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Does financial aid for top international graduate programs boost education and earnings? Evidence from Colombia[∗]

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Abstract

This paper estimates the impact of a postgraduate merit-based financial aid program in Colombia. Exploiting a regression discontinuity design using rich survey and administrative data, we find three main results by. First, credit constraints are binding and important even for talented individuals with higher education degrees. Our results indicate that financial aid beneficiaries increase their probability of attaining any graduate education by 33% and a graduate education at a top university *abroad* by 50%. Second, the labor market highly rewards this education. Beneficiary individuals earn an average a monthly labor income 45% higher than non-beneficiaries. Mediation analyses suggest that at least 50% of the impact is due to the signaling effect of being a financial aid scholar. Importantly, effects are driven by male candidates and in a higher proportion by those who attended private higher education institutions in their undergraduate studies. Third, back-of-the-envelope cost-benefit analyses suggest that this credit scholarship has a private and social IIR of 22% and 29%, respectively.

Keywords: merit-based financial aid, graduate education, returns to education, Colombia, International Studies, regression discontinuity.

JEL codes: I22, I23, I26

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¿La ayuda financiera para programas postgraduados internacionales de alto nivel aumentan la educación y los ingresos? Evidencia para Colombia

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Este artículo estima el impacto de un programa de ayuda financiera para posgrados en el exterior basado en el mérito. A través de un diseño de regresión discontinua y utilizando datos propios de encuestas, así como datos administrativos del gobierno, encontramos tres resultados principales. Primero, las restricciones crediticias son vinculantes e importantes incluso para personas talentosas con títulos de educación superior. Los resultados indican que los beneficiarios de ayuda financiera aumentan su probabilidad de obtener una educación de posgrado en un 33 % y una educación de posgrado en una de las mejores universidades en el extranjero en un 50 %. En segundo lugar, el mercado laboral recompensa altamente esta educación. Las personas beneficiarias ganan en promedio un ingreso laboral mensual 45% mayor que los no beneficiarios. Los análisis de mediación sugieren que al menos el 50% del impacto se debe al efecto de señalización de ser un becario de ayuda financiera. Es importante destacar que los efectos impulsan positivamente los ingresos términos laborales para los candidatos hombres y, en mayor proporción, por aquellos que asistieron a instituciones de educación superior privadas en sus estudios de pregrado. En tercer lugar, los análisis de costo-beneficio sugieren que esta beca-crédito tiene un IIR privado y social de 22% y 29%, respectivamente.

Palabras clave: ayuda financiera por mérito, educación de postgrado, retornos a la educación, Colombia, Estudios Internacionales, Regresión Discontinua.

Códigos JEL: I22, I23, I26

1. Introduction

Tertiary education fosters economic growth, reduces poverty, and decreases inequality. Within it, the relative importance of graduate education has been mounting in the past years. The number of individuals who undertake these studies has increased faster than those in undergraduate education (Stevenson, 2016; Morikawa, 2018). In the USA, for example, graduate enrollment increased at an annual average rate of 2.5% during the past decade, nearing two million individuals or almost 15% of all tertiary students in the country in 2020 (Zhou and Gao, 2021). Resources for graduate education in this country have been increasing too. Between 2010 and 2018, federal graduate loans grew by 21% - while undergraduate ones decreased by 7% - accounting for nearly 40% of all federal students' loans (Miller, 2019). Trends for tertiary education attainment in the developing world have followed suit. According to Ferreyra et al. (2017), the average gross enrollment rate in the Latin American region increased from 21% to 43% between 2000 and 2013. However, postgraduate education in these countries is still in its infancy of development, with average attainment rates of 3%, suggesting programs to promote it are in need (SEDLAC, 2018).

Despite its increasing importance, little is known about postgraduate education impacts and efficient programs to foster it. Only a handful of studies have analyzed the individual returns of pursuing postgraduate education. Moreover, all of them concentrate on evidence from developed countries, and the majority only provide correlations between this level of education and the labor income of individuals who attain it.¹ Few studies have tried to obtain causality between graduate education and labor market outcomes with non-experimental identification strategies. Most of the studies using a FE methodology concentrate on the returns for MBAs, including Arcidiacono et al. (2008), Grove and Hussey (2011), and Hussey (2012), finding them to be between 13% and 25%. Song et al. (2008) estimate the returns to

¹ Most of the papers that analyze the returns to postgraduate education use simple OLS correlations. For general postgraduate programs, studies include Walker and Zhu (2011) for USA and Morikawa (2018) for Japan. Returns for Ph.D. programs are estimated by Mertens and Röbbken (2013) for Germany and Wouterse et al. (2017) for the Netherlands. Lastly, under OLS regressions, estimates of attending law school are also estimated by Oyer and Schaefer (2019).

general postgraduate education using an IV methodology with instruments such as tuition levels, the likelihood of obtaining graduate support, and parental education. Finally, Stevenson (2016) estimate returns for general graduate programs in the USA under the Dubin and McFadden (1984) empirical procedure.

Even with this handful set of studies, it is evident there is a knowledge vacuum on the *causal* impact private and public resources have on postgraduate educational attainment and labor market outcomes. This paper fills this void by combining a regression discontinuity design with rich survey and administrative data to analyze the effects of a postgraduate merit-based credit-scholarship program in Colombia.

Since 1991 Colfuturo, a Colombian nongovernmental organization, has granted over 13,000 credit-scholarships to individuals previously accepted into graduate programs at top universities worldwide. From its onset, the Crédito-Beca Colfuturo (CBC for its acronym in Spanish) has been awarded through a merit-based selection criterion. The process is based on a continuous score for each applicant and a strict credit awarding threshold. The cutoff point varies by area of study and year of application, depending on the number of candidates and resources available. Using a regression discontinuity design, we causally estimate CBC's impact on numerous medium- and long-term outcomes of interest.

Specifically, through this quasi-random methodology, we find three main results. First, credit constraints are binding and important even for talented individuals with higher education degrees. Credit or scholarship programs for graduate education allow professionals the opportunity to achieve their highest educational aspirations. CBC's eligible individuals attain more and better-quality postgraduate education than ineligible ones. Compared with individuals closely below the CBC's eligibility cutoff, those to the right have a 33% higher probability of holding a graduate diploma and a 50% higher probability of receiving it from a top foreign educational institution.

Second, labor markets reward this postgraduate education. Returns to high-quality international postgraduate studies are economically important and highly significant. With both survey and administrative data, we consistently find that while the probability of being active in the labor market is identical for beneficiary and non-beneficiary individuals, the

labor income of the former is 45% higher than the one earned by non-beneficiaries. Heterogeneous analysis shows that returns are maintained in time as the coefficient of interest is very similar for individuals from different cohorts. We also find that returns are marginally higher for those who attended private undergraduate universities than public ones; and are positive for those who pursue an MBA or a master's degree, but no impact for Ph.D. applicants is found. Moreover, we also find that results are driven exclusively by male applicants with no impact on the labor income earned by female scholarship recipients.

Third, we provide evidence of the plausible channels that explain the labor income returns of high-quality international postgraduate education. As stated by Spence (1973), while education may increase productivity, in a world with incomplete information, employers might use it as a signal of individuals' abilities. We find that these two theories are non-rival and complement each other in explaining CBC's beneficiaries' labor income differences. Following Imai et al. (2010), we estimate mediation analysis models using postgraduate attainment, postgraduate attainment in a foreign university, and years of postgraduate education as different plausible mediators between CBC eligibility and labor income. We find that the mediator with the strongest influence on wages is having a graduate education from a foreign university, explaining nearly 40% of the eligibility impact. These quantitative results, united with evidence from a qualitative analysis of interviews with Colombian entrepreneurs suggest that, while Colfuturo may allow individuals to increase their productivity through the attainment of more and probably better postgraduate education, much of its effect may be through signaling. A Colfuturo scholar signals the labor market a high achievement and responsibility trademark which increases its income.

Even though the literature has several papers evaluating the impact of scholarships on tertiary education, this is the first one that analyzes it at the postgraduate level. As in the papers that study undergraduate scholarships in both developed and developing countries (Bettinger et al., 2019; Cohodes and Goodman, 2014; Scott-Clayton and Zafar, 2016; Castleman and Long, 2016; Solis, 2017; and Londoño-Vélez et al., 2020), we find that financial aid impacts on education attainment are significant both at the extensive and the intensive margins. In terms of labor income, contrary to the mixed or even null results found for undergraduate

financial aid in developed countries (Angrist et al., 2020; Dale and Kruger, 2011; Bettinger et al., 2019; Scott-Clayton, 2017), we find that CBC's beneficiaries obtain significant gains for pursuing this education level. In fact, the gains are so high that our estimates suggest a private and social IIR of 22% and 29%, respectively. However, care should be taken as these gains appear to accrue only for men, like the impacts observed in developing countries for undergraduate studies (Zimmerman, 2019; Bucarey, Contreras & Muñoz, 2019; Rau, Rojas and Urzúa, 2013) or in postgraduate education for MBAs in the USA (Bertrand et al., 2010).

This document includes six additional sections. The second and third sections describe Colfuturo's merit-based graduate credit program, and the data used in the study. Section four summarizes CBC's main impacts on education and labor market outcomes, provides heterogeneous effects and presents a mediation analysis of the plausible channels through which impacts occur. Finally, section five offers a back-of-the-envelope cost-benefit analysis of the program, while section six concludes.

2. Colfuturo's merit-based graduate credit program

Colfuturo's scholarship-credit program (*CBC* for its acronym in Spanish) was established in Colombia in 1991 as a public-private initiative to promote the enrollment of top graduate professionals at the best universities and programs worldwide. Since its inception, using both private and public funds, the program has financed international postgraduate studies for more than 13,000 Colombian nationals.

