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Approach for Colombia

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Do Loans for Higher Education Lead to Better Salaries? Evidence from a Regression Discontinuity Approach for Colombia*

Fabio Sánchez† Tatiana Velasco‡

Abstract

Since 2002 the ACCES credit for higher education has financed more than 280,000 students. Prior evaluations have shown evidence as to its positive effect on the academic performance and the reduction in the dropout rates of the recipients. Nevertheless, no evidence exists so far on the effect these credit programs have had on the labor market indicators of their beneficiaries. In this study we attempt to estimate such effect. In particular, the question we seek to answer is if, once working as graduates, do the beneficiaries of ACCES loans have higher salaries and if this is the case, why does this happen and through which channels does it occur. Using administrative data for more than 300 thousand applicants of this credit in Colombia and using a regression discontinuity design, we found that the recipients of the ACCES educational credit have starting salaries as graduates which are higher in comparison with those graduates not receiving this credit. We also undertake a mediation methodology within an Intent-to-Treat Regression Discontinuity framework that allows for a precise identification and quantification of the mediation channels. We concluded that once graduated, the ACCES beneficiaries' exhibit longer job search periods, which would substantially explain their greater starting salaries of their first formal jobs. Academic performance during college also account for the differences in starting salaries yet to lesser degree.

Key words: higher education, educational credit, regression discontinuity, job market

Classification JEL: 122, 123, 125

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¿Los préstamos para educación superior mejoran los salarios?

Una aproximación de regresión discontinua para Colombia¹

Fabio Sánchez²

Tatiana Velasco³

Resumen

El crédito para educación superior ACCES ha financiado los estudios de más de 280.000 estudiantes durante 11 años. Evaluaciones anteriores han evidenciado su efecto positivo en el desempeño académico y en la reducción de la deserción de sus beneficiarios. Sin embargo, hasta ahora no existía evidencia sobre el efecto de estos programas en indicadores de mercado laboral. En este estudio se estiman dichos impactos respondiendo a la pregunta de si, una vez convertidos en profesionales, los beneficiarios del crédito ACCES tienen mejores salarios y si es este el caso, por qué ocurre y a través de qué canales. Utilizando datos administrativos de más de 300 mil aspirantes al crédito y mediante la estrategia de regresión discontinua, se encuentra que los beneficiarios del crédito educativo ACCES una vez son profesionales tienen salarios de entrada al mercado laboral más altos en comparación con los no beneficiarios. En el marco de la regresión discontinua utilizada para la estimación del efecto del intento de tratamiento, también se lleva a cabo un análisis de mediación que permite la cuantificación de los canales que median el impacto encontrado. Este permite concluir que los beneficiarios de ACCES exhiben un tiempo de búsqueda de empleo formal más largo después de su graduación que explicaría en gran proporción sus mayores ingresos laborales de entrada. El desempeño académico durante la universidad también explica las diferencias en los salarios de entrada, aunque en una menor proporción.

Palabras clave: educación superior, crédito educativo, regresión discontinua, mercado laboral.

Clasificación JEL: I22, I23, I25

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I. Introduction

Although it has been amply proven the positive impact of the college credit Access with Quality to Higher Education –ACCES (by its acronym in Spanish)—on access to and performance of the recipients at the university level (Melguizo, Sánchez & Márquez, 2014), there is not, however, evidence regarding its impact on labor market performance once the recipients graduate and enter into the formal job market⁴. Nevertheless, if the credit for higher education differentially affects the human capital of its recipients as they may perform better academically and at the same time, it entails the accumulation of debt and a schedule of credit payments in conditions that are more manageable than those of the non-recipients; it is expected then that the beneficiaries of college loans will have different both employment opportunities and job search behaviors vis a vis non-beneficiaries, which may bring about different salaries.

The objective of this study is to estimate the effect that the ACCES credit has had on labor market indicators of the recently graduated beneficiaries. In particular, the question this study seeks to answer is if, once working as professionals, do the beneficiaries of ACCES loans have higher entry salaries and if this is the case, why does this happen and through which channels does it occur. Using administrative data from more than 300 thousand students seeking this credit in Colombia and through a regression discontinuity approach, we found that the beneficiaries of the ACCES educational credit have starting salaries in the professional labor market which are sizably higher in comparison with those not receiving this credit. Upon looking into the channels that explain this result, it is found -by using a mediation analysis within a Regression Discontinuity framework- that the beneficiaries of ACCES exhibit a longer time span of job search after having graduated, which would substantially explain their greater starting salary when entering the job market. In addition, it is also found that the better academic performance of ACCES beneficiaries during their university studies contribute to account for the said differences in starting salaries, however to lesser extent,

The literature which evaluates the impact educational credit have found positive effects on variables such as access to institutions of higher education, coverage,

⁴ Formal job entails the payments of contributions and taxes to the Colombia's social security system in particular for pensions and health both by the part of the employer and the worker.

permanence and graduation (Heller 1997; Dynarski, 2003; Melguizo, Sánchez & Márquez, 2014; Castleman & Long, 2013). Nevertheless, there are very few which seek to evaluate the impact that college credit has on the labor market indicators of their beneficiaries. Furthermore, current studies do not reflect a consistent impact. While some find no impact, others find a negative relation (Minicozzi, 2005; Mhamed & Rita Kasa, 2010; Yang, 2011; Price, 2004). Therefore, this impact evaluation constitutes an important contribution not only to public policy but also to the current academic literature.

The ACCES credit is awarded mostly to students from social strata levels 1 and 2 (which comprise most of the poorest households) and the eligibility criteria is principally based on a minimum score obtained on the SABER 11 tests, carried out on students at the end of their secondary (high school) educational studies. This minimum score to be eligible—which varies regionally—constitutes the cutoff to estimate a regression discontinuity model which allows for quantifying the impact of the ACCES credit on the starting salary (as formal workers).

The results show a positive and significant impact of the ACCES credit on the time span of the job search once graduated as well as on the starting salaries of their beneficiaries. Through the mediation analysis methodology, we established that the longer job search exhibited by the beneficiaries of ACCES explains 57% of the difference in the starting salaries between recipients and non-recipients.

This document is organized as follows: section II presents the literature review and the conceptual framework. Section III presents a brief characterization of the ACCES credit and describes how it functions. Section IV details the data sources and the way it was put together, while section V describes the sample and provides some of the descriptive statistics of the data. Section VI explains the empirical estimation strategy while section VIII explains the results of the mediation analysis through which the direct and indirect channels of the impact effect are identified and finally, section IX provides for conclusions and a discussion regarding the policy implications and recommendations.

II. Literature review and conceptual framework

The conceptual framework of this paper comprises literature of both higher education and labor market. On the one hand, there is ample evidence supporting the

impact of educational credits for higher education on college access, academic performance and drop out rates (Heller 1997; Dynarski, 2003; Melguizo, Sánchez & Márquez, 2014; Castleman & Long, 2013); and on the other hand, there is a smaller group of literature on the effects of the access to higher education on performance indicators in the job market (Price, 2004; Minicozzi, 2005; Saavedra, 2014; Mhamed & Rita Kasa, 2010; Yang, 2011; Zimmerman, 2013). This work is situated somewhere between these two bodies of literature.

At the international level, the majority of studies find that greater financing leads to greater access and lower drop-out rates in higher education. Heller (1997) reviewed nearly 20 published studies in the eighties and nineties which explored the association or impact of educational credits and, with the exception of two papers (Hansen, 1983; Kane, 1994), the evidence shows that decreases in the available financial aid lead to reductions in the access to higher education. Dynarski (2003), using a difference in differences strategy for data from the USA finds that educational credits increase university attendance in 1/3. For their part, Castleman and Long (2013) also for the USA, carry out a regression discontinuity analysis finding positive effects in attendance and increases of 4.6 percentage points in the probability of graduation of the students who are beneficiaries of educational credit. For Colombia, there is recent evidence of the impact of ACCES credit on university enrollment. In this regard, Melguizo, et al (2014) find evidence that ACCES increases the probability of enrolling in higher education by 30 percentage points for students of lower socioeconomic levels, and Sánchez & Márquez (2012) show evidence of lower drop-out levels of the beneficiaries of ACCES credits in comparison with non- beneficiaries (10.3% vs 16.54%).

