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Reducing credit constraints to post-secondary
technical education in developing countries.
Evidence from Colombia

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Reducing credit constraints to post-secondary technical education in developing countries. Evidence from Colombia

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Abstract

We assess the importance of credit constraints for post-secondary education using different discontinuities that affect enrollment in free-technical education and eligibility for educational grants in Colombia. Our strategy makes use of multiple RD estimators in order to identify the importance of covering the opportunity cost on enrollment, completion and access to formal labor market for poor young individuals who want to enter tertiary education. We find evidence of large increases in enrollment and graduation rates. Particularly, the probability of obtaining a certification in technical studies rises from 3\% to 14\%. We also find an important increase in formal labor market participation in the medium term, individuals who received monetary aid to enroll and finish technical education from 2014 to 2016 are 50\% more likely to have a formal job in 2017. We find that reducing credit constraints has no differential effects with respect to educational variables but only affects the labor market of men

1   Introduction

Demand-side factors seems to limit access to tertiary education be especially important because of the middle and low income households opportunity cost of studying in developing countries. In this paper we exploit a double discontinuity in a national program aimed to increase the participation of poor high-school graduates in tertiary education. We make use of information about a program called *Jóvenes en Acción* (JeA, hereafter), launched by the Colombian government in November 2012 that offers a monthly grant around 68 USD to poor youths who enroll in vocational education or professional studies DPS (2017). JeA provides a grant using a poverty index as eligibility criteria, but since most of the students should take an exam to obtain a seat in courses traditionally over-demanded, the program also aims to increase the enrollment rate for its targeted population reserving 30\% of total seats in the SENA courses which have excess of demand. This is known as preferential entry. As a result, JeA includes one discontinuity in access to the grant and a second discontinuity in the access to the courses that allows us to determine the importance of subsidizing the opportunity cost of technological education in Colombia.

Understanding differences of human capital accumulation across income levels has always attracted the attention of economics literature. Since Becker (1960) many authors have been interested by the different trends in human capital accumulation between and within countries. For example, according to World Bank gross enrolment rates, tertiary education enrollment rates were 41% in high income countries and only 8.5% in low and middle-income countries in 1990 and they increased in both areas, reaching 73% and only 29%, respectively in 2014. The increase in education enrollment rates is not equally distributed by income levels as is documented by authors as Carneiro and Heckman (2002). Whether the rich-poor access gap to higher education is due to differences in tastes and abilities caused by long-term differences

in educational investments that affect readiness for college or is partially driven by credit constraints faced by lower-income families, is a matter of much debate.

A human capital model predicts that under normal conditions, the optimal decision for a high-school graduate is to enter college because her expected future income exceeds the net costs of studying. However, the existence of borrowing constraints could prevent or discourage human capital accumulation (postpone college by working and saving to enter in the future). Recent active labor market programs (ALMP) are intended to increase employability through vocational training, to increase the labor demand by employment subsidies and to increase available information providing search assistance for individuals with low access levels. In contrast, Solis (2017) states that high income students have not only better access to credit markets but also higher endowments for higher education (better academic preparation, and family support).

Despite these shocking differences, there is non-consensus about the causes of the income gap in postsecondary education. Specifically, there is an inconclusive debate about how much short run liquidity constraints explain part of these differences. There is extensive empirical evidence in favour of and against this argument in developed countries, mainly the United States. On the one hand, Lochner and Monge-Naranjo (2011) mention that college attendance is strongly increasing in ability even controlling by family income, but conditional on ability, college attendance is also strongly increasing in family income (and wealth). That is, parents provide economic resources to pay the fees for higher education but at the same time, they are encouraging the importance of studying since childhood regarding the abilities of their children, but the lack of both supports is common in low income households. Similar evidence is found by Brown et al. (2011); Belzil et al. (2017).

On the other hand, works such as Keane and Wolpin (2001); Carneiro and Heckman (2002); Cameron and Taber (2004) show small or no real effect of short run liquidity constraints on enrollment in tertiary education. Among these authors, long run and structural differences such as *ability* or *readiness* to study explain the differences shown in the data over existence or not of credit constraints. Furthermore, works such as Stinebrickner and Stinebrickner (2007) provide evidence about college dropout in low income students caused by reasons other than credit constraints. In a country recognized by its high inequality both hypotheses can be valid. Credit constraints limit access to education for all young applicants but inequality of opportunities also limits cognitive and non-cognitive skills development and future expectations.

The debate in developing and middle-income economies is more recent, but nevertheless is also inconclusive. Alfonso (2009) states that Latin American countries experienced a boom of students enrolling in post-secondary education, but they mostly come from the highest income quartiles. A considerable fraction of student population does neither finishes secondary education nor pursues tertiary studies due to demand barriers. Although, recent works brought evidence about the importance of credit constraints in developing or middle-income countries, for example C´aceres-Delpiano et al. (2015); Rau et al. (2013); Solis (2017) for the case of Chile, Attanasio and Kaufmann (2009) using the case of *Progresa* in Mexico or more recently Londono-Velez et al. (2017) for Colombia. Our work contributes to this new literature.

We use administrative data from the highest Colombian national center for vocational training and data from the beneficiaries of a program that aimed to increase the participation of poor high-school graduates to assess how important liquidity constraints in access to and graduation from post-secondary education.

The case of Colombia is interesting for several reasons. Tertiary education is segmented in Colombia because professional studies provided by universities are traditionally attended for middle and high income pupils meanwhile vocational studies belong to people from most vulnerable households. This fact has important implications since labor markets are highly segmented between well-paid formal jobs affordable for people with higher education and low-

wage informal occupations. Colombian is recognized for its high income inequality during the last decades (Gini index over 0.5). Wages vary considerably between workers with tertiary (professional and vocational) and secondary education. That is, a typical worker with middle education earns between 250-350 US dollars per month and someone with a professional degree can earn about 500 US dollars during her first year employed. These differences encourage young people to invest in education but in many cases they are making such an investment under false expectations. Most of the high school students reflect their low knowledge about labour markets when their labor expectations are asked and it prevents some of them from undertaking this educational level (Bonilla et al 2017; Gamboa and Rodriguez (2017)}. The annual fee in a private high quality university may fluctuate between 4,500 and 10,000 US while the minimum wage earned by an important fraction of population is about 3,000 US per year.

The number of students enrolled in tertiary education grew from 1.3 million in 2007 to 2.1 million in 2015 (average annual growth rate of 6.4%), and a considerable part was due to the growth of technical and technological enrollment around 7% a year. However, during the period 2013-2014 only 34% of those leaving high schools were enrolled at higher education after graduating from their secondary studies and less than 2 percent of low-income students were enrolled in top universities, according to data from Ministry of Education.[1] Most of low income households which are eligible to JeA program do not use banking services nor have access to credit (Murcia (2007)) which may have some effects on tertiary enrollment. As an example, the annual fee in a private high-quality university may fluctuate between 4,500 to 10,000 US while the minimum wage earned by an important fraction of population is about 3,000 US per year.[2] This fact has important implications since labor markets are highly segmented between well-paid formal jobs affordable for people with higher education and low-wage informal occupations.

For our analysis we use information about a program called *Jovenes en Accion* (JeA, hereafter), launched by the Colombian government in November 2012 (Prosperidad-Social (2017)). JeA offers a monthly grant around 68 USD to poor youths who enroll in vocational education (technical/technological studies) or professional studies in public universities in order to encourage human capital accumulation for low income population. What is more, JeA also aims to increase the enrollment rate for its targeted population reserving 30% of total seats in the SENA courses which have excess of demand. This is known as *preferential entry*.

In this work we focus on the Program's branch on vocational studies offered in the National Learning Service Institution SENA (Servicio Nacional de Aprendizaje, for its Spanish acronym) which is a public institution in charge of training for technical occupations ascribed to the Ministry of Labor.[24]

We contribute to previous literature (for example Solis (2017)) by using two discontinuities: one discontinuity in access to the grant offered by JeA and a second discontinuity in the access to public free education at SENA. This strategy allows us to quantify the importance of subsidizing the opportunity cost of technological education in Colombia. Furthermore, we will show evidence that low uptake rate on SENA's education is mainly caused by liquidity constraints, thus we provide evidence to support the existence and importance of credit constraints in tertiary education. Finally, we extend our analysis following Attanasio et al. (2011, 2017) to assess short and medium-term effects of lifting credit constraints and increasing access to post-secondary schooling on formal labor market participation.

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[1] According to ICFES, less than 5% of low income students achieve scores above the upper decile of Saber 11 test which is the main criteria for admission to a Top Universities. 2

In a previous work Acevedo et al. (2008) provides some evidence of demand for tertiary education in Colombia, showing that demand barriers as household income limit access to vocational studies but this is not recent evidence.

[2] This program has the same name as the one studied in Attanasio et al. (2017) and Attanasio et al. (2011). However, the intervention we use in our analysis differs from previous versions in terms of the eligible population and the benefits given to enrolled individuals.

[4] We analyze JeA's impact on individuals who applied to college education in a companion paper.

We found that monetary aid to keep studying increases the probability of being enrolled, certificated and, what is more interesting, increases the labor participation for students in vocational students. SENA enrollment rate rises by 10 pp for individuals eligible for JeA. Additionally, participation in JeA increases the probability of obtaining a certification from SENA for 3% to 14%. We found as well JeA's impacts are increasing in individuals' ability. The latest is evidence of how the monetary aid is more important than affirmative action. Given that expected returns of technical education are larger for individuals with more skills, we can conclude that JeA's main impact is to lift short run liquidity constraints associated with the ability to cover the opportunity cost of studying after high school. We extend our analysis adding to previous literature and find that formal labor market participation increases from 48% to 69% for JeA beneficiaries. Despite the fact that the impacts in educational attainment are uniform over different populations, the results in labor formal labor markets are focused on males. This result is opposite to Attanasio et al. (2017)'s findings and opens a window for future research.

This paper is structured as follows. Section 2 describes some characteristics of the Colombian education system and how JeA and vocational education at SENA are designed. Section 3 describes our estimation strategy and the data employed for our estimations. We present and discuss the main results in section 5, including evidence of how JeA lifted liquidity constraints. We complement our analysis with robustness checks in section 6 and a cost benefit analysis in section 7. Section 8 concludes.

2   Institutional context

Higher education in Colombia includes professional studies at universities with an average duration between 4-5 years and vocational studies of shorter duration (2-3 years) offered at smaller institutions. Vocational studies include short-term (up to one year and a half) courses known as technical programs and middle-term courses named technological programs (about 3 years). Traditionally, low-performing students on standardized tests tend to consider vocational programs because of their entry requirements (lower admission scores and lower fees). Colombia has about 330 higher education institutions that differ in multiple aspects such as their administration (public or private), prestige (high demanded and low demanded institutions) and the kind of programs offered (vocational or academic) for more than 55 different fields of study. According to the National System of Higher Education (SNIES, *Sistema Nacional de Informacion de la Educacion Superior*, in Spanish) in 2005, the number of people enrolled in higher education was 4.284.885 (undergraduate programs), being 33,3% at vocational studies and the remaining 66% in professional programs.

In spite of this education scheme, there is still a considerable fraction of population without access to tertiary education because of demand and supply barriers. According to the Ministry of Education, 637 out of 1100 municipalities (57%) had at least one person enrolled in tertiary education in 2016. Some recent data suggest that women have higher (lower) participation in Professional (vocational) studies than men. In 2016, 55% out of the vocational students were men and 54% out of the people enrolled at universities studying professional studies were women. The cost of these programs has a high variability according to many factors but it is very common that students from professional studies in private universities pay higher fees than those from public ones or those from vocational studies. As a result, important wage differentials emerge.

Colombian has been known for its high income inequality during the last decades (Gini index over 0.5). This inequality is evident when we deal with labor earnings. First wages vary considerably between workers with tertiary (professional and vocational) and secondary education. That is, a typical worker with middle education earns between 250-350 US dollars per month and someone with a professional degree can earn about 500 US dollars during her first year employed. These differences encourage young people to invest in education but in many cases they are making such an investment under false expectations. Most of the high school students reflect their low knowledge about labour markets when their labor expectations

are asked and it prevents some of them from undertaking this educational level (Bonilla et al., 2017; Gamboa and Rodriguez, 2017).

2.1 Professional training at SENA

SENA's main task is to provide vocational studies (technical and technological) free of charge serves as an intermediary among entrepreneurs, workers and the national government in terms of demands and job offers.

This institution includes several spheres of society in its management structure at national and local levels [3]. This institution provides the academic infrastructure for the design and development of short (up to two years) courses in different cities and in the online modality. Since SENA includes institutions from the private and public sector, it allows the process of collecting information about demand and supply of labor and the central skills and competences needed in the labor market.

