Liquidity constraints, opportunity cost and post-secondary education. Evidence from Colombia

VI Congreso de Economia Colombiana – Universidad de los Andes

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Do liquidity constraints matter in higher education?

- Evidence from developed countries:
  - Yes: Lochner and Monge-Naranjo (2011); Brown et al. (2011)
  - No: Carneiro and Heckman (2002); Cameron and Taber (2004)
- Evidence from developing countries:
  - Yes: Solis (2017); Rau et al. (2013); Attanasio and Kaufmann (2009); Londono-Velez et al. (2017)
  - No: Alfonso (2009)
- Other Factors: Debt Aversion, Opportunity cost of studying!!!
  - Low enrollment rates even when the tuition fees are close to zero.
  - Opportunity cost can be observed in the probability of completion of studies and labor participation.

Our contribution

- **What do we do?** We use two discontinuities to identify the effects of reducing liquidity constraints to studying tertiary vocational education in low income individuals in Colombia.
- **Two discontinuities?**
  - i Access to monetary support via poverty score.
  - ii Access to free vocational education via an entry exam.

JeA and vocational education in Sena

Youth in Action ***(JeA)***, is a national program for poor youths who finished secondary school and want to enter into public tertiary education (*IES* and *SENA*).

I Sena

- Two types of courses: Technical (1 year) and technological (2 years).
- **No tuition fees**.
- Includes an internship program.
- ***In case of excess of demand, selection is done using an entry exam.***

II JeA for Sena

- **Period of analysis**: Applicants from 2014-II to 2015-I
- **Grant**: $ 200.000 per month conditional on being enrolled
- **Preferential entry**: Reserves 30% of total places when a course is over demanded

III JeA selection process.

- Age: 16 to 24 with Completed secondary
- Vulnerable population:
  Sisben score lower than a cutoff (by type of municipality) (87%)

Data

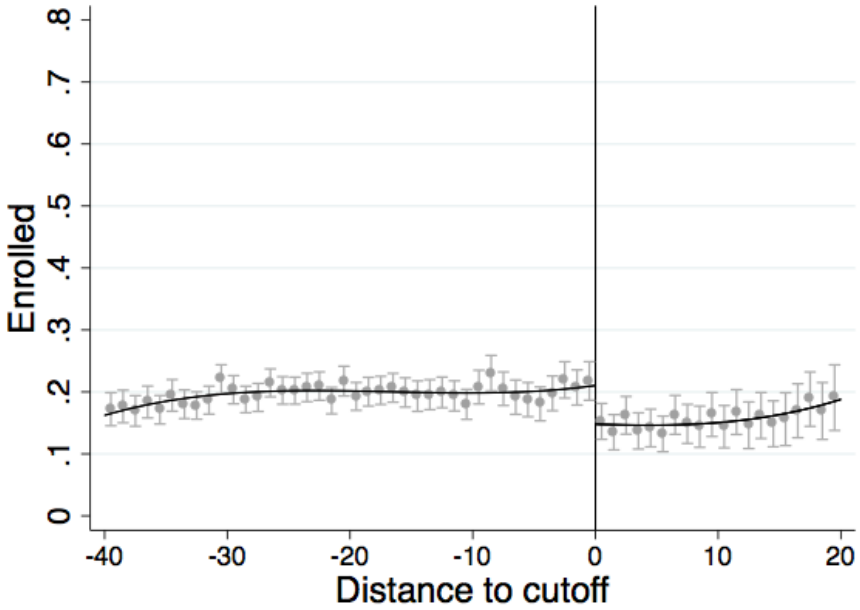
We use the following administrative data:

- The program (JeA): Registry of beneficiaries and payments.
- Vocational education (Sena): Applicants to all courses since January 2013.
- Poverty score (Sisben): All individuals 16 to 24 y.o. in JeA municipalities.
- Social security registry (PILA): we matched Sena's data with the national registry – 2014/06 - 2017/12

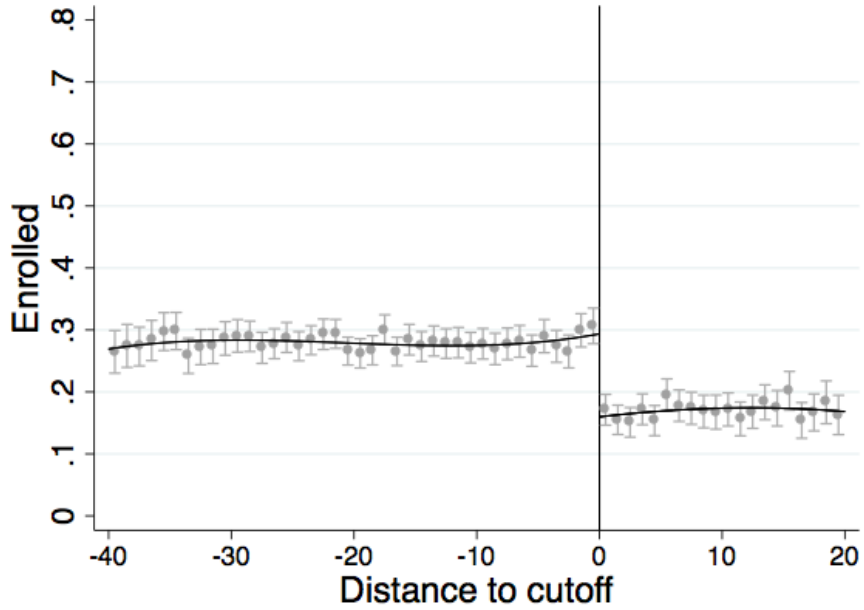
Descriptive statistics | Continuity on observables | Manipulation

Sisben's discontinuity and enrollment in Sena

Figure 1: Effect on enrollment - Sisben's discontinuity



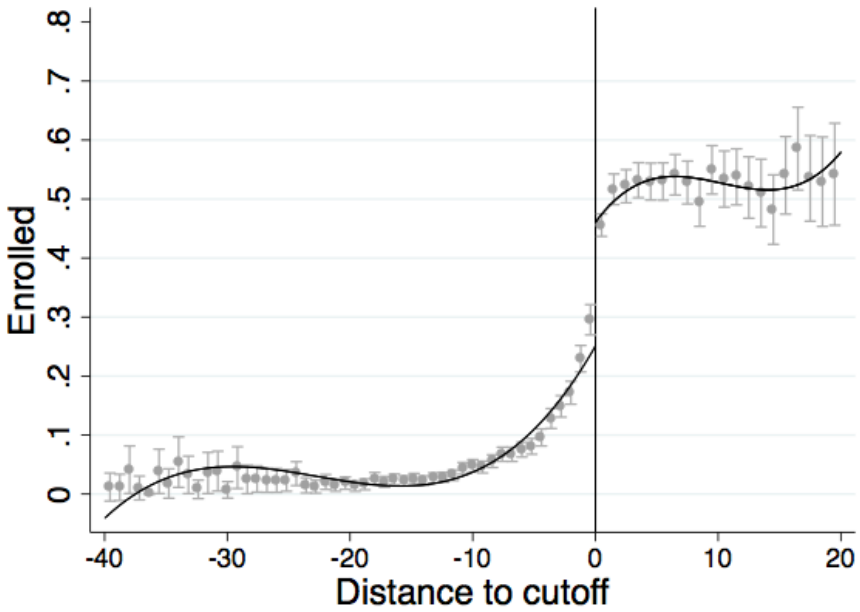
(a) 1 year course



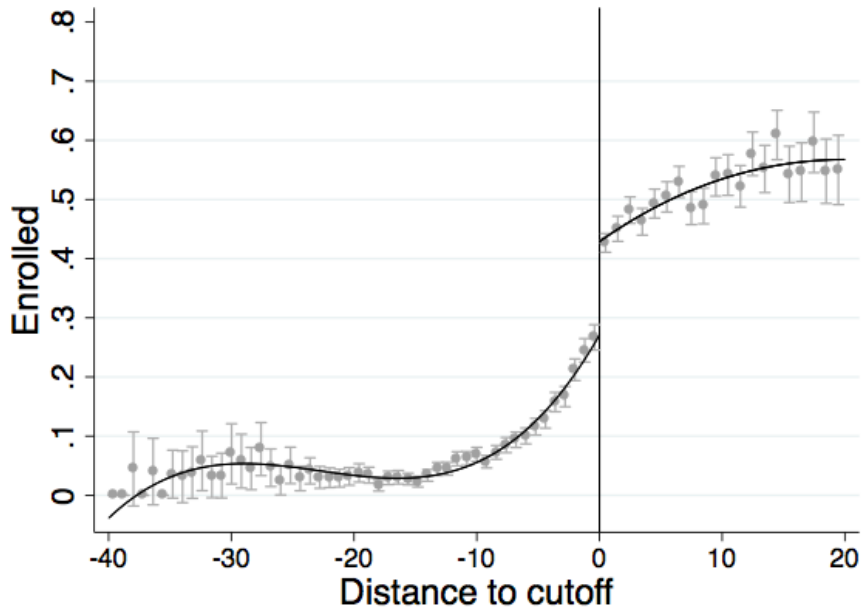
(b) 2 year course

Exam's discontinuity and enrollment in Sena

Figure 2: Effect on enrollment - TEST's discontinuity



(a) 1 year course



(b) 2 year course

Estimation strategy

We use a double discontinuity approach to estimate the effect of entering into Sena's education with and without financial aid.

$$Y_i = \alpha_0 + \alpha_1 D_i + \alpha_2 A_i + \alpha_3 D_i \times A_i + g(s_i) + f(e_i) + X_i + \mu_i \quad (1)$$

Where :

- $D_i = 1$ if Sisben $\leq$ JeA cutoff.
- $A_i = 1$ if Exam $\geq$ course cutoff.
- $g(s_i)$ and $f(e_i)$ are polynomials of distance in Sisben and Test, respectively

Both discontinuities apply only when:

- Course is over-demanded
- There is an entry exam
- There is no second exam

Enrollment in Sena

Table 1: Double discontinuity on Enrollment - **1 year course**

	All		Female		Male	
α_1	0.058	0.050	0.029	0.035	0.085	0.078
	(0.036)	(0.034)	(0.043)	(0.042)	(0.054)	(0.050)
α_2	0.106*	0.095**	0.118*	0.135*	0.101^{+}	0.091
	(0.041)	(0.035)	(0.057)	(0.054)	(0.060)	(0.055)
α_3	0.063**	0.062**	0.093**	0.078**	0.030	0.034
	(0.019)	(0.017)	(0.027)	(0.024)	(0.024)	(0.022)
Constant	0.283**	-0.221	0.300**	-0.321	0.268**	1.448**
	(0.050)	(0.161)	(0.075)	(0.201)	(0.071)	(0.102)
$\alpha_1 + \alpha_3$	0.002	0.002	0.019	0.015	0.020	0.017
$\alpha_2 + \alpha_3$	0.000	0.000	0.000	0.000	0.010	0.007
$\alpha_1 + \alpha_2 + \alpha_3$	0.000	0.000	0.002	0.001	0.011	0.010
Controls		✓		✓		✓
R^2	0.21	0.34	0.25	0.38	0.19	0.35
Observations	7244	7244	3329	3329	3915	3915

Notes: Standard errors clustered at municipality level. + 0.1 * 0.05 ** 0.01. Controls include gender, age, participation in FeA, application year, number of applications and course takeout rate. Also include Sisben's area, Sena centre and Sena program fixed effects.

Enrollment in Sena

Table 2: Double discontinuity on Enrollment - **2 year course**

	All		Female		Male	
α_1	0.084**	0.078**	0.073*	0.061*	0.092**	0.092**
	(0.024)	(0.018)	(0.035)	(0.025)	(0.022)	(0.025)
α_2	0.035	0.039	0.099	0.085	-0.019	-0.006
	(0.047)	(0.044)	(0.070)	(0.068)	(0.040)	(0.039)
α_3	0.094**	0.069**	0.074*	0.053	0.109**	0.076**
	(0.023)	(0.020)	(0.037)	(0.037)	(0.021)	(0.018)
Constant	0.263**	0.314**	0.210**	0.279**	0.310**	0.360**
	(0.031)	(0.068)	(0.049)	(0.072)	(0.034)	(0.096)
$\alpha_1 + \alpha_3$	0.000	0.000	0.002	0.002	0.000	0.000
$\alpha_2 + \alpha_3$	0.001	0.002	0.001	0.002	0.021	0.063
$\alpha_1 + \alpha_2 + \alpha_3$	0.000	0.000	0.000	0.001	0.000	0.001
Controls		✓		✓		✓
R^2	0.16	0.32	0.17	0.35	0.16	0.31
Observations	12056	12056	5551	5551	6505	6505

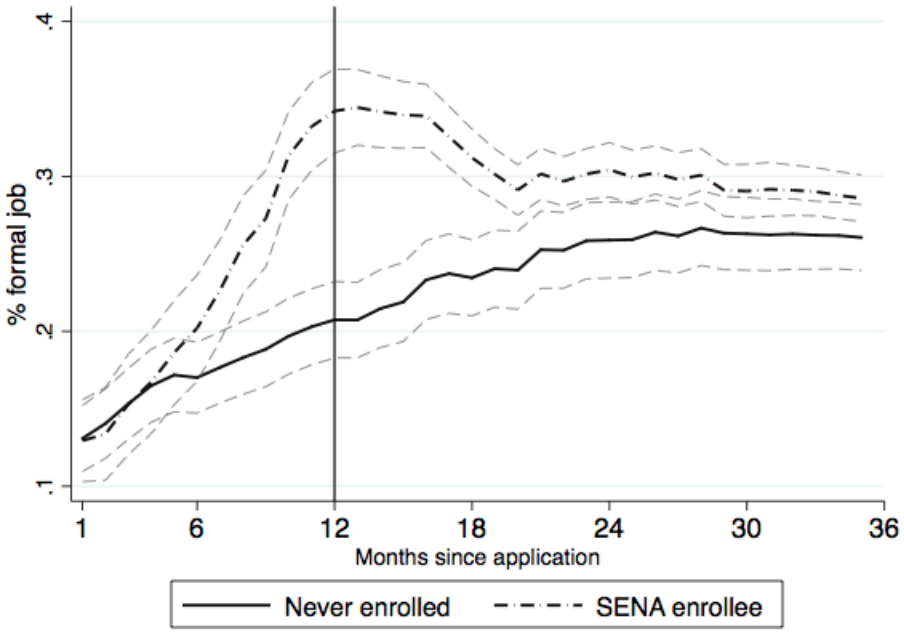
Labor market outcomes

To obtain an intuition of the importance of the financial aid for people in the labor markets, we check some outcomes:

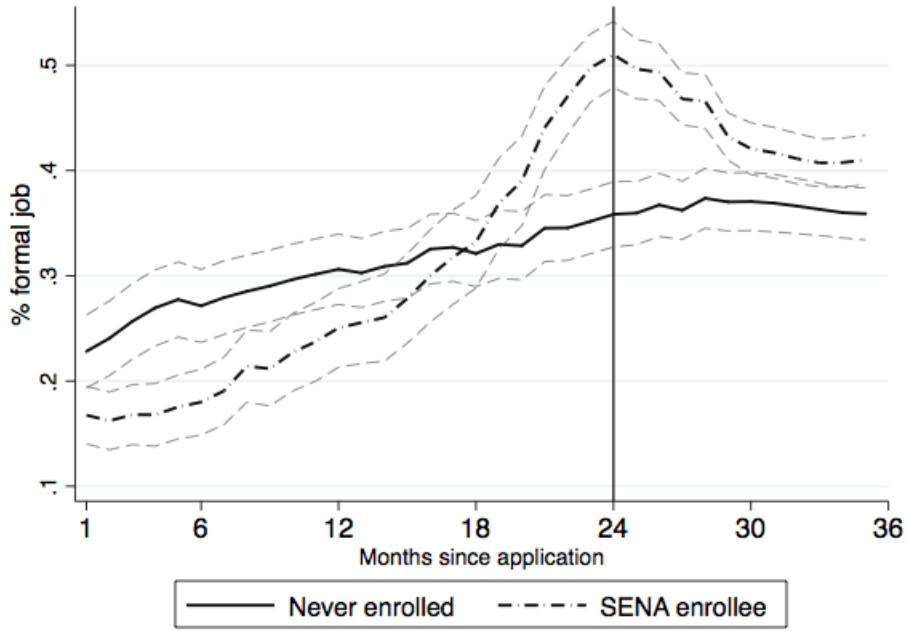
- Proportion of periods working
- Longest employment spell
- Longest unemployment spell

Labor market participation and enrollment in Sena

Figure 3: Formal labor market participation by enrollment in Sena



(a) 1 year course



(b) 2 year course

Labor market participation - post studying

Table 3: Double discontinuity on proportion of periods with a formal job

	1y. course			*2y. course*		
	All	Female	Male	All	Female	Male
α_1	0.055*	0.019	0.070	**0.101****	0.060	**0.139****
	(0.026)	(0.053)	(0.053)	(0.038)	(0.052)	(0.041)
α_2	-0.009	-0.066	0.028	0.001	-0.021	0.023
	(0.030)	(0.051)	(0.022)	(0.017)	(0.026)	(0.029)
α_3	0.050*	0.077**	0.031	-0.002	-0.011	0.004
	(0.023)	(0.028)	(0.028)	(0.017)	(0.033)	(0.014)
Constant	-0.552**	-0.706**	-0.894**	-0.149^{+}	0.117	-0.338**
	(0.061)	(0.131)	(0.131)	(0.084)	(0.138)	(0.071)
$\alpha_1 + \alpha_3$	0.004	0.053	0.166	0.002	0.279	0.001
$\alpha_2 + \alpha_3$	0.027	0.834	0.061	0.971	0.269	0.352
$\alpha_1 + \alpha_2 + \alpha_3$	0.000	0.731	0.086	0.007	0.545	0.001
R^2	0.18	0.16	0.23	0.17	0.17	0.19
Observations	7244	3329	3915	12056	5551	6505

Labor market participation - post studying

Table 4: Double discontinuity on longest employment spell

	1y. course			*2y. course*		
	All	Female	Male	All	Female	Male
α_1	**1.218***	0.105	1.662	**1.777***	1.124^{+}	**2.459***
	(0.556)	(1.282)	(1.007)	(0.704)	(0.584)	(0.979)
α_2	0.327	-0.793	1.094^{+}	0.014	-0.381	0.396
	(0.606)	(1.060)	(0.594)	(0.360)	(0.474)	(0.432)
α_3	0.647	1.172^{+}	0.205	-0.189	-0.233	-0.129
	(0.517)	(0.653)	(0.622)	(0.296)	(0.423)	(0.271)
Constant	-10.160**	-12.964**	-7.446**	-4.190**	0.177	-7.745**
	(1.384)	(3.514)	(2.180)	(1.425)	(1.600)	(1.479)
$\alpha_1 + \alpha_3$	0.005	0.266	0.192	0.004	0.088	0.013
$\alpha_2 + \alpha_3$	0.039	0.737	0.129	0.686	0.150	0.625
$\alpha_1 + \alpha_2 + \alpha_3$	0.000	0.802	0.059	0.041	0.467	0.012
R^2	0.17	0.16	0.23	0.19	0.19	0.22
Observations	7244	3329	3915	12056	5551	6505