Additionally, even though the existing evidence of the effects of educational credit on the job market performance of the beneficiaries is limited, there is some which points out that access to higher education has positive effects on entering the job market and salaries. Zimmerman (2013) uses a regression discontinuity design to analyze the impact that higher education has on students comparing applicants around the cutoff score for admission finding that those who were admitted into universities achieve higher salaries than the non-admitted and their earnings surpass the total costs of attending college. Furthermore, Saavedra (2014)—also using regression discontinuity with Colombian data—

analyzes the effect that entering a high quality university has on their subsequent access to the labor market and finds that those who gain access to quality higher education have 16% higher probability of finding a job in less than a year. This was observed most evidently for students coming from lower socioeconomic levels.

Minicozzi (2005) evaluates the determinants of starting salaries upon graduation and their later growth during the four following years and found although the recipients of educational credits exhibit greater starting salaries upon graduating, the growth of these during the four following years is less than that of non-recipients (Minicozzi, 2005). A study for Latvia (Mhamed & Rita Kasa, 2010) found through a ANOVA test that those who graduate and were recipients of educational loans are similar to the non-recipients in terms of gender, career trajectory and income. This result is similar to a study for China (Yang, 2011) which, by using a Propensity Score Matching methodology, found no differences in labor income between recipients and non-recipients even though the study did find differences with respect to job opportunities and access to graduate study programs. Finally, Price (2004) through a multinomial logit, found that for the United States those who have higher amounts of educational credit have, on average, lower salaries after graduating than those who have had lower amounts.

III. Description of ACCES program

One of the factors that have contributed to the relatively low access to higher education in Colombia is the lack of financial support available for low-income students. Before 2003—the year in which the ACCES credit program was initiated—, only 24.4% of high school graduates went on to pursue higher education (Gaviria & Toro, 2012), in part due to the restrictions for gaining a traditional credit loan (Cerdan-Infantes & Bloom, 2007). In addition to that, the credit available at that time only covered 50% of the tuition costs and the student was expected to begin repayment of the loan immediately upon graduating with market interest rates, while the repayment period set up for the debt was usually no longer than the duration of the program financed.

It was under these conditions that the Colombian government, thanks to a loan of 200 million dollars from the World Bank, which was added to a sum of 87 million coming from national resources, created the Access with Quality to Higher Education (ACCES)

program, which had (and continues to have) the objective of improving equity in access to higher education by facilitating the enrollment and permanence of low-income students with fairly good academic performance.

The ACCES credit is administered by ICETEX, a government entity created more than 60 years ago with the objective of financing higher education of Colombians through different lines of credit. ACCES is the long-term line and its principal characteristic is that it reduces the restrictions to obtain a loan in comparison with traditional lines of credit. The program simplifies the requirements and paperwork in addition to financing up to 75% of the tuition costs for students of lower socioeconomic levels (typically from economic strata 1 and 2)⁵. For their part, the beneficiaries of SISBEN 1 and 2⁶ receive a sustenance subsidy of 25%. This group of beneficiaries has a term of up to 10 years to pay back the debt and they must begin to pay it back one year after having graduated with a real interest rate of 0%⁷. Given that the applicants from strata 1 and 2 are the group the program is directed at, this paper will focus only on students from said strata.

The program finances the number of semesters set forth by the study plan for the chosen college program. In addition, ICETEX demands that their loans' recipients maintain an academic GPA above a 3.4 over 5.0 in order to keep the credit during the following semester. Since 2004, ICETEX has awarded ACCES loans to nearly 170,000 students of university level education, of which an approximate of 90,000 belong to strata 1 and 2.

Eligibility criteria and the awarding process of ACCES credit

The credit assignment process of ACCES is illustrated in diagram 1 and summarized in the following steps:

- 1) Credit application: all students applying for an ACCES loan must go to the webpage of ICETEX and fill out the application form. The application requires them information about: the score and ranking obtained in the standardized Saber 11 tests—which all

⁵ In Colombia, the government divides the general population into 6 socioeconomic strata in which 1 is the lowest level and 6 is the highest.

⁶ An additional method for identifying the necessities of the general population is the SISBEN, which is an information system designed for targeting social programs. For more information, consult the webpage: <https://www.sisben.gov.co/default.aspx>

⁷ Those candidates for loans from stratum 3 receive up to 50% of the tuition costs with a real interest rate of 0% and the students from strata 4,5 and 6 a loan up to 50% of the tuition with a real interest rate of 4%.

Colombian high school students must take upon finishing their last year of high school--; their socioeconomic stratum; information about the co-debtor, who will be the guarantor of the student, and finally the university the applicant was admitted to.

- 2) Selection of eligible applicants: it takes into account academic merit, socioeconomic level and the characteristics of the institution of higher education. As of academic merit, ICETEX defines the minimum cutoff position that the student must occupy on the standardized Saber 11⁸ test if they wish to be eligible for an ACCES loan for their first or second academic semester. Since 2009, ICETEX has determined that to be eligible the applicant should attain a SABER 11 test score above the 70th percentile of the distribution of scores in the department (state) the applicant took the test. This departmental percentile corresponds to a position at national level⁹. In terms of the socioeconomic level, ICETEX gives priority to students in strata 1 & 2 even though this does not exclude the possibility of students from other strata receiving loans. Finally, applicants admitted to universities classified as high quality by the National Ministry of Education, receive an additional advantage to become recipients given that they are already eligible based on academic merit.
- 3) Assignment of credit: once those eligible for ACCES credit have been determined, the assignments of loans are carried out in accordance with the resources allotted to each department (state). In this way, each department ranks their eligible applicants based on their Saber 11 test scores, allocating the loans according to such rank until the available resources are used up. The students who received at least one ACCES loan outlay for the payment of their tuition will be henceforth considered beneficiaries or recipients.

⁸ Given that the Saber 11 test is used as a reference for distinct selection processes in higher education—including ACCES—, ICFES created a systematic process to calculate the minimum ranking which was incorporated into national legislation (Resolution 489, October 20, 2008). These rankings are related to the performance of all the students in the group and is organized into positions from 1 to 1000 in which students in position 1 are those with the highest scores and the students in position 1000 are the lowest scores. For example, if 400.000 students took the test in any given semester, position 1 would correspond to the 400 students who obtained the 400 best scores. The students in position 1000 are those 400 who obtained the 400 lowest scores.

⁹ For example in 2009 in Antioquia the 70th percentile of the SABER 11 score distribution corresponded to the position 697 at national level. In Chocó—the poorest department—the 70th percentile corresponded to the position 817 at national level. Before the year 2009, there was a single cutoff position nationwide which guaranteed a potential coverage of 85% of the students. If, on the other hand, the student wishes to obtain a credit to finance their education from the third university semester onwards, ICETEX takes into account the university GPA which cannot be lower than 3.4 over 5.0.

Graph 1 compares the cutoff position for the Saber 11 tests in each department, with the proportion of students in strata 1 and 2. As can be seen, to the degree that the proportion of students in these strata is greater, the cutoff point for the department is higher. This implies although academic merit is truly the chief criteria for the selection of eligible applicants; this is adjusted in accordance with the characteristics of the population of each department. In this way, in addition to the existence of a cutoff point, the selection criteria varies both annually and between departments which provides a source of exogeneity for the estimation of causal effects.