In 2015 SENA enrolled around 856 hundred individuals which is about one fifth of undergraduate enrollment (professional + vocational) and 60% of technical and technological students. Gender composition is balanced in SENA (51% of people are men).[4] Most of these students are carrying out programs related to economy, business, accounting and engineering courses (about 74%)

Since we are only dealing with vocational studies, it is convenient to put in context the differences between technical and technological formation for the reader. On one side, a technical professional may serve in occupations of operating and instrumental character. She develops skills related to the application of knowledge in a set of labor activities, carried out in different contexts with a high degree of specificity and a lower level of complexity. On the other side, technological studies allow the person to develop skills related to the application and practice of knowledge in a set of labor activities more complex and non-routine, in most cases, and performed in various contexts. The use of theoretical concepts is more frequent and allows her to intervene in the processes of design and improvement. This role has the biggest capacity of decision and evaluation as well as creativity and innovation because it requires a considerable degree of autonomy and sometimes the orientation of other workers.[5]

2.1.1 Selection process at SENA

Education at SENA is free and usually offers a direct connection with the labor market via an internship program. There are several schedules available for most programs (mornings, afternoons, weekends and midnight hours) and each program establishes minimum requirements for admission that must be fulfilled by applicants to the programs offered. Each center chooses its offer of training programs according to several criteria such as sectoral needs, regional and local development plans and availability of facilities for the program at the center.

Therefore some courses are highly demanded, thus the institution has a selection process based on entry exam. All applicants sit a standardized test (scores from 0 to 100) and scarce

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[3] The National council of administration is composed by Ministries of Labor, Trade and, Education, the representatives of the Industry (Andi, Asociacion Nacional de Industriales, in Spanish), Commerce (Fenalco, Federacion Nacional de Comerciantes, in Spanish) and agriculture (SAC, Sociedad de agricultores de Colombia), the National Science Office (Colciencias) and a delegate of farmers.

[4] It is important to mention that one person could be enrolled in more than one course, which prevents us to talk about different individuals

[5] The entire formation of a technical professional worker corresponds to practices in the operation, support, data collection, monitoring and reporting for quality assurance, and control of the times, methods and movements that are based on the theory. In the case of a technological worker, her formation corresponds to management practices of collection, processing, evaluation and qualification of information for planning, schedule and control processes for innovation. See www.mineduc.gov.co for details

seats are offered in descending order from the highest score downwards until all the seats are allocated.

In this case aspirants should take a 25 minutes computer-based test intended to identify those candidates whose profile, skills and competencies are to a greater extent the expected profile in terms of basic, civic/citizenship, labor and cognitive skills.[6] For some courses with large demand a second test may apply which consists of a web test or a selection workshop. These tests seek to identify the academic foundation that will ensure that applicants understand the content from the formation stage and the minimum cognitive and motor skills necessary for an adequate performance within the training program.

2.2   The Program

JeA (Youths in action) is a nationwide program with the aim of *"encouraging human capital formation in young poor and vulnerable population"* in Colombia (Prosperidad-Social (2017)) managed by *Prosperidad Social* (The Office of Social Prosperity in charge of social policy).[7] Specifically, the main objectives of JeA are to encourage the demand for education in technical, technological and professional degrees; to increase educational attainment; to reduce dropout rates from the educational system and, to strengthen the cross-curricular skills to facilitate social and labour insertion of young people in conditions of poverty and vulnerability. In this sense, the JeA program includes two main components: Training for work and abilities for the life. Although JeA-program began in 2005, since then frequent changes have taken place within it. Throughout this paper, we focus in the intervention carried out from August 2014 until October 2015.

Admission to the program was established so that priority would be given to the access of the following population groups in strict order: 1. Individuals in the adoption list of the ICBF *"Instituto Colombiano de Bienestar Familiar"*, which is the national institution on child protection; 2. Individuals from recognized indigenous groups; 3. Individuals part of *Red Unidos* (RU) which means United Network and it is national the program which coordinates different social welfare interventions; 4. Forced displaced people registered in RUV (RUV stands for *Registro Unico de Vˊıctimasˊ*) or RUPD (*Registro Unico de Vˊıctimasˊ* is the Armed conflict Victims Registry from the Colombian armed conflict); and 5. Individuals in low economic conditions classified by the SISBEN III (National system of selected beneficiaries of public subsidies). SISBEN III assigns a score between 0 to 100, being 0 the lower conditions and 100 to the rich households. Then, JeA provides access to people ranked below a specific regional cutoff point.

The goals of JeA are achieved through the use of four different strategies. Firstly, JeA provides a *preferential entry* at SENA to their beneficiaries consisting of the allocation of 30% of seats in each course regarding of the score obtained at the entry exam. Thus, when a course has excess of demand the preferential entry scheme increases the probability of a JeA's beneficiary to enroll even when her entry exam may not be within the eligible range. Secondly, the program offers a 68 USD monthly grant to young individuals (16 to 24 years old) classified as poor by SISBEN III score while they are enrolled in vocational education (technical/technological studies) free of charge at SENA or, enrolled in professional studies in public universities that have previous agreements that facilitate the admission. As it can be seen, there are two available discontinuities in these strategies (entry Test and SISBEN III score) that allow us to employ our methodology but also limit our analysis to people targeted by SISBEN III. Thirdly, in addition to that cash incentive, those who achieve a minimum grade point

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[6] These tests assess whether the applicant is able to communicate, to think in a logical way, to use science for understanding, to recognize the coexistence, democratic participation and solidarity, and attitudes necessary for acting efficiently

[7] The Resolution No. 1970 of 21/nov 2012, stated the creation of a work-group from the Social Income Office to manage JeA. This will "create, monitor, and manage" all the processes and activities related to this Program

average established by the authorities of JeA will earn extra money during their studies.[8] Last, for people enrolled at SENA, there is an additional component intended to strengthen their abilities for seeking a job in the labor market (This component includes things such as learning to write a curriculum vitae, to learn how to perform in a recruiting process, among others).

There are at least two important features of the JeA actual design which are different from that version of JeA-2005 assessed in Attanasio et al. (2017) and Attanasio et al. (2011). First, young people attend the training process completely carried out by SENA instructional centers while they were trained by private centers in 2005. Second, people in the current version of the program are selected on a poverty-based criteria instead of a decentralized ability-based criteria because of the social inclusion emphasis of the actual program.

In our period of analysis the Program enrolled around 353 thousand individuals in 98 cities. Despite that the SISBEN III criteria is the last one in the list, 87% of the total beneficiaries entered JeA using this criteria (see Table **1**). Furthermore, 71.9% studied in SENA (43% and 57% in technical and technological courses respectively) and the remaining 28.1% are enrolled in Universities known as Superior Education Institutions (IES *"Instituciones de Educaci´on Superior"*). As we explained above, we focus in this paper analyzing the individuals who applied to the SENA since the purpose of their programs and its duration differ from professional studies.[9]

3. Estimation strategy

The main purpose of this paper is to exploit two different discontinuities in SENA's and JeA's enrollment process to disentangle the importance of liquidity constraints on enrollment, completion of technical education and access to formal labor markets. The first discontinuity we explore is JeA eligibility criteria using SISBEN's scores. As mentioned in the last section, the SISBEN score is a mechanism used by Colombian authorities to prioritize social services. JeA enrolls more than 80% of its participants using this score. The second discontinuity comes from the existence of an admission test which is designed to allocate the seats, mainly for over demanded courses.

Firstly, estimations using SISBEN's discontinuity will quantify the impact of JeA on the outcome variables listed above. This impact will include the aggregated effect of monetary aid, preferential entry and soft skills training.[10] In order to separate each impact we will show different estimations taking into account the individuals that are more likely to be affected by each JeA's component.

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[8] The maximum time allowed to anyone in JeA depends on the type of training or career but it ranges from 21-36 months (technical studies at SENA) and 48-60 months (professional academic programs in public universities)

[9] Another work forthcoming using the individuals who enrolled in public universities

[10] The soft skill training (habilidades para la vida) was taken voluntarily by 33% of JeA beneficiaries

Table 1: SENA applicants 2014-II to 2015-II. Descriptive statistics

	Non JeA participant				JeA participant			
	Mean	S.D	Min	Max	Mean	S.D	Min	Max
All Individuals								
Individuals	1380926.00	.	.	.	89350.00	.	.	.
In Sample	0.71	0.45	0.00	1.00	0.94	0.24	0.00	1.00
Sample with SISBEN score								
Individuals	968183	.	.	.	83451	.	.	.
Enrolled	0.19	0.40	0	1	1	0	1	1
Certified	0.02	0.13	0	1	0.16	0.36	0	1
Certified[1]	0.09	0.28	0	1	0.16	0.36	0	1
Formally employed	0.45	0.50	0	1	0.50	0.50	0	1
Enrollment period								
2014-II	0.26	0.44	0	1	0.44	0.50	0	1
2015-I	0.40	0.49	0	1	0.42	0.49	0	1
2015-II	0.34	0.47	0	1	0.14	0.35	0	1
Targeting area								
Area 1	0.47	0.50	0	1	0.39	0.49	0	1
Area 2	0.46	0.50	0	1	0.52	0.50	0	1
Area 3	0.07	0.25	0	1	0.09	0.29	0	1
Male	0.46	0.50	0	1	0.43	0.50	0	1
Age	19.54	2.39	16	24	19.05	2.13	16	24
Technical	0.51	0.50	0	1	0.36	0.48	0	1
Took entry exam	0.77	0.42	0	1	0.74	0.44	0	1
Entry exam score	39.11	17.20	0	111.33	49.31	8.29	0	138.10
Eligible FeA	0.49	0.50	0	1	0.61	0.49	0	1
Second test taker	0.17	0.38	0	1	0.46	0.50	0	1
Other support	0.01	0.08	0	1	0	0.03	0	1
Courses	21303	.	.	.	9909	.	.	.
Seats	37.28	20.89	1	730	38.09	23.70	5	520
Demand	101.17	165.52	1	4025	155.85	212.87	2	4025
Takeout (%)	0.34	0.24	0	1.08	0.48	0.19	0.01	1.08
Excess of demand (%)	0.53	0.50	0	1	0.77	0.42	0	1
With second test (%)	0.25	0.43	0	1	0.42	0.49	0	1

Notes: Authors' calculations using data from SENA and SISBEN. Only includes SENA centers where JeA beneficiaries applied. 1 Conditional on being enrolled.

Secondly, when we use the admission exam's discontinuity we need to take into account the following characteristics of SENA's enrollment process. (i) Even though almost all applicants have to take an entry exam, this criteria will only apply when there is an excess of demand for a given course.[11] (ii) As we will show in the next section, the entry exam does not create a sharp discontinuity in enrollment, however, scores above a given cutoff will get the first offer to enroll. Just when these applicants decline, offers to join the course will be made to the remaining applicants in descending order with respect to the score. (iii) Finally, having the first offer does not imply access to monetary support, thus, we use this discontinuity to explain the impact of having the first offer to enroll in free technical education with or without obtaining financial aid. Without financial aid, individuals will still need to cover their opportunity cost.

Declare s_i as the difference between individual i's SISBEN score and the cutoff of her area.[12] Then, we can declare $D_i = 1[s_i \leq 0]$, which represents a dummy variable with the value of 1 if the individual i is eligible for JeA. Furthermore, T_i takes the value of 1 if i is a beneficiary of JeA.

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[11] Sometimes firms (private and public) ask SENA for specialized training, in this cases participants do not take an entry exam.

[12] It is important to remember that JeA uses three different cutoffs for different areas

Then, following Lee and Lemieux (2010), we estimate the impact of JeA using a RD-IV strategy where D instruments the endogenous participation in the program T. So, if Y_i is an individual i's outcome variable, the equation 1 shows that τ_Y represents the estimated impact of JeA on Y:

$$\tau_Y = \frac{lim_{c\uparrow 0} E\left[Y | s_i = c\right] - lim_{c\downarrow 0} E\left[Y | s_i = c\right]}{lim_{c\uparrow 0} E\left[T | s_i = c\right] - lim_{c\downarrow 0} E\left[T | s_i = c\right]} \tag{1}$$

As explained before, τ_Y includes the effect of all JeA components on Y. In order to isolate the impact of affirmative action (preferential entry), we explore the heterogeneity in the results with respect to two dimensions, demand for the course and applicant's ability. Preferential entry only applies when a course, with a JeA applicant, has an excess of demand. Furthermore, students with low scores in the entry exam are more likely to be affected by affirmative action. Thus, one can expect that the difference in τ_Y estimates in each case gives information about how much the impacts are driven by the monetary aid with respect to the full package.

We firstly analyze heterogeneous effects regarding individuals' ability. For this analysis, we use information about the entry score of every applicant in every single course since it is the most important step to obtain an admission at any SENA course. With this data we replicated SENA's selection process and simulated the exam score cut-offs with and without preferential entry in order to quantify how many JeA applicants directly benefited and how many non-applicants lost their seat as a consequence of this mechanism. As a result, we categorized individuals in the scenario with and without preferential entry (see table 2). As we can see, preferential entry affects directly around 50 thousand individuals, 23.8 thousand (2.23% out of total applicants) now get an offer in exchange of 25.9 thousand (2.42%) that should give away their place.

Table 2: Preferential entry 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. Simulations based on the entry exam results using only courses with excess of demand and at least one JeA applicant.

We can also see that the first group entry exam score is 5.5 points lower than the average of the group they are taking a place from, which could represent a fall in the average quality of the cohorts. Furthermore, cut-offs do not create a sharp discontinuity because the probability of enrolment is positive but lower than one for all individuals independent of their position with respect to the simulated cutoffs (46.4% admitted by preferential entry and 33.2% out of those who are always admitted because of their high performance at entry exam are already enrolled at SENA).