Labor market participation - post studying

Table 5: Double discontinuity on longest unemployment spell

	1y. course			*2y. course*		
	All	Female	Male	All	Female	Male
α_1	-1.081	0.087	-1.672	-1.812*	-1.488	**-2.071****
	(0.734)	(1.535)	(1.167)	(0.707)	(0.990)	(0.759)
α_2	0.432	1.698	-0.391	0.122	0.618	-0.400
	(0.614)	(1.318)	(0.700)	(0.295)	(0.655)	(0.557)
α_3	-1.344*	-2.167**	-0.717	0.022	0.181	-0.079
	(0.593)	(0.782)	(0.677)	(0.334)	(0.672)	(0.239)
Constant	38.619**	44.807**	52.780**	15.741**	11.065**	19.298**
	(1.853)	(4.124)	(4.559)	(1.381)	(2.651)	(1.100)
$\alpha_1 + \alpha_3$	0.006	0.147	0.138	0.003	0.132	0.010
$\alpha_2 + \alpha_3$	0.032	0.719	0.265	0.720	0.072	0.407
$\alpha_1 + \alpha_2 + \alpha_3$	0.008	0.868	0.146	0.018	0.465	0.003
R^2	0.16	0.16	0.20	0.13	0.15	0.16
Observations	7244	3329	3915	12056	5551	6505

Instrumenting enrollment

We can use each discontinuity to show the effect that enrollment in Sena has on labor market participation for different type of compliers.

$$Y_i = \pi_0 + \pi_1 (E_i | D_i) + g(s_i) + f(e_i) + X_i + \mu_i \tag{2}$$

and

$$Y_i = \lambda_0 + \lambda_1 (E_i | A_i) + g(s_i) + f(e_i) + X_i + \mu_i \tag{3}$$

Where $E_i = 1$ if the individual is enrolled at Sena.

- π_1 captures the effect of Sena's enrollment on Y, for those who enrolled because they where eligible for financial aid.
- λ_1 captures the effect of Sena's enrollment on Y, for those who enrolled because they got the first offer to enroll.
- $g(s_i)$ and $f(e_i)$ are polynomials of distance in Sisben and Test, respectively

Sena enrollment on labor market participation

Table 6: IV - Enrollment on proportion of periods working

	1y. course			*2y. course*		
	All	Female	Male	All	Female	Male
Instrumenting with D_i						
π_1	1.019	0.781	0.886	**0.956****	0.672	**1.158****
	(0.703)	(1.100)	(0.903)	(0.289)	(0.585)	(0.344)
Constant	-0.718**	-0.537**	-0.790*	-0.484*	-0.124	-0.750**
	(0.246)	(0.190)	(0.339)	(0.208)	(0.324)	(0.214)
F Test	4.09	1.55	3.60	39.24	12.16	21.82
Instrumenting with A_i						
λ_1	0.172	-0.064	0.427	-0.003	-0.229	0.640
	(0.138)	(0.241)	(0.304)	(0.237)	(0.195)	(0.997)
Constant	-0.509**	-0.461**	-0.651**	-0.088	0.230	-0.527
	(0.071)	(0.104)	(0.148)	(0.099)	(0.146)	(0.429)
F Test	21.31	15.77	5.61	5.21	5.77	1.13
Observations	7244	3329	3915	12056	5551	6505

Sena enrollment on labor market participation

Table 7: IV - Enrollment on longest employment spell

	1y. course			2y. course		
	All	Female	Male	All	Female	Male
Instrumenting with D_i						
π_1	20.437	8.433	18.988	**16.258****	12.511^{+}	**19.874****
	(12.777)	(22.651)	(17.794)	(5.570)	(6.948)	(7.324)
Constant	-14.562**	-10.349**	-16.588**	-9.921**	-4.313	-14.842**
	(4.513)	(3.695)	(6.173)	(3.591)	(3.506)	(4.420)
F Test	4.09	1.55	3.60	39.24	12.16	21.82
Instrumenting with A_i						
λ_1	5.496	0.171	11.060	-1.308	-4.434	7.906
	(3.477)	(5.258)	(8.130)	(4.404)	(3.520)	(15.403)
Constant	-10.871**	-9.610**	-14.188**	-2.666	2.348	-9.709
	(1.925)	(2.603)	(3.347)	(1.975)	(2.075)	(6.615)
F Test	21.31	15.77	5.61	5.21	5.77	1.13
Observations	7244	3329	3915	12056	5551	6505

Sena enrollment on labor market participation

Table 8: IV - Enrollment on longest unemployment spell

	1y. course			2y. course		
	All	Female	Male	All	Female	Male
Instrumenting with D_i						
π_1	-21.595	-10.347	-20.850	**-17.211****	-17.175	**-17.310****
	(15.857)	(28.877)	(20.216)	(5.456)	(11.918)	(5.845)
Constant	43.451**	37.520**	47.785**	21.856**	17.254**	25.413**
	(5.808)	(4.605)	(8.595)	(3.765)	(6.569)	(3.656)
F Test	4.09	1.55	3.60	39.24	12.16	21.82
Instrumenting with A_i						
λ_1	-3.171	0.884	-7.551	1.707	6.128	-11.310
	(2.884)	(6.139)	(8.907)	(3.702)	(4.619)	(20.315)
Constant	38.900**	36.516**	43.760**	14.043**	8.095*	22.839*
	(1.697)	(3.227)	(5.143)	(1.567)	(3.259)	(8.992)
F Test	21.31	15.77	5.61	5.21	5.77	1.13
Observations	7244	3329	3915	12056	5551	6505

Wrapping up!

Initial results:

- Financial aid benefits Sena students in the Labor markets
- Labor market outcomes exhibit better results for longer courses. It suggest that opportunity cost does not matters in short courses.
- Opportunity costs are heterogeneous between women and men

Ongoing research:

- Survival analysis.
- Job quality?
- ...

Thanks

Comments are more than welcome at luisfw.gamboan@utadeo.edu.co

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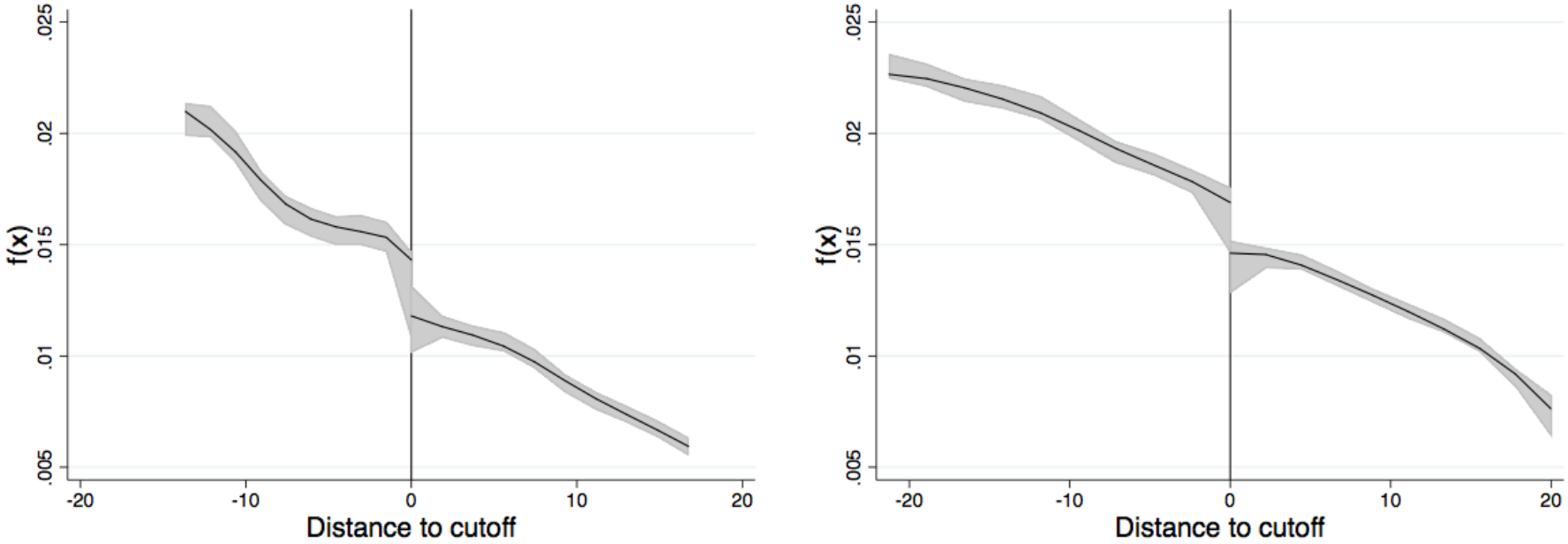
Table 9: Sena applicants 2014-II to 2015-I. Descriptive statistics

	Without JeA		JeA beneficiaries	
	Mean	S.D	Mean	S.D
All individuals				
Individuals	1380926	.	89350	.
In Sample	0.71	0.45	0.94	0.24
Sample with Sisben score				
Individuals	977263	.	84020	.
Enrolled	0.19	0.40	1	0
Area 1	0.47	0.50	0.39	0.49
Area 2	0.46	0.50	0.52	0.50
Area 3	0.07	0.25	0.09	0.29
Male	0.46	0.50	0.43	0.50
Age	19.54	2.39	19.05	2.13
Technical	0.51	0.50	0.36	0.48
Entry exam score	39.11	17.19	49.31	8.29
Eligible FeA	0.49	0.50	0.61	0.49
Second test taker	0.17	0.38	0.46	0.50
Other support	0.01	0.08	0	0.03
Courses	14876		9404	.
Seats	37.02	20.01	38.09	23.78
Demand	102.83	171.33	155.04	212.71
% excess of demand	0.52	0.50	0.76	0.4
% second test	0.25	0.44	0.42	0.49

Notes: Authors' calculations using data from Sena and Sisben. Only includes Sena centers where JeA beneficiaries applied.