IV. Data Sources

The data utilized for this research is quite rich. The different sources of administrative information allows us to identify the students who took the Saber 11 test, the subset of those who applied to the ACCES credit and of them, applicants that were admitted into higher education, graduated and entered the formal labor market. The subset of students who applied to the ACCES credit —both recipients and non-recipients—that can be observed in the labor market will be the sample of interest for this study. This sample has already corrected the selection biases that may arise from comparing beneficiary students with other students who, for different unobservable characteristics did not even apply for a credit.

Four administrative data sources were combined for this research which brought together information at the individual level by semesters as follows: a) the results of the standardized Saber 11¹⁰ tests taken by all students at the end their secondary education; b) the data from the System of Information for the Prevention of Higher Education Dropout (SPADIES by its acronym in Spanish), which gathers information on all students who enter higher education and follow them up until they either drop out or graduated; c) the Labor Observatory for Education (OLE by its acronym in Spanish)¹¹, which collects yearly information of all the graduates of higher education in Colombia on employment status,

¹⁰ The authors wish to thank the collaboration of the Colombian Institute for the Promotion of Higher Education ICFES (by its acronym in Spanish), especially to Adriana Molina and Jorge Andrés Morales in the Consulting Office of Research Project Management.

¹¹ The authors would like to thank the National Ministry of Education for the gathering and management of this data.

economic sector, and current salary and; d) administrative data of ICETEX that allow for identifying the applicants and recipients of ACCES loans in each period.

The initial information comprised 4.7 millions⁴⁵⁷ students that took the Saber 11 test between the first semester of 2003 and the second semester of 2012. Of those, 3.4 million belong to strata 1 and 2. Of the latter, 131,527 applied for an ACCES loan of which 70,499 of them were eligible in accordance to their ranking in the Saber 11 tests. A total of 61,307 ACCES applicants enrolled in universities and 35,492 obtained an ACCES loan to finance their first or second semester onwards. Finally, 2,635 applicants -2,070 recipients and 505 non-beneficiaries- can be observed in the Labor Observatory for Education (OLE), who will be the object of this study. Annex 2 presents a diagram describing the structure of these data.

The socio-demographic characteristics of the applicants were extracted from the Saber 11 database that besides the information on test scores also includes, among other student variables, age, gender, educational level of parents, socioeconomic strata, and department of residence. This information is obtained when the student registers for the test. Additionally, the information collected from SPADIES makes possible to characterize the performance of the students in higher education in terms of the dropout, passing of subjects and graduation.

V. Descriptive Statistics

Panel A of table 1 presents the descriptive statistics of the applicants once graduated and working in the formal labor market as professionals. We divided the applicants between eligible and non-eligible; and between recipients and eligible and, non-recipients and non-eligible. As can be observed, on average, those eligible and recipients of ACCES performed better on the Saber 11 test and came from households with better educated mothers. In addition, both eligible (92.50%) and eligible recipients (93.43%) passed a greater percentage of college subjects than non-eligible (80.35%) and non-recipients and non-eligible (75.77%).

Regarding the labor market variables e, differences are also observed in the time span of job search and in the salaries earned. While the non-eligible applicants spend on average 0.82 years to find their first formal job after graduation, the eligible ones spend 1.38 years.

The non-recipients devote 0.62 years to find a formal job compared to the 1.44 for the ACCES beneficiaries. Moreover, the starting salary of an ACCES eligible is on average 1.06 million Colombian pesos in contrast to 711 thousand of a non-eligible; in the case of ACCES recipients, the average starting salary amounts 1.07 million Colombian pesos compared to 700 thousand of a non-recipient.

Graph 1 shows the probability of being an ACCES beneficiary around the cutoff, locating to the left those who are not eligible. As can be observed, while for the non-eligible, the probability of treatment is less than 0.4 for the eligible the probability of receiving ACCES jumps to 0.6 and grows as the Saber 11 score gets away from the cutoff point. The assignment criteria established by ICETEX that brings about the jump in the probability of being ACCES beneficiary validates the estimation strategy. In fact, when there is an ordered selection criteria with a cutoff point determining eligibility, it is possible to undertake a regression discontinuity strategy.

Table 1. Descriptive statistics of the applicants to the ACCEs credit in professional labor market.

A. Complete sample				B. In optimal bandwidth ^a				
	Non-eligible	Eligible	Non-recipient	recipient	Non-eligible	Eligible	Non-recipient	Recipient
<i>Socio-demographic Characteristics</i>								
Age	23.20	23.24	23.03	23.30	23.04	23.55	22.72	23.91
Sex (Female Base)	0.31	0.37	0.30	0.36	0.32	0.33	0.31	0.35
Standardized Score SABER 11	40.04	48.06	40.05	48.30	41.05	43.74	40.88	43.59
Mother 's Level of education								
Primary	0.40	0.27	0.37	0.27	0.41	0.36	0.38	0.36
Secondary	0.44	0.43	0.50	0.42	0.45	0.46	0.51	0.46
Non-Professional	0.16	0.21	0.13	0.22	0.14	0.12	0.11	0.11
University	0.00	0.09	0.00	0.09	0.00	0.06	0.00	0.06
Area of Knowledge of the University Program								
Agronomy, veterinarian and related	0.03	0.02	0.03	0.01	0.04	0.01	0.04	0.00
Fine arts	0.01	0.01	0.02	0.01	0.01	0.01	0.02	0.01
Sciences of Education	0.07	0.04	0.05	0.04	0.04	0.05	0.02	0.05
Health Sciences	0.27	0.23	0.28	0.24	0.29	0.27	0.31	0.31
Social and Human Sciences	0.08	0.15	0.03	0.15	0.08	0.14	0.02	0.13
Economics, Administration, Accounting and related areas	0.24	0.26	0.33	0.25	0.26	0.29	0.35	0.28
Engineering, Architecture and Related	0.28	0.28	0.25	0.28	0.28	0.22	0.25	0.21
Mathematics and Natural Sciences	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01
<i>University Performance</i>								
% of passed subjects	83.40	92.61	79.00	93.46	82.13	90.09	77.28	91.36
<i>Labor Market Performance</i>								
Time span of job search	0.92	1.36	0.73	1.42	0.93	1.30	0.76	1.43
Starting Salary *	810.96	983.28	788.28	998.57	797.64	905.61	784.20	942.69
N	95	2,540	60	2,035	85	492	55	334

^a Bandwidth calculated using optimal bandwidth over dropout rate, Imbens and Kalyanaraman (2009).

* The salaries are deflated using the Consumer Price Index of the year 2010.

Source: ICIFES, SPADIES, ICE/TEX, OLE (2013) Authors' calculations.

VI. Empirical strategy: Regression discontinuity

The basic assumption behind a regression discontinuity strategy is that observations around the cutoff point are very similar and only differ in their treatment eligibility (Lee & Lemieux, 2010). Thus, the students whose ranking on the Saber 11 test was just below the eligibility criteria are not that different in their characteristics, observed or unobserved, from the students whose ranking was just above the eligibility criteria. Hence, we can state that the individuals around the cutoff point are comparable to one another almost as they would be if the ACCES credit were assigned randomly. In order to choose the sample around the cutoff point, we use the Imbens and Kalyanaraman (2013) methodology.

The other assumptions which should be verified before continuing with the regression discontinuity are:

A discontinuity in the treatment probability should be observed around the cutoff point

This assumption can be evaluated taking the results in graph 2 into consideration. As can be observed, the ranking or position obtained on the Saber 11 test is associated graphically with being an ACCES beneficiary. In consequence, a discontinuity in the probability of being a ACCES recipient can be observed around the cutoff point,

No evidence of manipulation of the assignment variable should be observed

To verify whether the eligibility requirement was manipulated, we carried out the McCrary test (McCrary, 2008). The results, displayed in graph 3, show no evidence of score manipulation to favor eligibility to ACCES credit. Moreover, given that the cutoff for eligibility depends upon the position of the applicant in the Saber 11 test and given that the position is established relative to all students -applicants and non-applicants taking the test, it is unfeasible that an applicant student would be able to manipulate her position in such test.