Figure 1: SENA entry exam and distribution of entry cutoffs for JeA applicants and non-applicants and enrollees

(a) Applicants

(b) Entry cutoff

(c) Enrolled
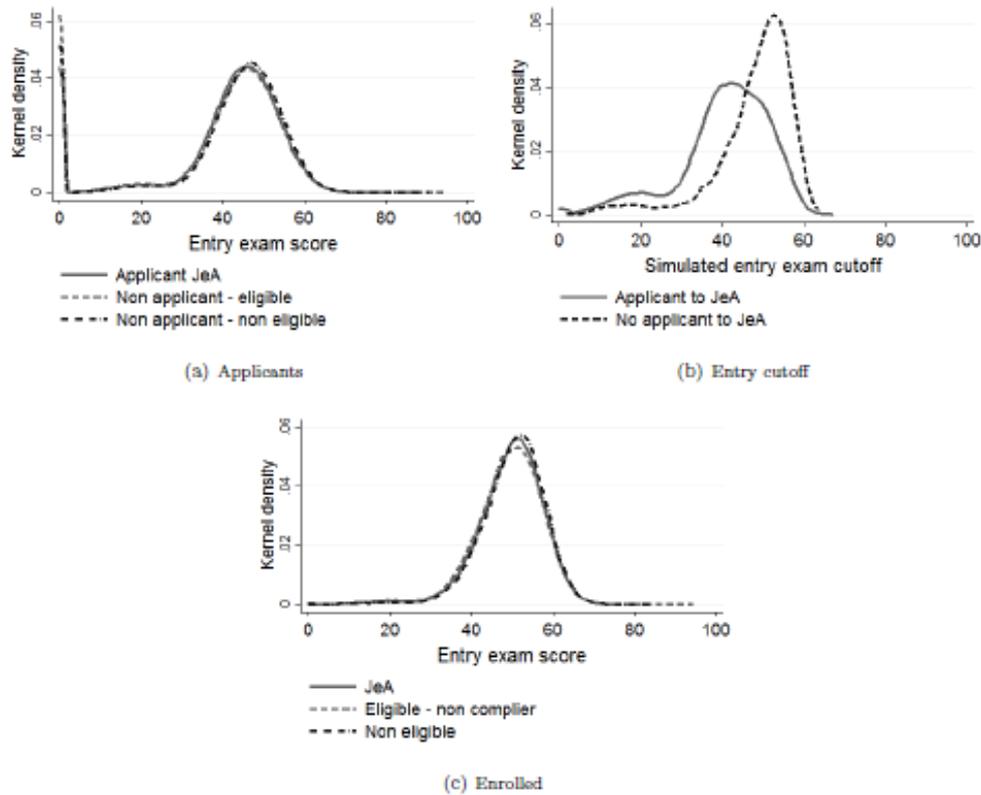
Notes: Authors' calculations using SENA applicant's data

Furthermore, Figure 1- panel A shows that there is no difference in the exam distribution among JeA applicants and non-applicants, therefore one can say that JeA does not attracts better or worse applicants. However, panel b shoes how the simulated exam entry cutoff distribution for possible beneficiaries of the Program moves left with respect to the distribution of those who did not ask for the benefits of the Program. Nevertheless, when we see the distribution of the individuals that finally enroll in SENA, there are no differences between participants and non-participants in JeA.

One can expect that if preferential entry drives the impacts of the program, they will be larger for group of individuals with low scores (low ability) than individuals with high scores (high ability), because the first group is more likely to receive the benefits of both the monetary aid and the preferential entry, while the second group would have had entered in SENA without the preferential entry and represents the impact of the monetary aid on the outcome variables. Nevertheless, the composition of applicants may have changed due to JeA. In order to avoid composition effects we define low/high ability with respect to the exam distribution in the same course but before preferential was being used. Hence, a given individual will be labeled low ability if her score when applied to a specific course in the period of analysis is lower than the simulated cutoff of the same course before our period of analysis, otherwise she will be considered as high ability.[13] So if high ability individuals are less likely to be affected by the preferential entry, we can also estimate the impact of this affirmative action by the difference of $\tau_Y^{Low-ability} - \tau_Y^{High-ability}$.

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[13] We use the applications made from the first semester of 2013 to the first semester of 2014 as a baseline

The second dimension we analyze is related with the demand of a given course. In those courses where there was no excess of demand, the preferential entry mechanism does not work so they provide information about the monetary aid's effect. Once again, the demand of the course could have been affected by JeA. To get rid of this effect we categorize each course according to their demand level before preferential entry was being used, the idea is that when a course has been over demanded in baseline, is more likely to have an excess of demand when the program uses preferential entry and will give more information about the importance of the monetary aid over the direct impact of affirmative action. Then, using these estimations, the effect of affirmative action would simply be $\tau_Y^{Over-demanded} - \tau_Y^{Under-demanded}$.

Thereafter, we use SENA's selection process and the admission cutoff in each course. Lets define e_i distance between individual i's exam score and the admission cutoff in the course she applied to. $A_i = 1[e_i \geq 0]$ is a dummy value with the value of one if the individual i gets the first offer to enroll in the course. If E_i takes the value of one if the individual enrolled in SENA and zero otherwise. Thus, we can estimate the impact of enrolling in SENA on Y using the RD-IV estimates as:

$$\gamma_Y = \frac{lim_{c\uparrow 0}E\left[Y|e_i = c\right] - lim_{c\downarrow 0}E\left[Y|e_i = c\right]}{lim_{c\uparrow 0}E\left[E|e_i = c\right] - lim_{c\downarrow 0}E\left[E|e_i = c\right]} \qquad (2)$$

As explained before, γ_Y represents the impact of SENA's enrollment on the outcome Y. This analysis is especially important in the case of the access to formal labor markets, because it represents the impact of having the opportunity to study but without financial support. It is important to point out that in all our RD estimations will be done within the optimal bandwidth estimated following Calonico et al. (2014).

Finally, we can also compare the discontinuities in s_i and e_i using a reduced form approach as:

$$Y_i = \alpha_0 + \alpha_1 D_i + \alpha_2 A_i + \alpha_3 D_i \times A_i + g(s_i) + f(e_i) + X_i + \mu_i \qquad (3)$$

In this case, α_1 represents the effect of being eligible for JeA but with a low score in the admission exam, which is closer to the aggregated impact of the monetary aid and preferential entry. α_2 represents the impact of having a high score but not necessarily financial aid (at least not JeA). Finally, α_3 represents the joint effect of receiving the first offer to enroll (via a high score) and being eligible for the financial aid of JeA.

4   Data

We use administrative data from SENA about all the individuals who applied for a technical or technological course from one year (From the second half of 2014 to the first semester of 2015). We combined SENA's data with administrative data from SISBEN III in order to determine which individuals were eligible for the program and which individuals were not. We also observe whether the individual joined SENA and whether or not each individual that entered SENA finished her course obtaining a certification (diploma). After SENA's certification, individuals go to labor market to work in formal or informal jobs. Finally, we combine this data with JeA registry records in order to identify its beneficiaries.

As we mentioned before, informal labor markets are hard to follow because of the absence of information about wages and labor mobility. Then, in order to estimate the medium/long term effects of the program, we use administrative data from the social security contributions from the Colombian Ministry of Labor (PILA) for the first semester of 2017. That is, 18 months after JeA closed inscriptions. The PILA database contains information about the compulsory contributions made by employed individuals to social security. Given that PILA contains a census of all contributions, we look for individuals who applied for SENA from 2013 to 2015 in PILA. Following Attanasio et al. (2017), an individual has a formal job if she is found in that

database. However, it is important to mention that people with no reports to PILA are either not working (unemployed or inactive) or working in the informal market.

Table 1 shows the main characteristics of our sample of analysis. There are two facts that are important to point out. First, the matching between SENA's data and SISBEN's data was different between participants and non-participants of JeA. Given that SISBEN is used by the Program to target its beneficiaries we matched 94% of the cases but only 71% in the case of non-participants. We discuss the implications of this issue in the following section. The second fact is that for JeA participants and non-participants, around 74% of applicants took the entry exam. This will be important when we estimate the effect of both discontinuities following equation 3.

It is also important to notice that certification rate and formal employability are larger for JeA participants than for non-participants.

5 Results
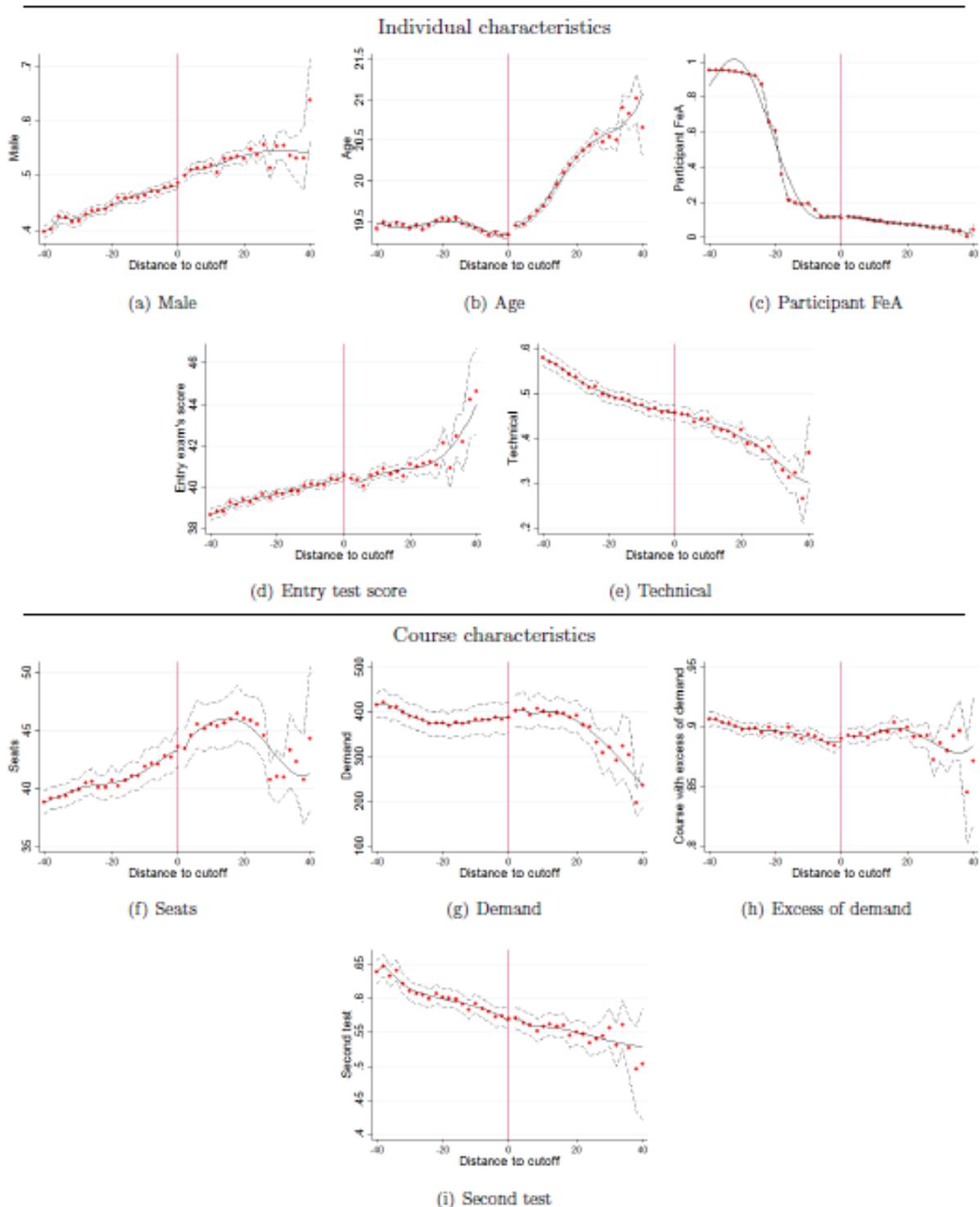
5.1 Validity of the RD design

According to Lee and Lemieux (2010), to estimate a policy's causal effect using RD two conditions must be fulfilled. (*i*) all observable and unobservable characteristics are continuously related with the factor variable and (*ii*) individuals are not able to manipulate the factor variable. We focus on the analysis of the SISBEN score because the discontinuity in the entry exam is not known by any individual in advance and the cutoffs are endogenous.

Figure 2 shows graphical representation of the continuity in confounding characteristics. We do not observe any strong change (a jump) around the cutoff for all the observable variables. However, the SISBEN is employed to select the beneficiaries for many other social programs in Colombia. Consequently, the same cutoffs are used by JeA as well as subsidised healthcare (RSS).[14] RSS provides access to medical services without paying periodical contributions and reduced co-payments to low-income households, specifically to individuals without a formal job (or in a household where the head has no formal job) and living in a household with a SISBEN score below the cutoff points we use in this paper.[15]

Figure 2: Balanced test for SENA applicants. Control variables vs distance to cutoff

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[14] RSS stands for Régimen Subsidiado en Salud in Spanish
[15] Details about RSS in prosperidad-Social (2014)

Individual characteristics

(a) Male

(b) Age

(c) Participant FeA

(d) Entry test score

(e) Technical

Course characteristics

(f) Seats

(g) Demand

(h) Excess of demand

(i) Second test

Notes: Authors calculations using SENA inscriptions and SISBEN data. 95% CI in dashed lines, standard errors clustered at course level. Bin size of 2 points. Adjusted function form using 4 degree polynomial.

