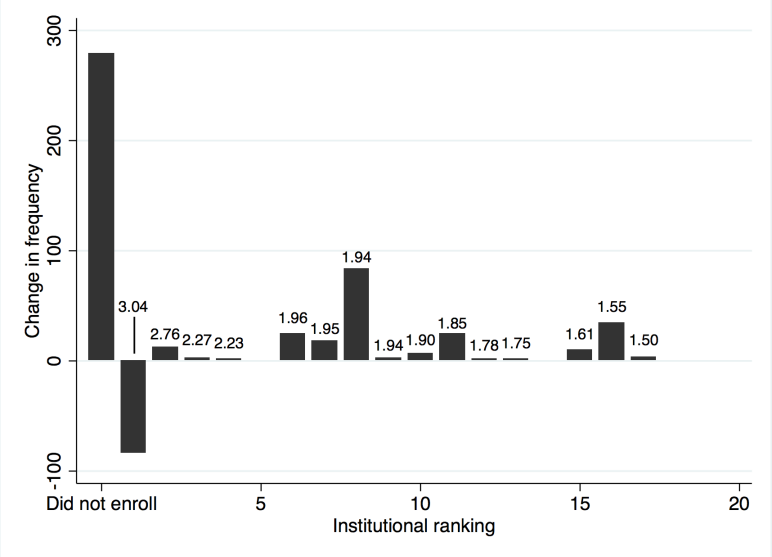
(a) All displaced applicants

(b) Relatively wealthy displaced applicants



Notes: These figures tracks the postsecondary institution in which displaced applicants from a flagship private university immediately enrolled. A Spring 2015 applicant is considered "displaced" if he/she is *not* eligible for SPP, has standardized SABER 11 test score above the previous year's admission cutoff, and was not admitted. The values above the bars represent institutional mean normalized SABER 11 test score of Spring 2014 entering cohort. Panel A suggests around 42% of displaced students did not immediately enroll in any postsecondary institution in Colombia, with the remainder enrolling at institutions with significantly lower-quality students. Panel B restricts the sample to displaced applicants from strata 4, 5, and 6. *Sources:* Authors' calculations based on university administrative data, ICFES, DNP, MEN, and SPADIES (2016).

Figure E.3: Difference in frequency of displaced and would-be displaced applicants before and after SPP



Note: This figure presents the difference in the frequency of displaced and would-be displaced applicants enrolled at each institution before and after SPP. A Spring 2014 applicant is considered "displaced" if he/she is *not* eligible for SPP, was admitted the year he/she applied, and has standardized SABER 11 test score below the following year's admission cutoff. A Spring 2015 applicant is considered "displaced" if he/she is *not* eligible for SPP, has standardized SABER 11 test score above the previous year's admission cutoff, and was not admitted. Values represent institutional mean normalized SABER 11 test score of Spring 2014 entering cohort. The figure suggests there was an increase in the number of students that did not immediately enroll in postsecondary education and that enrolled in a lower-ranked institution. *Sources:* Authors' calculations based on university administrative data, ICFES, DNP, MEN, and SPADIES (2016).

6 Shifts in College Demand using College Admission Records

This section studies demand responses to financial aid using college admission records. First, we use data on undergraduate applications received by HEIs between 2012 and 2016 from SNIES, the Ministry of Education's information database on postsecondary education. We employ a difference-in-difference approach comparing the relative difference in the number of undergraduate applications received by HEI j in year t for Spring (treatment) and Fall (control) enrollment across time using specification (2). The coefficients of interest represent the difference in the number of undergraduate applicants with a given HEI in the Spring (treatment) and Fall (control) terms across time.

Figure F.1 plots the β_k coefficients from specification (2). The figure shows the number of applicants increased at high-quality private HEIs but remained unchanged at all other HEIs. High-quality private universities reacted to the higher demand by expanding their cohort size. Indeed Figure F.2, which re-estimates specification (2) using the number of incoming students as the outcome variable, shows that entering cohort size significantly increased at these institutions, while remaining relatively

unaffected at other institutions.[9] Critically, these impacts cannot be explained by changes in HEIs' decision to re-allocate spaces from Spring to Fall semester following scholarship rollout. Figure F.3, Panel A shows that, while the number of Fall test-takers (treated) accessing private high-quality HEIs immediately after high school increased significantly after SPP, the number of Spring test-takers (control) remained stable.

Unfortunately, inconsistent application reporting by some HEIs affects SNIES's data quality. For instance, the SNIES data misses undergraduate admission records for Colombia's flagship public and high-quality HEI, UNAL, in several years. For this reason, we complement SNIES data with admissions records provided specially to us by selected private high-quality HEIs. Figure F.4, Panel A, plots the number undergraduate applicants at several private high-quality colleges from Spring 2011 to Spring 2016 (normalized to equal 1 in Spring 2014) in the four largest metropolitan areas: Los Andes, PUJ, Sabana, and Jorge Tadeo Lozano, in Bogota; EAFIT and EIA, in Medellin; ICESI, in Cali; and Norte, in Barranquilla. The number of applicants increased between 19 percent (EAFIT) and 94 percent (ICESI) between 2014 and 2015. One year later, this fraction had further increased to 80 percent (Los Andes, PUJ – Bogota), 97 percent (Jorge Tadeo Lozano), and even 150 percent (Sabana, ICESI).[10] Importantly, this rise in college applications at private high-quality HEIs stands in stark contrast with their public counterparts. For instance, at UNAL, Colombia's flagship public university, the number of applicants stayed constant between 2014 and 2016.

Consequently, admission rates plummeted at most high-quality HEIs, with the fall being particularly severe at top-ranked universities: at Los Andes and Javeriana, admission rates fell by almost 50 percent and 35 percent in just two years, respectively (Figure F.4, Panel C).[11] This phenomenon is not restricted to private colleges in Bogota: the admission rate fell by 20 percent in Barranquilla's Norte University, 15 percent in Medellin's EIA, and 15 percent in Cali's ICESI. In contrast, the undergraduate admission rate at UNAL, Colombia's top public HEIs, *increased* from 8.3 percent in 2014 to 9.5 percent in 2016.