Figure 4: Sisben's manipulation test - density around the cutoff

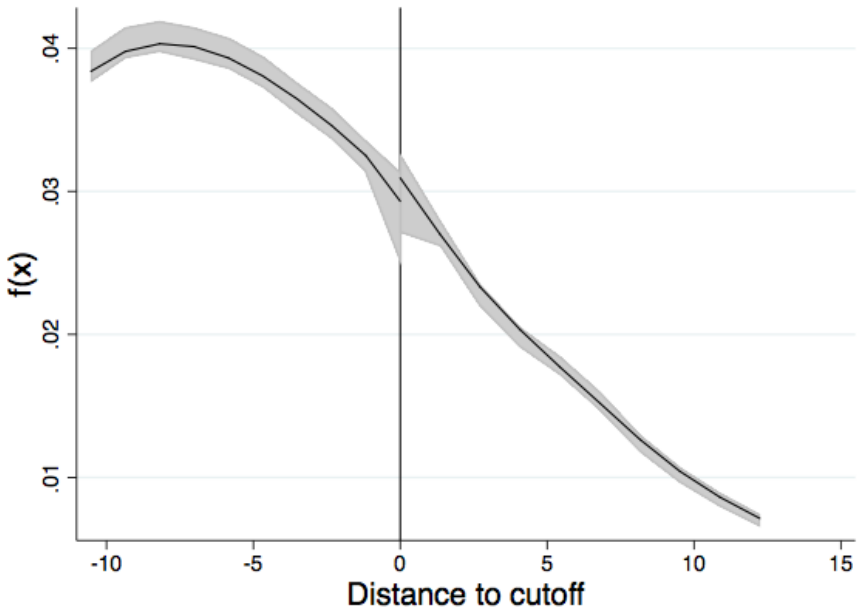


(a) 1y. course

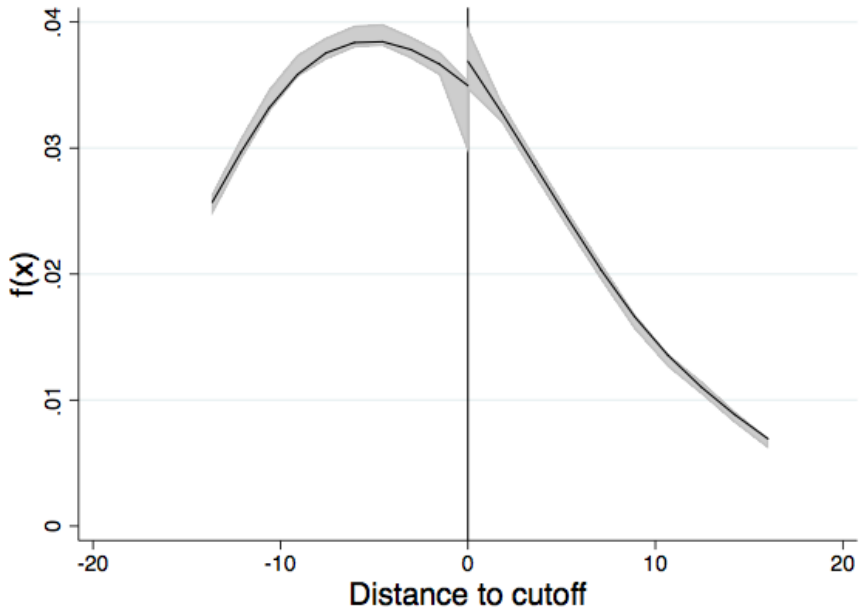
(b) 2y. course

Return

Figure 5: Sena exam's manipulation test - density around the cutoff



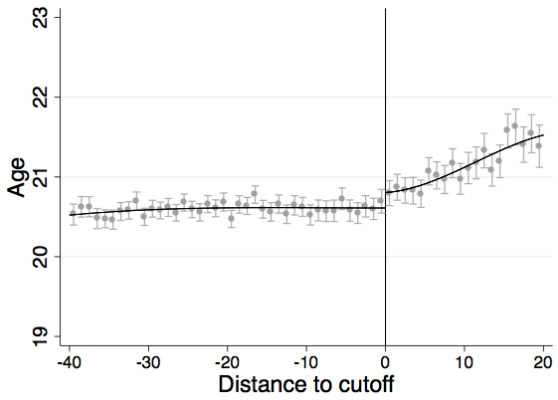
(a) 1y. course



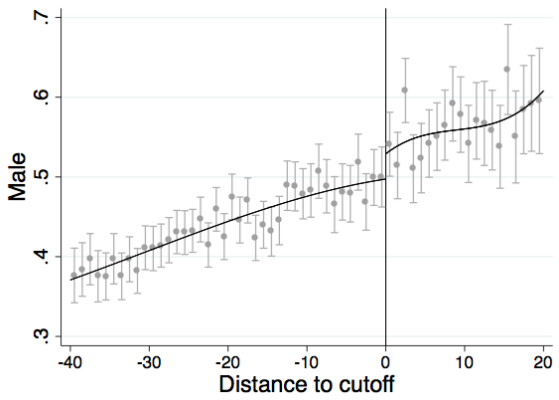
(b) 2y. course

Return

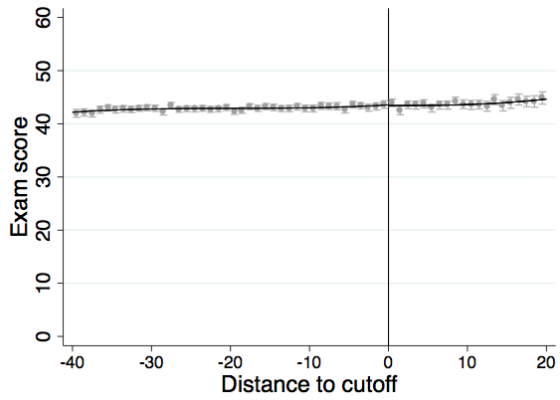
Figure 6: Continuity in observables around the Sisben's cutoff - 1y. course



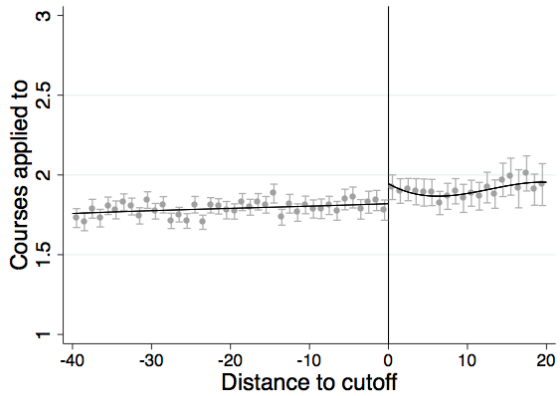
(a) Age



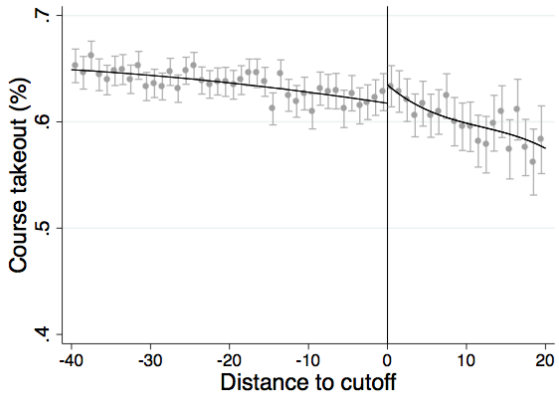
(b) Gender (% male)



(c) Test score



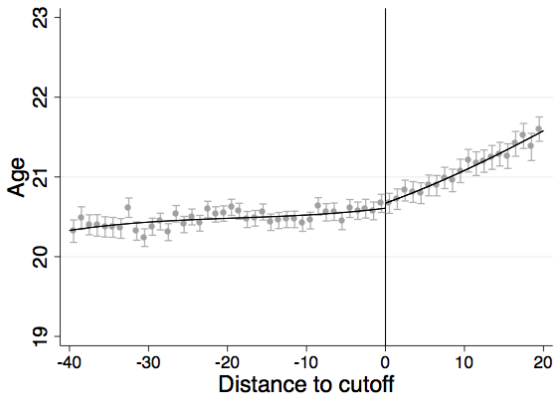
(d) Applications



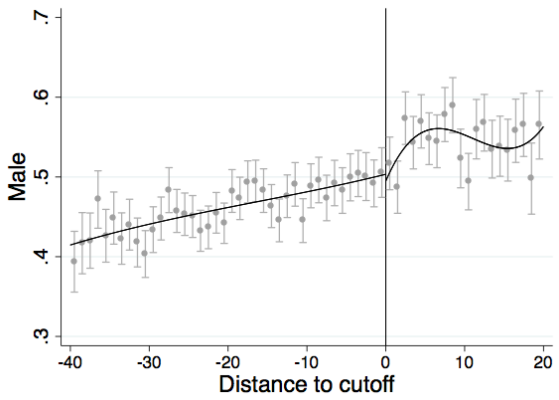
(e) % takeout

Return

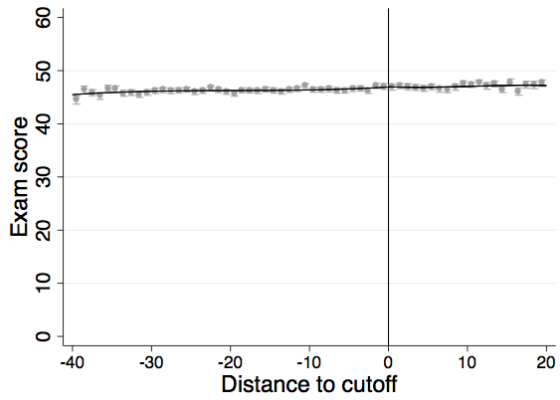
Figure 7: Continuity in observables around the Sisben's cutoff - 2y. course