A discontinuity around the selection cutoff point should be observed in the outcome variables.

As depicted in graph 4, for the variables of time span of job search and the starting salary in thousands of pesos, a jump can be observed at the cutoff point. In particular, to the right of the cutoff point both the time span of job search and the starting salary are greater than the same variable to the left of the cutoff point.

Graph 2. Proportion of ACCES Beneficiaries within the applicants around the cutoff point of Saber 11

Source: ICFES, SPADIES, ICETEX (2013). Estimation of the optimal bandwidth Imbens and Kalyanaraman (2013)

Graph 3. McCrary Test

Source: ICFES, SPADIES, ICETEX (2013).

Graph 4. Outcome variables around the cutoff point.

Salaries deflated using the Consumer Price Index of the year 2010. Estimation in the optimal bandwidth Imbens y Kalyanaraman (2013)
Source: ICFES, SPADIES, OLE, ICETEX (2013).

Graph 5. Applicants' characteristics around the cutoff point

Source: ICFES, SPADIES, ICETEX (2013). Estimation in the optimal bandwidth Imbens and Kalyanaraman (2013)

Regression discontinuity model

Having validated the fundamental assumptions for the implementation of the regression discontinuity strategy in our data, and limiting our sample to the individuals within the optimal bandwidth around the cutoff point, we proceed to estimate the causal effects of the ACCES credit on labor market variables.

We first estimate an *intent-to-treat* model that allows determining the effect of being eligible for the ACCES credit on the starting salary as follows:

$$(1) Y_i = \beta_0 + \beta_1 \text{Eligible}_i + f_1(\text{Sb11score}) + \beta_2 \text{sociodemographics}_i + \gamma_k + \rho_t + \mu_i$$

In equation (1) *Eligible* is a dichotomous variable which takes the value of 1 when the student is eligible for the ACCES credit -in accordance with their performance on the Saber 11 test- and zero otherwise. We control for socio-demographic individual characteristics including age, sex and the mother's educational level. We also include dummies for department k where the individual graduated γ_k – and for the year t when the graduate started to work- ρ_t . $f_1(\text{Sb11score})$ is the polynomial of the assignment variable¹² which captures the relation between the latter and the outcome variable.

We also estimated a *Local average treatment effect* model - LATE. Given the fact that we find non- eligible ACCES beneficiaries we should undertake a two stage estimation as suggested for the case of a fuzzy regression discontinuity (Jacob and Zhu, 2012). In the first stage—equation (2)-, we estimated the probability of being an ACCES beneficiary as a function of being eligible controlling for a polynomial of the assignment variable –that captures the relation between the selection criteria and being eligible-, and other controls. In the second stage—equation (3)-, the probability of being ACCES beneficiary -predicted in stage 1-, is used to establish the causal effect of having ACCES loans on the variables of interest.

$$(2) P(T_i) = \alpha_0 + \alpha_1 \text{Eligible}_i + f_1(\text{Sb11score}_i) + \alpha_2 \text{Sociodemographics}_i + \gamma_k + \rho_t + \epsilon_i$$

$$(3) Y_i = \beta_0 + \beta_1 P(\hat{T}_i) + f_1(\text{Sb11score}) + \beta_2 \text{Sociodemographics}_i + \gamma_k + \rho_t + \mu_i$$

¹² This polynomial can be expressed as follows:

$$f_1(\text{Sb11score}) = \sigma_1 \text{SB11score}_i + \sigma_2 \text{Eligible}_i * \text{SB11score}_i + \sigma_3 \text{SB11score}_i^2 + \sigma_4 \text{Eligible}_i * \text{SB11score}_i^2$$

VII. Results

Time span of job search

The first outcome of interest is to determine whether the ACCES recipients, once graduated, exhibit longer time spans to find their first formal job than non-recipients. To measure *time span of job search* —we use the data both from SPADIES that reports the information of the year of graduation and from the Educational Labor Observatory (OLE) that reports the year when the recent graduate was hired (as formal worker). Based on these two pieces of information we can calculate our measure of *time span of job search* (in years)¹³.

Graph 6 shows the distribution of the said variable for eligible and non-eligible around the cutoff point. It is observed that, on average, non-eligible graduates reveal shorter *time spans of job search* than eligible ones. In fact, 40% of the non-eligible graduates are hired within a year after graduation compared to 25% of the eligible graduates.

Graph 6. Distribution of Time Span of Job Search for ACCES eligible and non-eligible

Sample of applicants around the cutoff point. Calculation in the bandwidth sample Imbens and Kalyanaraman (2009)

In order to test whether this difference is significant and attributable to ACCES, we estimate both intent-to-treat (ITT) and the local average treatment effect (LATE) models

¹³ The available data permits counting only the number of years that passes between the year of graduation and the year of being hired as formal worker. For example, if a student finishes her university studies in the first semester of 2010 and is hired in December of the same year, this variable will take the value of zero.

as specified in equations (1) and (3). The results of the estimations are presented in tables 2a and 2b respectively. On the one hand, the ITT results indicate that, after including all controls, those ACCES eligible reveal a time span of job search 0.95 years longer than that of non-eligible. This result is robust to different specifications. On the other hand, the LATE estimations presented in table 2b show that, on average, the ACCES recipients spend 1.78 years more in their first job search than those non-recipients. Thus, ACCES beneficiaries behave differently in terms of job search than non-beneficiaries which suggests that ACCES recipients bear less pressure to find a job rapidly. Such behavior may be linked to their lesser financial needs immediately after graduation.

*Table 2a. Impact of ACCES credit on Time Span of Job Search. Regression Discontinuity Estimates.
Intent-to-Treat (ITT)*

	(1)	(2)	(3)	(4)	(5)
				Half bandwidth	Bandwidth and a half
ACCES Eligible	0.367 (0.123)***	1.445 (0.191)***	0.948 (0.179)***	0.932 (0.175)***	0.975 (0.183)***
N	577	577	577	243	1,033
Polynomial		x	x	x	x
Socioeconomic characteristics			x	x	x

* p<0.1; ** p<0.05; *** p<0.01 Robust standard error in parentheses. Ordinary least square estimation. Optimal bandwidth Imbens and Kalyanaraman (2009). Polynomial: standardized score in Saber 11 of first and second order by eligibility to ACCES. Socioeconomic Characteristics: male, age, squared age and mother's level of education and fixed effect by the department where the individual is attending to university and by the year when the graduate started to work

Table 2b. *Impact of ACCES credit on Time Span of Job Search. Regression Discontinuity Estimates.*

Local Average Treatment Effect (*LATE*)

	(1)	(2)	(3)	(4)	(5)
				Half bandwidth	Bandwidth and a half
ACCES Beneficiary	1.127 (0.388)***	2.301 (0.432)***	1.779 (0.425)***	1.741 (0.411)***	1.866 (0.443)***
<i>First Stage</i>					
ACCES Eligible	0.326 (0.055)***	0.628 (0.092)***	0.533 (0.093)***	0.535 (0.100)***	0.522 (0.090)***
N	577	577	577	243	1,033
Polynomial		x	x	x	x
Socioeconomic characteristics			x	x	x

* p<0.1; ** p<0.05; *** p<0.01 Robust standard error in parentheses. Ordinary least square estimation. Optimal bandwidth Imbens and Kalyanaraman (2009). Polynomial: standardized score in Saber 11 of first and second order by eligibility to ACCES. Socioeconomic Characteristics: male, age, squared age and mother's level of education and fixed effect by the department where the individual is attending to university and by the year when the graduate started to work

Starting salary

To measure the impact of the ACCES credit on the starting salary of the graduates we rely on the information of the Labor Observatory of Education. Graph 7-A shows the distribution of the first salary after graduation (in thousands of pesos) of ACCES eligible, which are clearly higher than those of the non-eligible. Graph 7-B displays the same variable after performing a non-parametrical correction that takes into account the fact that ACCES eligible exhibit lower dropout rates –nearly 20 percentage points–during their college studies than non-eligible¹⁴ (Melguizo et. al 2014). After the correction –that takes away 5% of the lowest salaries on the distribution of ACCES eligible– the difference in labor earnings between the two groups becomes even larger.