Hence, identification may be compromised because individuals just below the cutoff are not only eligible to JeA but also to the RSS. Possible bias comes from the correlation between the decisions of demanding professional training in SENA and RSS's benefits. On the one hand, correlation may be negative because seeking tertiary education in SENA is a signal of the desire of obtaining a job in the labor market, but once an individual sign a contract (formal job), she losses her RSS benefits. On the other hand, RSS means lower expenditure in healthcare.

Hence, individuals may have less pressure to work after finishing high school and more income to cover the costs of studying at SENA. In the next section we discuss RSS's eligibility on our estimates.

Figure 3: SISBEN III distribution (centered at regional cutoff)

(a) For individuals matched with SENA

(b) All individuals in JeA's municipalities (interviews from 2014)
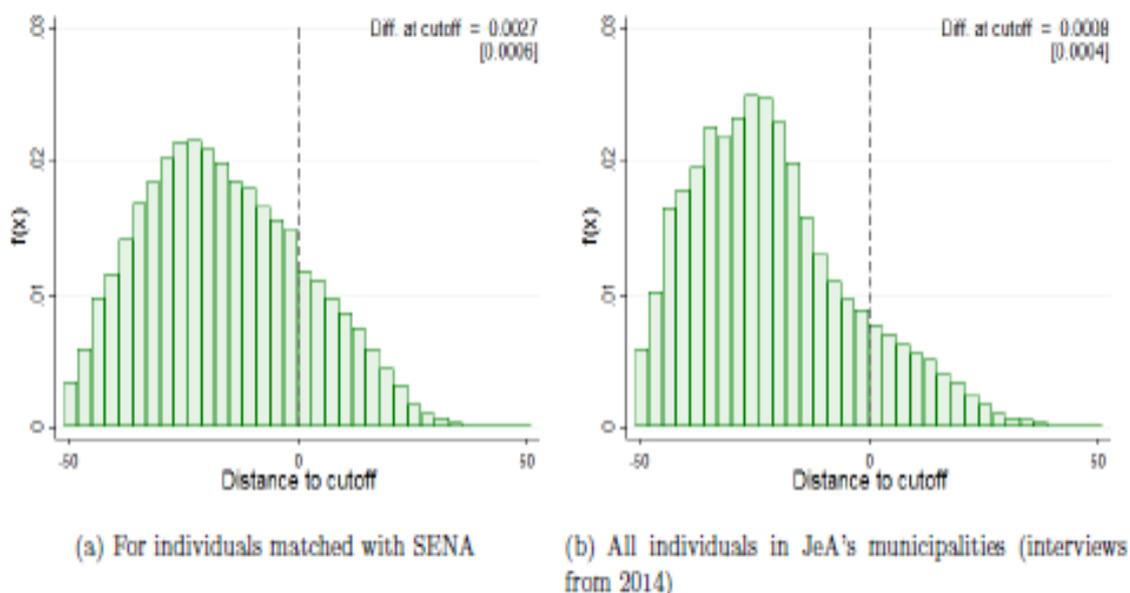
Notes: Authors calculations using SENA inscriptions and SISBEN data for individuals from 16 to 24 years old. Distance at cutoff estimated as Cattaneo et al. (2016). Bootstrap standard errors clustered at municipality level in square brackets

The second assumption for RD estimations means that individuals cannot manipulate their score to receive the benefits of the program. Figure 3 panel A shows the distribution of the SENA applicants' SIBSEN score including the density difference at the cutoff estimated following Cattaneo et al. (2016). Based on the figure and the discontinuity test we cannot reject the hypothesis of manipulation of SISBEN scores by the cutoff. However, the jumps by the cutoff may not be only caused by manipulation but by two other additional factors.

Firstly, we have information only about applicants to SENA, thus if there is a positive, unobservable, impact in the demand of SENA education, the jump will be partially explained by new applicants just by the cutoff. Secondly, as shown in table 1 the proportion of individuals we were able to match between SENA and SISBEN data is considerably larger for treated individuals and control individuals (94% and 71% respectively). Given that SISBEN is a selection criterion for JeA it is understandable that JeA administrative data already contains this information. However, the matching data for other individuals was done using ID numbers and names which was problematic.

Table 3: Probability of matching between SENA and SISBEN data by treatment status

	(1) Non-beneficiaries	(2) JeA beneficiaries	(3) All
JeA			1.066**
			(0.057)
Male	0.002	0.053*	0.003
	(0.007)	(0.024)	(0.007)
Age (18 to 22)	-0.119**	-0.174**	-0.121**
	(0.027)	(0.027)	(0.027)
Age (22 to 24)	0.266**	0.030	0.261**
	(0.031)	(0.061)	(0.031)
Technical course	0.009	0.014	0.008
	(0.011)	(0.020)	(0.010)
Seats	-0.000	0.000	-0.000
	(0.000)	(0.000)	(0.000)
Demand	0.000**	-0.000**	0.000**
	(0.000)	(0.000)	(0.000)
Eligible FeA	0.693**	0.914**	0.699**
	(0.030)	(0.089)	(0.031)
Course with second test	0.067**	-0.127**	0.062**
	(0.014)	(0.020)	(0.012)
Entry test score	0.001+	0.006**	0.001+
	(0.000)	(0.000)	(0.000)
Other support	-0.103**	-0.049	-0.101**
	(0.018)	(0.135)	(0.018)
Department capital	-0.032	-0.115**	-0.036
	(0.035)	(0.044)	(0.035)
Unconditional probability	0.71	0.94	0.72
Observations	1380889	89227	1470239

Notes: Authors' calculations using data from SENA and SISBEN. Marginal effects (differences between categories for discrete variables). Standard errors clustered at municipality level, + 0.1 * 0.05 ** 0.01. Include application year and SENA center fixed effects.

But not only was the loss of data larger for non-beneficiaries, the loss was also not random. Table 3 shows the probability of matching between SENA and SISBEN as function of some individual factors (sex, age, course, socio-economic status through eligibility to FeA, individual performance), and institutional factors (seats, demand, center, and municipality). The marginal effects exhibit considerable differences in the size and their correlation around variables such as age (22 to 24), demand, course with second test and the existence of an additional support. Figure 4 shows how the estimated probability distribution of being in our sample of analysis differs significantly between beneficiaries and non-beneficiaries of JeA. To control for this loss of information, we will show our results controlling for some observables variables. Also, we will try to correct for this non-random loss of data in the fashion of Moffit et al. (1999) and others. Finally, we use the *Donuts* estimations as Bajari et al. (2011) to show that our results do not only depend on this non-random selection loss around the cutoff.

Figure 4: Estimated probability of matching between SENA and SISBEN data for JeA beneficiaries and non-beneficiaries

(a) Non-beneficiaries

(b) Beneficiaries

(c) All
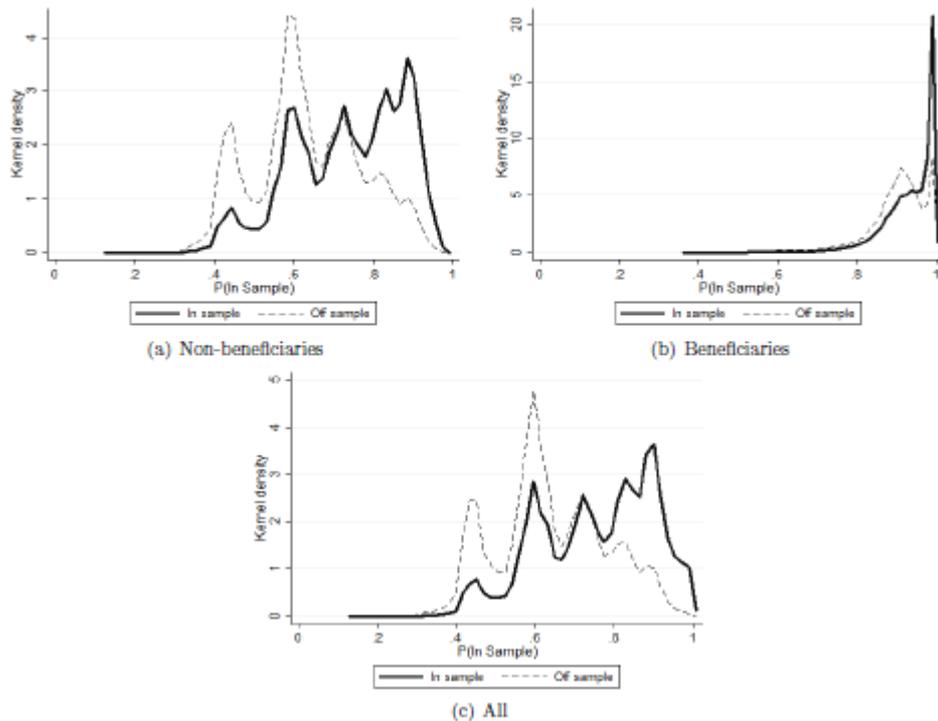
Notes: Calculations using SENA inscriptions and SISBEN data. Probabilities follow the probit estimations in Table 3.

In order to give more evidence about possible score manipulation we use information for all individuals from 15 to 24 years old. Firstly, figure 3 panel b shows SISBEN's distribution and the density difference at the cutoff, which reduces more than 50% with respect to the estimated difference in panel a's figure. Nevertheless, we cannot reject manipulation yet, especially for the interviews made before 2014. Figure 5 gives evidence that manipulation is systematic mainly by households' interest on RSS, as documented by Bottia et al. (2012).

Figure 5: Proposition of repeated interviews and distribution of its scores

(a) Repeated interviewes proportion per year

(b) SISBEN distribution for repeated interviews after 2014
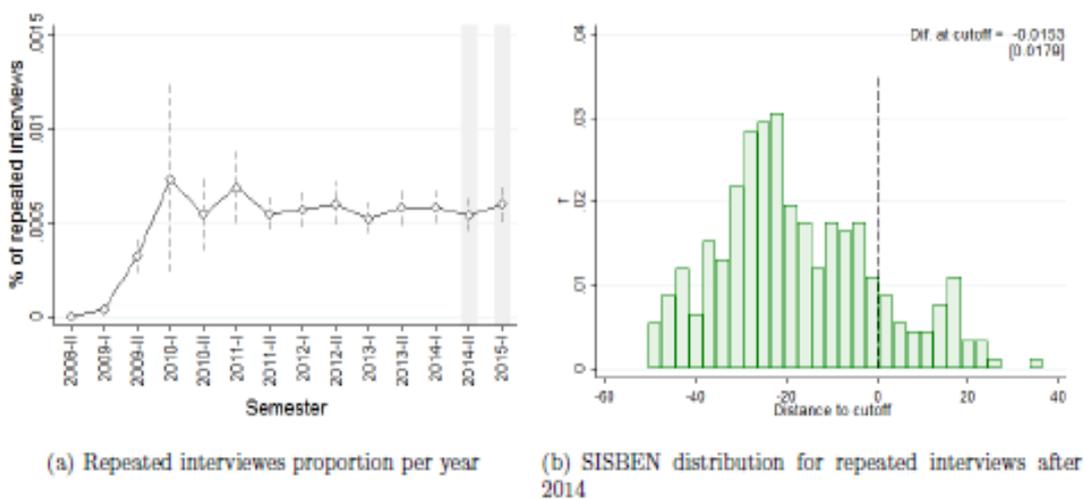
Notes: Authors calculations using SISBEN data for individuals from 16 to 24 years old in municipalities JeA. Distance at cutoff estimated as Cattaneo et al. (2016). Bootstrap standard errors clustered at municipality level in square brackets

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Firstly, panel A shows that the rate of repeated interviews does not increase during JeA years. If young individuals are successful in reducing their SISBEN scores to be eligible (lower score than the cutoff) by asking for a new interview with authorities, one should observe a jump in the new interviews in 2014 and 2015. Secondly, panel b shows that the distribution of new interviews are not concentrated below the cutoff after 2014, so we can reject manipulation of new interviews when JeA open inscriptions.

5.2   JeA's impact on SENA's enrollment and certification

By using the discontinuity generated by SISBEN scores, we first assess the impact of JeA on access to SENA over the sample of students that applied there during the second semester of 2014 and the first semester of 2015. Figure 6 plots the *take up* of JeA (Panel a) and the increase of enrollment to SENA (panel b).[16] The figure shows that the 12% take-up of the program around the cutoff increases by 8 pp the probability of being enrolled at SENA. Then, since the baseline enrolment rate is 20%, JeA increases by 40% the probability of enrollment among eligible individuals.