CBC helps individuals finance full-time postgraduate studies abroad - masters, doctorates, and specializations in the health area – providing up to USD 50,000 to be distributed between 9 and 24 months in any way the beneficiary desires. It is a US-dollar loan requiring two co-debtors and charging a differentiated interest rate in time.² *CBC* encourages beneficiaries to

² The interest rates charged are 7% while the individual is studying, 9% during the amortization period, and 15% during any period of default.

return to Colombia to apply their knowledge through active participation in the labor market. If individuals return to the country once their studies are completed and work for three years, they could deduct 20% if they graduated from MBA or LLM studies, or 40% if they graduated from any other area of knowledge. An additional 20% can be deducted if they work as a full-time public official or in academia. Finally, another 20% can be deducted if they work in a city other than Bogotá. CBC provides additional advantages to its beneficiaries, such as the autonomy to choose the program of their preference, no age requirement, and the possibility to apply at any moment in their studies, even if they are living abroad. CBC further gives a one-year grace period after graduation to initiate payments and allows scholars to stay up to three years abroad once the academic program is completed and then return to Colombia to obtain the benefits of the scholarship.

Since its onset, CBC's beneficiaries have been selected through a merit-based process. Calls are opened every year between January and February; the information provided by the prospective candidates is analyzed between March and April, and by mid-May, Colfuturo announces the selected beneficiaries. When candidates apply, they must give basic socioeconomic characteristics as well as detailed information on their undergraduate studies, information on the program they seek to attend, proof of their knowledge of English, and an essay of why they wish to pursue their selected graduate program and how they see themselves contributing to Colombia once they finish their studies. After checking if the information is complete, Colfuturo assigns each candidate a continuous score that is a weighted average of the candidate's undergraduate GPA (42%), their ranking in the undergraduate class (15%), the quality of the graduate program she seeks to attend (38%)³ and the quality of the essay (5%).

Candidates are classified in descending order according to Colfuturos' score and divided into one of twelve areas of knowledge.⁴ Committees integrated by five renowned professionals

³ As explained, Colfuturo uses QS World University ranking to determine the quality of programs and universities.

⁴ The 12 areas are: i) Business and Administration; ii) Architecture and design; iii) Arts; iv) Agricultural and Environmental Sciences; v) Basic sciences; vi) Health Sciences; vii) Political Science and International Relations; viii) social Sciences; ix) Law; x) Economics; xi) Education, and; xii) Engineering.

in each area – all with international graduate studies – analyze the applicants’ information, rank them according to Colfuturo’s score and recommends to the Board of Directors which candidates should be offered the *CBC*. Depending on the available funds and the number of candidates, each year, the Board determines a specific cut-off point for each area, and all those candidates above it are offered the scholarship. Results are made public, and candidates have approximately one month to decide if they accept or not the scholarship. This meritocratic selection process, united with three rich databases, allows us to estimate *CBC*’s impact on its beneficiaries using a regression discontinuity design as detailed in the following sections.

3. Data

To understand the impact that *CBC* has brought to its beneficiaries, we construct a database at the individual level using three different information sources: administrative data from Colfuturo, self-reported data from a survey specially designed and implemented for a pool of eligible and non-eligible applicants of the program and governmental administrative data corresponding to the payroll taxes for formal workers in Colombia. We describe each of these data sources in detail below.

3.1 Administrative data from Colfuturo

Colfuturo collects individuals’ sociodemographic information at the time of application, including basic characteristics such as sex, age, marital status, information regarding the applicants’ background undergraduate education, and work experience. Education background information includes whether the applicant attended a private or public undergraduate university, if the university is certified with a high-quality accreditation, and the area of studies. Furthermore, it provides information about the education program that

the applicant expects to receive the grant for, including the university they are applying to, the type of program (MA, MBA, or Ph.D.), and the area of study.

We use information from 17,997 individuals who applied for the scholarship between 2003 and 2016.⁵ We drop 394 individuals who applied to an area of knowledge where all candidates in a given year were selected as beneficiaries of the program, as we need individuals both above and below the cut-off point for each area of knowledge-year combination. Also, we only kept information from the last application of candidates as 14% of them applied twice and 1,6% applied more than three times. This is our universe of Colfuturo applicants of interest. The first two columns of Table A1 in the appendix present the pre-treatment characteristics of these individuals obtained from these records.

3.2 Colfuturo Survey

During the first semester of 2019, a survey specially designed for this impact evaluation was sent to all these *Colfuturo* applicants by email. The survey included questions regarding the applicants' level of education, detailing the universities, programs, and degrees obtained, their most recent employment, and some socioeconomic characteristics such as marital status and number of children. This detailed information is not available in any official data source and is critical to understand the impact of financial aid on educational and personal outcomes.

A total of 2,859 individuals, 16% of Colfuturo's universe, answered the questionnaire. Table A1 in the appendix compares pre-treatment characteristics between the sample of individuals who answered the survey and the universe from Colfuturo's administrative records. As can be observed, there is an over-representation of *CBC* candidates from recent years. In the survey, 60% of respondents applied to *CBC* between 2013-and 2016, while the percentage of these candidates in the universe is 48%. This may be explained because it is more likely to have up-to-date contact information for more recent cohorts. In turn, the percentage of eligible respondents is 74% in the survey, compared to 59% for the universe. This indicates

⁵ Even though Colfuturo has information up until 2018, we kept information on individuals who applied until 2016 to give them enough time to graduate from their programs and join the labor market.

that those eligible may be more willing to answer the survey than those not eligible for the program. To remove this oversampling of eligible individuals, we randomly selected a subset of them from the survey and created a representative subsample of 1,994 used in all empirical exercises that follow.⁶ This assures that the percentage of individuals eligible and ineligible is proportional in both the sample survey and Colfuturos' records. However, all impact results presented in this paper are maintained when the oversampled survey information is used, and they are available upon request.

We construct some descriptive statistics from the survey to characterize our sample of study in 2019 according to their eligibility status. As shown in Table A2, the average age of the respondents in 2019 is 35 years, and 46% are women. Regarding their marital status, 55% of the non-eligible and 51% of the eligible are single. Concerning their previous education, 84% of those surveyed studied in a private K-12 schools, and approximately 30% received bilingual education. Additionally, 71.3% of the non-eligible and 67.2% of the eligible completed their undergraduate studies at a private university. These basic statistics suggest that pre-treatment education was very similar between both groups.

The survey includes information on the graduate academic achievements and professional trajectory of individuals. Regarding the former, 93% of those eligible for the CBC completed their postgraduate studies compared to 69% of the ineligible candidates. Furthermore, as evidenced in Table A2, 89% of those eligible for *CBC* completed their postgraduate studies abroad, while only 59% of ineligible did. This indicates that although a large proportion of the non-eligible completed their postgraduate education, many do so in Colombia. Self-reported data from employment suggests that almost 90% of the eligible and ineligible population work at the time of the survey, while 77% and 83% reside in Colombia, respectively. Finally, the questionnaire included information on the labor income earned in their current job. Individuals were asked to report in which of six different wage brackets their current monthly labor income was. With this information, we estimated a continuous wage variable. As standard in the labor market literature, we transformed their reported labor

⁶ We repeated this random selection process several times and consistently found the same statistical results.

income into logarithmic values to carry out the econometric exercises.⁷ As observed, clear differences emerge in this simple comparison with self-reported wages higher for eligible than for ineligible individuals, both for those who reside and work in Colombia and for those who do so abroad.

3.3 Administrative labor force records for formal employees –PILA

To complement information from the survey and allow heterogeneous and robustness checks on labor market impacts, we use administrative records from the *Integrated Form of Social Security Contributions – PILA* (by its acronym in Spanish). This database, administered by the Ministry of Labor in Colombia, includes information for all formal workers that pay their contributions to the social security system in the country. Through an agreement between Colfuturo and the Ministry, we received anonymized data from the *PILA* records between 2008 and 2019 for 93% of the pool of applicants to the CBC. The last columns in Table A1 show that, as expected, there are no significant baseline differences between the universe of Colfuturo’s applicants and those merged with the administrative records.

PILA administrative records include monthly information that enables us to construct the yearly labor history of applicants, including their information on the daily base labor income declared to the government to pay social security contributions, the number of days worked in the year, type of worker (employee or self-employed), the municipality where they work and some basic characteristics of the firm in which they are employed. The last two columns in Table A1 in the Appendix present the main descriptive statistics from this data comparing it to the universe records from Colfuturo.

⁷ For those individuals who responded that they lived abroad, we asked them to report their labor income in US dollars. To make them comparable with the labor income reported for those living in Colombia, we adjusted the values considering the average exchange rate at the time of the survey, which was 3,900 pesos per dollar.

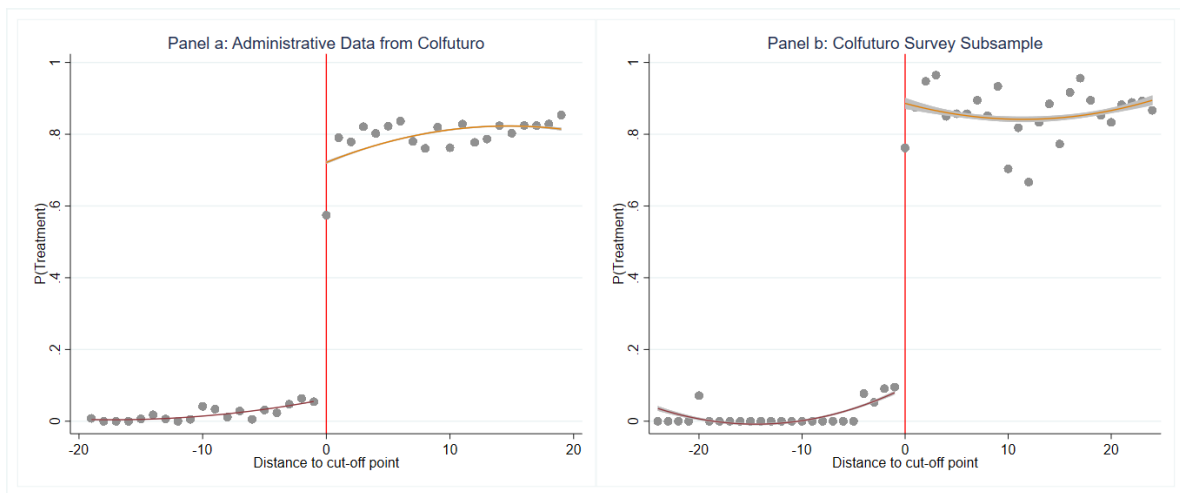
4. CBC impacts on graduate education and labor market outcomes

The ranking-based selection process of Colfuturo allows the estimation of the impact *CBC* has brought to the education and labor market outcomes of its beneficiaries through a regression discontinuity design (RD). This section presents the validity of the identification strategy chosen, the main impacts obtained, plausible impact mediators, and some heterogeneous effects and robustness checks.