Importantly, again, private colleges expanded supply as a response to this rise in demand. Panel B in Figure F.4 shows that the increase between 2014 and 2016 in the size of entering cohorts varies significantly across institutions, from 8 percent in EAFIT to 100 percent in ICESI. Note, however, that the slope of the curves flattens after 2015, suggesting a possible conscientious attempt on behalf of some elite colleges to restrict this increase in supply (see MacLeod and Urquiola, 2015).[12]

[9] It should be noted that private colleges are relatively indifferent between admitting a SPP recipient and a non-recipient regarding tuition payments: they charge the same tuition and thus receive the same payment from parents or the government for either student type. In contrast, public colleges do receive more payments for enrolling SPP recipients starting 2016: in addition to the usual annual subsidies from the central government, SPP transfers to these institutions the students' average *cost*—not the tuition fee, which is artificially lower thanks to heavy government subsidies. This implies that, all else equal, public, high-quality colleges do have an incentive to enroll a SPP beneficiary over another student. While we do not observe such behavior, our finding that SPP beneficiaries sort *out* of—not *into*—public colleges suggests that, if public colleges are in fact actively changing their admission practices to favor SPP beneficiaries, their efforts are being met with limited success.

[10] Using admissions microdata from a private, high-quality university in Bogota, Londoño-Vélez (2016) shows that the documented rise in applications after SPP is driven exclusively by low-SES applicants from the bottom socioeconomic strata.

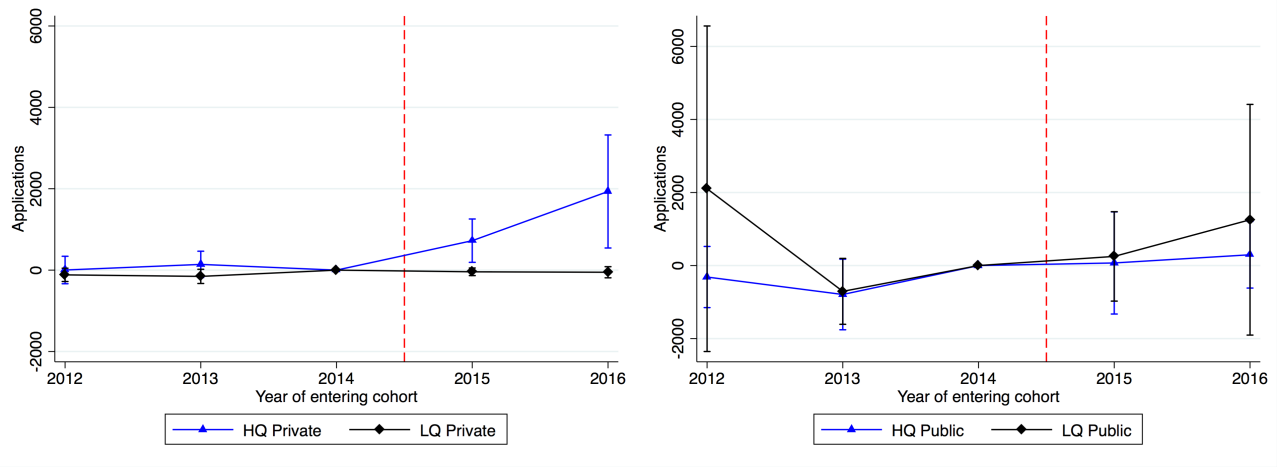
[11] Note that average admission rates are significantly lower in public versus private universities. Moreover, universities are generally more selective in Bogota than elsewhere in the country: the admission rate in Spring 2014 was 57 percent in the University of Los Andes and Sabana, and 58 percent in PUJ, versus 92 percent in EAFIT and 96 percent in EIA.

[12] MacLeod and Urquiola (2015) offer a model to explain why elite colleges have restricted supply despite increasing college applications. In their setup, asymmetric information about individual innate ability leads firms to set wages to expected skill conditional upon college reputation and an individual-specific measure of skill. As a response, college applicants display an endogenous taste for abler peers and colleges with good reputation. This provides schools with incentives to be selective and remain small.

Figure F.1: Applications by Quality and Type of HEI (SNIES data)

(a) Private HEIs

(b) Public HEIs

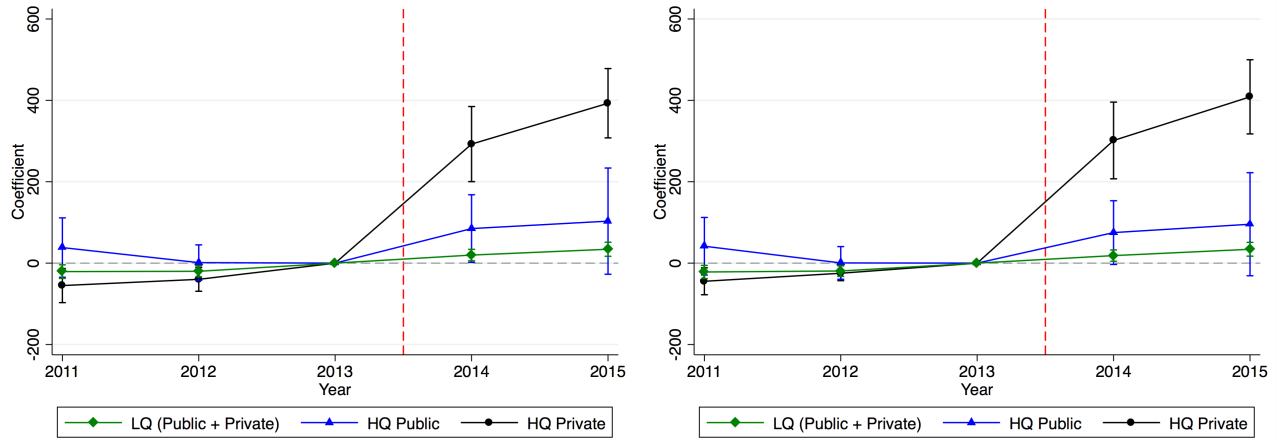


Notes: Panel A plots the difference in the number of undergraduate applicants at HEIs in the Spring (treatment) and Fall (control) terms, using specification (2). The figure suggests that the number of applicants increased only at high-quality private HEIs. The sample is restricted to a balanced sample of HEIs that reported annually between 2012 and 2016. Standard errors are clustered at the HEI level. *Source:* Authors' calculations using SNIES.