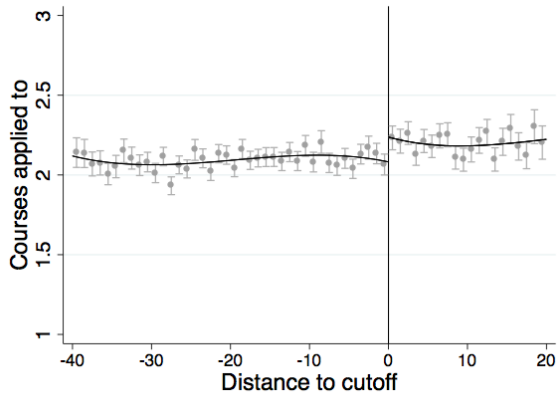
(a) Age



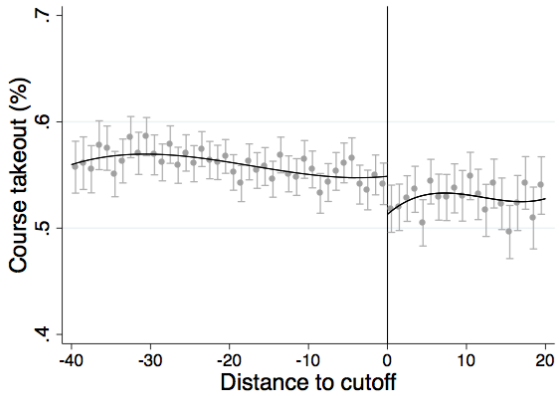
(b) Gender (% male)



(c) Test score



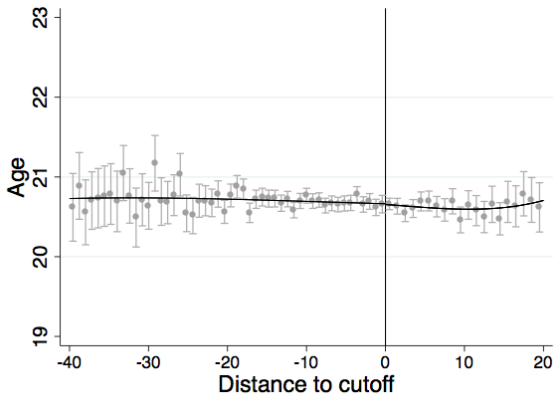
(d) Applications



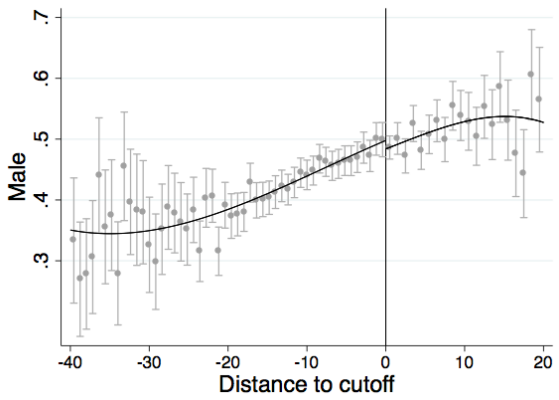
(e) % takeout

Return

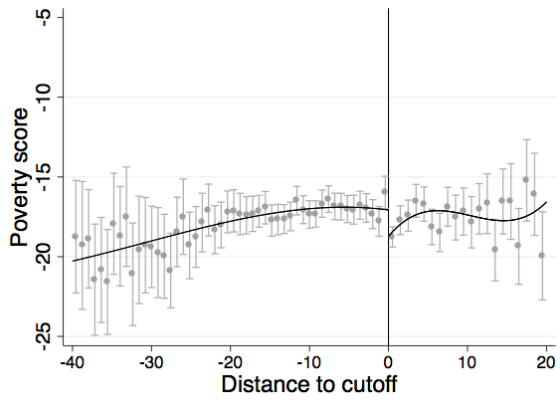
Figure 8: Continuity in observables around the Sena exam's cutoff - 1y. course



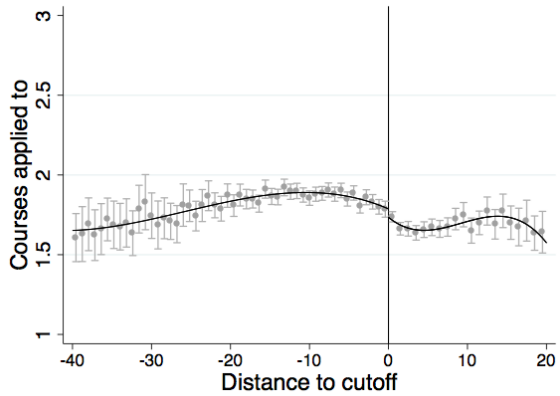
(a) Age



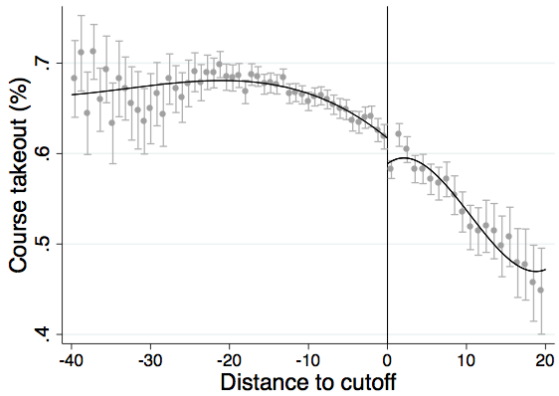
(b) Gender (% male)



(c) Sisben score



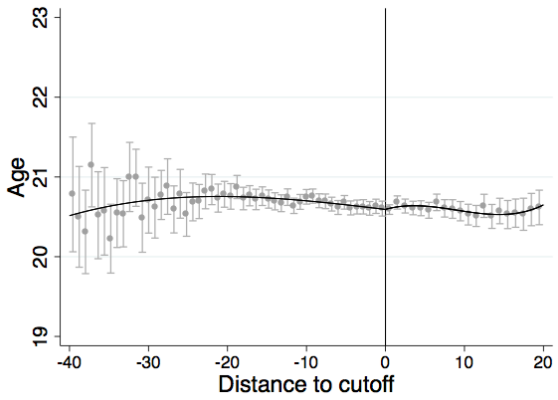
(d) Applications



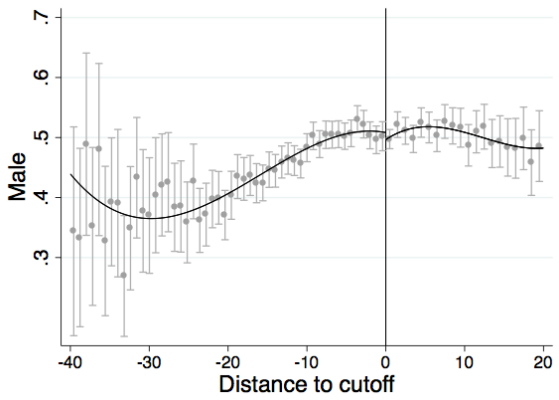
(e) % takeout

Return

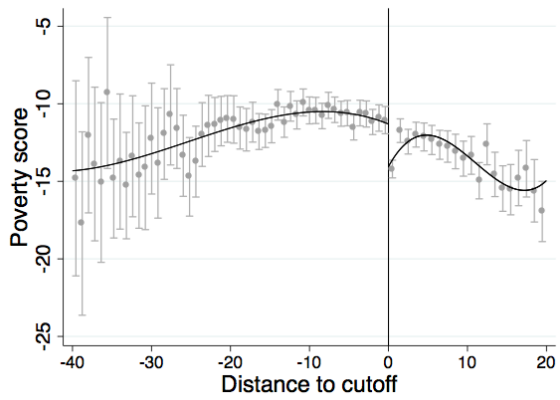
Figure 9: Continuity in observables around the Sena exam's cutoff - 2y. course



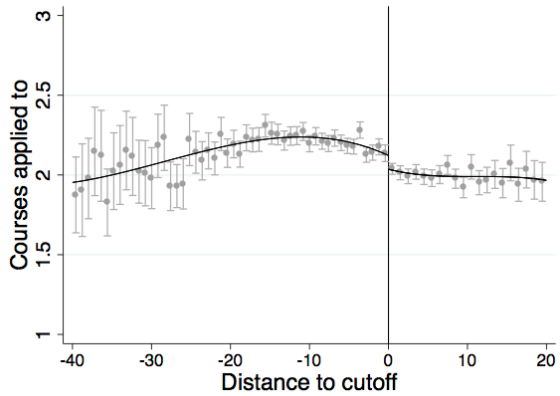
(a) Age



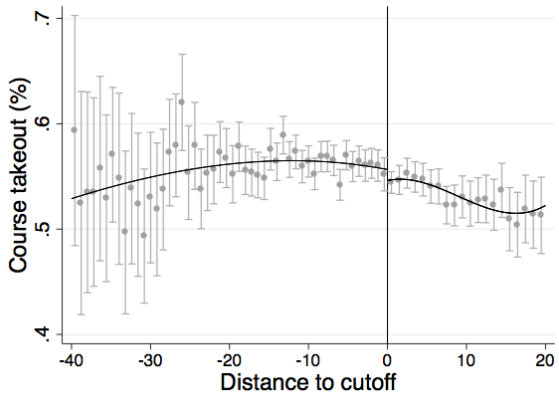
(b) Gender (% male)