4.1 RD design and compliance with validity assumptions

The selection process that defines which candidates are offered the CBC depends exclusively on their Colfuturo score. Each year, candidates are classified in descending order for each type of program and area of knowledge. A cutoff point is determined according to the number of individuals who applied and the available resources. All those above their respective cutoff are offered the scholarship. To implement the RD design, we normalized each of the cutoff points for the different years and areas of knowledge to zero and computed the distance to the threshold for each candidate.

Figure 1 - Discontinuity in the Probability of Receiving CBC



Note: The figure plots the take-up rate, that is, the probability of receiving CBC as a function of the distance to the Colfuturo's scores eligibility cutoff using information from Colfuturo universe (panel a) and from the random representative subsample of the survey (panel b). Source: Authors' calculations based on Colfuturo's administrative data and survey.

Figure 1 presents how the probability of being a CBC beneficiary changes around this normalized cutoff point for the almost 18,000 individuals from the universe of Colfuturo candidates (panel a) as well as for the 1,994 individuals in the representative subsample of the Colfuturo survey (panel b). As observed, the probability of being a *CBC* recipient increases from close to zero to 75% and 82.7% percent around the cutoff point, respectively. Data from the survey allows us to determine that almost 16% of eligible candidates did not take up the *CBC* either because they did not pursue all their academic plans or obtained funds from other sources. In fact, data from the survey indicate that almost 50% of candidates seek additional funds to finance their graduate education. Given this non-sharp compliance to the treatment, we use a fuzzy RD design in the exercises below.

RD analyses also require no selective sorting of applicants across the cutoff line. Even though the formula for estimating the Colfuturo score is publicly available to everyone, we argue that knowing ex-ante, the cutoff line, will be impossible for individuals. Not only the cutoff varies by area of knowledge and year, but it also depends on the number and quality of the applicants each year, variables that are out of control for anyone. To formally prove this exogeneity, we use the polynomial density estimator proposed by Cattaneo, Jansson, and Ma (2019) and obtained a robust-corrected p-value of 0.46. This, as well as the figures from this test and the results of the traditional McCrary test presented in Figure A1 and A2 in the appendix, suggest no manipulation of the Colfuturo's score.⁸

Finally, Table A3 and A4 in the appendix provides the results of the balance check of pretreatment variables around the treatment threshold. As observed, we cannot reject the null hypothesis that there is balance across all baseline characteristics. Notably, both the level of

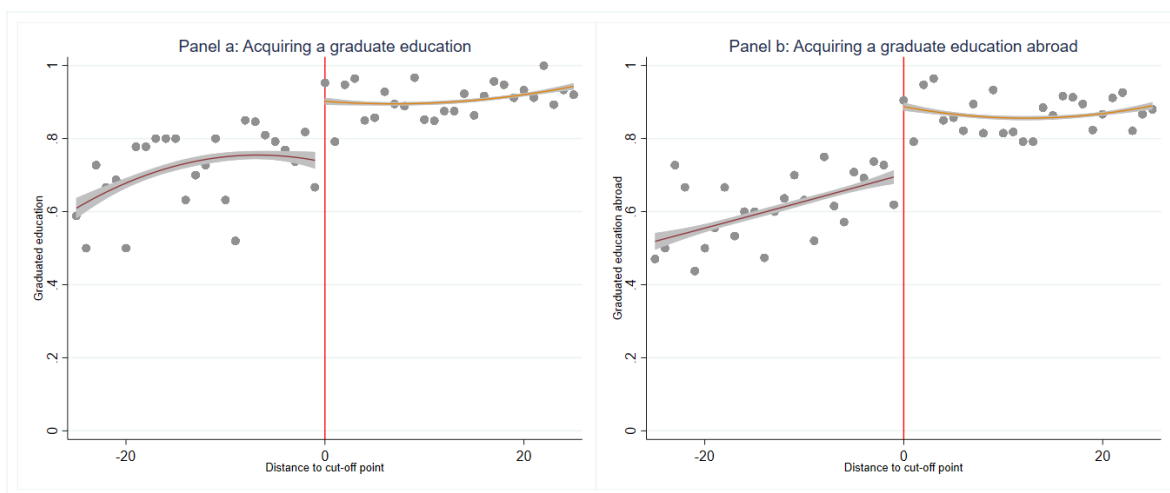
⁸ In turn, Figures A3 and A4 present these same tests when information from all 2,859 individuals in the survey sample is used. As observed, the first stage is strong and significant. However, the null hypothesis of no manipulation is rejected. This is not surprising given that there is an overrepresentation of eligible individuals who completed the survey with higher scores, causing, as expected, a discontinuity in its density. However, a balance of baseline characteristics using the complete survey sample is obtained, as observed in Table A5.

education and wages earned just before the application are statistically identical for both eligible and ineligible candidates in both the universe of candidates as well as those in the survey. This implies that any difference in these variables in 2019 would be explained by the probability of being a *CBC* beneficiary.

4.2 Impacts on graduate education attainment.

Since its onset, Colfuturo's primary purpose has been to sponsor talented professionals to acquire a graduate education in the best programs and universities worldwide. Using information from the survey and a data-driven local-polynomial-based robust inference procedure proposed by Cattaneo et al. (2014), Figure 2 depicts how *CBC* has accomplished its goal. Even though all *CBC* applicants are highly talented Colombian professionals who might not be budget-constrained, being an eligible individual significantly impacts the graduate education attained. As observed in panel a, while almost 70% of ineligible individuals obtain a graduate degree, this probability increases by nearly 20 percentage points – or 25% - for those just above the cutoff score.

Figure 2 – CBC eligibility and graduate education attainment in the Colfuturo survey



Notes: The figure plots how the probability of acquiring a graduate education (panel a) and the probability of obtaining a graduate education abroad from Colombia (panel b) varies around Colfuturo's eligibility cutoff

using information from the random subsample of the survey. Source: Authors' calculations based on Colfuturo's administrative data and survey.

Panel b in Figure 4 presents the impact eligibility has on the plausible quality of the academic programs eligible individuals were able to attend thanks to CBC. Around 60% of barely ineligible individuals obtain their graduate degrees from universities abroad Colombia; this percentage increases by 25 percentage points or 40% for barely eligible ones. Analyzing the list of the most common universities CBC candidates attend gives an idea of the quality of graduate education they receive. Common universities of CBC scholars include the London School of Economics (LSE), Politecnico di Milano, New York University, Columbia University, IE Business School, University College London, Universidad de Barcelona, University of Melbourne, Hult International University Business School, Universidad Autonoma de Barcelona, Harvard University, University of Manchester, Georgetown University, Erasmus University Rotterdam, Delft University of Technology, Kings College London, among others.

Table 1 presents the ITT and LATE outcomes obtained after controlling for sex, age at application, type of program, area of study, and year of application.⁹ Impacts of CBC are positive and significant. Even though all applicants are highly trained professionals with a privileged background, it is evident that this graduate scholarship serves to attain longer and higher quality graduate education. Compared to individuals marginally below the cutoff point, those who accepted the CBC increased their probability of acquiring a graduate degree and a graduate degree abroad by 22 and 28 percentage points, a 31% and 50% difference with respect to the control group, respectively. There is no impact on the number of years of postgraduate education attained, suggesting that the length of the programs studied is the same for those who undertake them.

⁹ Results are maintained when controls are not used and are available upon request. Moreover, even though the results presented in this section are associated with information from the random subsample of Colfuturo's survey, when the complete sample is used, main impacts are also maintained. The most important outcomes with data from the complete survey are presented in Table A7 for interested readers. All others are available upon request.

Table 1 – Impacts of CBC on education outcomes in the Colfuturo survey

	Obtained a graduate education		Obtained a graduate education abroad		Years of graduate education	
	ITT	LATE	ITT	LATE	ITT	LATE
Robust	0.182** (0.078)	0.220** (0.093)	0.235*** (0.082)	0.283*** (0.096)	0.279 (0.298)	0.337 (0.355)
Number of individuals	1817	1817	1817	1817	1817	1817
Beta first stage	.	.829***	.	.829***	.	.829***
SE first stage	.	.054	.	.054	.	.054
Band width	25.60	25.60	25.60	25.60	25.60	25.60
Obs left	395	395	395	395	395	395
Obs right	624	624	624	624	624	624
Control mean	.724	0.698	.615	0.566	1.629	1.513
Percentage difference	25.1%	31.4%	38.1%	50%	17.1%	22.2%

*Notes: The table presents the impact of CBC eligibility and treatment using a regression discontinuity design. The dependent variables are: a) acquiring a graduate education program; b) acquiring a graduate education program abroad; c) the number of years of graduate education acquired. All estimations use Colfuturo's scores as the running variable and are estimated using bias-corrected methods from Calonico, Cattaneo, and Titiunik (2014). Robust standard errors in parenthesis, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Source: Authors' calculations based on Colfuturo's administrative data and survey.*