¹⁴ The different dropout rates may generate an estimation bias which can be corrected by using non-parametric methods. In fact, if the ACCES credit lowers the dropout probability of the recipients, there is a fraction of them that would not have graduated had ACCES not existed. Based on Angrist et. al (2006) we use the non-parametric correction to even up the dropout rates of both groups. Hence, it is reasonable to suppose that this fraction of eligible corresponds to those ones with the lowest salaries. The latter entered the labor thanks to the prior impact of ACCES.

*Graph 7. Starting Salary Before and After the non-parametric
Correction for ACCES eligible and non-eligible*

Deflated salaries using the Consumer Price Index of the year 2010. Estimation in the optimal bandwidth Imbens and Kalyanaraman (2013). Non-parametric correction to the 22nd percentile of the eligible applicants.

Source: ICFES, SPADIES, OLE, ICETEX (2013).

The ITT and LATE results of the impact of ACCES credit on the starting salaries of recent graduates are displayed in tables 3a and 3b. The ITT results in table 3a shows that starting salaries of ACCES eligible are higher than those of non-eligible for both the full and the corrected sample. The LATE estimations of table 3b reassert the positive and significant difference of the starting salaries of the ACCES beneficiaries vis a vis those ones of non-beneficiaries.

Based on the results of the complete sample, we found after including all controls¹⁵, that the ACCES eligibility increases the starting salaries of eligible on average by 307 thousand Colombian pesos (nearly 150 US Dollars). Upon determining the average effect of ACCES on the recipients, we found that the starting salaries of ACCES beneficiaries are on average 570 thousand Colombian pesos (nearly 280 US Dollars) higher than that of the non-beneficiaries. Once again, these results hold using different bandwidth sizes.

¹⁵ In addition to the socio demographic control we include controls such as the branch of economic activity of the new graduate, the type of contract and the quality of the university among others. The inclusion of these controls does change neither the magnitude nor the significance of the estimations.

Table 3a. Impact of ACCES credit on starting salary in thousands of pesos. Regression Discontinuity

Estimates. Intent-to-treatment effect.

	(1)	(2)	(3)	(4)	(5) Bandwidth Half bandwidth and a half
<i>Complete sample</i>					
ACCES Eligible	107.966 (46.429)**	319.716 (78.633)***	306.671 (82.691)***	251.681 (84.929)***	284.993 (81.472)***
N	577	577	577	243	1,033
<i>Non-parametric correction</i>					
ACCES Eligible	148.289 (46.618)***	356.274 (78.378)***	344.967 (83.471)***	304.547 (87.726)***	317.065 (81.935)***
N	531	531	531	225	940
Polynomial		x	x	x	x
Socioeconomic characteristics			x	x	x

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$ Robust standard error in parentheses. Ordinary least square estimation. Optimal bandwidth Imbens and Kalyanaraman (2009). Polynomial: standardized score in Saber 11 of first and second order by eligibility to ACCES. Socioeconomic Characteristics: male, age, squared age and mother's level of education and fixed effect by the department where the individual is attending to university and by the year when the graduate started to work. Non-parametric correction in percentile 5 of the lower bound of the salaries distribution for the eligible graduates.

Table 3b. *Impact of ACCES credit on starting salary in thousands of pesos. Regression Discontinuity Estimates. Local Average Treatment Effect (LATE)*

	(1)	(2)	(3)	(4) Half bandwidth	(5) Bandwidth and a half
<i>Complete Sample</i>					
ACCES Beneficiary	331.266 (146.268)**	509.000 (139.853)***	570.201 (167.781)***	466.218 (162.786)***	539.671 (167.022)***
<i>First stage</i>					
ACCES Eligible	0.326 (0.055)***	0.628 (0.092)***	0.538 (0.093)***	0.54 (0.100)***	0.528 (0.090)***
N	577	577	577	243	1,033
<i>Non-parametric correction</i>					
ACCES Beneficiary	670.476 (196.648)***	708.738 (158.492)***	784.005 (193.665)***	665.056 (189.272)***	746.163 (192.892)***
<i>First stage</i>					
ACCES Eligible	0.266 (0.058)***	0.577 (0.097)***	0.493 (0.100)***	0.487 (0.108)***	0.48 (0.096)***
N	500	500	500	214	880
Polynomial		x	x	x	x
Socioeconomic characteristics			x	x	x

* p<0.1; ** p<0.05; *** p<0.01 Robust standard error in parentheses. Ordinary least square estimation. Optimal bandwidth Imbens and Kalyanaraman (2009). Polynomial: standardized score in Saber 11 of first and second order by eligibility to ACCES. Socioeconomic Characteristics: male, age, squared age and mother's level of education and fixed effect by the department where the individual is attending to university and by the year when the graduate started to work. Non-parametric correction in percentile 22 of the lower bound of the salaries distribution for the eligible and beneficiaries graduates.

VIII. Mediation analysis

The results presented so far clearly evidence the positive impact that the ACCES credit has on the starting salaries of the recipients. On average, the eligible and beneficiaries of ACCES exhibit both longer job search of their first formal employment as graduates and higher starting salaries in comparison to the non-eligible and non-recipients. The results obtained are robust under different specifications and bandwidth sizes.

However, in this paper we enquire about the likely channels through which the ACCES credit affects the starting salary of the eligible or beneficiaries. We found that both eligible and recipients reveal longer time spans of search for their first formal employment as professionals. Furthermore, the descriptive statistics in table 1 indicate that on average,

the ACCES eligible and recipients have a better academic performance -measured as the percentage of subjects passed during their university studies- in comparison with the non-eligible and non-recipients. Based on these results, we may hypothesize that the higher starting salaries of eligible and recipients can be explained both by their better academic performance during college and by their longer time spans of job search after graduation. In other words, we may ask ourselves whether the higher starting salaries of the ACCES eligible or beneficiaries are the result of i) better professional skills –consequence of superior academic performance-, or ii) better job match, as they undergo less pressure to find employment given the relatively manageable payments conditions of the ACCES debt, compared to the conditions of other source of financing university studies (relatives, commercial banks, informal credit, etc.).

With the purpose of determining which of the above mentioned channels explained the higher starting salaries of eligible (compared to the non-eligible) we use the methodology of mediation analysis implemented by Baron and Kenny (1986) and Preacher and Hayes (2008). This methodology allows for identifying if the higher salaries of the eligible are in part explained indirectly or mediated by the two variables mentioned—longer time spans of job search and better academic performance. Thus, we undertake the mediation methodology within an Intent-to-Treat Regression Discontinuity framework that allows for a precise identification and quantification of the mediation channels.

Through the mediation analysis it is possible to establish that there may exist an indirect effect of the ACCES eligibility –ITT- through its impact on the mediating variables when:

- a) ACCES eligibility is related to the outcome variable i.e. the starting salary,
- b) ACCES eligibility is related to the channels of mediation i.e. academic performance and time span of job search and,
- c) upon including both the ACCES eligibility and the mediating variables, the latter significantly explains the outcome variable. If the significance of the eligibility variable disappears, it can be concluded that the total effect ACCES eligibility has on the starting salaries is all *indirect* and occurs through the channels of mediation. If this is not the case, a percentage of the effect of the ACCES eligibility on the

starting salaries is explained *directly* by that variable while the remaining percentage comes about through the mediating channels.