Figure F.2: Entering Cohort Size by Quality and Type of HEI (SPADIES data)

(a) All students

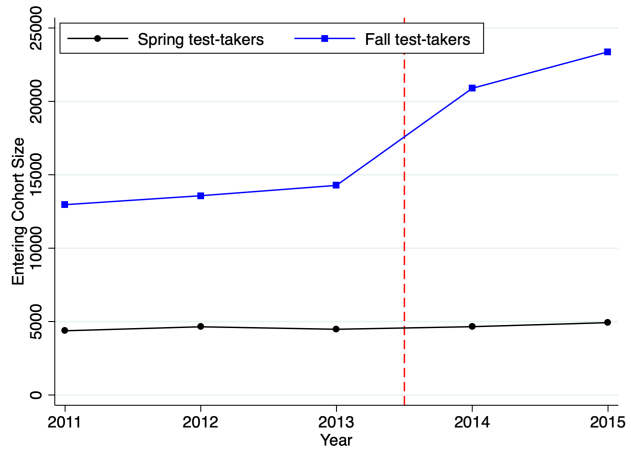
(b) Students Strata 1–3 Only



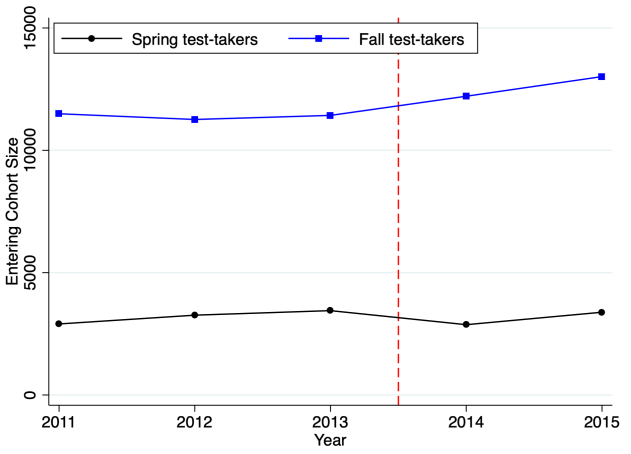
Notes: These figures plot the difference in the number of students who immediately enroll at a HEI after presenting SABER 11 in Spring (control) or Fall (treatment), using specification (2). Panel A uses information for students, while Panel B restricts the sample to students from strata 1–3. The figures suggest that entering cohort size increased only at high-quality private HEIs. This rise was driven by low-income students. The sample is restricted to a balanced sample of HEIs that reported annually between 2011 and 2015. Standard errors are clustered at the HEI level. *Source:* Authors' calculations using ICFES and SPADIES.

Figure F.3: Cohort Size by HEI Type Before and After SPP

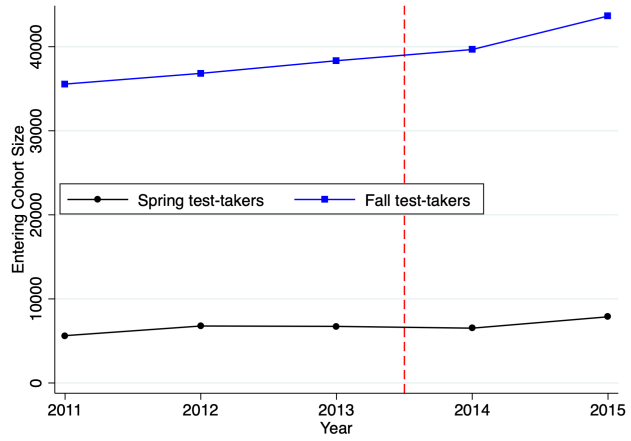
(a) Private High Quality HEIs



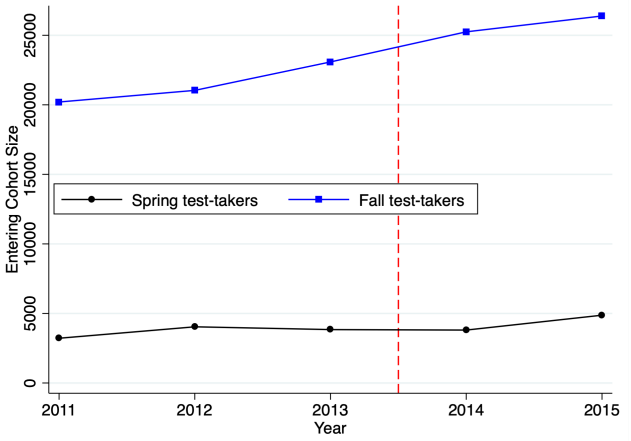
(b) Public High Quality HEIs



(c) Private Low Quality HEIs



(d) Public Low Quality HEIs

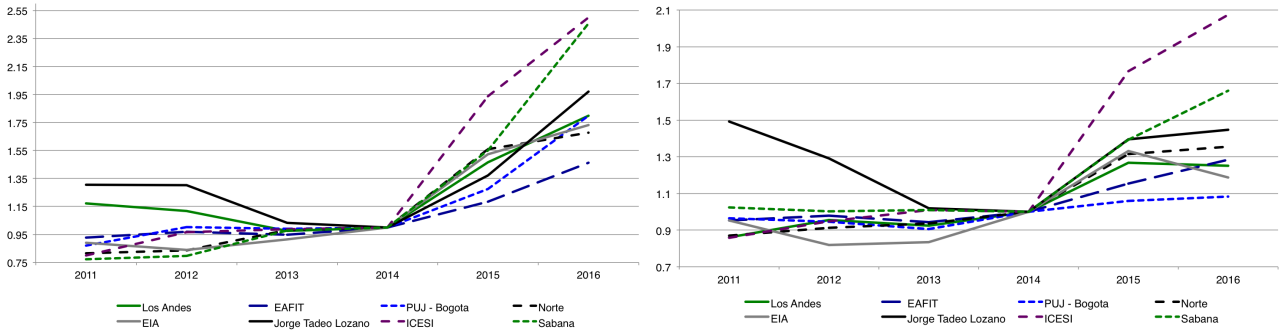


Note: This figure plots the number of students who access HEIs immediately after graduating high school between 2011 and 2015, separately for Fall (treated, in blue) and Spring (control, in black) test-takers, by type of HEI. *Sources:* Authors' calculations based on ICFES, DNP, and MEN (2016).