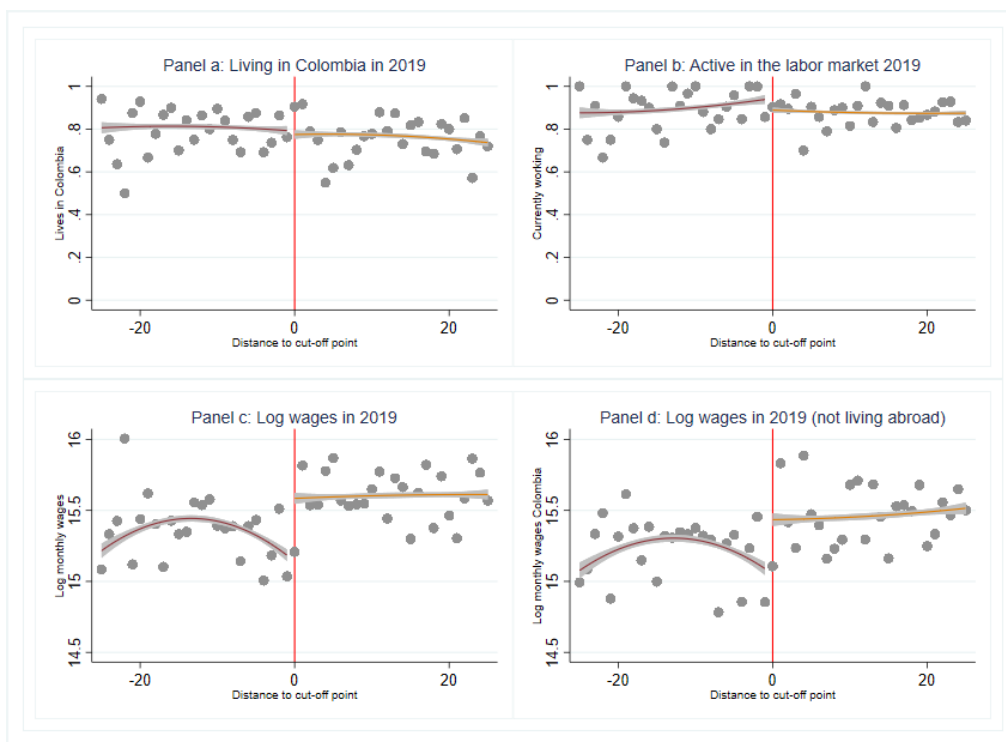
4.3 Impacts on labor market outcomes.

Is this higher postgraduate education attained by beneficiary individuals associated with higher wages? Studies for developed countries have shown that investing in postgraduate education is associated with positive returns. Still, as mentioned in the introduction, there is almost no causal evidence in the literature to answer this question. Moreover, only a handful of studies analyze the impacts of *undergraduate* scholarships on labor market outcomes and its evidence is mixed. Even though positive impacts are found for some undergraduate scholarships in developed countries, these effects are small or concentrated in a group of individuals (Angrist et al., 2020, and Dale and Kruger, 2011). Moreover, in many other settings impacts on labor income are either imprecisely estimated or close to zero (Bettinger

et al., 2019; Scott-Clayton, 2017). For developing countries, causal studies for Chile have shown no significant positive returns in terms of labor income for most students receiving scholarships or undergraduate study credits and only positive ones for those who come from elite family backgrounds (Zimmerman, 2019; Bucarey, Contreras & Muñoz, 2019; Rau, Rojas and Urzúa, 2013).

The information of the survey allows us to evaluate CBC's impact on labor market outcomes. We center our attention on four outcomes of interest: whether individuals return or not to Colombia after finishing their graduate programs, whether the individuals are working at the time of the survey, and their self-reported labor income (in Colombia or abroad). Figure 3 presents the impact on these four outcomes. As observed, being eligible for CBC has no impact on either living in Colombia nor on the probability of being working in 2019 (panels a and b). Almost 80% of applicants to CBC end up living in Colombia, and nearly 90% are active in the labor market. However, the impact of CBC on labor income is economically important. As observed in panels c and d, there is a clear discontinuity of around 30% in the labor income reported by eligible and non-eligible candidates using either the complete sample or only those who reside and work in Colombia.

Figure 3 – CBC eligibility and labor market outcomes in the Colfuturo Survey



Notes: The figure plots: a) the probability of living in Colombia in 2019; b) the probability of working in 2019; c) self-reported log wages, and d) self-reported log wages for those living in Colombia as a function of the distance to the Colfuturo's scores eligibility cutoff using the random subsample of the survey. Source: Authors' calculations based on Colfuturo's administrative data and survey.

Table 2 presents the main ITT and LATE results of the RD estimations. Even though almost 85% of eligible CBC candidates study their graduate programs overseas, most of them return to Colombia. Moreover, eligibility has no impact on the probability that they are active in the labor market either, which is not surprising given that all of them are highly qualified and motivated professionals. The absence of impacts in these two outcomes further facilitates our interpretation of the impact of CBC on the labor income earned by its applicants. The last two columns show that eligible CBC candidates earn a self-reported labor income almost 36% higher than non-eligible candidates. In fact, those who took the scholarship and studied abroad make a labor income 45% higher than those who did not receive this opportunity.

Table 2 – Impacts of CBC on residence and labor market outcomes

	Lives in Colombia		Work		Log monthly wages Total	
	ITT	LATE	ITT	LATE	ITT	LATE
Robust	0.057 (0.079)	0.069 (0.095)	-0.039 (0.060)	-0.047 (0.073)	0.362** (0.157)	0.451** (0.188)
Number of individuals	1,817	1,817	1,817	1,817	1,613	1,613
Beta first stage	.	.829***	.	.829***	.	.829***
SE first stage	.	.054	.	.054	.	.054
Band width	25.60	25.60	25.60	25.60	25.60	25.60
Obs left	395	395	395	395	354	354
Obs right	624	624	624	624	552	552
Control mean	0.808	0.808	.9	.887	15.365	15.341
Percentage difference	-	-	-	-	36.2%	45.1%

*Notes: The table presents the impact of CBC eligibility and treatment on the place of residence and labor market outcomes using a regression discontinuity design. The dependent variables are a) residing in Colombia in 2019; b) working in 2019; c) self-reported labor income in 2019. All specifications use Colfuturo's scores as the running variable and are estimated using bias-corrected methods from Calonico, Cattaneo, and Titiunik (2014). Robust standard errors in parenthesis, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Source: Authors' calculations based on Colfuturo's administrative data and survey.*

Reflecting on the channels that explain such large impacts of CBC on labor income is essential. Education is undoubtedly a key determinant of wages, and in recent years the returns to higher education have increased worldwide. In economics, two theories explain the mechanisms through which these returns are generated. As stated in his seminal study, Spence (1973) argues that education can increase wages thorough different channels. First, education enhances the labor productivity of the individual and, as a result, raise the wages earned. However, in a world of incomplete information, acquiring more education can become a sign of the individual's intellectual abilities. In this case, even if education does not contribute per se to the worker's productivity, employers may be willing to pay a higher wage to those with higher levels of education. Of course, these theories are not excluding but rather complementary in explaining the labor income finally earned by individuals.

The literature that analyzes the classic relationship between education and wages in developed and developing countries is ample. Studies that examine education as a signaling problem are scarcer. In the United States, there are studies with mixed results. For example, while Lang and Kropp (1986), Bedard (2001), and Tyler et al. (2000) find evidence of the existence of returns to secondary education due to signaling, Clark and Martorell (2014) do not find any evidence for this. For the specific case of the Colombian labor market, the literature suggests that both theories come into play when reviewing returns to higher education. On the one hand, Arteaga (2018) shows that the Colombian labor market does respond to the accumulation of human capital. Nonetheless, rigorous evidence has also been found about the existence of returns by signaling from the best universities in the country (Saavedra, 2009; Barrera-Osorio and Bayona, 2019; MacLeod et al., 2017).

To understand which channels could explain the impacts of CBC, we undertake a mediation analysis strategy following Imai et al. (2010). Given the impact of CBC on education outcomes, two mediators are chosen: having a graduate education and having a graduate education abroad. Table 3 summarizes the main results from this analysis. The first column simply presents the ITT impact of CBC on labor income using the conventional RD estimator, which amounts to 21.3%. The other columns analyze how much the two complementary mediators explain these returns. The first mediator explored is having a graduate education which, as previously shown, increases for eligible candidates. As specified in the lower seven rows of the table, the indirect effect that occurs through this rise in the quantity of the graduate education explains an increase in labor income of 6%, that is, the equivalent of 28.7% of the total impact.

The higher labor income observed for CBC's beneficiaries may be explained by the type of postgraduate degrees individuals can attend. Columns 4 and 5 in the table analyze this possibility by having as mediator an indicator variable if postgraduate education was obtained abroad. As expected, being eligible effectively increases the probability of having a postgraduate degree abroad. Notably, a graduate education abroad explains 40% of the income labor difference between barely eligible and ineligible individuals. This could be related to the fact that programs abroad have a higher quality than postgraduate programs in

Colombia. Suggestive evidence of this is obtained by comparing the quality of the programs attained using the QS World University Rankings.¹⁰ While there is no difference between the ranking of academic programs individuals applied for CBC, the average ranking of programs effectively attended is higher for eligible than non-eligible individuals. However, it is difficult to ascertain that the portion of the impact explained by this mediator is a productivity effect. Of course, other variables that may be impacted by the scholarship, such as professional networks, self-confidence, and the opportunity to live abroad, might also impact labor income. However, these variables are non-observable, restricting the possibility of using them as plausible alternative mediators.