The mediation model which explains the impact of the ACCES eligibility on the starting salaries of the recipients can be represented by the following equation:

$$(4) \text{ Salary}_{entry_i} = \beta_o + \beta_1 \text{AcademicPerformance}_i + \beta_2 \text{SearchTime}_i + \beta_3 \text{SearchTime}_i^2 + \phi \text{Elegible}_i + f_1(\text{Sb11score}_i) + \alpha_2 \text{Sociodemographics}_i + \gamma_k + \rho_t + u$$

Where *Elegible_i* is the ACCES eligibility, *AcademicPerformance_i* is the percentage of passed subjects, *SearchTime_i* is the time span of job search and *Salary_{entry_i}* is the starting salary earned. Additionally, we include all controls that utilized in the estimations of impact.

In order to test mediation as explained in b) we should establish whether *Elegible_i* affects the proposed channels of mediation: *AcademicPerformance_{i1}* and *SearchTime_i* as follows:

$$(5) \text{ AcademicPerformance}_i = \gamma_1 \text{Elegible}_i + f_1(\text{Sb11score}_i) + \alpha_1 \text{Sociodemographics}_i + \gamma_k + \rho_t + e$$

$$(6) \text{ SearchTime}_i = \gamma_2 \text{Elegible}_i + g_1(\text{Sb11score}_i) + \alpha_2 \text{Sociodemographics}_i + \gamma_k + \rho_t + e$$

$$(7) \text{ SearchTime}_i = \gamma_2^2 \text{Elegible}_i + m_1(\text{Sb11score}_i) + \alpha_3 \text{Sociodemographics}_i + \gamma_k + \rho_t + e$$

Upon replacing (5), (6) and (7) in equation (8) we obtain the following expression:

$$(8) \text{ Y}_i = [(\beta_1 * \gamma_1) + (\beta_2 * \gamma_2) + (\beta_3 * \gamma_2^2) + \phi] * \text{Elegible}_i + b(\text{controls}) + s_1(\text{Sb11score}_i) + \gamma_k + \rho_t + e$$

Where $\beta_1 * \gamma_1$ measures the indirect effect of ACCES eligibility on starting salaries stemming from academic performance, while $\beta_2 * \gamma_2$ y $\beta_3 * \gamma_2^2$ measure the said indirect

effect brought about by the time span of job search. Conversely, ϕ captures the direct effect of ACCES eligibility on starting salaries.

In order to obtain the magnitude of these direct and indirect effects, we estimate Intent-to-Treat models for the equations (5), (6), (7) and (8). So as to correct for potential correlation of the error terms among these equations we make use of the Seemingly Unrelated Regression (SUR) methodology (Zellner, 1962). Subsequently, we carry out a bootstrapping process to determine the statistical significance of the estimated coefficients capturing both the direct effect ϕ and the indirect effect $(\beta_1 * \gamma_1) + (\beta_2 * \gamma_2) + (\beta_3 * \gamma_2^2)$ as stated in equation (8).

Table 4 presents the results of the estimation of the SUR models using the sample in the optimal bandwidth. Column (1) displays the estimated coefficients of equation (5) and columns (2), (3) and (4) those of the equations (6), (7) and (8). For all models, we use the same control variables of the previous estimations. The ITT results indicate that in fact, ACCES eligibility impact significantly and positively the percentage of passed subjects. On average, the ACCES eligible pass 22 percentage points more subjects than the non-eligible¹⁶. Additionally and, in line with the previous estimations, the ACCES eligibility impacts significantly and positively the time span of job search both linear and quadratic.

¹⁶ Estimations of the impact of ACCES both ITT and LATE for academic performance using the sample of applicants during their university years indicate that in fact such credit positively affect the percentage of passed subject. The LATE difference of passed subjects for the sample of recipients and non-recipients still during college is nearly 30 percentage points (See Melguizo et al (2014). For details see annex 3.

Table 4. Mediation Analysis of the ACCES credit impact on the starting salary. Seemingly Unrelated Regression

	Optimal bandwidth			
	(1) Starting salary	(2) % of passed subjects	(3) Time Span of Job Search	(4) Time Span of Job Search squared
ACCES Eligible	93.69 (83.30)	22.34 (3.85)***	1.07 (0.18)***	6.33 (1.38)***
% of passed subjects	1.46 (0.87)*			
Time Span of Job Search	569.91 (101.16)***			
Time Span of Job Search ²	-72.05 (13.37)***			
N	577	577	577	577

* p<0.1; ** p<0.05; *** p<0.01 Standardized robust errors in parenthesis. Apparently unrelated model equations estimated on the the sample in the optimal bandwidth (Imbens & Kalyanaraman, 2009). Polinomial: standardized score in Saber 11 of first and second order by eligibility to ACCES. Socioeconomic Characteristics: male, age, squared age and mother's level of education and fixed effect by the department where the individual is attending to university and by the year when the graduate started to work.

Based on the coefficients of Table 4 we first calculate the direct and indirect effects as stated in equation (8) and then we perform a bootstrapping procedure in order to obtain the statistical significance of the said effects. Table 5 presents the bootstrapped direct and indirect effect of ACCES eligibility on the starting salaries while diagram 2 illustrates how they work. Tables 5 indicate that the ITT total effect of the ACCES eligibility on the starting salary amounts to 280 thousand COP. As observed, the percentage of passed subjects and the time span of job search -both linear and quadratic- are in fact channels that indirectly explain that impact of ACCES eligibility. Table 5 indicates that the bootstrapped coefficients $(\beta_1 * \gamma_1) = 32.65$ $(\beta_2 * \gamma_2) = 609.46$ and $(\beta_3 * \gamma_2^2) = -456.02$ are statistically significant. Thus, the indirect effect of ACCES eligibility through the percentage of passed subjects equals 33 thousand Colombian pesos (approximately 16 USD), representing 11.67% of the total ITT effect; and the indirect effect through the time span of job search equals 153 thousand Colombian pesos COP¹⁷ (approximately 75

¹⁷ This result comes about by adding rows 2 and 3 (609.464 - 456.02) in table 7.

USD), accounting for 54.85% of the ITT total effect.¹⁸ Additionally, the direct effect of the ACCES eligibility yet marginally significant explains the remaining 33.49% of the difference equivalent to 93.69 thousand pesos COP (46 USD).

Table 5. Direct and indirect effects of ACCES credit on starting salary. Bootstrapped estimations.

	% Explain by the indirect channels	Coefficient	Bootstrap SE
Indirect effect of passed subjects	11.67	32.65	(15.63)**
Indirect effect of Time Span of Job Search	54.85	609.46	(126.64)***
Time Span of Job Search ²		-456.02	(102.68)***
<i>Total Indirect Effect</i>	<i>66.52</i>	<i>186.09</i>	<i>(33.25)***</i>
<i>Total Direct Effect</i>	<i>33.49</i>	<i>93.69</i>	<i>(51.69)*</i>

* p<0.1; ** p<0.05; *** p<0.01 standardized bootstrap errors between parenthesis. Calculation based on intent-to-treatment based on apparently unrelated regressions, having in the estimations for the sample in the optimal bandwidth. Polinomial: standardized score in Saber 11 of first and second order by eligibility to ACCES. Socioeconomic Characteristics: male, age, squared age and mother's level of education and fixed effect by the department where the individual is attending to university and by the year when the graduate started to work.

Diagram 2. Mediation model of the ACCES effect on the first salary

Estimated results using the sample in the optimal bandwidth of table 6

Thus, the percentage of passed subjects during university and the time span of job search are key mediators of the impact of ACCES eligibility on the starting salaries of the

¹⁸ 66.52% results from adding the indirect effects of passed subjects and time span of job search and dividing this sub-total on the ITT total effect (280 thousand COP). The latter effect results from adding both the indirect and directs effects.

new graduates. Nonetheless, the portion corresponding to the direct effect of ACCES eligibility remains unexplained and may be related to motivations and other unobserved factors.