(c) Sisben score



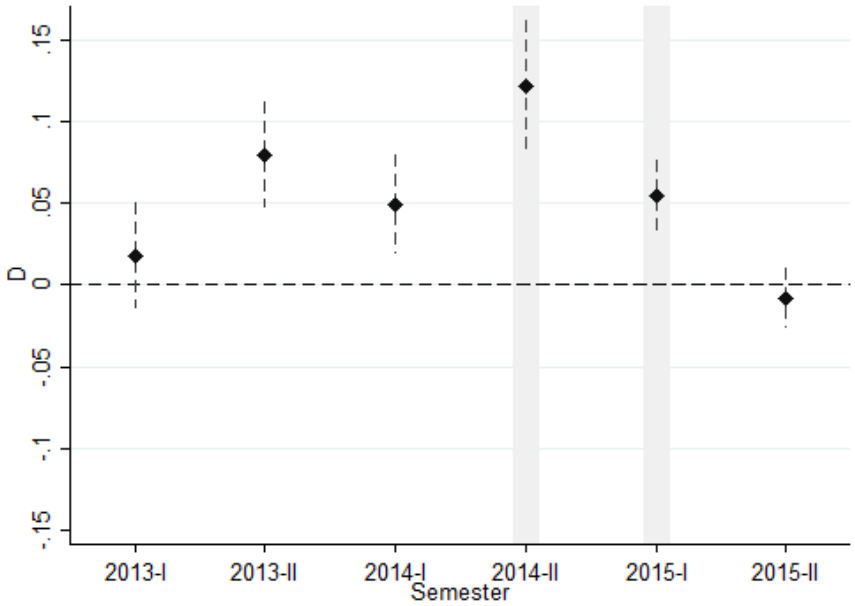
(d) Applications



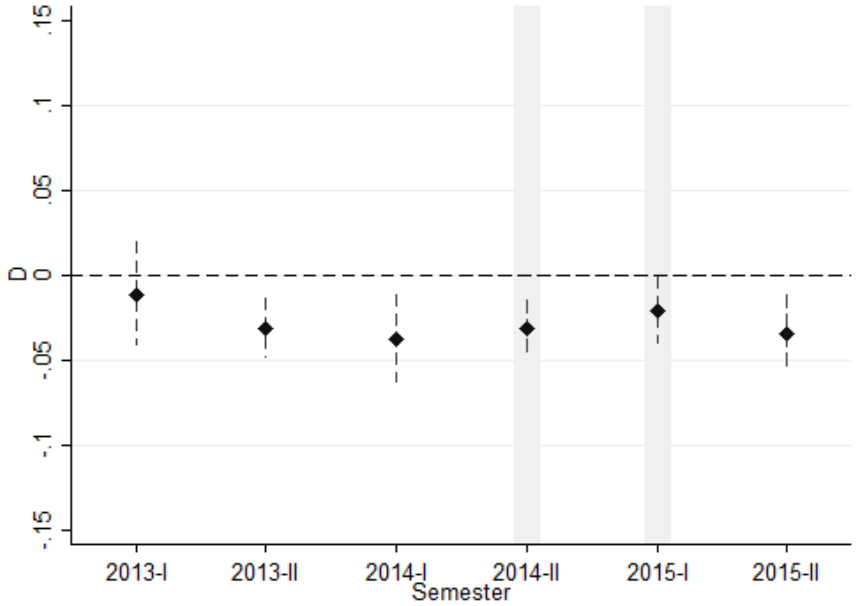
(e) % takeout

Return

Figure 10: Impact of JeA on enrollment in Sena. Reduced form estimates by enrollment semester)



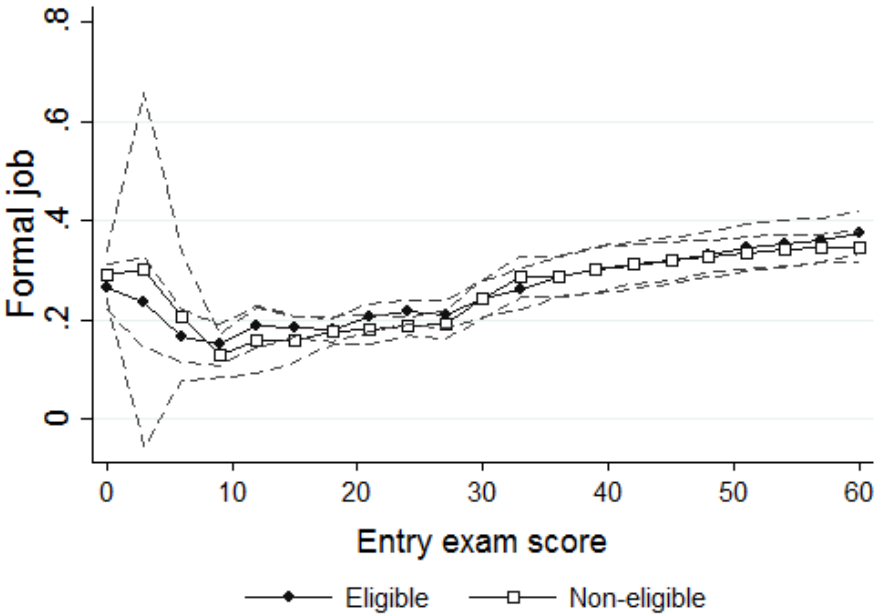
(a) Unconditional



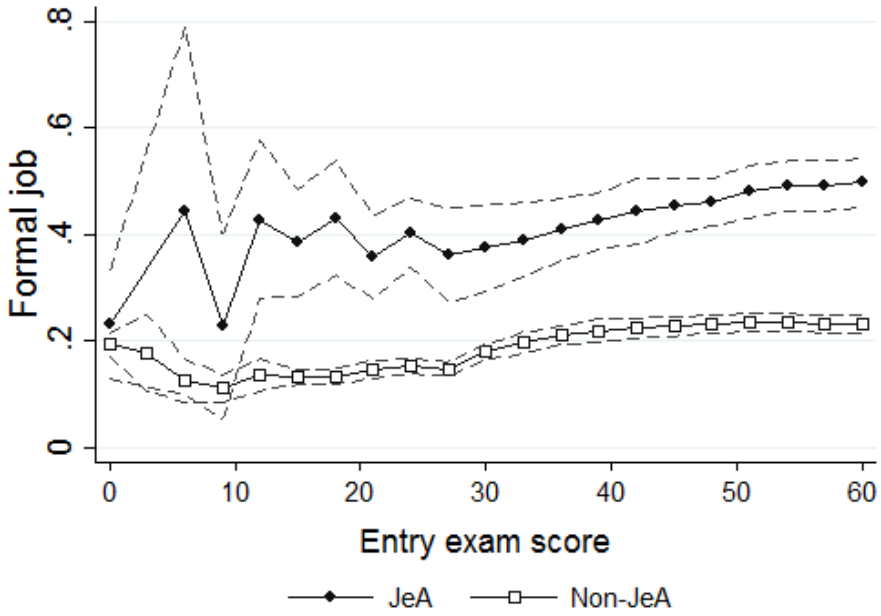
(b) Controlling by the effect of JeA

Return

Figure 11: Probability of formal employment by entry exam's score



(a) Eligible vs Non-eligible



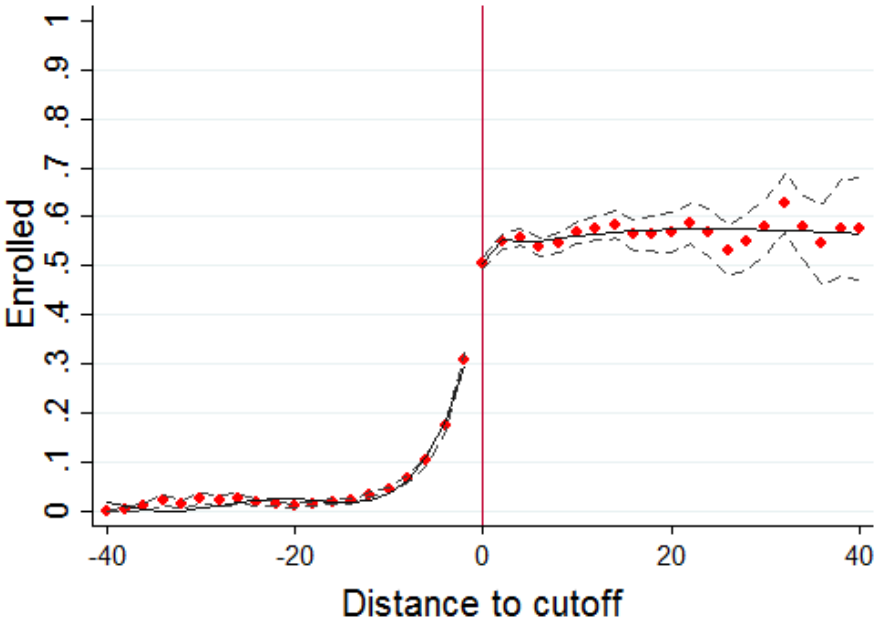
(b) JeA vs Non-JeA

Return

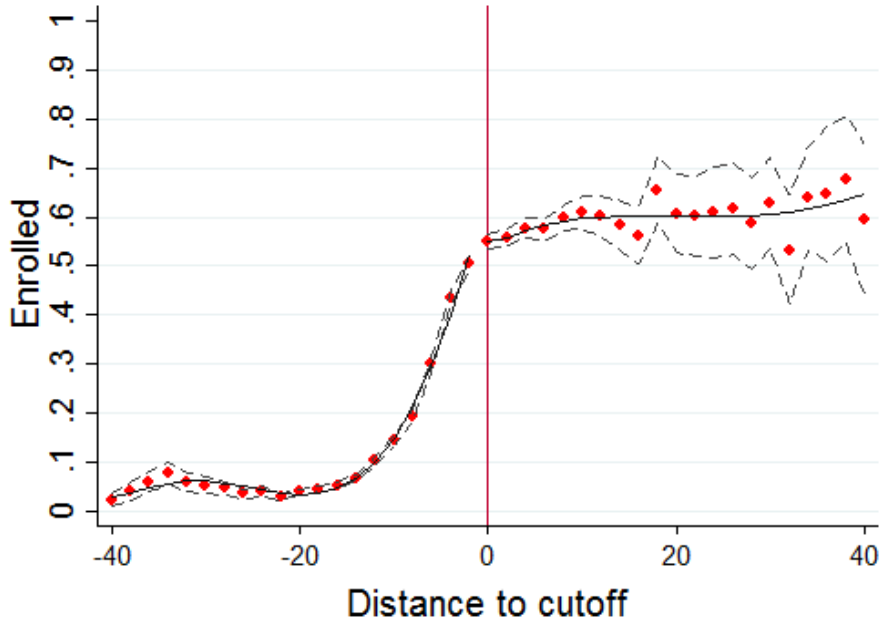
Table 10: JeA's indirect impact on formal employment