Figure 6: Enrollment in JeA and SENA by SISBEN score
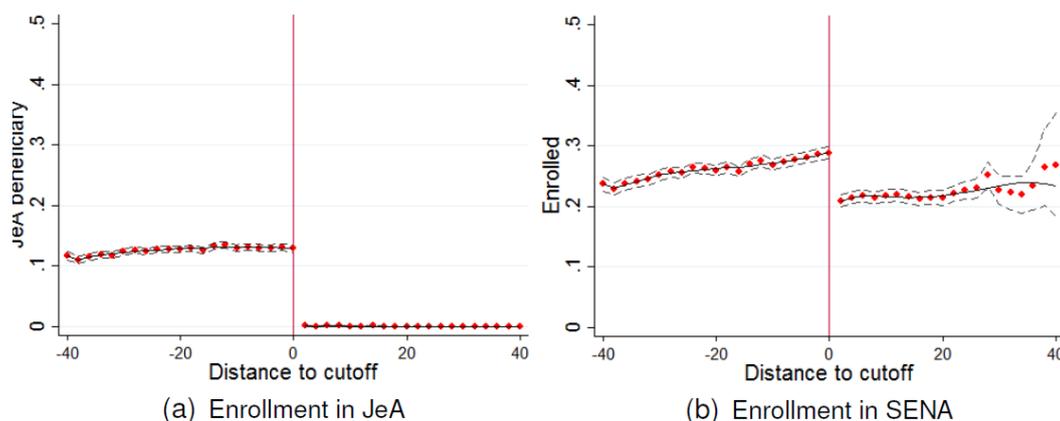
(a) Enrollment in JeA   (b) Enrollment in SENA

Notes: Authors' calculations using SENA inscriptions and SISBEN data. 95% CI in dashed lines, standard errors clustered at course level. Bin size of 2 points. Adjusted function form using 4 degree polynomial.

It is important to point out the low level of take up among eligibles (SENA 39% of eligible individuals), conditional on being enrolled. Information from a survey with eligible individuals who did not participate in JeA indicates that lack of information was the main reason for the low take up.[17] Even though, there may be some *self- selection* by the cutoff, identification is not compromised because one can expect that same selection bias for individuals just above the cutoff. What is more, according to Carneiro and Heckman (2002); Keane and Wolpin (2001) we can (and will) use selection by the cutoff to discuss the importance of liquidity constraints. Table 4 summarizes the estimations showing the reduced form (columns 1 to 3) and the instrumental variables IV approaches (columns 4 to 6). Estimated coefficients indicate an increase of about 0.07 percentage points in the probability of being enrolled at SENA.

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[16] We exclude from the analysis JeA-participants with SISBEN scores above the Program's cutoff because they must have entered JeA by another targeting criteria.

[17] According to the evaluation report by Econometría-S.A. (2017), more than 70% of non-participants do not know JeA selection criteria or if they are eligible for the Program.

Table 4: JeA on access to SENA

	RF			IV		
	(1)	(2)	(3)	(4)	(5)	(6)
Eligible	0.083**	0.075**	0.074**			
	(0.014)	(0.012)	(0.012)			
JeA beneficiary				0.652**	0.728**	0.728**
				(0.062)	(0.045)	(0.045)
Constant	0.207**	0.031**	-0.056**	0.207**	-0.007	-0.057**
	(0.017)	(0.010)	(0.016)	(0.017)	(0.009)	(0.010)
Controls	No	Yes	Yes	No	Yes	Yes
SENA center FE	No	No	Yes	No	No	Yes
F Test				50.25	55.85	54.87
R2	0.00	0.14	0.16	0.26	0.47	0.47
Observations	301953	263284	263284	301953	263284	263284

Notes: Calculations using data from SENA. Standard errors clustered at municipality level, + 0.1 * 0.05 ** 0.01. 15.91 points bandwidth following Calonico et al. (2014). Individual controls are gender, age, participation in FeA, entry exam's score, application year and area fixed effect. Course level controls are seats, demand and second exam requirement

Although it is a small increase, when it is compared with the non-conditional probability of being enrolled (0.20), the increase in access is non-negligible. It is also important to point out that once we add individual and course level characteristics and SENA center fixed effects the coefficients do not change significantly. This last result is evidence that impacts are not driven by the nonrandom loss of information in the matching between SENA and SISBEN data.

Table 5: JeA on access to SENA by groups

	Gender		Age		Course type		Area		
	Female	Male	16-18	19-24	Technological	Technical	1	2	3
First stage									
Eligible	0.104**	0.092**	0.087**	0.111**	0.125**	0.066**	0.071**	0.128**	0.156**
	(0.015)	(0.015)	(0.013)	(0.018)	(0.019)	(0.012)	(0.010)	(0.013)	(0.018)
Reduced Form									
Eligible	0.053**	0.056**	0.057**	0.047**	0.071**	0.036*	0.041**	0.071**	0.070**
	(0.012)	(0.013)	(0.011)	(0.011)	(0.014)	(0.014)	(0.010)	(0.016)	(0.020)
Constant	0.219**	0.243**	0.189**	0.286**	0.208**	0.257**	0.227**	0.231**	0.260**
	(0.016)	(0.017)	(0.014)	(0.016)	(0.012)	(0.022)	(0.022)	(0.016)	(0.030)
Second stage									
JeA beneficiary	0.515**	0.610**	0.654**	0.424**	0.566**	0.544**	0.581**	0.553**	0.446**
	(0.077)	(0.117)	(0.078)	(0.073)	(0.074)	(0.162)	(0.106)	(0.093)	(0.132)
Constant	0.218**	0.243**	0.189**	0.286**	0.208**	0.256**	0.227**	0.231**	0.260**
	(0.016)	(0.017)	(0.014)	(0.016)	(0.012)	(0.022)	(0.022)	(0.016)	(0.030)
Prueba F	48.96	37.98	48.04	37.12	41.13	31.38	55.88	101.38	73.79
R2	0.19	0.17	0.20	0.15	0.25	0.11	0.15	0.21	0.21
Observations	225469	213687	256663	182498	236775	202381	226089	175440	37627

Notes: Authors' calculations using data from SENA. Standard errors clustered at municipality level, + 0.1 * 0.05 **. 0.01. 15.91 points bandwidth following Calonico et al. (2014).

Figure 7: Impact of JeA on enrollment in SENA. Reduced form estimates by enrollment semester
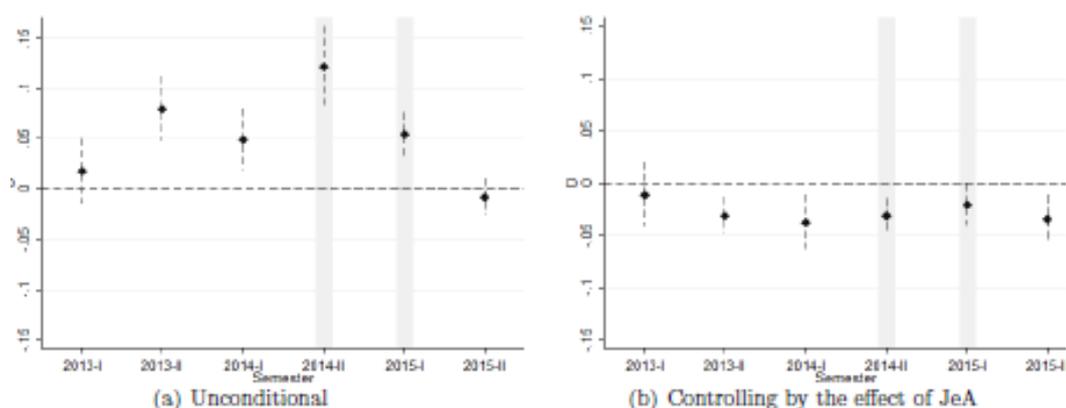
(a) Unconditional
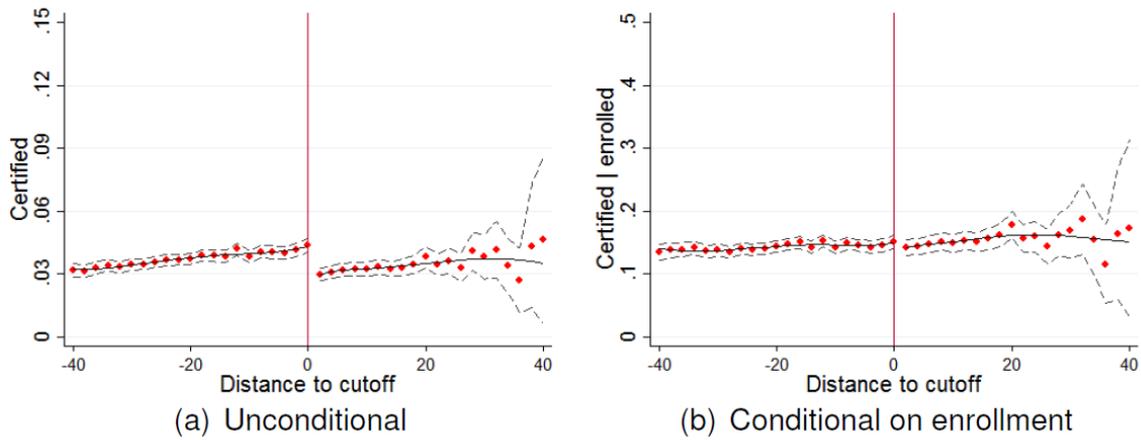
(b) Controlling by the effect of JeA

Notes: calculations using SENA inscriptions and SISBEN data. 95% CI in dashed lines, standard errors clustered at municipality level.

We also estimate heterogeneous effects by gender, age group, type of program or targeting area. Impacts are always positive and statistically significant. Furthermore, there is no significant difference in any group of analysis (see table 5). We also estimate JeA's impact on enrollment by semester of application. As shown in figure 7 the change in enrollment by the SISBEN cutoff is larger in the second semester of 2014. Even more, the change is positive and significant for the first semester of 2015 but it disappears in the second semester. For that reason, for the following estimations we will only use 2014-II and 2015-I as treatment periods.

It also important to point out the positive and significant effect of the program the two semesters before the treatment. As explained above, the program began in November 2012 and over 2013 and in the first semester of 2014 there was an "*informal*" enrolling in JeA. When we exclude JeA participants and estimate the change in enrollment by the SISBEN cutoff the coefficients in every period are negative (figure 7). This could be evidence of the negative correlation between being eligible for subsidised healthcare and JeA. Hence, we may have underestimated the impact of JeA's on our outcome variables.

Once a young individual is enrolled in SENA a risk emerges of dropping out the educational system. Then, JeA provides a periodical cash transfer conditional on attending the courses to encourage the individual to keep studying until she obtains a *certification* of her technical education, which is a good signal when she looks for a job. Figure 8 -panel A, shows two different dimensions of this analysis. Firstly, panel A shows the unconditional discontinuity on the probability of obtaining a certification around the cutoff. This figure represents the reduced form of JeA's aggregated impact. In panel b we plot the probability of obtaining a certification against the SISBEN score only for the individuals who did enroll.

Figure 8: Probability of obtaining a certificate from SENA by SISBEN score (conditional and unconditional on enrollment)

| (a) Unconditional | (b) Conditional on enrollment |

Notes: Calculations using SENA inscriptions and SISBEN data. 95% CI in dashed lines, standard errors clustered at course level. Bin size of 2 points. Adjusted function form using 4 degree polynomial.

In panel A, we show a positive significant effect of JeA on the probability of getting a certification. The size has to be read with caution, despite it seeming to be small - about 1 pp - it reflects an increase of 64.2%. Furthermore, the IV estimations show that the probability of certification increases from 2.8% to 17% (column 4 table 6). However, when conditioning on enrollment, the effect around the cutoff vanishes. It is worth mentioning that this last estimation suffers from selection bias. We know that due to JeA some individuals on the left-hand side of the cutoff would not have enrolled without financial aid and they may not be comparable with the individuals that were able to enroll without financial and are just to the right of the cutoff.

Table 6: JeA on the probability of certification from SENA

	RF			IV		
	(1)	(2)	(3)	(4)	(5)	(6)
Eligible	0.018**	0.013**	0.013**			
	(0.003)	(0.003)	(0.003)			
JeA beneficiary				0.143**	0.130**	0.133**
				(0.021)	(0.025)	(0.026)
Constant	0.028**	-0.001	-0.010+	0.028**	-0.008	-0.011*
	(0.006)	(0.008)	(0.006)	(0.006)	(0.008)	(0.005)
Controls	No	Yes	Yes	No	Yes	Yes
SENA center FE	No	No	Yes	No	No	Yes
F Test				49.24	58.22	57.75
R2	0.00	0.03	0.04	0.04	0.09	0.10
Observations	324844	283525	283525	324844	283525	283525

Notes: Calculations using SENA. Standard errors clustered at municipality level, + 0.1 * 0.05 ** 0.01. 17.15 points bandwidth following Calonico et al. (2014). Controls: gender, age, participation in FeA, entry exam's score, application year and area fixed effect. SENA controls are seats, demand and second exam requirement

Table 7 summarizes the estimations of the aggregated impact (access and certification) of JeA over different populations. Once again, the results are positive and significant for all groups. However, there is a significant difference in the impact between technical and technological courses. The impact of JeA on technical courses is around five times the impact on technological

courses,[18] which could be explained simply by the duration of each type of course (technical courses are one year and technological two).