IX. Conclusions

The ACCES credit has supported the higher education of more than 280 thousand students across the country by co-financing their undergraduate studies and allowing them to begin their credit payments a year after graduation. During the functioning of this program, it has been demonstrated that ACCES has positive effects on the access to higher education and on academic performance as well as on the lowering of the dropout rates of its recipients (Sanchez & Marquez, 2012; Melguizo, et al, 2013).

In this paper, we evaluated the impact the credit for Access to Higher Education ACCES has on the starting salary of the recipients once graduated. The results suggest that both the eligible and recipients of ACCES loans have a starting salary in the formal labor market greater than that of non-eligible and non-recipients. By using the methodology of mediation analysis, we conclude that the time span of job search -which is significantly higher for the eligible than that for non-eligible—and academic performance –measured as the percentage of passed subject during college -explain 66% of the difference in the starting salaries between eligible and non-eligible. The unexplained 33% -encapsulated in the direct effect- involves non-observable factors also likely consequence of the credit. For instance skills developed during their university studies due to enrollment in accredited programs, greater availability of social capital, networking, etc.

The fact that the ACCES eligible dedicate more time to searching for their first employment as professionals may be due to the more manageable payment conditions of the credit such as not debt payments while studying, low interest rates and one year grace period. In contrast, the non-eligible whose sources of financing comes from family, relatives, commercial banks and informal credits, among others may face more stringent payments conditions of their college debts and in consequence are compelled to find a job more rapidly.

The results of this paper highlight the importance that financial aid programs have for higher education by providing a long-term repayment method for the recipients. The

ACCES credit model, which allows a grace period of a year to the recipients after their graduation before beginning repayment of the loans, facilitates credit recipients to make a more thorough first employment search which translates into a higher starting salary in comparison with their non-recipient peers.

The results of our paper stress the importance of credit programs for higher education targeted to low income individuals. These types of programs not only encourage access to and permanence in higher education, but also improve through a more efficient job search the starting salaries of new graduates belonging to poor households.

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Diagram 1. Process of ACCES credit assignment

Annex 1. Cutoff point for ACCES eligibility According to SABER 11 spot

Year of cutoff criteria	2002 to 2008		2009		2010		2011		2012		2013	
	%	Ranking cutoff	%	Ranking cutoff	%	Ranking cutoff	%	Ranking cutoff	%	Ranking cutoff	%	Ranking cutoff
	85%		70%		70%		70%		70%		70%	
AMAZONAS	85.00%	850	70.04%	758	70.04%	792	70.04%	832	70.04%	820	70.04%	824
ANTIOQUIA	85.00%	850	69.99%	697	69.99%	729	69.99%	742	69.99%	722	69.99%	736
ARAUCA	85.00%	850	70.05%	654	70.05%	753	70.05%	730	70.05%	745	70.05%	729
ATLANTICO	85.00%	850	70.03%	749	70.03%	754	70.03%	752	70.03%	766	70.03%	748
BOLIVAR	85.00%	850	70.01%	765	70.01%	786	70.01%	796	70.01%	816	70.01%	809
BOYACA	85.00%	850	70.03%	604	70.03%	618	70.03%	638	70.03%	664	70.03%	622
CALDAS	85.00%	850	70.07%	641	70.07%	665	70.07%	672	70.07%	661	70.07%	694
CAQUETA	85.00%	850	70.00%	736	70.00%	779	70.00%	768	70.00%	755	70.00%	753
CASANARE	85.00%	850	70.12%	690	70.12%	714	70.12%	707	70.12%	689	70.12%	714
CAUCA	85.00%	850	70.06%	648	70.06%	774	70.06%	784	70.06%	785	70.06%	761
CESAR	85.00%	850	70.06%	700	70.06%	758	70.06%	759	70.06%	770	70.06%	748
CHOCO	85.00%	850	70.06%	817	70.06%	884	70.06%	873	70.06%	891	70.06%	878
CORDOBA	85.00%	850	70.00%	744	70.00%	764	70.00%	769	70.00%	781	70.00%	762
CUNDINAMARCA	85.00%	850	70.01%	659	70.01%	676	70.01%	653	70.01%	654	70.01%	650
DISTRITO CAPITAL	85.00%	850	70.08%	571	70.08%	559	70.08%	571	70.08%	555	70.08%	554

Year of cutoff criteria		2002 to 2008			2009			2010			2011			2012			2013		
	%	Ranking cutoff		Ranking cutoff	%	Ranking cutoff		%	Ranking cutoff		%	Ranking cutoff		%	Ranking cutoff		%	Ranking cutoff	
	Cutoff	85%		85%		70%		70%		70%		70%		70%		70%		70%	
GUAINIA	85.00%	850		850	70.50%	644		70.50%	646		70.50%	679		70.50%	631		70.50%	637	
GUAVIARE	85.00%	850		850	70.03%	706		70.03%	731		70.03%	683		70.03%	750		70.03%	745	
HUILA	85.00%	850		850	70.02%	656		70.02%	695		70.02%	705		70.02%	719		70.02%	698	
LA GUAJIRA	85.00%	850		850	70.00%	796		70.00%	824		70.00%	819		70.00%	839		70.00%	812	
MAGDALENA	85.00%	850		850	70.09%	793		70.09%	828		70.09%	833		70.09%	841		70.09%	841	
META	85.00%	850		850	70.03%	701		70.03%	709		70.03%	691		70.03%	692		70.03%	692	
NARINO	85.00%	850		850	70.08%	633		70.08%	678		70.08%	683		70.08%	688		70.08%	667	
NORTE SANTANDER	85.00%	850		850	70.00%	702		70.00%	723		70.00%	718		70.00%	701		70.00%	703	
PUTUMAYO	85.00%	850		850	70.03%	655		70.03%	719		70.03%	707		70.03%	702		70.03%	707	
QUINDIO	85.00%	850		850	70.08%	643		70.08%	660		70.08%	682		70.08%	657		70.08%	680	
RISARALDA	85.00%	850		850	70.07%	645		70.07%	672		70.07%	677		70.07%	651		70.07%	678	
SAN ANDRES	85.00%	850		850	70.02%	714		70.02%	829		70.02%	822		70.02%	814		70.02%	772	
SANTANDER	85.00%	850		850	70.04%	620		70.04%	632		70.04%	656		70.04%	658		70.04%	655	
SUCRE	85.00%	850		850	70.08%	725		70.08%	755		70.08%	778		70.08%	801		70.08%	771	
TOLIMA	85.00%	850		850	70.12%	687		70.12%	716		70.12%	719		70.12%	722		70.12%	719	
VALLE DEL CAUCA	85.00%	850		850	70.06%	703		70.06%	732		70.06%	710		70.06%	684		70.06%	705	
VAUPES	85.00%	850		850	70.09%	689		70.09%	774		70.09%	815		70.09%	788		70.09%	815	
VICHADA	85.00%	850		850	70.19%	747		70.19%	783		70.19%	793		70.19%	772		70.19%	769	

Source:

ICETEX

(2014)

Annex 2. Composition of the Sample

Annex 3. Impact of ACCES credit on the percentage of passed subjects

In order to support our hypothesis that ACCES impacts indirectly the eligible starting salaries through its effect on the percentage of passed subjects, we proceed to present the Regression Discontinuity estimations for both the sample of applicants with salary information—that was used in this paper- and the full sample of applicants that attend university education.

First, we measure whether the ACCES recipients have better college performance than non-recipients for the full sample of applicants enrolled in the university. Graph A1 displays for this sample the percentage of passed subjects for those non-eligible-non-beneficiaries and eligible-beneficiaries (i.e. LATE effect) around the cutoff point. It is observed that for the former, the percentage of passed subjects is much lower than for the ACCES eligible-beneficiaries whose percentage of passed subjects reaches more than 75%.

Graph A1. Percentaje of Passed Subjects Around the Cutoff Point. – College Sample-

Estimation in the optimal bandwidth Imbens y Kalyanaraman (2013)
Source: ICFES, SPADIES, ICETEX (2013).