Table 3 – Mediation analysis of the impacts of CBC on labor income

	Total Effect on labor income	Having graduate education		Having graduate education abroad	
		Mediator	Labor income	Mediator	Labor income
Eligible	0.213** (0.099)	0.161*** (0.047)	0.152 (0.098)	0.214*** (0.051)	0.120 (0.097)
Mediator			0.378*** (0.068)		0.432*** (0.063)
Constant	10.132*** (1.862)	-0.342 (0.888)	10.261*** (1.831)	-0.339 (0.956)	10.278*** (1.816)
Observations	906	906	906	906	906
Bandwidth	25.60	25.60	25.60	25.60	25.60
Mean control	15.24	.724	15.37	.615	15.37
Indirect effect			0.061*** (0.021)		0.092*** (0.026)
Direct effect			0.152 (0.098)		0.120 (0.097)
Total effect			0.213** (0.099)		0.213** (0.099)
% Explained by indirect effect			28.7%		43.4%

*Notes: The table presents a mediation analysis of CBC's impact following Imai et al. (2010). The two plausible mediators are having a postgraduate diploma and postgraduate education abroad. Robust standard errors in parenthesis, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Source: Authors' calculations based on Colfuturo's administrative data and survey.*

¹⁰ For information on the ranking, visit <https://www.topuniversities.com/qs-world-university-rankings/methodology>.

The mediation analysis shows that almost 50% of the impact cannot be explained by the additional education individuals attain and thus could be explained through a signaling mechanism. Possibly, being an eligible CBC candidate gives individuals an extra signal that is rewarded by the market in the country. Interviews with entrepreneurs in Colombia suggest that this is the case. In fact, Colombian entrepreneurs ascertain that those individuals who succeeded through Colfuturo's selection process can be characterized as determined, responsible, and committed professionals.¹¹

4.4 Robustness checks and heterogeneous impacts using administrative payroll records.

We use the government's administrative tax data to conduct robustness checks and heterogeneous impacts. Almost 90% of applicants were found in PILA's administrative records. However, since twenty percent of them live abroad, we are left with administrative taxpayers' records for almost 12,000 of Colfuturo's applicants between 2009 and 2019. We use this information to check whether the labor market results obtained with the self-reported data in the survey are maintained when this alternative source of information is used.¹²

In the administrative records, each applicant is observed for an average of nine years, allowing us to have over sixty-one thousand observations for the estimation of these exercises. As shown in the first column of Table 4, despite the difference in the information source and the longer timespan used with PILA's records, the impacts using administrative

¹¹ In total 50 interviews with entrepreneurs, public sector officials as well as beneficiary and non-beneficiary individuals were carried out by Colfuturo in 2019. This view is one of the most common responses they gave when asked about Colfuturo's scholars. Results from these qualitative analyses can be obtained in <https://impacto.colfuturo.org/apps/impacto/>.

¹² We tested that the three requirements for the implementation of an RD analysis are satisfied when using the PILA administrative data. As observed in Figures A5 and A6, not only is there a clear discontinuity in the probability of receiving the CBC at the cutoff point, but also there is no evidence of manipulation of the Colfuturo score. Similarly, Table A6 shows that all baseline characteristics are statistically identical at the cut-off score.

data are remarkably similar as those obtained using the survey data. On average, beneficiary CBC candidates earn 45.9% higher labor income than their peers.¹³ Moreover, the similarity of impacts also suggests that candidates did not provide false information, neither in Colfuturo's application forms nor in the survey conducted in 2019.

Administrative data allows us to estimate a placebo model that gives further credence to the results obtained. The second column in Table 4 presents the difference in the labor market income reported to the government in PILA for all candidates *before* applying to the CBC. There were no significant differences between eligible and ineligible individuals' yearly labor income before applying for the scholarship. This is consistent with the balance obtained in baseline wages reported by individuals in Colfuturo's administrative records.

The last columns in Table 4 summarize the results of some heterogeneous impacts. Previous studies have shown that the impact of financial aid sometimes depends on the candidate's gender, academic history and socioeconomic background. For example, Zimmerman (2019) finds that only men who studied in private schools have positive returns from studying in Chile's most selective programs and universities. We test if these results are also observed in the Colombian labor market.

Regarding gender, as is common worldwide, administrative records show that women earn lower labor incomes than men. Furthermore, the estimates reveal that being eligible for CBC only brings positive returns for men. While eligible and ineligible women earn the same income from work, eligible men earn a labor yearly income 70% higher than those just below the cutoff point. Columns (7) and (8) in Table 4 present the results according to the type of university the candidates attended in their undergraduate studies. As observed, for those individuals who attended a private university, being eligible for CBC increases yearly labor income by around 40%. This impact is reduced to 27% for graduates from public universities. Finally, the last columns show that impacts of CBC accrue to individuals who pursue an MBA or a MA degree, but no effect is found for those who apply for a Ph.D. program.

¹³ As observed in Table A7 in the appendix, this higher annual labor income of beneficiary individuals is explained by both number of days worked (5%) and daily wages earned (35%).

Table 4 – Robustness checks and heterogeneous impacts (LATE estimates)

	Period of PILA information used		Yearly average labor income				By type of graduate program			Type of work		
	2009 - 2019 (I)	Prior to application (II)	By gender		By undergraduate university		MBA (VI)	MA (VII)	Ph.D. (VIII)	Yearly salary per employee (mean) (IX)	Independent worker (X)	Mean number of employees (XI)
			Men (III)	Women (III)	Public (IV)	Private (V)						
Robust	0.459*** (0.085)	-0.107 (0.115)	0.703*** (0.115)	0.067 (0.088)	0.271** (0.106)	0.398*** (0.097)	0.404*** (0.150)	0.314*** (0.086)	0.199 (0.191)	-0.038 (0.106)	-0.095*** (0.037)	0.728*** (0.253)
Number of observations	61,138	20,330	33,199	27,939	15,204	44,274	6,978	48,264	5,394	47,572	56,880	60,582
Number of individuals	11996	11359	6347	5649	3049	8614	1277	9671	959	10233	11689	11872
Beta first stage	.589***	.67***	.585***	.648***	.681***	.576***	.781***	.596***	.526***	.629***	.594***	.588***
SE first stage	.018	.024	.024	.02	0.025	0.02	.027	.019	.043	.019	.018	.018
Band width	12.90	12.90	13.21	20.48	23.10	13.65	20.17	14.74	26.07	12.90	12.902	12.90
Obs left	6434	2329	3627	4564	2546	5052	1322	5678	885	4983	5961	6373
Obs right	9036	3498	5304	6669	4446	6995	1721	8321	1655	6991	8375	8947
Control mean	17.1	16.6	17.1	17.0	17.0	17.1	17.3	17.0	17.4	14.70	.266	4.23

Notes: The table presents the impact of being CBC treatment on labor market outcomes using a regression discontinuity design and governmental administrative tax records. The dependent variables are a) yearly income; b) yearly income before Colfuturo application; c) yearly income by gender; and; d) yearly income by type of University where undergraduate studies were undertaken. All specifications use Colfuturo's scores as the running variable and are estimated using bias-corrected methods from Calonico, Cattaneo, and Titiunik (2014). Robust standard errors in parenthesis, *** p<0.01, ** p<0.05, * p<0.1. Source: Authors' calculations based on Colfuturo and PILA's administrative data.

Finally, the last three columns of Table 4 present evidence on the type of jobs and firms where eligible and ineligible individuals' work. As observed in model 10, the higher wages beneficiary individuals earn are not explained by working in firms with higher mean wages. They work in firms with the same average wage. However, there is a difference in that eligible individuals have a lower probability of being self-employed and therefore work in firms with fewer employees.

5. Cost-Benefit Analysis

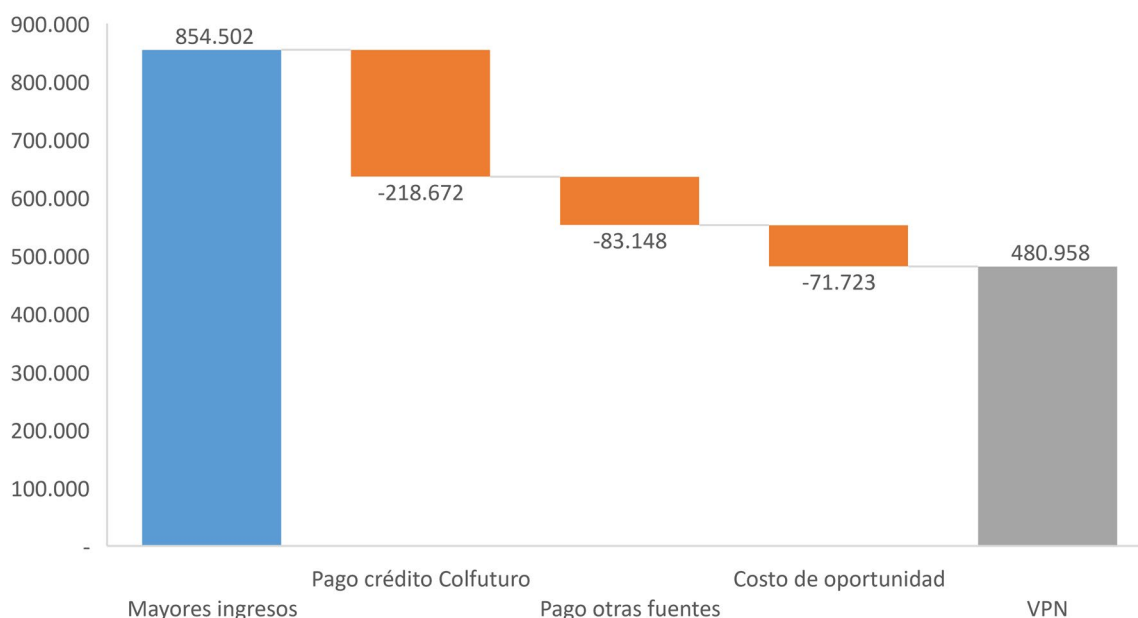
The cost-benefit analysis enables us to identify the changes in the welfare of the Colombian society brought by CBC through the measurement and monetization of the impacts it has on the different agents involved (Castro and Mokate, 2003; Boardman, Greenberg, Vining and Weimer, 2011). Four main agents participate in the costs and benefits of the program: the scholarship beneficiaries and their families, Colfuturo as an institution, the government, and the society in general. The private benefits and costs correspond to those perceived directly by the scholarship beneficiaries and their families. In contrast, the social benefits and costs comprise both these private ones and those perceived by Colfuturo as an institution, the government, and society in general. In addition, the benefits and costs can be divided between those susceptible to monetization and those that are not given the available information.