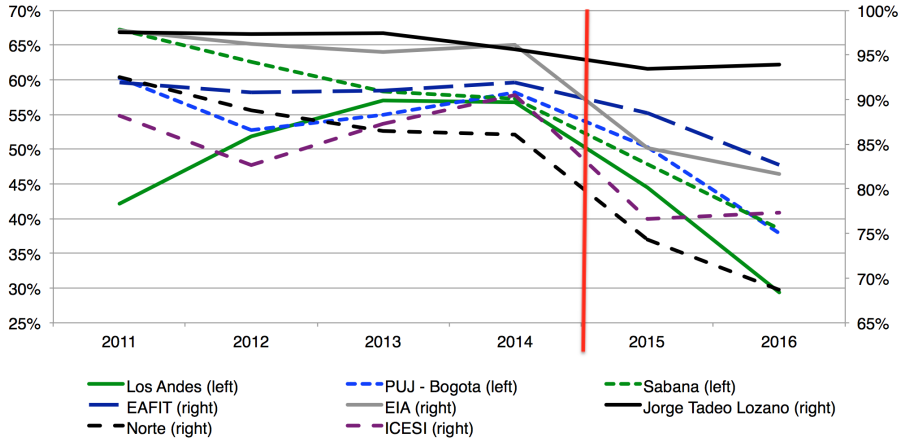
Figure F.4: Admissions at Selected Private High-Quality HEIs

(a) Number of Spring Applicants

(b) Size of Entering Cohort



(c) Admission Rates



Notes: Panel A plots the number of undergraduate applicants at selected private high-quality institutions from Spring 2011 to Spring 2016 (normalized for each institution to equal 1 in Spring 2014), in the four largest metropolitan areas in Colombia. The figure suggests that the number of applicants increased between 46 percent (EAFIT) and 150 percent (ICESI) between 2014 and 2016. Panel B plots the size of the entering cohort at these same institutions (normalized for each institution to equal 1 in Spring 2014), and suggests that cohort size increased between 8 and 100 percent between 2014 and 2016. Panel C plots the admission rate, that is, the share of applicants that are admitted, and suggests that this fraction decreased significantly across institutions. *Source:* Authors' calculations using administrative data.

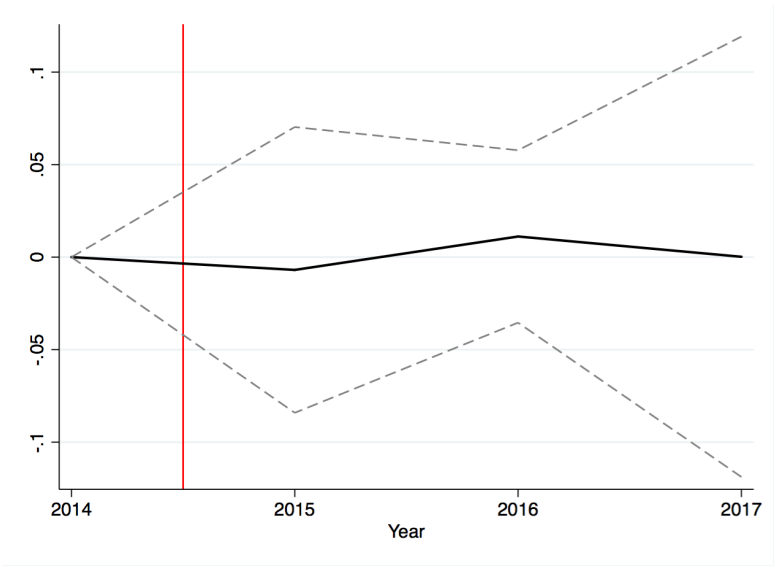
7 Institutional Responses: Tuition Fees

A final concern is whether the expansion of government-provided financial aid and the resulting higher demand for education has been captured (partly or entirely) by schools via tuition hikes, as predicted by the so-called Bennett Hypothesis.[13] Private colleges would be especially prone to have this behavioral response, as they have significantly more flexibility in setting their own tuition fees than their public counterparts. Interestingly, however, real tuition fees for entering, full-time undergraduate students at private high-quality HEIs have remained stable in 2014 through 2017 and not statistically

[13]The Bennett Hypothesis is named after former Secretary of Education William J. Bennett who, in a New York Times opinion piece published in February 18, 1987, argued that "increases in financial aid in recent years have enabled colleges and universities blithely to raise their tuitions, confident that Federal loan subsidies would help cushion the increase."

different than private low-quality HEIs between 2014 and 2017.[14][15] We therefore do not yet find empirical evidence that aid increases feed tuition increases.[16]

Figure G.1: Difference in the relative tuition fees between high- and low-quality private HEIs



Note: This figure presents the difference in relative tuition fees between high-quality and low-quality private HEIs in Colombia in 2014–2017. The figure compares tuition fees for first-time, undergraduate students from a balanced sample of 40 private HEIs, 5 of which are high-quality and 35 of which are low-quality. The average HEI tuition relative to 2014 is regressed on a full interaction of year fixed effects and a dummy that equals 1 if the HEI has received High Quality Accreditation status by 2014 (2014 is the omitted category). The black solid line plots the coefficient on the interaction terms. The gray dashed lines represent the 95 percent confidence intervals. The red vertical line marks the period SPP is announced. The figure shows that tuition did not increase at high-quality private HEIs relative to low-quality private HEIs despite the rightward shift in demand for the former type of education. Results using an unbalanced sample of HEIs are qualitatively similar. *Sources:* Authors' calculations based on MEN (2018).

8 A Stylized Cost-Benefit Discussion

Ultimately, when assessing the impact of SPP on students, we care about how their long-run life outcomes are affected, such as college exit test scores, graduation rates, earnings, and the likelihood of employment. These long-run outcomes also enable cost-benefit assessments of the program. For instance, SPP geared students towards private high-quality universities, which have the highest returns to schooling but are also more costly to both the taxpayer and the student (if he or she were to drop out) relative to their public and low-quality counterparts. Unfortunately, having begun their undergraduate studies in 2015, SPP recipients will only begin to graduate *circa* 2020. Therefore we

[14] Appendix Figure G.1 presents the results from running a regression of a full interaction of year fixed effects and a dummy for a HEI having received High Quality Accreditation by 2014 on a balanced sample of HEIs. The figure suggests there is no statistically significant difference in relative tuition fees between accredited and non-accredited private institutions, despite the rightward shift in the demand for the former type of education. Results using an unbalanced sample of HEIs are qualitatively similar. It should be noted that public HEIs are excluded from this comparison because these institutions set their tuition fees by student household income.