	Via enrollment	Via certification
1st stage (D)	0.102**	0.102**
	(0.005)	(0.005)
2nd stage (T)	0.749**	0.161**
	(0.045)	(0.028)
3rd stage	0.491**	2.284**
	(0.143)	(0.761)
R2		
Observations	137409	137409

Figure 12: Enrollment by distance to entry exam's cutoff - JeA

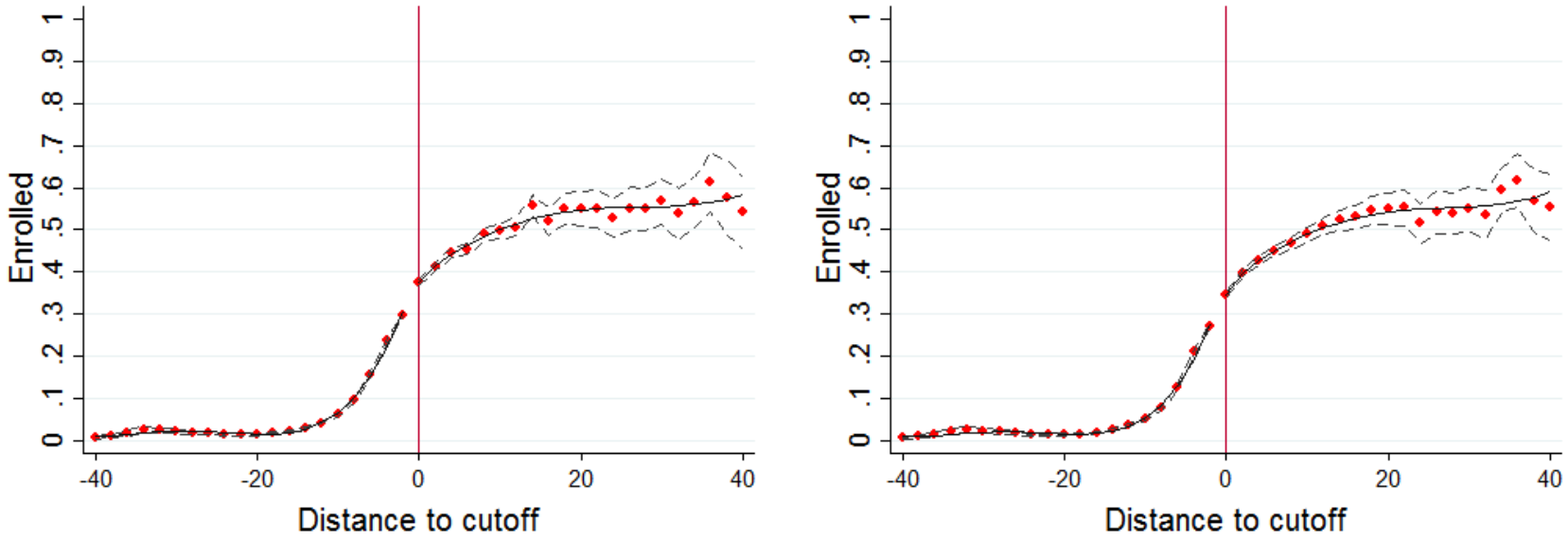


(a) With pref. entry



(b) Without pref. entry

Figure 13: Enrollment by distance to entry exam's cutoff - No JeA



(a) With pref. entry

(b) Without pref. entry

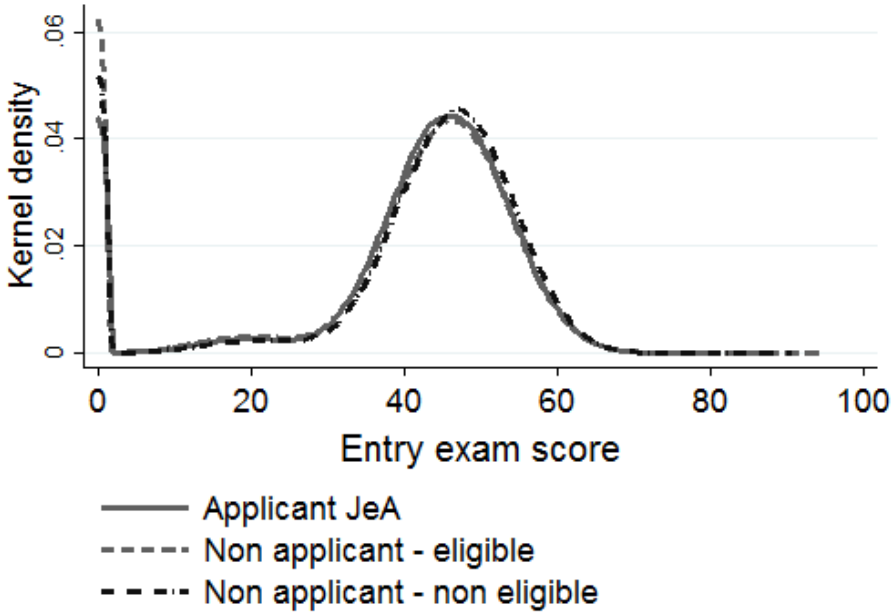
Affirmative action - JeA's preferential entry

Table 11: Preferential entry's effect on Sena's composition

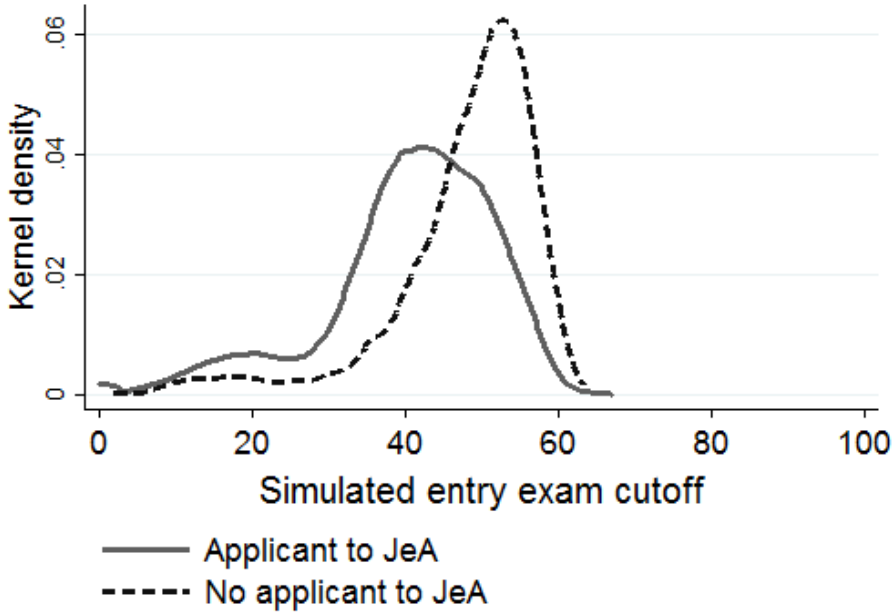
	Never admitted	Admitted by PE	Exclude by PE	Always admitted
Observations	815356	23875	25982	204471
Entry exam's score	42.681	**45.608**	**51.317**	53.415
	(0.323)	(0.433)	(0.534)	(0.384)
% Enrolled	0.060	0.464	0.231	0.332
	(0.004)	(0.014)	(0.008)	(0.009)

Notes: Authors' calculations using data from Sena.