Once the benefits and costs of the program are determined, we calculate the different flow of funds and the usual returns indicators, particularly the Net Present Value (NPV), the Benefit-Cost Ratio (BCR), and the Internal Rate of Return (IRR). For the private NPV, BCR, and IRR estimations, we use a 6.87%¹⁴ discount rate, while for the social estimates, we use a 9% social discount rate.

¹⁴ This is the average real rate of interest beneficiaries pay on the loan.

The private positive benefit of the program included in our estimation is the higher labor income earned¹⁵ while the negative ones include the payment of the loans to Colfuturo and other sources of funds as well as the opportunity cost measured as the forgone labor income during the time of the studies abroad. The estimation of the returns that a Colfuturo's beneficiary would perceive after graduation – a key indicator for the decision to apply for the scholarship – comprises the calculations of the present value of the flows of benefits and costs. Using a 6.87% discount rate, the benefits amount to 854.502 million pesos, whereas the cost reaches 373,543 million pesos. The present value of the costs - see Figure 4 - includes the loan payment to Colfuturo (58.5%), the payment of other sources of funds (22.3%), and the opportunity cost of the foregone labor income (19.2%).

Figure 4 – Present Value of the estimated private benefits and costs



Source: Own calculations based on information from Colfuturo, National Bureau of Statistics, Administrative Records of Pension Contribution (PILA), and surveys applied to Colfuturo's applicants (2019).

¹⁵ Higher wages and labor income comprise the largest proportion of the private benefits. To estimate the flows of its benefits, we use the impact of the program on labor income obtained with the RD methodology. Specifically, the estimated impact on this variable is equal to 0.45 and comes from Table 4 column 1. The present value is calculated using the labor income flows over a time span of 23 years.

Once we compare the direct benefits and costs from Figure 4, the estimated private IRR of the Colfuturo's scholarship equals 24.5%. In contrast, the private BCR reaches 2.29, indicating that each beneficiary spends to pursue a graduate degree abroad obtains a 2.29 Colombia peso benefit for each Colombian peso.

The social benefits and costs comprise both the private and those generated for the government, Colfuturo as an institution, and the society in general, including among the latter remittances¹⁶ sent to Colombia by the beneficiaries that stayed abroad, and the additional tax revenues¹⁷ levied on the beneficiaries that returned to the country. Nonetheless, several social benefits are not susceptible to monetization, including the greater intellectual production -for instance, publications of books and journal articles- the improvement of the Colfuturo's status in the society, and the diversification of the areas of knowledge, particularly medical specialties. Using a 9% social discount rate, the social IRR reaches 29%. At the same time, the BCR equals 2.24, indicating that for each peso the society spends on the Colfuturo's scholarship program, the Colombian society obtains at least 2.24 pesos of monetizable benefits.

6. Conclusions

Private and public funds are constantly mobilized worldwide to increase the educational attainment of individuals. The returns of these investments for elementary and secondary education have been thoroughly studied for both developed and developing economies. Recently, a rapidly growing literature has analyzed the causal impacts of loans and merit or need-based scholarships on college enrollment, graduation rates, and labor income. To the best of our knowledge, this paper complements the existing literature by being the first one to analyze the causal impact that graduate education financial aid programs have on the individuals who receive them.

¹⁶ The present value of the remittances equals COL\$ 1583 million comprising 0.3% of the total social benefits.

¹⁷ The present value of the tax revenues equals COL\$ 68134 million comprising 13.7% of the total social benefits.

Through a regression discontinuity design, we find that the impacts of these programs are important. Credit constraints for this population are binding, and thus eligible individuals can attain more and probably better quality of postgraduate education than ineligible ones. Moreover, the labor market values international graduate education, implying that wages are higher for the former too. At least half of the impact on this outcome is probably explained by the signaling that being a Colfuturo scholar has to the Colombian entrepreneurs.

This credit program, which is a public and private initiative, is reaching the goals that it was created for. Indeed, the number of Colombian graduate professionals from top universities has increased thanks to the program. Moreover, most beneficiaries return to the country and apply their knowledge in the national labor market, contributing to economic growth. However, areas of improvement or concern regarding the impacts it is bringing remain. Amongst the most important ones is that all the labor income impacts are explained by the impact on men, as we find no difference in wages of eligible and ineligible women. Although this result goes in hand with evidence recently found in other developing countries, actions to try and change this are necessary. Also, returns appear to be higher for individuals who were able to attend a private undergraduate institution suggesting that the mobility impacts of the scholarship, although present, could improve too.

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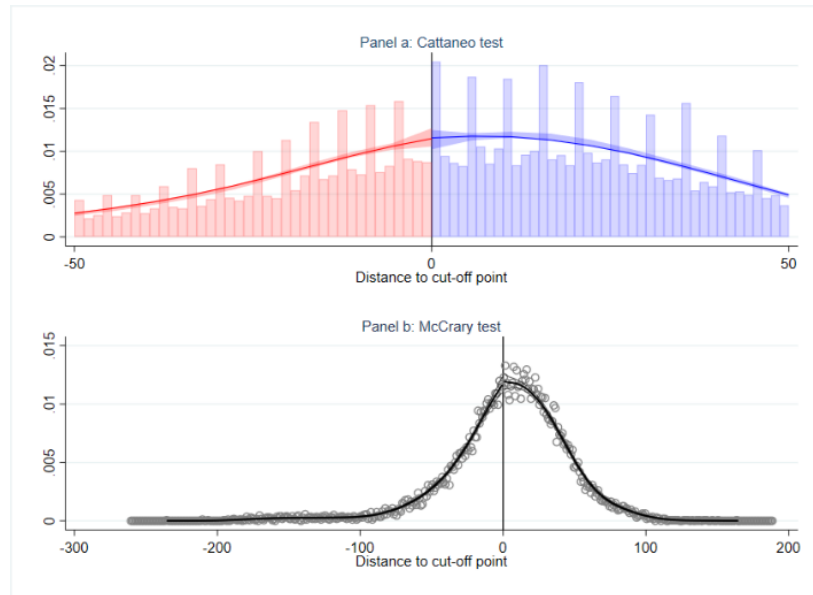
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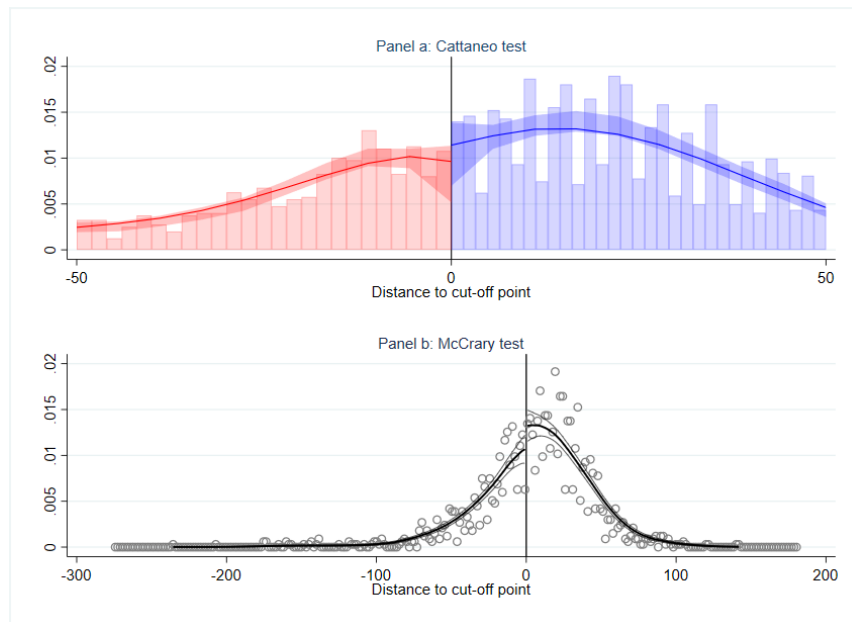
Appendix

Figure A1 – No manipulation tests for Colfuturo’s universe of applicants between 2003-2016



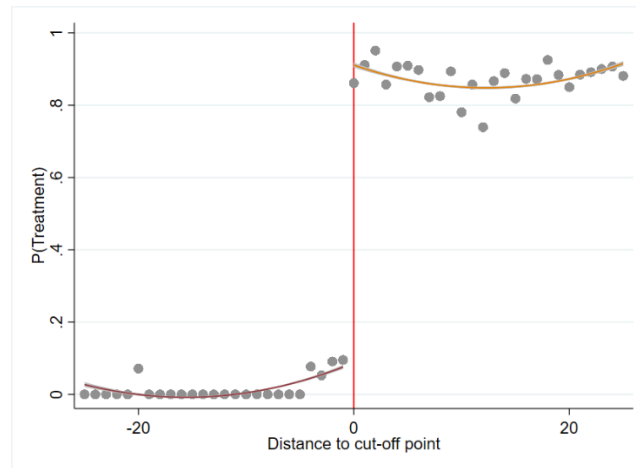
Note: The figure presents the results obtained when both Cattaneo, Jansson, and Ma (2019) and McCrary’s tests of no manipulation are performed using information from *all* Colfuturo Applicants between 2003 and 2016. Source: Authors’ calculations based on Colfuturo’s administrative data.