Table 7: JeA on the probability of certification from SENA by groups

| | Gender | | Age | | Course type[1] | | Area | | |
	Female	Male	16-18	19-24	Technological	Technical	1	2	3
Reduced form									
Eligible	0.018*	0.018**	0.016**	0.021**	0.014**	0.042**	0.011**	0.028**	0.025+
	(0.007)	(0.003)	(0.005)	(0.004)	(0.005)	(0.010)	(0.003)	(0.005)	(0.013)
Constant	0.033**	0.023**	0.029**	0.027**	0.014**	0.050**	0.034**	0.017**	0.036**
	(0.009)	(0.004)	(0.006)	(0.007)	(0.002)	(0.004)	(0.011)	(0.004)	(0.011)
Second stage									
JeA beneficiary	0.134**	0.148**	0.137**	0.149**	0.072**	0.360**	0.112**	0.173**	0.136+
	(0.039)	(0.041)	(0.033)	(0.022)	(0.025)	(0.079)	(0.027)	(0.030)	(0.074)
Constant	0.033**	0.023**	0.029**	0.027**	0.014**	0.050**	0.034**	0.017**	0.036**
	(0.009)	(0.004)	(0.006)	(0.006)	(0.004)	(0.011)	(0.009)	(0.004)	(0.011)
F Test	46.82	45.94	47.75	43.35	49.87	26.06	53.39	124.00	54.27
R2	0.05	0.03	0.04	0.04	0.04	0.15	0.03	0.05	0.05
Observations	167410	157434	183005	141839	82808	52175	165361	131743	27740

Notes: Calculations using SENA. Standard errors clustered at municipality level, + 0.1 * 0.05 ** 0.01. 17.15 points bandwidth following Calonico et al. (2014). 1 Only for individuals who applied in the second semester of 2014.

So far we found a positive impact of JeA on enrollment and on the probability of obtaining a certification from SENA. These estimates are the accumulated effect of monetary aid and affirmative action. Therefore, we now try to disentangle the impact of each component.

5.3   Monetary aid or affirmative action?

The existence of a preferential entry scheme, in which some individuals can obtain their seats despite lower scores in entry exams, allow us to test the importance of monetary aid in technical education at SENA. As we can see, figure 9 shows that both the proportion of JeA applicants and enrollees do not jump around the preferential entry quota. The continuity of both distributions at around 30% shows that the preferential entry is not more binding than usual which is evidence of its low importance.

As we explained in section 3 we will disentangle the impact of this affirmative action by estimating JeA's impact on different groups that may be more or less affected by affirmative action. Firstly, table 8 summarizes the RD estimates on enrollment and certification for two alternative subsets: under and over demanded courses.

This table (8) suggests that impact is greater in over demanded courses indicating that preferential entry is highly important. However, there is a considerable difference in the baseline enrollment rate in *under-demanded* (80%) and *over-demanded* (13%) courses that makes comparison between groups more difficult, even if we cannot reject the hypothesis that JeA has an impact in the probability that a certain course is over demanded.

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[18] In this estimation we only use the individuals who applied in the second semester of 2014 to guarantee that even those who enroll in technological courses should have finished

Table 8: JeA on enrollment and certification at SENA by excess of demand

	Under demanded		Over demanded	
	(1)	(2)	(3)	(4)
	RF	IV	RF	IV
Enrollment				
Eligible	0.038$^+$		0.087**	
	(0.020)		(0.016)	
JeA beneficiary		0.186$^+$		0.744**
		(0.099)		(0.049)
Constant	0.801**	0.801**	0.133**	0.133**
	(0.028)	(0.027)	(0.013)	(0.013)
F Test		50.64		44.41
R2	0.00	0.03	0.01	0.35
Certification				
Eligible	0.019		0.020**	
	(0.017)		(0.003)	
JeA beneficiary		0.091		0.168**
		(0.081)		(0.025)
Constant	0.076**	0.076**	0.022**	0.022**
	(0.027)	(0.026)	(0.004)	(0.004)
F Test		50.64		44.41
R2	0.00	0.01	0.00	0.05
Observations	23583	23583	182623	182623

Notes: Authors' calculations using data from SENA and PILA. Standard errors clustered at municipality level, + 0.1 * 0.05 ** 0.01. Bandwidths compute following Calonico et al. (2014). Individual controls are gender, age, participation in FeA, entry exam's score, application year and area fixed effect. Course level controls are seats, demand and second exam requirement

In consequence, we also compare the effect on courses with and without excess of demand before the preferential entry. That is, we need to assess whether JeA has a differential impact in each group, but in this case we are not worried about the effect of the program on the demand of a certain course. The estimated results differ from the previous estimations since the average enrollment rate for *non-beneficiaries* is around 20% in both cases, and the estimated impacts are statistically the same with regard to use of reduced form or IV (See Table 9). Thus, our results suggest that once the effect of the program on the demand of some courses is controlled, being affected by preferential entry or not has no differential impact on enrollment and certification. Then, monetary aid seems to be driving the impact instead of affirmative action.

Secondly, we also test whether there are differential impacts with respect to ability. As it is shown in the replications carried out in the preferential entry section, the assumption behind this strategy is to allow that low-performer individuals obtain a seat which consequently reduces the exam entry cutoff for the individuals who applied to the Program. So, individuals with low ability are more likely to be affected by both, the preferential entry and the money aid, while high ability individuals (high scores in entry exam) will enter in SENA's courses even without preferential entry.

Reduced form estimations summarized in table 10 exhibit important differences between these groups, because the size of the effect and non-conditional average enrollment are larger for high scoring individuals. To put this in context, enrollment in non-eligible low scoring individuals is 7% in while it is 19% in non-eligible high scoring ones. It increases up to 14% for eligible low scoring individuals and 32% for high scoring ones respectively.

Table 9: 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

Notes: Calculations using data from SENA and PILA. Standard errors clustered at municipality level, + 0.1 * 0.05 ** 0.01. Bandwidths compute following Calonico et al. (2014). Individual controls are gender, age, participation in FeA, entry exam's score, application year and area fixed effect. Course level controls are seats, demand and second exam requirement

Figure 10 (panel A) also shows how the differences in enrollment rates between eligible and non-eligible individuals are increasing in the entry exam. Nor do we observe a jump around 40 points which is the average cutoff for the individuals who applied for JeA and were more likely to get the direct benefits of affirmative action (see fig. 1 panel B).

We do not observe such a clear behavior for the probability of obtaining a certification (panel b). If the expected net returns of education are increasing in ability, the incentives to participate in JeA are also increasing in ability (Figure 10 panel A).

In contrast, since take up of the program is larger in high performers, IV results indicate that the impact on low skilled individuals is larger than the impact on high skilled individuals. This pattern is also observed for the probability of finishing studies and obtaining a certification.

Table 10: 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: calculations using data from SENA and PILA. Std errors clustered at municipality level, + 0.1 * 0.05 ** 0.01. Bandwidths compute following Calonico et al. (2014). Individual controls are gender, age, participation in FeA, entry exam's score, application year and area fixed effect. Course level controls are seats, demand and second exam requirement

Figure 10: Enrollment and certification by entry exam score

(a) Enrolled

(b) Certified
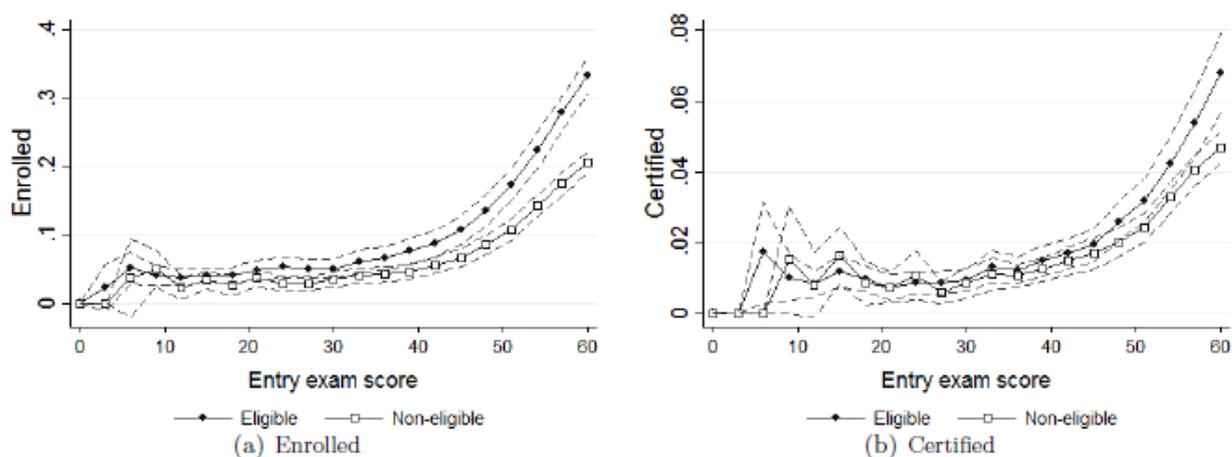
Both analyses, by demand and ability, show no different estimates in enrollment and certification by group, which according to our strategy shows that affirmative action has no (or very small) differential impact. Hence, JeA's impact is due to the monetary aid the Program provides to its beneficiaries. Later on, we will use these results to show evidence of liquidity constraints in the educational choices of poor youth in Colombia.

5.4   Monetary aid for education and formal labor market participation

The aim of policies that encourage access to tertiary education rest on the assumption that people enrich their skills and consequently, that it increases their chances of entering labor markets. By following Attanasio et al. (2011) in their approach to social security payments, our aim is to identify medium term effects of JeA on the probability of being formally employed around 2 to 3 years after applying to technical education at SENA. Our results should be read with caution, because we do not know what those individuals outside the formal labor market are doing. That is, they can either be economically inactive (e.g. attending a higher education program, taking care of a household), unemployed or working in the informal labor market. However, our discontinuities allow us to show if there is any change in the probability of being formally employed under the assumption that the reasons mentioned for not working are randomly distributed around the cutoff.

Table 11 summarizes the estimations. With and without controlling by individual characteristics and SENA center fixed effects, we found that JeA increases the probability of being in a formal job. The reduced form estimates show an increase of 3.4 pp at the SISBEN cutoffs. What is more, the IV estimates show an increase for JeA participants of 20 pp in the probability of having a formal job. This is a very important result in the case of Colombia where the labor market is characterized by high incidence of informality. Then, by providing monetary resources to keep studying in tertiary education, it is likely to increase the chances of perceiving an income (retirement pension) during adulthood and to have a better quality of life.

Table 11: JeA on the probability of formal employment

	RF			IV		
	(1)	(2)	(3)	(4)	(5)	(6)
Eligible	0.034*	0.031+	0.038*			
	(0.016)	(0.016)	(0.016)			
JeA beneficiary				0.209+	0.236+	0.298*
				(0.109)	(0.127)	(0.131)
Constant	0.489**	0.431**	0.301**	0.489**	0.367**	0.239**
	(0.037)	(0.059)	(0.039)	(0.036)	(0.070)	(0.047)
Controls	No	Yes	Yes	No	Yes	Yes
SENA center FE	No	No	Yes	No	No	Yes
F Test				62.44	74.25	73.38
R2	0.00	0.03	0.07	-0.01	0.02	0.06
Observations	154654	137437	137437	154654	137437	137437

Notes: Calculations using SENA and PILA. Standard errors clustered at municipality level, + 0.1 * 0.05 ** 0.01. 10.78 points bandwidth following Calonico et al. (2014). Individual controls include gender, age, participation in FeA, entry exam's score, application year and area fixed effect. Course level controls are seats, demand and second exam requirement

Table 12 summarizes the estimations over distinct population groups. Despite JeA has no differential impacts in enrollment and certification, the Program only has a positive impact on the labor market participation of younger individuals, men and people targeted in main cities (Area 1) or rural areas (Area 3) and those who studied any technological program. The significant effect found at Area 1 is explained by the existence of more developed markets (higher firms, more trade and better public facilities) and gender difference in formalization claims for more analysis since it is common that women tend to accept jobs with more flexible conditions due to reasons such as childcare or care of their parents.

Table 12: JeA on the probability of formal employment by groups

	Gender		Age		Course type		Area		
	Female	Male	16-18	19-24	Technological	Technical	1	2	3
First stage									
Eligible	0.175**	0.152**	0.119**	0.268**	0.203**	0.113**	0.124**	0.204**	0.254**
	(0.022)	(0.021)	(0.018)	(0.032)	(0.029)	(0.016)	(0.015)	(0.017)	(0.025)
Reduced form									
Eligible	-0.000	0.070**	0.038*	0.024	0.046+	0.015	0.047*	0.005	0.086*
	(0.020)	(0.020)	(0.018)	(0.017)	(0.026)	(0.022)	(0.022)	(0.027)	(0.041)
Constant	0.490**	0.489**	0.488**	0.495**	0.543**	0.425**	0.522**	0.451**	0.426**
	(0.045)	(0.032)	(0.038)	(0.036)	(0.036)	(0.034)	(0.041)	(0.029)	(0.051)
Second stage									
JeA beneficiary	-0.003	0.464**	0.319+	0.088	0.224+	0.129	0.375*	0.024	0.339*
	(0.114)	(0.154)	(0.165)	(0.067)	(0.134)	(0.201)	(0.183)	(0.132)	(0.159)
Constant	0.490**	0.489**	0.487**	0.495**	0.543**	0.425**	0.522**	0.451**	0.426**
	(0.045)	(0.032)	(0.037)	(0.036)	(0.036)	(0.034)	(0.041)	(0.029)	(0.051)
Prueba F	61.80	54.34	43.97	71.52	50.15	48.75	66.03	147.08	105.71
R2	0.00	-0.05	-0.02	0.01	-0.01	-0.00	-0.03	0.00	-0.04
Observations	77932	76722	110863	43791	86826	67828	82178	59708	12768

Notes: Authors' calculations using data from SENA and PILA. Standard errors clustered at municipality level, + 0.1 * 0.05 ** 0.01. 10.78 points bandwidth following Calonico et al. (2014).