[15] In Colombia, private HEIs are forbidden by law to have for-profit status. Their tuition fees are regulated, and may be increased annually based on the maximum annual inflation rate as of December of the previous year.

[16] On a related note, after SPP, many high-quality universities have incorporated new academic and financial aid complementary programs available to all their student body with the aim of reducing dropout rates and providing a smoother transition into postsecondary education (DNP, CNC and UniAndes, 2016).

currently lack complete information on the full costs and benefits of the program.[17]

In addition to these timing and data availability constraints, there are a number of other complications in our analysis. First, SPP recipients are very different from other graduates of high-quality HEIs, both in terms of SES and test scores. It is not clear that their labor market outcomes will resemble those of other graduates or similar graduates from prior cohorts, as some evidence suggests SES and college quality are complementary educational inputs (Riehl, 2018) and elite colleges produce high-end labor market outcomes only for students from wealthy households (Zimmerman, 2019). Moreover, we ignore potential market-wide earnings losses from graduates of high-quality colleges resulting from low-SES student entry at these schools (Riehl, 2018). If SPP indeed changes the education production function, an ideal cost-benefit analysis should take these changes into account. Second, we find evidence that SPP also indirectly positively impacted college access for aid-ineligible students, which should also be incorporated in a comprehensive cost-benefit analysis. Third, the initial shock in college admissions caused by SPP at elite private colleges, documented in Section 5, displaced some applicants to lower-ranked universities the first year SPP was introduced. These displaced applicants could potentially incurr some earnings losses. Unfortunately, we do not observe application behavior nor college preference rank orderings for all high school students, so we cannot identify all displaced applicants to incorporate these "losers" into our cost-benefit analysis.[18] Finally, a more careful analysis would also include, *inter alia*, the potential societal gains from promoting class diversity at elite colleges, and the positive peer effects at private high-quality HEIs (and potentially negative peer effects at public low-quality HEIs). We leave that exercise for future work.

These complications imply that our cost-benefit discussion is therefore necessarily speculative, as the only way to be sure of SPP's long-run effects is to directly measure long-run outcomes for SPP participants. It is imperative that future research evaluate the impact this program will have on social mobility and explore its effects on longer-term outcomes when these data become available.

Notwithstanding these limitations, we proceed with the cost-benefit analysis as follows. Using data on total payments in tuition fees to universities and maintenance subsidies to beneficiaries, Appendix Table H.1 presents the annual cost for the first cohort of SPP recipients in 2015, which amounted to 135.4 billion Colombian pesos (USD 42.7 million) or 14.8 million pesos per capita (USD 4,657). This is around 4.2 percent of annual central government spending on higher education. Assuming the annual dropout rate stabilizes at 2.32 percent after 2016, and given the average program is 9.5 semesters long, the cost of the full 4.5 years of study for the first cohort of SPP recipients reaches 598.9 billion pesos (USD 188.7 million), or 78.4 million (USD 24,691) per beneficiary. After this first cohort, and as a response to complaints that resources were disproportionately benefitting private institutions, the government appeased critics by paying public universities the marginal student cost instead of their tuition fee (artificially lower after public subsidies). This shrank the per student resource gap between public and private institutions, but raised the cost of the program to 913.8 billion (USD 287.9 million) pesos for this second cohort, that is, 94.7 million pesos per beneficiary (USD 29,845).

Since earnings are unavailable for our sample because SPP recipients have not yet graduated college,

[17] In addition, the ultimate returns of SPP requires observing a more diverse set of outcomes, such as how the program affected, *inter alia*, labor force decisions, mobility, health, and family formation. This too requires following students over a much longer time-frame than is currently possible.

[18] Indeed, Section 5 documented how a SPP recipient who is admitted to and attends a top school instead of a lower-ranked college reaps a lifetime benefit, but that student displaces another student from attending that top school, who then attends a slightly less prestigious school. That displaced student in turn displaces another student at that school, and so on. The empirical literature suggests that the long-term effects of not attending a top-ranked institution are substantial. Exploiting discontinuities in entry into the University of Los Andes, Saavedra (2009) estimates admitted applicants are 18 percent more likely to be formally employed and earn 20 percent more one year after graduation. Moreover, admitted applicants who enroll are 30 percent more likely to have a formal job and earn 35 percent more after graduation. Importantly, the effects on exit exam scores and formal employment are larger for low-SES students than for high-SES students.

we project earnings impacts using income data from household surveys and social security contributions. We caution that our projections will produce reliable estimates of earnings impacts if the relationship between (type of) college attendance and earnings is causal, a strong assumption that is not likely to hold due to selection into (type of) college. We complement our analysis with literature estimates that relate the *type* of college attended with later life outcomes, but this still leaves the important caveat that the treated populations from SPP are very different from that of previous studies, both in terms of SES and test scores. This becomes particularly relevant in contexts where elite colleges produce high-end labor market outcomes only for students from wealthy households (Zimmerman, 2019), although evidence from Colombia is more nuanced.[19] Moreover, the magnitude of the impacts documented in Section 5 could potentially also affect labor market outcomes for these cohorts (Riehl, 2018). This implies that our cost-benefit discussion will be necessarily speculative, as the only way to be sure of SPP's long-run effects is to directly measure long-run outcomes for SPP participants.