Figure A2 – No manipulation tests (Colfuturo’s survey representative subsample)



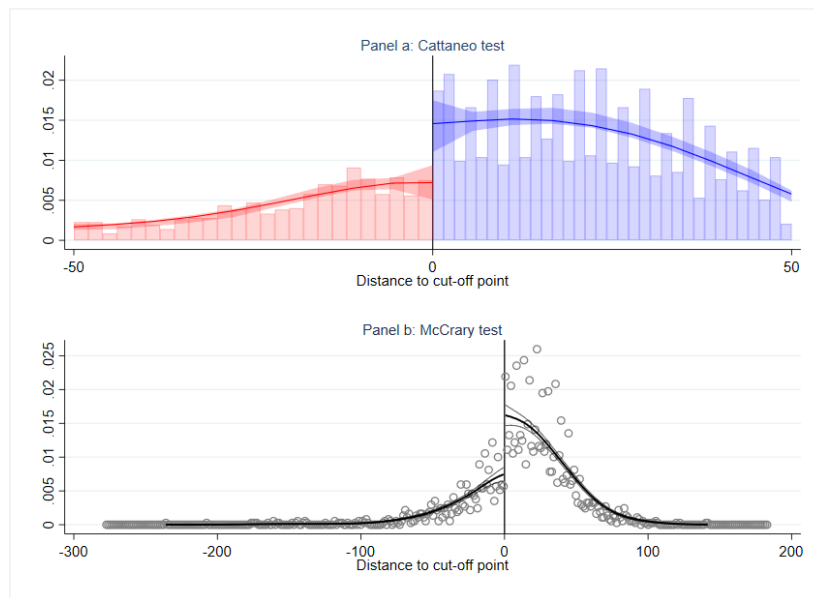
Note: The figure presents the results obtained when both Cattaneo, Jansson, and Ma (2019) and McCrary’s tests of no manipulation are performed using information from random subsample of the Colfuturo Survey. Source: Authors’ calculations based on Colfuturo’s administrative data and survey.

Figure A3 - Discontinuity in the Probability of Receiving CBC (Colfuturo's Survey complete information)



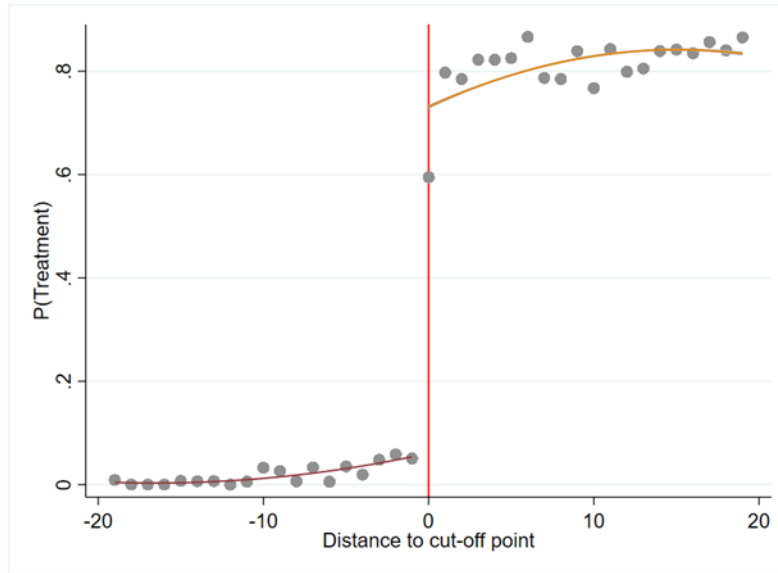
Note: The figure plots the take-up rate, that is, the probability of receiving CBC as a function of the distance to the Colfuturo score's eligibility cutoff using information from Colfuturo's survey complete information. Source: Authors' calculations based on Colfuturo's administrative data and complete survey.

Figure A4 – No manipulation tests (Colfuturo's Survey complete information)



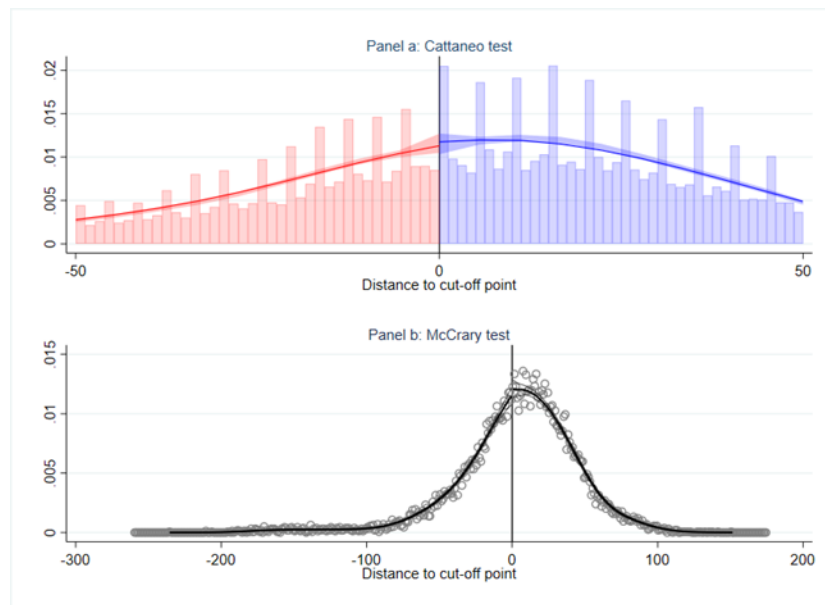
Note: The figure presents the results obtained when both Cattaneo, Jansson, and Ma (2019) and McCrary's tests of no manipulation are performed using information from Colfuturo's complete survey information. Source: Authors' calculations based on Colfuturo's complete survey.

Figure A5 - Discontinuity in the Probability of Receiving CBC (PILA information)



Note: The figure plots the take-up rate, that is, the probability of receiving CBC as a function of the distance to the Colfuturo score's eligibility cutoff using information from PILA. Source: Authors' calculations based on Colfuturo's administrative data and PILA.

Figure A6 – No manipulation tests (PILA information)



Note: The figure presents the results obtained when both Cattaneo, Jansson, and Ma (2019) and McCrary's tests of no manipulation are performed using information from PILA. Source: Authors' calculations based on Colfuturo's and PILA administrative records.

Table A1 – Pre-treatment characteristics of CBC's applicants and survey respondents

	(1) Colfuturo Applicants Universe (2003 - 2016)	(2)	(3) Colfuturo Survey	(4)	(5) Universe vs. Survey	(6) P- value	(7) Subsample of survey	(8)	(9) Universe vs. Subsample Survey	(10) P- value	(11) PILA	(12)	(13) Universe vs. PILA	(14) P- value
	N	Mean	N	Mean	Diff		N	Mean	Diff		N	Mean	Diff	
Application year 2003-2007	17,603	0.11	2,859	0.04	0.07	0.00	1,994	0.05	0.06	0.00	15,884	0.09	0.14	0.00
Application year 2008-2012	17,603	0.41	2,859	0.35	0.05	0.00	1,994	0.35	0.06	0.00	15,884	0.41	-0.12	0.00
Application year 2013-2016	17,603	0.48	2,859	0.60	-0.12	0.00	1,994	0.60	-0.13	0.00	15,884	0.50	-0.02	0.06
Colfuturo score	17,603	4.17	2,859	4.26	-0.11	0.00	1,994	4.21	-0.03	0.00	15,884	4.17	-0.02	0.09
% Eligible applicants	17,603	0.59	2,859	0.74	-0.18	0.00	1,994	0.62	-0.01	0.49	15,884	0.59	-0.04	0.00
% PhD applicants	17,603	0.07	2,859	0.09	-0.02	0.00	1,994	0.08	-0.01	0.28	15,884	0.07	-0.01	0.30
% Medical specialization applicants	17,603	0.01	2,859	0.00	0.00	0.16	1,994	0.00	0.00	0.12	15,884	0.01	0.00	0.19
% Master applicants	17,603	0.82	2,859	0.83	-0.01	0.31	1,994	0.83	-0.01	0.12	15,884	0.82	0.05	0.00
% MBA applicants	17,603	0.10	2,859	0.08	0.02	0.00	1,994	0.09	0.02	0.01	15,884	0.10	-0.04	0.00
Age at time of application	16,169	27.43	2,611	27.57	-0.17	0.01	1,817	27.56	-0.13	0.07	14,606	27.49	-0.66	0.00

Women	17,603	0.47	2,859	0.46	0.01	0.43	1,994	0.45	0.02	0.06	15,884	0.47	-0.05	0.00
Born in capital city	17,603	0.32	2,859	0.30	0.02	0.04	1,994	0.29	0.03	0.00	15,884	0.32	-0.01	0.51
Married	17,603	0.18	2,859	0.19	-0.02	0.01	1,994	0.18	-0.01	0.57	15,884	0.17	0.01	0.16
Work	17,603	0.94	2,859	0.94	0.00	0.37	1,994	0.93	0.00	0.50	15,884	0.94	0.06	0.00
Wage less than 1MM COP	16,472	0.14	2,686	0.15	0.00	0.65	1,994	0.13	0.00	0.87	14,951	0.14	0.04	0.00
Wage between 1-3 MM COP	16,472	0.36	2,686	0.39	-0.04	0.00	1,994	0.38	-0.05	0.00	14,951	0.37	-0.13	0.00
Wage between 3-5 MM COP	16,472	0.18	2,686	0.21	-0.04	0.00	1,994	0.20	-0.03	0.00	14,951	0.18	-0.05	0.00
Wage greater than 5 MM COP	16,472	0.32	2,686	0.25	0.08	0.00	1,994	0.23	0.09	0.00	14,951	0.30	0.14	0.00
Undergraduate program Colombia	17,603	0.97	2,859	0.98	-0.01	0.00	1,994	0.98	-0.01	0.00	15,884	0.97	-0.04	0.00
Undergraduate private university	17,032	0.71	2,797	0.68	0.03	0.00	1,950	0.68	0.03	0.00	15,429	0.72	-0.11	0.00
Undergraduate high quality university	17,032	0.95	2,797	0.95	-0.01	0.23	1,950	0.95	-0.01	0.28	15,429	0.95	-0.01	0.08

Notes: The table presents the main characteristics of all CBC's applicants between 2003 and 2016 (columns 1-2); CBC's survey (columns 3-4); CBC's survey subsample (columns 7-8) and PILA (columns 11-12). Columns 5-6 and 9-10 present mean differences between CBC's pool of applicants and survey and subsample of survey respondents, respectively.