5.5   Entry exam vs Eligibility to JeA

So far we have shown the impact of JeA on enrollment, certification and formal labor market participation. Furthermore, we have shown evidence of monetary aid as the driving force of the results we have found. Now, as explained in section 3 we can use the SENA's entry procedure to estimate the impact of having the first offer to enroll independent of receiving or not financial support. As explained above we use the entry exam results to simulate the cutoffs for each course with excess of demand. Figure 11 shows the changes in enrollment and certification at the simulated cutoff.

We can observe, in terms of enrollment, that the entry exam does not create a sharp discontinuity. As we previously explained, being above the cutoff gives the individual the first option to enroll; if the individual rejects, SENA start offering a place to the individual next to the cutoffs and so on.

Table 13 shows that regarding of the controls used in the estimations, the increase in the probability of being enrolled or being certified is higher under SISBEN (in percentage points and relative terms) than under the exam. However, the effect of the program on access to a formal job is close to zero and not significant around the entry exam's cutoff. Following our strategy, we have evidence of $\tau_Y > \gamma_Y$ in terms of formal employability. However, the differences between both coefficients are not statistically significant.

Figure 11: Probability of enrollment and certification from SENA by entry exam

(a) On enrollment

(b) On certification
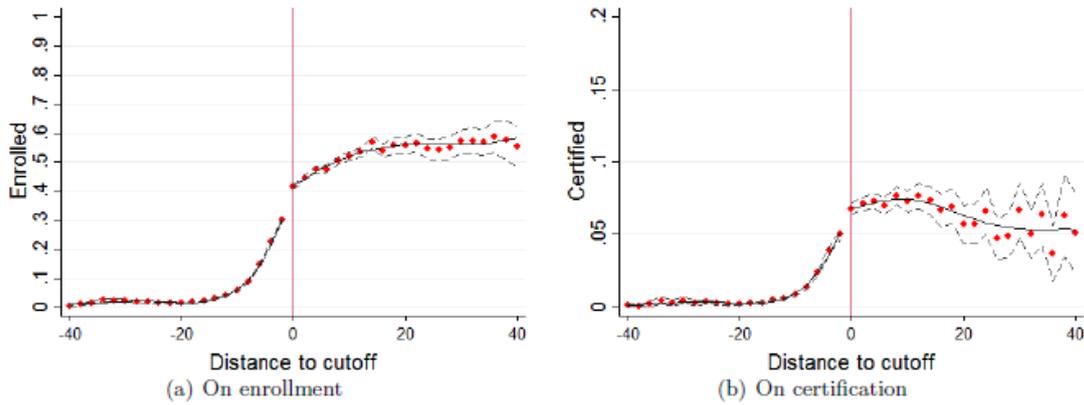
Notes: Authors' calculations using SENA applications data. 95% CI in dashed lines, standard errors clustered at course level. Bin size of 2 points. Adjusted function form using 4 degree polynomial.

Table 13: Effect of SISBEN vs SENA entry exam discontinuity on enrollment, certification and formal labor market participation

	SISBEN		Entry exam	
	(1)	(2)	(3)	(4)
On enrollment				
Eligible JeA	0.090**	0.071**		
	(0.014)	(0.006)		
Accepted by entry exam			0.076**	0.059**
			(0.007)	(0.007)
Constant	0.109**	0.233**	0.335**	0.464**
	(0.010)	(0.008)	(0.014)	(0.010)
On certification				
Eligible JeA	0.019**	0.015**		
	(0.004)	(0.003)		
Accepted by entry exam			0.011**	0.013**
			(0.003)	(0.003)
Constant	0.015**	0.043**	0.056**	0.085**
	(0.002)	(0.004)	(0.005)	(0.005)
On formal employment				
Eligible JeA	0.031[+]	0.035**		
	(0.018)	(0.011)		
Accepted by entry exam			0.000	0.008
			(0.008)	(0.007)
Constant	0.491**	0.415**	0.487**	0.444**
	(0.038)	(0.017)	(0.034)	(0.013)
Individual controls and course FE	No	Yes	No	Yes
Observations	125690	123987	198938	198938

Notes: Authors' calculations using data from SENA and PILA. Standard errors clustered at municipality level, + 0.1 * 0.05 ** 0.01. Bandwidths following Calonico et al. (2014). Individual controls are entry exam, SISBEN score, gender, age, participation in FeA, application year and area fixed effect. Course level controls are seats, demand and second exam requirement

Therefore, we apply the double discontinuity analysis following equation 3. Table 14 summarizes the results of these estimations. We can see that in all cases α_1 is positive statistically significant while α_2 is never statistically different than zero. Hence, JeA's monetary aid does have a differential impact regardless of the effect of receiving the first offer to enroll in SENA. What is more, α_3 is positive in the cases of enrollment and certification but not in the

case of formal employability. This result goes according to our discussion on the affirmative action used by JeA, because they are the individuals who are more likely to be affected by monetary aid and the preferential entry scheme. According to this result, the effects of affirmative action vanish in time.

So far we have shown that both discontinuities have an effect on enrollment and certification. Hence we can use each discontinuity as an instrument of education in SENA to estimate the impact of tertiary education on the probability of having a formal job nowadays.

Table 14: SENA and JeA impacts. Double discontinuity approach.

	On enrollment		On certification		On labor markets	
	(1)	(2)	(3)	(4)	(5)	(6)
Eligible JeA (α_1)	0.082**	0.085**	0.025**	0.024**	0.025	0.034[+]
	(0.013)	(0.013)	(0.006)	(0.006)	(0.018)	(0.019)
Accepted by entry exam (α_2)	0.012	-0.012	0.002	-0.000	0.010	0.015
	(0.013)	(0.013)	(0.006)	(0.006)	(0.016)	(0.017)
Eligible JeA x Accepted by entry exam (α_3)	0.086**	0.088**	0.015**	0.015**	0.002	0.010
	(0.008)	(0.008)	(0.004)	(0.003)	(0.009)	(0.010)
Constant	0.278**	0.371**	0.040**	0.072**	0.499**	0.441**
	(0.014)	(0.020)	(0.006)	(0.009)	(0.019)	(0.029)
Individual controls and course FE	No	Yes	No	Yes	No	Yes
R^2	0.109	0.107	0.012	0.013	0.004	0.004
Observations	67074	67074	67074	67074	52568	52568

Notes: Authors' calculations using data from SENA and PILA. Standard errors clustered at municipality level, + 0.1 * 0.05 ** 0.01.
Bandwidths following Calonico et al. (2014). Individual controls are gender, age, participation in FeA, application year and area fixed effect. Course level controls are seats, demand and second exam requirement

Table 15: Effect of SENA education on formal employment. Instrumenting enrollment and certification using SISBEN and exam discontinuities

	SISBEN cutoff		Exam cutoff	
	(1)	(2)	(3)	(4)
Marginal effects				
Enrolled	0.257*		0.004	
	(0.126)		(0.092)	
Certified		0.524**		0.026
		(0.039)		(0.614)
Weak instrument (F Test)	68.50	33.53	80.29	10.90
Observations	127186	127186	201112	201112

Notes: Authors' calculations using data from SENA and PILA. Standard errors clustered at municipality level, + 0.1 * 0.05 ** 0.01.
Bandwidths following Calonico et al. (2014).

Table 15 columns 1 and 2 use the SISBEN cutoff which defines eligibility in JeA to instrument for enrollment and certification in SENA. Columns 3 and 4 use the discontinuity in entry exam as instrument. As we can see the results from JeA are stronger than the effects of admission exam. What is more, the marginal effect of certification is twice the marginal effect of enrollment which shows the premium of finishing technical education. Following this last idea, one can conclude that access to technical education may not be enough if public policy does not cover the opportunity cost of education when individuals cannot afford not to work while studying.

5.6   Is JeA reducing liquidity constraints?

So far we have shown the importance of JeA on post-secondary education, especially the importance of monetary aid on enrollment and certification. Nevertheless, the results could be simply the consequence of paying for studying or lifting borrowing constraints. We now give evidence of the latest.

Firstly, access to credit in Colombia is very low for poor households. According to Murcia (2007) only 20% of individuals in poor households access the financial system while almost 70% does in rich households. What is more, educational loans are only given for individuals applying to university education and do not cover SENA, especially because there are no tuition fees in SENA. Secondly, using data from the Colombian National Life Quality Survey, comparing with secondary education, finishing technical education increases by 28% the income in informal jobs and 6% the income in formal jobs. Furthermore, the probability of getting a formal job increases from 14% to 24%. What is more, the present value of lifetime benefits from finishing technical education are around USD 7000 while the forgone income from not working for 24 months is USD 1145. Thus, if the individual could loan money and invest in 2 years of education she would do it.

6   Robustness checks

Our estimations suffer from two main threats. Firstly, as explained above, the matching between SENA and SISBEN data was large for non-participants of JeA and depends on observables as shown in table 3. We test that our results no not depend on this uneven matching. To do so we compute the probability of matching using a probit (Table 3 col. 3) and control for a function of the estimated probability. We follow Moffit et al. (1999), but given that the probability of matching does not follow a normal distribution we use a third-degree polynomial.[19]

Table 16 shows the impact of JeA on enrollment, certification and formal employment controlling for the estimated probability of matching with SISBEN data. Columns 1, 3 and 5 show the estimates without the control function for the sake of comparison. As we can see, the estimated probability reduces the JeA estimate impact on enrollment by 17 points, however this change is not statistically significant. In the case of certification and formal employment the estimated impact increases but once again the change is not significant. We also test the joint significance of the polynomial in the 3 cases. The effect of the polynomial is significantly different than zero for enrollment and certification but not for the case of employability.

Our second concern is the possible manipulation around the cutoff. We proved already that such manipulation was not the result of the JeA's implementation, however one may be afraid of some selection of individuals just below the cutoff. We also already show that if anything, there may be a negative correlation between eligibility to JeA and free healthcare.

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[19] We follow in some way the Blundell and Powell (2004)'s control function approach.

Table 16: JeA impact on enrollment, certification and formal employment correcting by the probability of matching with SISBEN data

	Enrollment		Certification		Formal employment	
	(1)	(2)	(3)	(4)	(5)	(6)
JeA beneficiary	0.673**	0.509**	0.129**	0.134**	0.209[+]	0.502*
	(0.049)	(0.110)	(0.021)	(0.040)	(0.108)	(0.234)
$P(SISBEN)$		10.669**		0.348		-5.037
		(2.770)		(1.307)		(3.433)
$P(SISBEN)^2$		-17.273**		-0.645		9.441
		(4.465)		(2.118)		(5.975)
$P(SISBEN)^3$		9.128**		0.344		-5.908[+]
		(2.371)		(1.121)		(3.476)
Weak instrument (F test)	49.07	50.82	49.78	53.71	63.79	50.55
Control Function (p value)		0.00		0.00		0.23
R2	0.26	0.25	0.04	0.04	-0.01	-0.01
Observations	301895	301879	324786	324769	154609	154607

Notes: Authors' calculations using data from SENA. Standard errors clustered at municipality level, + 0.1 * 0.05 ** 0.01. Bandwidths following Calonico et al. (2014). Probabilities follow the probit estimation in Tab 3 col. 3.

We use Bajari et al. (2011) Donuts approach to check if the effect of JeA on our outcome variables comes from self-selected individuals just below the cutoff. In the case of enrollment the estimate increases for large donuts, reinforcing the idea of the negative correlation between the eligibility of free healthcare and JeA. Therefore, we may be underestimating the impact of monetary aid enrollment in SENA. Unfortunately, the cost of increasing the donut's size reduces the accuracy of the estimates and the standard errors get larger. The effect is not as clear for the case of certification but the increasing estimate impact is found once again in the case of formal employability.

As we discussed above, a person loses the right of free healthcare if she finds a formal job, so in this case we were clearly underestimating the effect of JeA. Finally, figure 13 shows the behavior of our estimations for different bandwidths. We can observe that estimated impact does not change drastically when we change the set of analysis.

7. Cost benefit analysis

The simplest way to compute the benefits of JeA is computing the present value of the lifetime increase in income due to increasing the probabilities of enrolling and finishing technical education in SENA. Using household data from the Colombian National Life Quality Survey we compute the average income of a person with secondary education, incomplete and complete technical education with a formal and an informal job. We also compute the probability of having an informal and a formal job by education level. We compute incomes and probabilities by age from 20 to 64 years old.[20] Using this information and a discount rate of 10%[21] the benefits by individual are around COP 3.9 million (USD 1340).[24] Given that half of the beneficiaries took one-year courses and the other half two years courses, we assume that the average individual receives benefits over 18 months. Adding up operational costs the program's cost per

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[20] We assume that individuals do not get higher education and that once unemployed there are no differences in income among educational levels.

[21] Folloing Sinergia (2014)

[24] If we use the nominal interest rate of 5.49 as Attanasio et al. (2011) or Londono-Velez et al. (2017) benefits rise up to USD 3464

beneficiary is around COP 3.6 million (USD 1231). Therefore, the program's return rate per beneficiary is 9%.

