

Impacts of Financial Aid for Top International Graduate Education

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Abstract

This paper estimates the impact of a postgraduate merit-based credit-scholarship program in Colombia. Exploiting a regression discontinuity design with rich survey and administrative data we find three main results. Credit constraints are binding and important even for talented individuals with higher education degrees. Our results indicate that beneficiary individuals increase their probability of attaining any graduate education by 33% and a graduate education abroad by 50%. Second, labor market rewards this education as beneficiary individuals earn on average 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 calculations suggest that this credit-scholarship has a private and social IIR of 15% and 18%, respectively.

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

JEL codes: I22, I23, I26

1. Introduction

Tertiary education is considered a key element for fostering economic growth, reduce poverty and decrease 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 been increasing at a faster rate than those in undergraduate education (Stevenson, 2016; Morikawa, 2018). In the USA, for example, graduate enrollment increased at 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 towards 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 nearly 40% of all federal students' loans (Miller, 2019). Trends in the developing world have followed suit.

Despite its increasing importance, 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 labor income of individuals who attain them.¹ There is a knowledge vacuum on the *causal* impact that private and public resources have on the postgraduate educational attainment and labor market outcomes of individuals who pursue them. 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.

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 Wouterese et al. (2017) for the Netherlands. Lastly, under OLS regressions estimates of attending law school are also estimated by Oyer and Schaefer (2019). Few studies have tried to obtain causality 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 returns to general postgraduate education using an IV methodology with instruments such as tuition levels, the likelihood of obtaining graduate support and parental education. Finally, Stevenson estimate returns for general graduate programs in the USA under the Dubin and McFadden (1984) suggested empirical procedure.

Since 1991 Colfuturo, a Colombian nongovernmental organization, has granted over 13,000 credit-scholarships to individuals accepted into graduate programs at top universities around the world. 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 that varies by area of studies and year of application depending on the number of candidates and resources available. This allows us to causally estimate CBC's impact on numerous medium- and long-term outcomes of interest using a regression discontinuity design.

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 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 their probability of being active in the labor market is identical, beneficiaries' labor income is 45% higher compared to that earned by non-beneficiaries. Heterogeneous analysis show that returns are maintained in time as the coefficient of interest is very similar for individuals who are between 26 and 46 years old and applied to the program after 2012, and those between 30 and 57 and applied before that year. We also find that returns are marginally higher for those who attended private undergraduate universities compared to 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 for 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 individual's abilities. We find that these two theories are non-rival and complement each other in explaining labor income differences of CBC's beneficiaries. 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 highest influence on wages is having a graduate education from a foreign university, explaining nearly 40% of the impact. These quantitative results, along with qualitative analysis of interviews to a group of Colombian entrepreneurs, suggest that while Colfuturo may allow individuals to attain more and higher postgraduate education increasing their productivity, much of the effect may be through signaling. Being a Colfuturo scholar provides a signal to the labor market of being high achievers and responsible individuals.

Even though the literature has several papers evaluating the impact of scholarships on tertiary education, this is the first one that analyzes impacts at the postgraduate level. As in papers for undergraduate scholarships in both developed and developing countries (Bettinger et al., 2019; Cohodes and Goodman, 2014; Scott-Clayton and Zafar, 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 and Dale and Kruger, 2011; Bettinger et al. 2019; Scott-Clayton, 2017), we find that beneficiaries obtain large gains for pursuing this level of education thanks to the CBC. In fact, the gains are so high that our estimates of suggest a private and social IIR of 15% and 18%, respectively. However, care should be taken as these gains appear to accrue only for men, similar to impacts observed in other developing countries for undergraduate studies (Zimmerman, 2019; Bucarey, Contreras & Muñoz, 2018; Rau, Rojas and Urzúa, 2013) or in postgraduate education for MBAs (Bertrand et al., 2010).

The remaining of the document includes six additional sections. The second and third section describe Colfuturo's merit-based graduate credit program, and the data used in the study, respectively. Section four summarize CBC's main impacts on education and labor market outcomes, provides heterogeneous effects and presents a mediation analysis results of the plausible channels through which impacts occur. Finally, section five presents 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 trained at the best universities and programs around the world. 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 to 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 anyway the beneficiary desires. It is a loan given in US dollars that requires two co-debtors and charges a differentiated interest rate in time.² *CBC* encourages beneficiaries to return to Colombia to apply their knowledge through their active participation in the labor market. If individuals return to the country once their studies are completed and work for three years, they can turn up to 80% of the loan into a scholarship according to the following criteria: 20% if they graduate from MBA studies or Master of Administration and Law; 40% if they graduate from any other area of knowledge; and an additional 20% if they work as a full-time public official or as a teacher or researcher for an educational institution, and an another additional 20% if they work outside of Bogotá and its metropolitan area. *CBC* provides other advantages to its beneficiaries such as the autonomy

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

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 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 provide 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 candidates' 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 a descending order according to Colfuturo's score and divided into one of twelve areas of knowledge.⁴ Committees integrated by five renowned professionals 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

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.

scholarship. This meritocratic selection process, united with three rich data bases, allows us to estimate the impact that *CBC* has brought to its beneficiaries using a regression discontinuity design as detailed in the following sections.