Our reduced form point estimate is that SPP eligibility raises enrollment in postsecondary education by 25.4 to 32.3 percentage points. Consider the strong assumption that the only impact of the program is to raise 30 of each 100 students from "no postsecondary education" to "high-quality postsecondary education", thus ignoring any graduate degree or other unobserved effects.[20] We estimate that the average college graduate from a high-quality HEI in Colombia will earn 1.37 billion in 2015 pesos (USD 432,625) over the course of his/her lifetime, while the average high school graduate will earn 448,891,226 pesos (USD 141,428).[21] To calculate the earnings gain of SPP recipients, we take into account the foregone earnings of attending a 4.5-year college (the average duration of a program attended by SPP recipients), as well as the monetary subsidies received by SPP beneficiaries over the course of their studies.[22] We thus estimate that SPP might raise earnings by an annuity of 16,309,969 pesos (USD 5,139) for forty years for a net present value of around 382,703,013 pesos (USD 120,574) at a 5 percent interest rate. This significant premium reflects the fact that Colombia has the largest return to college education in Latin America, and the second largest wage gap between college- and high school-educated workers in the region.[23]

Moreover, we documented how students sorted into high-quality HEIs, and especially top private schools. Previous literature has shown that graduates from top private HEIs in Colombia enjoy a significant wage premium over both low-quality HEIs and selective public universities (Camacho, Messina and Uribe, 2016; MacLeod and Urquiola, 2015; Riehl, Saavedra and Urquiola, 2016; Saavedra, 2009). To estimate how much more are SPP recipients likely to earn by switching to top private high-quality schools, we turn to administrative OLE data for 2008–2013 formal employees' wages for 2001–2013

[19] Appendix Figure H.3, which plots earnings profiles for graduates by socioeconomic stratum, suggests that, even controlling for a degree from a private, high-quality HEI, there is a positive correlation between baseline SES and earnings after college. Moreover, the wage gap between high- and low-SES graduates roughly doubles six years after graduation. Yet controlling for selection into college type yields different results: (Saavedra, 2009), exploiting a sharp discontinuity in the likelihood of admission into college, shows that low-SES students benefit disproportionately from attending the flagship private selective university in Colombia.

[20] See Appendix 8.1 for the list of assumptions made to obtain our estimates of earnings gain.

[21] The average wage of a college graduate from a high-quality institution is taken from the average monthly wage in 2013 of an individual graduating college in 2012, as recorded in OLE, weighted by the frequency of the institutions where SPP recipients enrolled and converted to 2015 pesos.

[22] Our calculations likely underestimate the total amount of subsidies received by SPP recipients. First, the government's *Departamento para la Prosperidad Social* provided additional subsidies upon completion of the academic semester as well as for good academic performance. Second, some private institutions provided in-kind subsidies (e.g., food, photocopies, transportation).

[23] The coefficient from the college dummy in a Mincer regression for men is 1.053 in Colombia compared to 1.004 in Costa Rica, 0.857 in Brazil, 0.851 in Chile, 0.719 in Mexico, 0.559 in Peru, and 0.417 in Argentina. Also, the ratio of hourly wages between workers with tertiary and secondary education is 2.82 in Brazil, 2.72 in Colombia, 2.61 in Mexico, 2.60 in Chile, 2.28 in Costa Rica, 1.7 in Peru, and 1.49 in Argentina (SEDLAC – CEDLAS and The World Bank).

college graduates.[24]

Figure H.1 plots the earnings profiles of college graduates by type of HEI. Panel A plots mean log monthly real earnings separately for graduates from high- and low-quality HEIs, while Panel B plots earnings profiles separately for college graduates from private and public high-quality HEIs.[25] Panel A illustrates the magnitude of the earnings gap between graduates from high- and low-quality HEIs. It also shows that the slope of workers' earnings-experience profiles is higher for high-quality than for low-quality HEIs, with the earnings gap more than doubling over the first nine years of experience. Moreover, there is a significant gap between earnings from private and public high-quality college graduates that stays roughly constant across time (Panel B).[26]

Although the correlation depicted in Figure H.1 cannot be interpreted as the causal effect of college type on earnings, we can use it to feed our back-of-the-envelope calculation of the benefits of SPP for beneficiaries. Thus, moving a college graduate from low- to high-quality education might raise earnings by an annuity of 2,455,573 pesos (USD 774) for forty years for a net present value of around 127.3 million pesos (USD 21,172) at a 5 percent interest rate.[27] Moreover, moving a college graduate from low-quality to *private* high-quality education raises earnings by an annuity of 3,941,820 pesos (USD 1,242) for forty years for a net present value of around 174.4 million pesos (USD 29,482) at a 5 percent interest rate.[28] Note that these returns reflect not only higher wages, but also lower unemployment and informality rates.

These back-of-the-envelope calculations suggest that SPP's costs are more than offset by the increased earnings of beneficiaries. The private internal rate of return of SPP is 44.5 percent, while the social rate of return—which takes into account the opportunity cost of other social investments, an expanded income tax base, positive externalities from an educated workforce, lower public spending on subsidized healthcare, and lower crime rates (see Appendix 8.1)—is 16.1 percent. Moreover, by subsidizing students to enroll in the universities with the highest returns, SPP has the potential to reshape intergenerational mobility in a country where social mobility has historically been low (Montenegro and Meléndez, 2014).

An argument, often voiced by critics of SPP, sustains that resources for SPP could have been used to benet a larger number of students at public, high-quality universities. Our estimations reveal that the biannual marginal student cost is roughly similar in high-quality private and public universities (see Table H.1). However, tuition fees at public HEIs are significantly lower because they are heavily subsidized. A direct implication is that such an argument is not entirely accurate.

[24] We restrict our sample by excluding the following observations: (i) self-employed workers (whose wages we do not observe) and other non-employees; (ii) non-university degrees (e.g., technical or technological, specialization, masters, PhD); (iii) distance learning degrees; (iv) earnings after obtaining a second undergraduate degree or a graduate degree; (v) ages below 18 or above 35; (vi) more than 9 years of experience (there are very few individuals in our data with 10 or more years of experience, making these estimates very noisy); (vii) graduates from the National Appenticeship Service (SENA), a public vocational training school; and (viii) graduates from military or police academies, as they would typically be outside of the traditional labor market.

[25] We define high-quality institutions as HEIs having received High Quality Accreditation by October 1, 2014, i.e., the day SPP was announced.