Figure 12: Estimated JeA impact excluding some individuals closer to the cutoff (Donuts approach)

(a) Enrollment
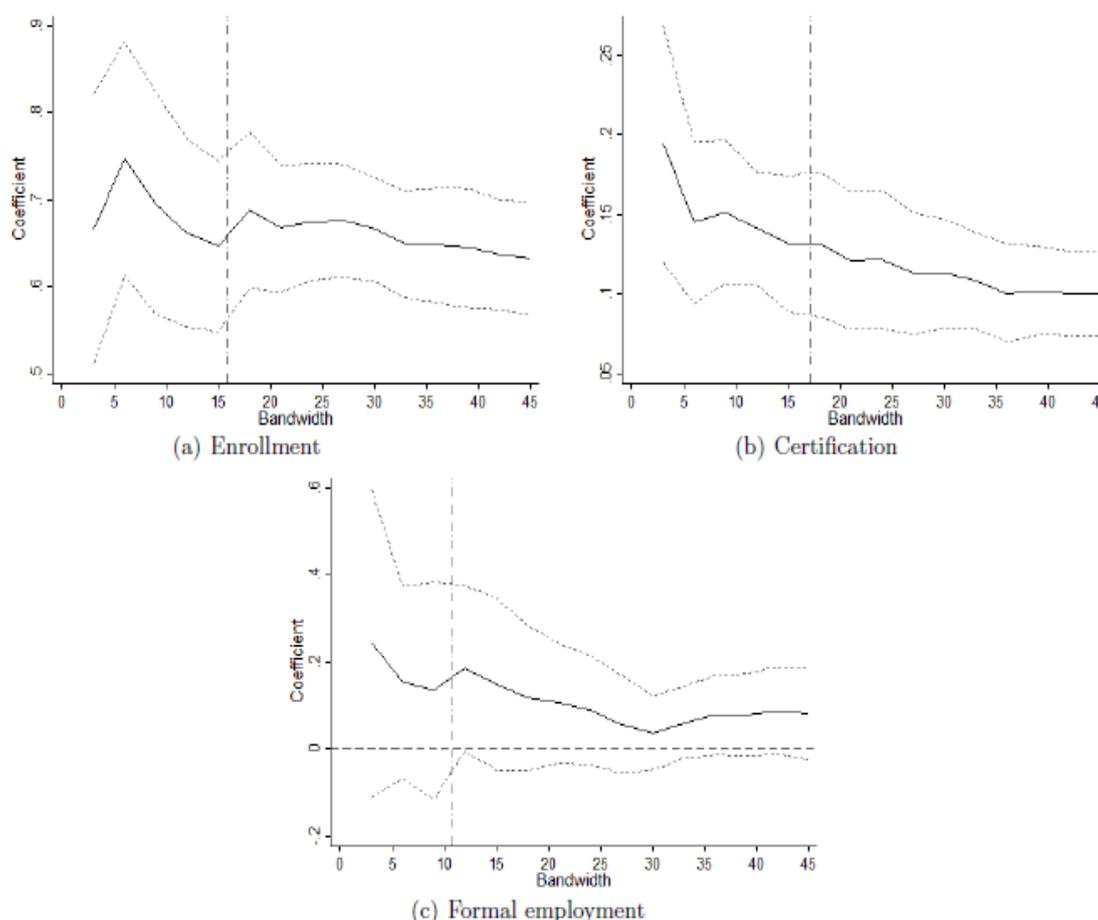
(b) Certification

(c) Formal employment
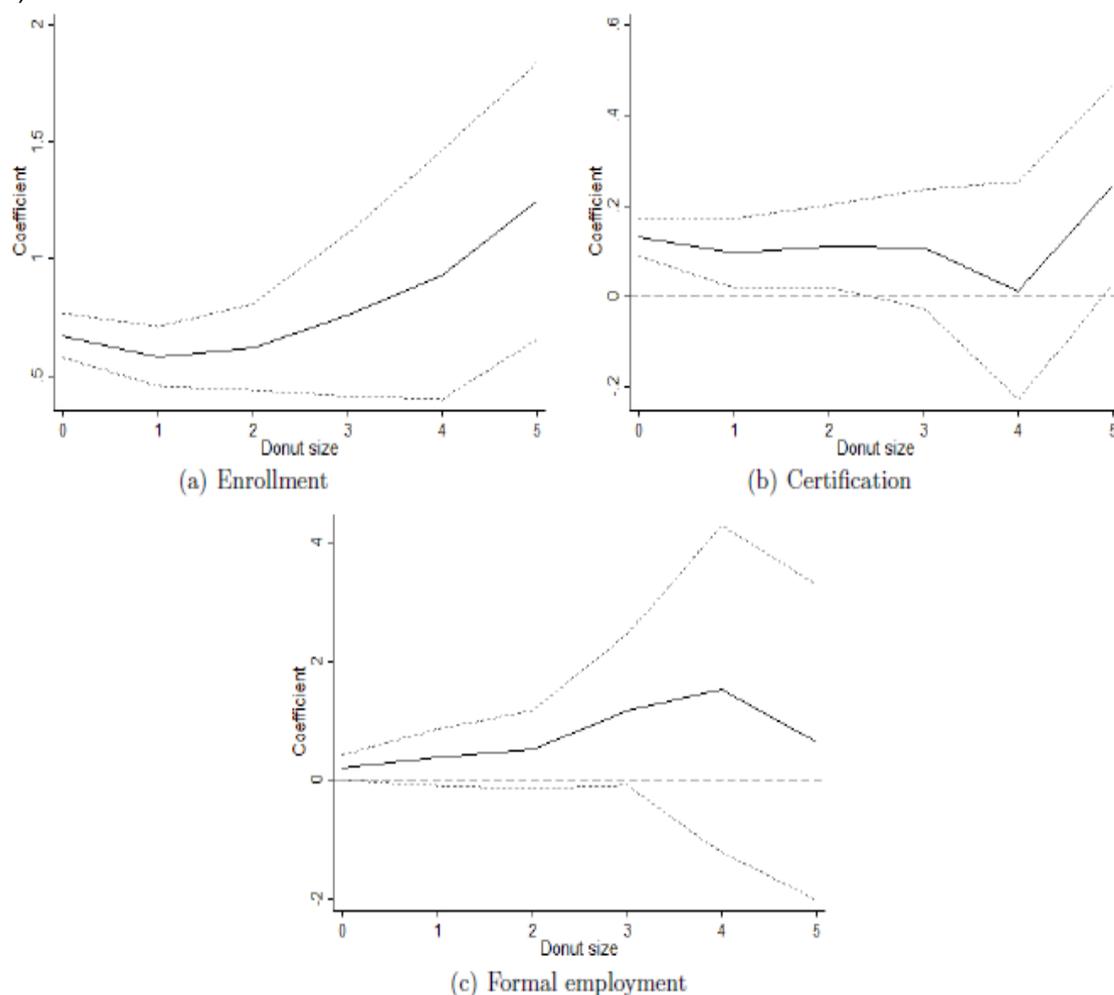
Notes: Authors' calculations using SENA inscriptions and SISBEN data following Bajari et al. (2011). 95% CI in dashed lines, standard errors clustered at municipality level.

8 Conclusions

Nobody doubts the importance of investing in human capital for individual and social welfare, but that is a goal unattainable for all individuals due to multiple factors. One of them is credit constraints that limit investments and make it riskier in scenarios where does not enough physical capital exists to pay debts. In the specific case of tertiary vocational education, drop outs are frequent because of lower and transitory income flows. Along this document, we provide evidence in favor of the effect of monetary aid for completing vocational studies in vulnerable *low-income* students. We exploit a double discontinuity caused by the design and admission criteria to a national youth training program in Colombia known as *Jovenes en Accion* and the admission process in technical education to disentangle the channels through which a young person obtains a formal job. Most of their intended outcomes are partially achieved regarding of the low take up of this program, but our estimates suggest the existence of asymmetric impacts of technical education on formal employability.

We provide evidence that reducing credit constraints has no differential effects with respect to educational variables but in terms of labor participation, the probability of being a formal worker is strongly concentrated on men, people aged 16-18 years old and individuals targeted in bigger cities. Also, in spite of the existence of multiple benefits of being part of the program, women labor participation seems to be unanswered after the program.

Figure 13: Estimated JeA impact by bandwidth of analysis

(a) Enrollment

(b) Certification

(c) Formal employment

Notes: Authors' calculations using SENA inscriptions and SISBEN data. 95% CI in dashed lines, standard errors clustered at municipality level.

Finally, differences in certification levels suggest that ability is not enough when demand barriers and important opportunity costs are faced in human capital investments. Thus, monetary aid fosters the likelihood of completing vocational studies and improves the quality of young people's lives with a formal job.

References

Acevedo, S., Zuluaga, F., and Jaramillo, A. (2008). Determinantes de la demanda por educación superior en Colombia. Revista de Economía del Rosario, 11(1):121148.

Alfonso, M. (2009). Credit constraints and the demand for higher education in Latin America. Working paper 3, IADB. Education Division.

Attanasio, O., Guar´ın, A., Medina, C., and Meghir, C. (2017). Vocational training for disadvantaged youth in colombia: A long-term follow-up. American Economic Journal: Applied Economics, 9(2):131–143.

Attanasio, O. and Kaufmann, K. (2009). Educational choices, subjective expectations, and credit constraints. Working Paper 15087, National Bureau of Economic Research.

Attanasio, O., Kugler, A., and Meghir, C. (2011). Subsidizing vocational training for disadvantaged youth in Colombia: Evidence from a randomized trial. American Economic Journal: Applied Economics, 3(3):188–220.

Bajari, P., Hong, H., Park, M., and Town, R. (2011). Regression discontinuity designs with an endogenous forcing variable and an application to contracting in health care. Working Paper 17643, National Bureau of Economic Research.

Becker, G. S. (1960). Underinvestment in college education? The American Economic Review, 50(2):346–354.

Belzil, C., Maurel, A., and Sidibe, M. (2017). Estimating the value of higher education financial aid: Evidence from a field experiment. (23641).

Blundell, R. W. and Powell, J. L. (2004). Endogeneity in semiparametric binary response models. The Review of Economic Studies, 71(3):655–679.

Bonilla, L., Bottan, N., and Ham, A. (2017). Information policies and higher education choices experimental evidence from Colombia. techreport 50, Escuela de Gobierno Universidad de los Andes.

Bottia, M., Sosa, L. C., and Medina, C. (2012). El Sisben como mecanismo de focalización individual del régimen subsidiado en salud en Colombia: ventajas y limitaciones. Revista de Economía del Rosario, 15(2):137–177.

Brown, M., Karl Scholz, J., and Seshadri, A. (2011). A new test of borrowing constraints for education. The Review of Economic Studies, 79(2):511–538.

Cáceres-Delpiano, J., Giolito, E., and Castillo, S. (2015). Early impacts of college aid. IZA Discussion Papers, (9238).

Calonico, S., Cattaneo, M. D., and Titiunik, R. (2014). Robust nonparametric confidence intervals for regression discontinuity designs. Econometrica, 82(6):2295–2326.

Cameron, S. V. and Taber, C. (2004). Estimation of educational borrowing constraints using returns to schooling. Journal of political Economy, 112(1):132–182.

Carneiro, P. and Heckman, J. J. (2002). The evidence on credit constraints in post-secondary schooling. The Economic Journal, 112(482):705–734.

Cattaneo, M. D., Jansson, M., and Ma, X. (2016). rddensity: Manipulation testing based on density discontinuity. The Stata Journal (ii), pages 1–18.

Econometríıa-S.A. (2017). Informe de evaluación de impacto del programa jóvenes en acción. Technical report.

Gamboa, L. F. and Rodriguez, P. (2017). Subjective earnings and academic expectations of tertiary education in Colombia. Technical report, Ensayos de Política Económica - Por Aparecer.

Keane, M. P. and Wolpin, K. I. (2001). The effect of parental transfers and borrowing constraints on educational attainment. International Economic Review, 42(4):1051–1103.

Lee, D. S. and Lemieux, T. (2010). Regression discontinuity designs in economics. Journal of economic literature, 48(2):281–355.

Lochner, L. J. and Monge-Naranjo, A. (2011). The nature of credit constraints and human capital. The American Economic Review, pages 2487–2529.

Londono-Velez, J., Rodriguez, C., and Sánchez, F. (2017). The intended and unintended impacts of a merit-based financial aid program for the poor: The case of ser pilo paga.

Moffit, R., Fitzgerald, J., and Gottschalk, P. (1999). Sample attrition in panel data: The role of selection on observables. Annales d' Economie et de Statistique, pages 129–152.

Murcia, A. (2007). Determinantes del acceso al crédito de los hogares colombianos. Ensayos sobre Política Económica, 25(55):40–83.

Prosperidad-Social (2014). Aseguramiento al sistema general de seguridad social en salud. Technical report, Departamento Administrativo para la Prosperidad Social, Bogotá - Colombia.

Prosperidad-Social (2017). Manual operativo programa jóvenes en acción. Technical report, Departamento Administrativo para la Prosperidad Social, Bogotá - Colombia.

Rau, T., Rojas, E., and Urza, S. (2013). Loans for higher education: Does the dream come true? Working Paper 19138, National Bureau of Economic Research.

Sinergia (2014). Guía metodológica para el seguimiento y la evaluación a políticas públicas. Technical report, Departamento Nacional de Planeación, Bogotá - Colombia.

Solis, A. (2017). Credit access and college enrollment. Journal of Political Economy, 125(2):562–622.

Stinebrickner, T. and Stinebrickner, R. (2007). The effect of credit constraints on the college drop-out decision: A direct approach using a new panel study. techreport 13340, National Bureau of Economic Research.