Table A2 – Eligible and ineligible 2019 characteristics of CBC’s survey representative subsample

	Ineligible Candidates			Eligible candidates			Differences	
	N	Mean	St. Dev.	N total	Mean	St. Dev.	Differences	P-value
Colfuturo score	750	3.92	0.34	1,244	4.38	0.19	-0.46	0.00
Women	750	0.45	0.50	1,244	0.45	0.50	0.00	0.85
Age in 2019	748	34.81	5.86	1,244	34.58	5.06	0.23	0.35
Single	750	0.55	0.50	1,244	0.51	0.50	0.04	0.08
Married	750	0.34	0.48	1,244	0.39	0.49	-0.04	0.06
Consensual unión	750	0.09	0.28	1,244	0.09	0.28	0.00	0.99
Divorced	750	0.02	0.14	1,244	0.02	0.13	0.00	0.87
Private K-12 School	750	0.84	0.37	1,244	0.83	0.37	0.01	0.59
Bilingual K-12 School	749	0.29	0.45	1,241	0.31	0.46	-0.02	0.28
Undergraduate program private University	739	0.71	0.45	1,211	0.67	0.47	0.05	0.03
Graduate Education	750	0.70	0.46	1,244	0.92	0.27	-0.22	0.00
Graduate Education abroad	750	0.59	0.49	1,244	0.88	0.32	-0.29	0.00
Work	750	0.89	0.31	1,244	0.88	0.32	0.01	0.35
Lives in Colombia	750	0.83	0.38	1,244	0.77	0.42	0.06	0.00
Wages in Colombia (\$)	557	3.64	2.27	862	4.68	2.77	-1.03	0.00
Wages abroad (US\$)	114	3.75	1.72	234	4.03	1.61	-0.28	0.14

Note: The table presents the main 2019 characteristics of CBC’s survey respondents in the subsample distinguishing between non-eligible and non-eligible candidates. Applicants between 2003 and 2016 (columns 1-2); CBC’s survey (columns 3-4) and CBC’s survey subsample (columns 7-8). Columns 5-6; 9-10 and 13-14 present mean differences between CBC’s pool of applicants and the three other samples respectively.

Table A3 – Balance around the cutoff point of baseline characteristics in the Colfuturo's survey representative subsample

	Age at application	Women	Born in one of the 13 main cities (DANE)	Married or with couple	Working at application	Wages at application				Undergraduate studies		
						Less than 1 MM COP	Between 1 and 3 MM COP	Between 3 and 5 MM COP	Greater than 5 MM COP	In Colombia	Private University	High quality
Colfuturo Subsample												
Robust	-0.095 (0.772)	-0.037 (0.121)	-0.118 (0.113)	0.061 (0.090)	-0.067 (0.059)	-0.049 (0.090)	0.083 (0.112)	0.081 (0.100)	-0.048 (0.071)	0.030 (0.024)	0.034 (0.109)	0.002 (0.048)
Observations	1,817	1,994	1,994	1,994	1,994	1,994	1,994	1,994	1,994	1,994	1,950	1,950
Number of individuals	1817	1994	1994	1994	1994	1994	1994	1994	1994	1994	1950	1950
Number of individuals in optimal bandwidth	982	1079	1079	1079	1079	1079	1079	1079	1079	1079	1062	1062
Beta first stage	.829***	.788***	.788***	.788***	.788***	.788***	.788***	.788***	.788***	.788***	.804***	.804***
SE first stage	0.055	.058	.058	.058	.058	.058	.058	.058	.058	.058	.056	.056
Band width	24.69	24.69	24.69	24.69	24.69	24.69	24.69	24.69	24.69	24.69	24.69	24.69
Obs left	380	425	425	425	425	425	425	425	425	425	421	421
Obs right	602	654	654	654	654	654	654	654	654	654	641	641
Control mean	27.684	.457	.28	.145	.096	.151	.386	.204	.163	.99	0.699	0.954

Notes: The table presents the reduced-form coefficient from a RD specification where the outcomes are the baseline characteristics of Colfuturos' applicants in the survey subsample and the running variable is Colfuturo score. All results are estimated with package rdrobust (Cattaneo, Calónico and Titiunik, 2014).

Table A4 – Balance around the cutoff point of baseline characteristics using the universe of Colfuturo's information.

	Age	Women	Working	Wage less than 1 MM COP	Wage between 1 and 3 MM COP	Wage between 3 and 5 MM COP	Wage greater than 5 MM COP	Undergrad university in Colombia	Private University	Accredited undergrad university	QS ranking of program of application
Robust	-0.125 (0.420)	-0.085 (0.068)	-0.021 (0.037)	0.019 (0.052)	-0.099 (0.065)	0.053 (0.055)	0.027 (0.043)	0.026 (0.017)	-0.123** (0.059)	0.041 (0.032)	-0.021 (0.052)
Observations	16,169	17,603	17,603	16,472	16,472	16,472	16,472	17,603	17,032	17,032	17,603
Number of individuals	14990	16245	16245	15279	15279	15279	15279	16245	15721	15721	16245
Number of individuals in optimal bandwidth	4611	5028	5028	4682	4682	4682	4682	5028	4907	4907	5028
Beta first stage	.596***	.591***	.591***	.583***	.583***	.583***	.583***	.591***	.591***	.591***	.591***
SE first stage	.03	.029	.029	.03	.03	.03	.03	.029	.029	.029	.029
Band width	13.06	13.06	13.06	13.06	13.06	13.06	13.06	13.06	13.06	13.06	13.06
Obs left	2177	2402	2402	2212	2212	2212	2212	2402	2346	2346	2402
Obs right	2664	2889	2889	2692	2692	2692	2692	2889	2820	2820	2889
Control mean	27.43	.464	.076	.163	.406	.188	.243	.975	.709	0.942	4.42

Notes: The table presents the reduced-form coefficient from a RD specification where the outcomes are the baseline characteristics of Colfuturos' applicants in the universe and the running variable is Colfuturo score. All results are estimated with package rdrobust (Cattaneo, Calonico and Titiunik, 2014).

Table A5 – Balance around the cutoff point of baseline characteristics using the complete Colfuturo survey information.

	Age	Women	Working	Wage less than 1 MM COP	Wage between 1 and 3 MM COP	Wage between 3 and 5 MM COP	Wage greater than 5 MM COP	Undergrad university in Colombia	Private University	Accredited undergrad university	QS ranking of program of application
Robust	0.042 (0.682)	-0.065 (0.108)	-0.064 (0.055)	-0.024 (0.082)	-0.031 (0.103)	0.082 (0.090)	-0.028 (0.065)	0.012 (0.025)	-0.069 (0.099)	-0.017 (0.045)	0.088 (0.077)
Observations	2,611	2,859	2,859	2,686	2,686	2,686	2,686	2,859	2,797	2,797	2,859
Number of individuals	2611	2859	2859	2686	2686	2686	2686	2859	2797	2797	2859
Number of individuals in optimal bandwidth	1429	1569	1569	1473	1473	1473	1473	1569	1544	1544	1569
Beta first stage	.855***	.827***	.827***	.819***	.819***	.819***	.819***	.827***	.843***	.843***	.827***
SE first stage	.046	.048	.048	.051	.051	.051	.051	.048	.046	.046	.048
Band width	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
Obs left	395	442	442	401	401	401	401	442	438	438	442
Obs right	1034	1127	1127	1072	1072	1072	1072	1127	1106	1106	1127
Control mean	27.686	.448	.088	.178	.427	.221	.174	.988	0.684	0.944	4.39

Notes: The table presents the reduced-form coefficient from a RD specification where the outcomes are the baseline characteristics of Colfuturos' applicants in the survey subsample and the running variable is Colfuturo score. All results are estimated with package rdrobust (Cattaneo, Calonico and Titiunik, 2014).

Table A6 – Balance around the cutoff point of baseline characteristics using PILA administrative information.

	Wages								Undergrad studies		
	Found in PILA	Age at application	Women	Working at application	Less than 1 MM COP	Between 1 and 3 MM COP	Between 3 and 5 MM COP	Greater than 5 MM COP	In Colombia	Private University	Accredited
PILA data set											
Robust	0.046 (0.044)	-0.221 (0.445)	-0.068 (0.072)	-0.038 (0.038)	0.031 (0.053)	-0.113* (0.068)	0.062 (0.058)	0.021 (0.046)	0.029 (0.018)	-0.146** (0.061)	0.010 (0.031)
Observations	16,169	14,606	15,884	15,884	14,951	14,951	14,951	14,951	15,884	15,429	15,429
Number of individuals	14990	13530	14648	14648	13851	13851	13851	13851	14648	14235	14235
Number of individuals in optimal bandwidth	4611	3886	4239	4239	3972	3972	3972	3972	4239	4148	4148
Beta first stage	.595***	.612***	.607***	.607***	.6***	.6***	.6***	.6***	.607***	.606***	.606***
SE first stage	.03	.031	.03	.03	.032	.032	.032	.032	.03	.03	.03
Band width	13.06	12.72	12.72	12.72	12.72	12.72	12.72	12.72	12.72	12.72	12.72
Obs left	2177	1796	1987	1987	1840	1840	1840	1840	1987	1946	1946
Obs right	2664	2270	2463	2463	2314	2314	2314	2314	2463	2410	2410
Control mean	.883	27.53	0.47	0.07	0.16	0.42	0.19	0.24	0.98	0.72	0.95

Notes: The table presents the reduced-form coefficient from a RD specification where the outcomes are the baseline characteristics of Colfuturos' applicants in PILA's administrative data set and the running variable is Colfuturo score. All results are estimated with package rdrobust (Cattaneo, Calonico and Titiunik, 2014).