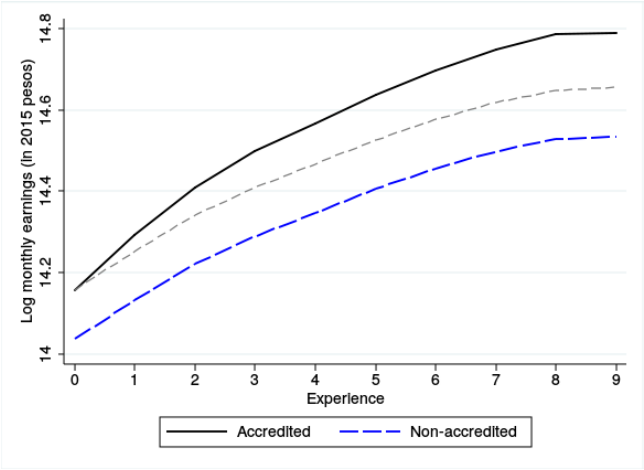
[26] Appendix Figure H.2 compares the average formal earnings profiles plotted in Figure H.1 with those of college graduates that are similar to SPP recipients in two observable characteristics, namely SES (strata 1–3) and SABER 11 score (top decile). These students enjoy a wage premium compared to an average graduate.

[27] We multiply OLE's monthly averages by twelve to obtain annual estimates.

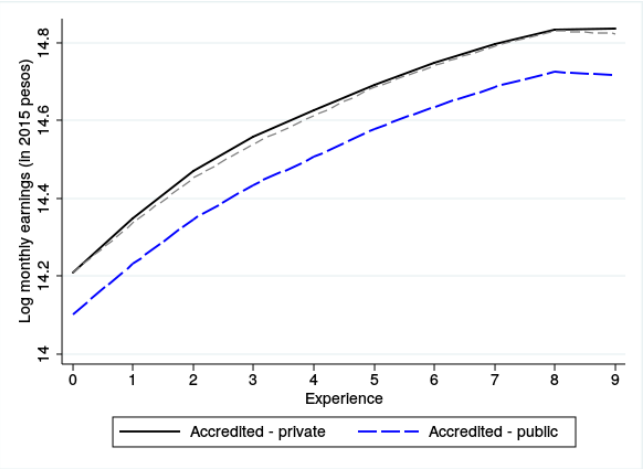
[28] These calculations assume wages stabilize after the ninth year of experience.

Figure H.1: Earnings profiles of college graduates

(a) High- versus low-quality



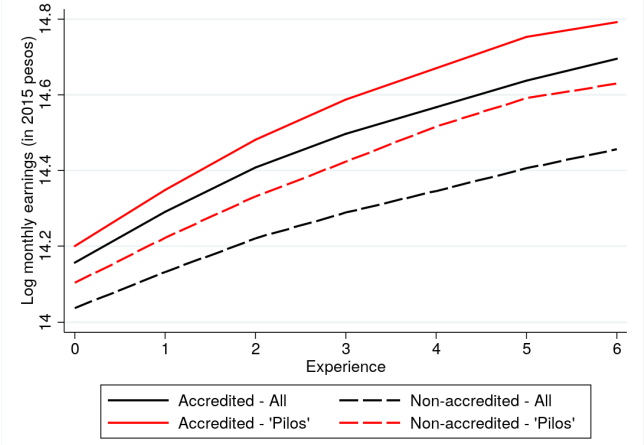
(b) Accredited: private versus public



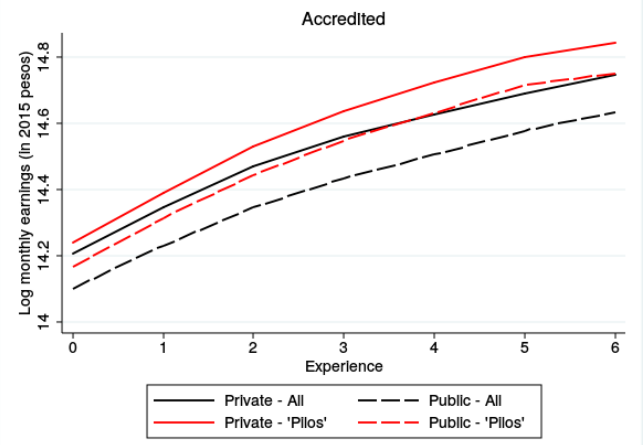
Notes: The figures include 2001–2013 graduates from 234 different college campuses with earnings observations in 2008–2013. Lines depict the mean log monthly real earnings (in 2015 Colombian pesos) for university graduates from high- and low-quality tertiary institutions (Panel A) and high-quality private and public institutions (Panel B). We define experience as earnings year minus graduation year. Wages with a value of zero (the unemployed) are excluded. The dashed gray line parrallels the low-quality (Panel A) and public high-quality (Panel B) profiles starting from the high-quality (Panel A) and private high-quality (Panel B) intercept. *Source:* Author's calculations using OLE and ICFES (2016).