Figure 14: Preferential entry's composition effect



(a) Applicants



(b) Entry cutoff

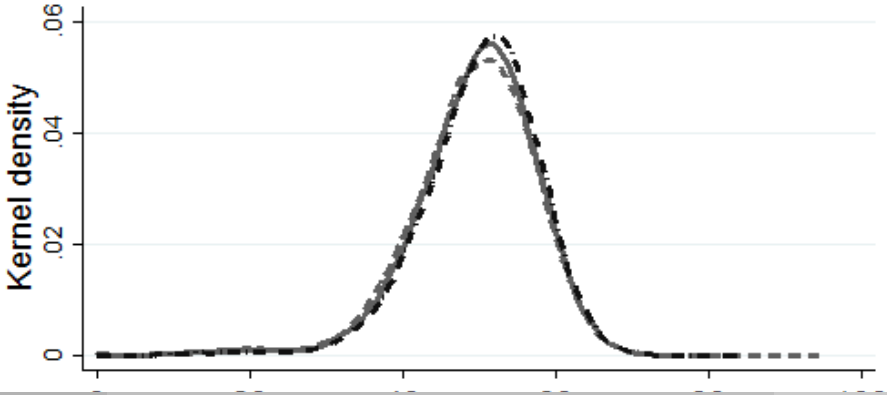
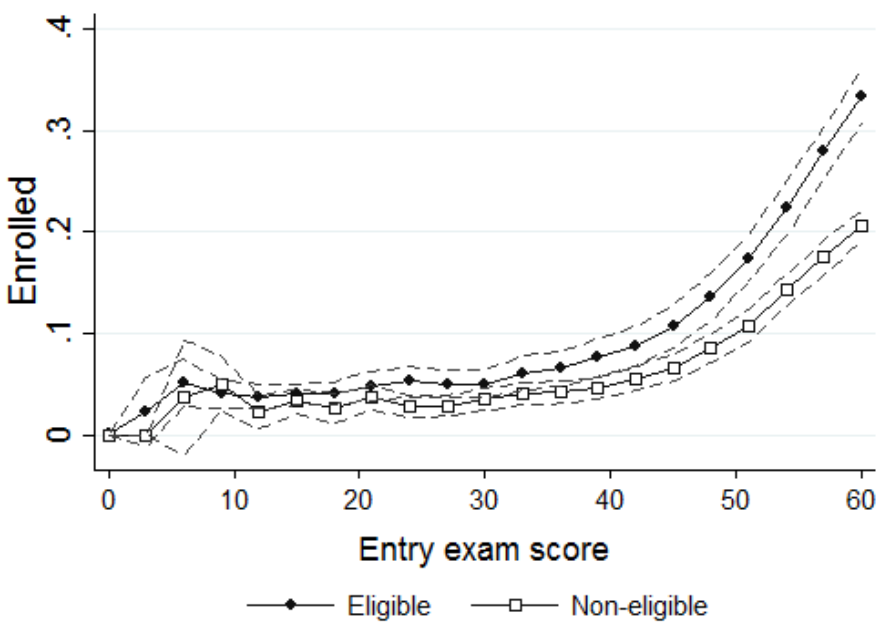
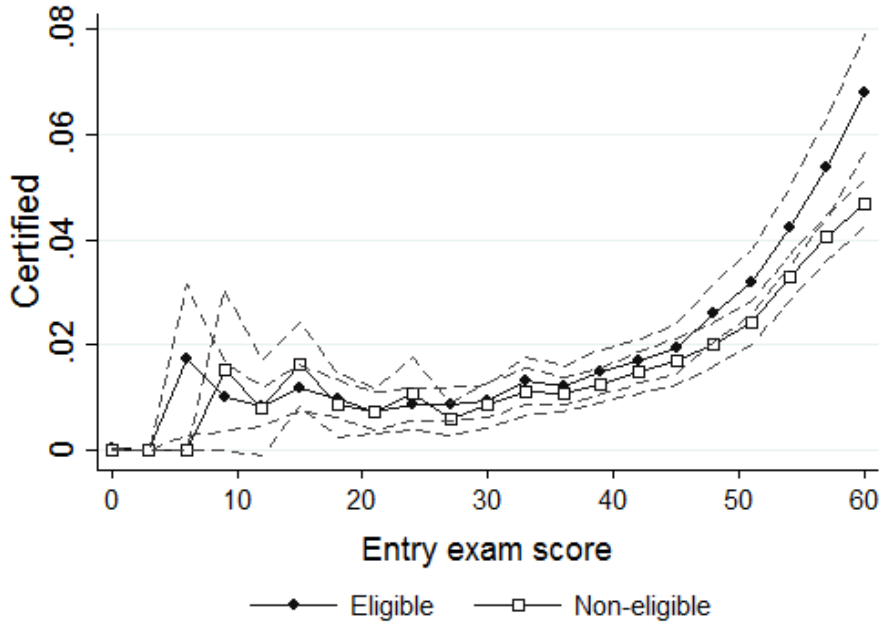


Figure 15: Enrollment and certification by entry exam's score



(a) Enrolled



(b) Certified

Table 12: Enrollment by student's score

	Low score		High score	
	(1)	(2)	(3)	(4)
	RF	IV	RF	IV
Enrollment				
Eligible	0.050**		0.119**	
	(0.008)		(0.019)	
JeA beneficiary		0.868**		0.673**
		(0.145)		(0.054)
Constant	0.047**	0.047**	0.209**	0.209**
	(0.012)	(0.012)	(0.011)	(0.011)
F Test		99.62		36.45
R2	0.00	0.40	0.01	0.32
Certification				
Eligible	0.012**		0.026**	
	(0.003)		(0.006)	
JeA beneficiary		0.210**		0.149**
		(0.049)		(0.030)
Constant	0.008**	0.008**	0.031**	0.031**
	(0.002)	(0.002)	(0.004)	(0.004)
F Test		99.62		36.45
R2	0.00	0.08	0.00	0.05
Observations	72051	72051	65547	65547

Notes: As table **??**

By excess of demand

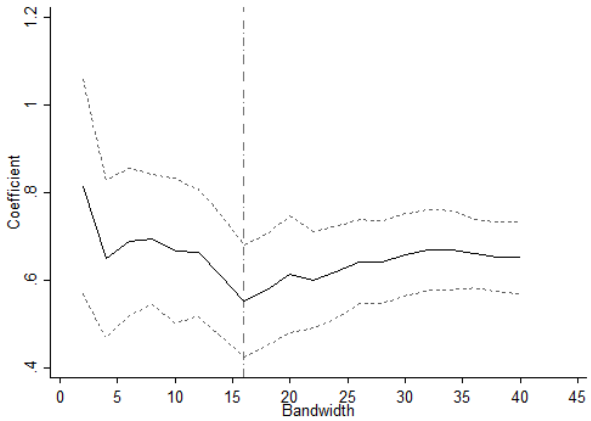
Table 13: Enrollment and Certification by excess of demand before JeA

	Under demanded		Over demanded	
	(1)	(2)	(3)	(4)
	RF	IV	RF	IV
Enrollment				
Eligible	0.100**		0.085**	
	(0.021)		(0.014)	
JeA beneficiary		0.643**		0.694**
		(0.119)		(0.052)
Constant	0.221**	0.221**	0.201**	0.201**
	(0.029)	(0.029)	(0.016)	(0.016)
F Test		86.34		47.84
R2	0.01	0.27	0.01	0.24
Certification				
Eligible	0.026**		0.019**	
	(0.009)		(0.004)	
JeA beneficiary		0.165**		0.157**
		(0.057)		(0.023)
Constant	0.021**	0.021**	0.029**	0.029**
	(0.006)	(0.006)	(0.006)	(0.006)
F Test		86.34		47.84
R2	0.00	0.02	0.00	0.04
Observations	26122	26122	180084	180084

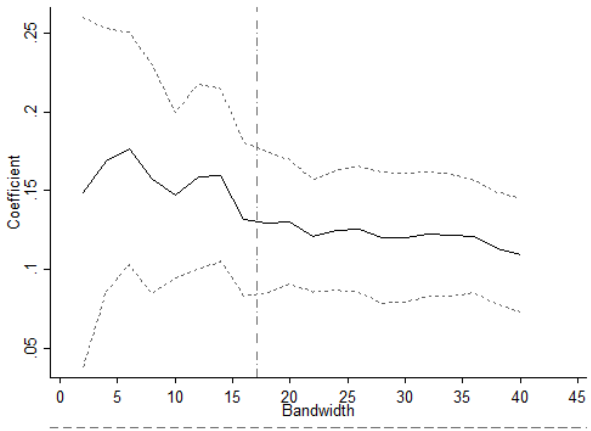
As table **??**

Return

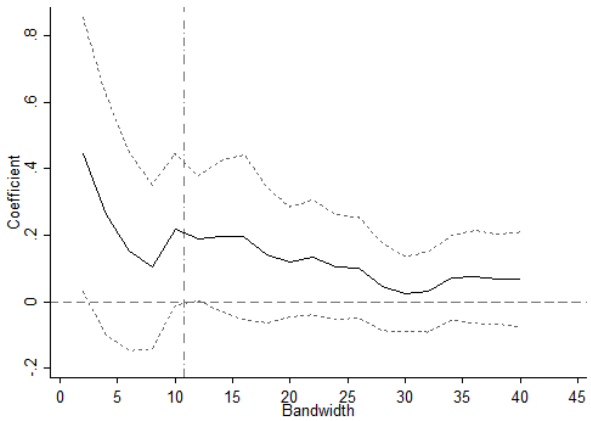
Figure 16: Estimated JeA impact by bandwidth of analysis



(a) Enrollment



(b) Certification



(c) Formal employment

Certification from Sena

Table 14: Double discontinuity on Certification - **1 year course**

	All		Female		Male	
α_1	0.037	0.043*	0.028	0.023	0.046^{+}	0.050^{+}
	(0.024)	(0.021)	(0.052)	(0.046)	(0.024)	(0.027)
α_2	0.002	0.006	-0.030	-0.010	0.033	0.037
	(0.040)	(0.037)	(0.054)	(0.051)	(0.030)	(0.029)
α_3	0.020	0.019	0.040^{+}	0.030	-0.002	0.001
	(0.016)	(0.015)	(0.023)	(0.023)	(0.015)	(0.013)
Constant	0.105**	0.155**	0.170**	0.062	0.049^{+}	1.032**
	(0.030)	(0.059)	(0.047)	(0.163)	(0.025)	(0.060)
$\alpha_1 + \alpha_3$	0.072	0.035	0.277	0.331	0.090	0.081
$\alpha_2 + \alpha_3$	0.503	0.415	0.830	0.646	0.264	0.172
$\alpha_1 + \alpha_2 + \alpha_3$	0.099	0.052	0.444	0.357	0.079	0.057
Controls		✓		✓		✓
R^2	0.05	0.13	0.07	0.18	0.03	0.15
Observations	7244	7244	3329	3329	3915	3915

Certification from Sena

Table 15: Double discontinuity on Certification - **2 year course**

	All		Female		Male	
α_1	0.012	0.011	0.020	0.012	0.004	0.011
	(0.009)	(0.010)	(0.013)	(0.013)	(0.009)	(0.010)
α_2	-0.003	-0.002	-0.003	-0.003	-0.002	-0.000
	(0.004)	(0.003)	(0.006)	(0.006)	(0.006)	(0.005)
α_3	0.012**	0.011**	0.011*	0.009^{+}	0.013*	0.011^{+}
	(0.003)	(0.003)	(0.005)	(0.005)	(0.006)	(0.006)
Constant	0.007^{+}	0.046**	0.010	0.051**	0.003	0.041
	(0.004)	(0.014)	(0.006)	(0.014)	(0.004)	(0.029)
$\alpha_1 + \alpha_3$	0.026	0.056	0.010	0.085	0.205	0.139
$\alpha_2 + \alpha_3$	0.010	0.008	0.318	0.378	0.008	0.020
$\alpha_1 + \alpha_2 + \alpha_3$	0.030	0.063	0.057	0.162	0.146	0.072
Controls		✓		✓		✓
R^2	0.01	0.07	0.01	0.12	0.01	0.07
Observations	12056	12056	5551	5551	6505	6505