Then, we run for the university sample ITT and LATE regression discontinuity models for percentage of passed subjects. The ITT model can be expressed as follows:

$$(I) Y_i = \beta_0 + \beta_1 \text{Eligible}_i + f_1(\text{Sb11score}) + \beta_2 \text{sociodemographics}_i + \gamma_k + \rho_t + \mu_i$$

Eligible in equation (I) is a dichotomous variable which takes the value of 1 when the student is eligible for the ACCES credit -in accordance with their performance on the Saber 11 test- and zero otherwise. We control for socio-demographic individual characteristics including age, sex and the mother's educational level. We also include departmental dummies γ_k for the location of the university and student's cohort dummies ρ_t . $f_1(\text{Sb11score})$ is the polynomial of the assignment variable¹⁹ which captures the relation between the latter and the outcome variable.

The LATE model is specified as follows:

$$(II) P(T_i) = \alpha_0 + \alpha_1 \text{Eligible}_i + f_1(\text{Sb11score}_i) + \alpha_2 \text{Sociodemographics}_i + \gamma_k + \rho_t + \epsilon_i$$

$$(III) Y_i = \beta_0 + \beta_1 P(\hat{T}_i) + f_1(\text{Sb11score}) + \beta_2 \text{Sociodemographics}_i + \gamma_k + \rho_t + \mu_i$$

As suggested for the case of a fuzzy regression discontinuity (Jacob and Zhu, 2012), in the first stage—equation (II)—, we estimate the probability of being an ACCES beneficiary as a function of being eligible controlling for a polynomial of the assignment variable and the above mentioned controls. In the second stage—equation (III)—, the probability of being ACCES beneficiary -predicted in stage 1-, is used to establish the causal effect of having ACCES loans on the variables of interest.

The ITT and LATE results of the impact of ACCES credit on the percentage of passed subjects are presented on table A1a and A1b. The ITT results in table A1a indicate that ACCES eligible approve 5.4 percentage points more subjects than non-eligible. Likewise, the LATE estimations reveal that ACCES eligible-recipients pass 28.07 percentage points more subjects than non-eligible-non-recipients, confirming the positive

¹⁹ This polynomial can be expressed as follows:

$$f_1(\text{Sb11score}) = \sigma_1 \text{Sb11score}_i + \sigma_2 \text{Eligible}_i * \text{Sb11score}_i + \sigma_3 \text{Sb11score}_i^2 + \sigma_4 \text{Eligible}_i * \text{Sb11score}_i^2$$

and significant impact on this particular outcome. The estimates also include a non-parametrical correction that takes into account the fact that ACCES eligible exhibit lower dropout rates –nearly 20 percentage points–during their college studies than non-eligible²⁰ (Melguizo et. al 2014).

Table A1a. Impact of ACCES credit on percentage of passed subjects. Regression Discontinuity Estimates –Intent to Treat (ITT)-. College sample.

	(1)	(2)	(3)	(4) Half bandwith	(5) Bandwith and a half
ACCES Eligible	7.697 (0.449)***	6.998 (0.747)***	5.406 (0.725)***	5.253 (0.799)***	5.924 (0.720)***
N	20,828	20,828	20,828	9,827	32,418
Polinomial		x	x	x	x
Socioeconomic variables			x	x	x

* p<0.1; ** p<0.05; *** p<0.01 Robust estandard error in parentheses. Ordinary least square estimation. Optimal bandwidth Imbens and Kalyanaraman (2009). Polinomial: standardized score in Saber 11 of first and second order by eligibility to ACCES. Socioeconomic variables: male, age, squared age and mother's level of education and fixed effect by department of university of the student and by the students' cohort. Non-parametric correction in percentile 5 of the lower bound of the distribution for the eligible students.

²⁰ The different dropout rates may generate an estimation bias which can be corrected by using non-parametric methods. In fact, if the ACCES credit lowers the dropout probability of the recipients, there is a fraction of them that would not have graduated had ACCES not existed. Based on Angrist et. al (2006) we use the non-parametric correction to even up the dropout rates of both groups. Hence, it is reasonable to suppose that this fraction of eligible corresponds to those ones with the lowest salaries. The latter entered the labor thanks to the prior impact of ACCES.

Table A1a. Impact of ACCES credit on percentage of passed subjects. Regression Discontinuity Estimates

-Local Average Treatment Effect (LATE)-. College sample.

	(1)	(2)	(3)	(4)	(5)
				Half bandwidth	Bandwidth and a half
ACCES Beneficiary	39.404 (2.758)***	39.121 (5.098)***	28.093 (4.761)***	31.342 (7.666)***	27.780 (3.800)***
<i>First Stage</i>					
ACCES Eligible	0.181 (0.007)***	0.164 (0.011)***	0.163 (0.011)***	0.113 (0.012)***	0.202 (0.011)***
N	20,245	20,245	20,245	9,708	30,996
Polynomial		x	x	x	x
Socioeconomic variables			x	x	x

* p<0.1; ** p<0.05; *** p<0.01 Robust standard error in parentheses. Ordinary least square estimation. Optimal bandwidth Imbens and Kalyanaraman (2009). Polynomial: standardized score in Saber 11 of first and second order by eligibility to ACCES. Socioeconomic variables: male, age, squared age and mother's level of education and fixed effect by department of university of the student and by the students' cohort. Non-parametric correction in percentile 22 of the lower bound of the distribution for the eligible and beneficiaries students.

Secondly, we perform the same estimations described in equations (I), (II) and (III) on the sample used to determine the impact on starting salaries. The ITT results in Table A2a show that ACCES eligible approve 13.39 percentage points more subjects than non-eligible do. Furthermore, the LATE results presented in table A2b indicate that, on average, ACCES eligible and beneficiaries approve 19.83 percentage points more subjects than ACCES non-eligible-non-beneficiaries.

Table A2a. Impact of ACCES credit on percentage of passed subjects. Estimates of Regression

Discontinuity models – Local Average Treatment Effect (LATE)-. Labor market sample.

	(1)	(2)	(3)	(4)	(5)
				Half bandwidth	Bandwidth and a half
ACCES Eligible	3.367 (2.063)	17.559 (3.484)***	13.393 (3.651)***	10.703 (4.256)**	12.461 (3.408)***
N	577	577	577	243	1,033
Polynomial		x	x	x	x
Controls			x	x	x

* p<0.1; ** p<0.05; *** p<0.01 Robust standard error in parentheses. Ordinary least square estimation. Optimal bandwidth Imbens and Kalyanaraman (2009). Polynomial: standardized score in Saber 11 of first and second order by eligibility to ACCES. Socioeconomic variables: male, age, squared age and mother's level of education and fixed effect by department of university of the student and by the students' cohort

Table A2a. Impact of ACCES credit on percentage of passed subjects. Estimates of Regression

Discontinuity models –Intent to Treat (ITT)-. Labor market sample.

	(1)	(2)	(3)	(4)	(5)
				Half bandwidth	Bandwidth and a half
ACCES Beneficiary	10.330 (6.356)	27.954 (6.628)***	24.902 (7.551)***	19.826 (8.145)**	23.596 (7.154)***
<i>First Stage</i>					
ACCES Eligible	0.326 (0.055)***	0.628 (0.092)***	0.538 (0.093)***	0.540 (0.100)***	0.528 (0.090)***
N	577	577	577	243	1,033
Polynomial		x	x	x	x
Controls			x	x	x

* p<0.1; ** p<0.05; *** p<0.01 Robust standard error in parentheses. Ordinary least square estimation. Optimal bandwidth Imbens and Kalyanaraman (2009). Polynomial: standardized in Saber 11 of first and second order by eligibility to ACCES. Socioeconomic variables: male, age, squared age and mother's level of education and fixed effect by department of university of the student and by the students' cohort