Figure H.2: Earnings profiles of college graduates: All versus SPP recipients

(a) High- versus low-quality

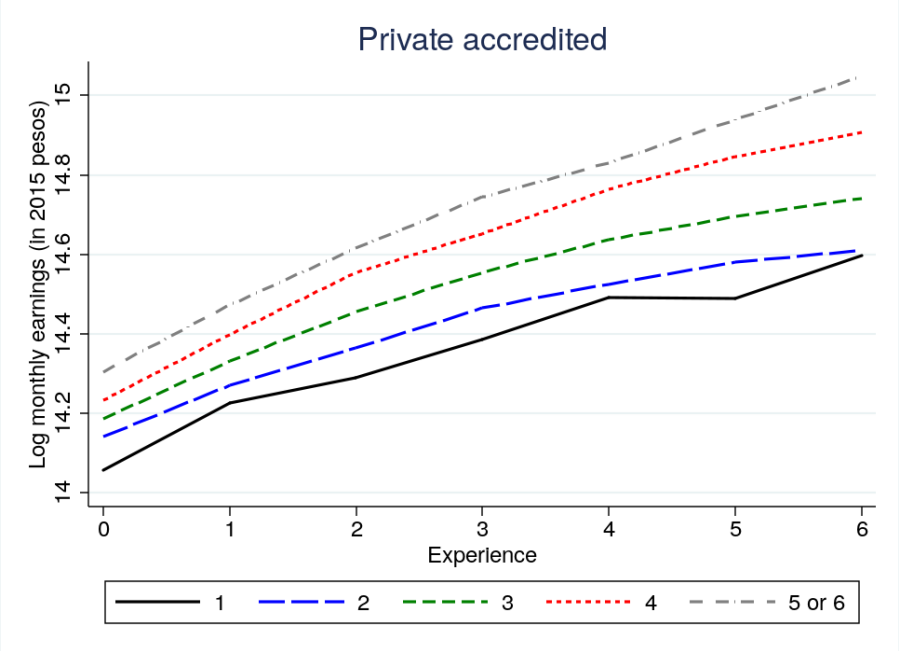


(b) Accredited: Private versus public



Notes: The figures include 2002–2013 graduates from 234 different college campuses with earnings observations in 2008–2013. Lines depict the mean log monthly real earnings (in 2015 Colombian pesos) for university graduates from high- and low-quality tertiary institutions (Panel A) and high-quality private and public institutions (Panel B). The red lines restrict the sample to high school graduates from strata 1, 2, and 3 scoring in the top SABER 11 decile. We define experience as earnings year minus graduation year. Wages with a value of zero (the unemployed) are excluded. The dashed gray line is parrallel to the low-quality (Panel A) and public high-quality (Panel B) profiles starting from the high-quality (Panel A) and private high-quality (Panel B) intercept. *Source:* Author's calculations using OLE and ICFES (2016).

Figure H.3: Earnings profiles of private and high-quality college graduates by socioeconomic stratum



Notes: The figures include 2002–2013 graduates from 234 different college campuses with earnings observations in 2008–2013. Lines depict the mean log monthly real earnings (in 2015 Colombian pesos) for university graduates from high-quality private tertiary institutions by socioeconomic stratum. We define experience as earnings year minus graduation year. Wages with a value of zero (the unemployed) are excluded.
Source: Author's calculations using OLE and ICFES (2016).

Table H.1: Cost of SPP tuition fees and maintenance subsidies (in Colombian pesos)

	First cohort				Second cohort		All 4 cohorts
	2015-1	2015-2	2016-1	Expected total	2016-1	Expected total	Expected total
Total tuition fees							
Total (in million pesos)	51,714	51,569	53,767	457,162	83,050	709,920	2,586,922.59
N	9,205	9,110	8,899	7,642	11,912	9,646.95	36,582.55
Per capita	5,618,051	5,660,747	6,041,968	59,824,651	6,971,921	73,590,110	280,594,981.45
Public institutions							
Subtotal (in million pesos)	3,421	3,423	3,651	30,876	11,426	97,675	323,900.15
N	2,018	1,941	1,906	1,637	1,879	1,521.71	6,201.84
Per capita	1,695,403	1,763,677	1,915,689	18,864,798	6,081,107	64,187,381	211,426,940.88
Private institutions							
Subtotal (in million pesos)	48,293	48,146	50,116	426,285	71,289	609,390	2,254,454.81
N	7,187	7,169	6,993	6,005	9,985	8,086.37	30,264.09
Per capita	6,719,471	6,715,875	7,166,619	70,988,599	7,139,612	75,360,128	297,068,984.36
Maintenance subsidies							
Total (in million pesos)	16,132	15,949	16,658	141,717	23,856	203,926	753,495.35
Per capita	1,752,485	1,750,744	1,871,884	18,545,258	2,002,698	21,138,909	81,961,985.22
TOTAL (in million pesos)	67,846	67,519	70,425	598,879	106,906	913,846	3,340,418.08
Per capita	7,370,536	7,411,490	7,913,852	78,369,909	8,974,619	94,729,024	91,311,785

Notes: 2015 USD 1 = COP 3174.

8.1 Assumptions in the cost-benefit calculation

Assumptions in the cost-benefit calculation

1. *Work life expectancy:* 40 years after graduating from university. We also assume that all college graduates are 25 years old at the time of graduation and experience no unemployment spells.

2. *Expected wages:* Mincerian regressions are used to derive wage profiles for high school and college graduates. The coefficient for an additional year of experience is 0.0386 and the curvature on age is -0.0008 (based on Sanchez and Nunez (2003), and Sanchez and Alvarez (2011)).

3. *Duration of study:* The average duration of study for SPP recipients is 9.5 semesters. We assume SPP recipients complete their undergraduate studies by the end of this period.

4. *Entry wage:* The entry wage for college graduates, taken from OLE, is 1,971,317 pesos. It is based on the observed wages in 2013 for students that graduated college in 2012, converted to 2015 pesos. To account for the fact that graduates from private and high-quality universities have higher average wages than those from public and low-quality institutions, we weight OLE observations by the frequency of SPP recipients enrolled in each institution. Wages for high school graduates are 612,152.48 pesos, based on household survey data (GEIH).

5. *Dropout rate:* Note that although the average drop out rate is 50 percent (SPADIES, 2016), it is much lower for students with financial aid. Based on first-year retention rates among SPP recipients, we estimate that the overall dropout rate for SPP recipients is 10 percent.

6. *Student cost for colleges:* Tuition fee before financial aid ("sticker price") roughly reflects average student cost at private high-quality universities in Colombia. Because 15.8 percent of SPP recipients enrolled in public institutions, whose student costs are significantly lower than sticker prices, we assume average student costs for colleges receiving SPP recipients are 80 percent.

7. *Maintenance subsidies provided by the government*: Average annual maintenance subsidies provided by the government to SPP recipients are 4,000,000 pesos. See Table H.1.

To calculate the social rate of return, we use the following additional assumptions:

1. *Opportunity cost:* We assume the opportunity cost for other social investments is 10 percent.

2. *Additional taxes collected:* The average additional income tax due to lower informality and higher wages is assumed to be 16 percent.

3. *Education externalities:* This is assumed to be 8 percent of the difference in average wages between high school and college graduates.

4. *Subsidized healthcare:* The rate of informality is 22 percent among college-educated workers and 55 percent among high school graduates (DANE, 2016), which thus translates into lower government healthcare subsidies (616,849.20 pesos per person, equivalent to the *UPC–Régimen Subsidiado* established by Resolution 5593 of 2015).

5. *Lower crime rate:* The annual cost of an incarcerated individual is 2015 pesos 13,122,078 (INPEC, 2012). We assume that the probability of committing a crime is 0 for college-educated workers, and 0.003171571 for high-school educated workers (this is the share of incarcerated individuals over population aged 16 and above in 2012).

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