3. Data

To understand the impact that the *CBC* has brought to its beneficiaries we construct a database at the individual level using three different data 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 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

At the time of application, Colfuturo collects individuals' sociodemographic information including basic characteristics such as sex, age, and marital status, information regarding the applicants' background education and work experience. Education background information includes whether the applicant attended private or public undergraduate university, if the university is certified with a high-quality accreditation, as well as the area of studies. Furthermore, it includes 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 to the scholarship between 2003 and 2016.⁵ We drop 394 individuals who applied to an area of knowledge where all

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.

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. The first two columns of Table A1 in the appendix presents basic pre-treatment characteristics of these individuals that are 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 attained detailing the universities, programs and degrees obtained, questions regarding their most recent employment as well as some socioeconomic characteristics such as marital status, number of children, among others. This detailed information is not available in any official data source.

A total of 2,859 individuals, 16% of the *Colfuturo* sample, answered the questionnaire. Table A1 in the appendix compares pre-treatment characteristics between the subsample of individuals who answered the survey and the complete sample 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 2013-2016, while the percentage of these candidates in the complete sample is 48%. This may be explained by the fact that 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 complete sample. This indicates that those eligible may be more willing to answer the survey than those who were not eligible for the program. To remove this overrepresentation, we randomly selected a subset of eligible individuals and created a subsample of 1,994 that will be used in all empirical exercises that follow. This assures that the percentage of individuals eligible and ineligible are proportional in both the survey as in

Colfuturos' records. However, all results presented in this paper are maintained when the complete sample of the survey is used, and they are available upon request.

From the survey we construct some descriptive statistics 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. Most of the individuals come from the highest and wealthiest socio-economic stratum (67%), while the minority report belonging to the strata 1 to 3 (20%), the least wealthy strata.⁶ 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% of them 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 those ineligibles 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 indicates that almost 90% of both eligible and non eligible population work at the time of the survey; while 83% and 77% of them 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 and as standard in the labor market literature we transform their reported labor income to logarithmic values to carry out the econometric

⁶ In Colombia, socioeconomic strata range from 1 to 6, with strata 1 encompassing the poorest households and strata 6 the richest ones. These are defined according to location of residence within a city and were originally created to cross subsidize public services in Colombia.

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 as for those who do 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 Colombia. Through an agreement between Colfuturo and the Ministry, we received anonymized information 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, number of days worked in the year, type of worker (employee or self-employed), municipality where work and some basic characteristics of the firm in which they are employed. The last two columns in Table A1 in the Appendix presents the main descriptive statistics from this data and compares it to the complete administrative 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 individuals 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

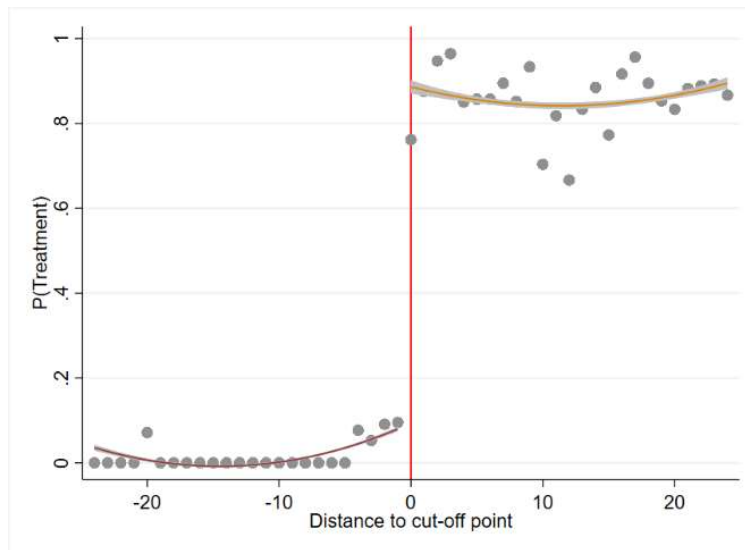
The ranking-based selection process of Colfuturo allows the estimation of the impact *CBC* has brought to the education and labor market outcomes of its beneficiaries through a regression discontinuity design (RD). This section presents the validity of the identification strategy chosen, the main impacts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

4.1 *RD design and compliance with validity assumptions*

As explained above, the selection process that defines which candidates are offered the *CBC* depends exclusively on their Colfuturo score. Each year, for each area of knowledge, candidates are classified in a descending order and a cutoff point determined according to the number of individuals who applied and the resources available. 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 compute the distance to the threshold for each candidate.

Figure 1 presents how the probability of being a *CBC* beneficiary changes around this normalized cutoff point for the 1,994 individuals in the subsample of the Colfuturo survey. As observed, the probability of being a *CBC* recipient increases from close to zero to 82.7% percent around the cutoff point. This is so, because almost 16% of eligible candidates did not take up the *CBC* either because they did not pursue after all their academic plans or because they 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 of the treatment, we use a fuzzy RD design in the exercises below.

Figure 1 - Discontinuity in the Probability of Receiving CBC for the Colfuturo survey subsample



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

RD analyses also require that there be no selective sorting of applicants across the cutoff line. Even though the formula of how to estimate the Colfuturo score is publicly available to everyone, we argue that knowing ex-ante which will be 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 figure from this test and the results of the traditional McCrary test presented in Figure A1 in the appendix, suggest no manipulation of the Colfuturo score.⁸

⁸ When the complete information of the almost 17,000 Colfuturo applicants between 2003 and 2016 is used, all assumptions for the implementation of a RD strategy are complied with. This is shown in Figures A2 and A3 in the Appendix and Table A4. In turn Figures A4 and A5 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 and whose scores are higher causing, as expected, a

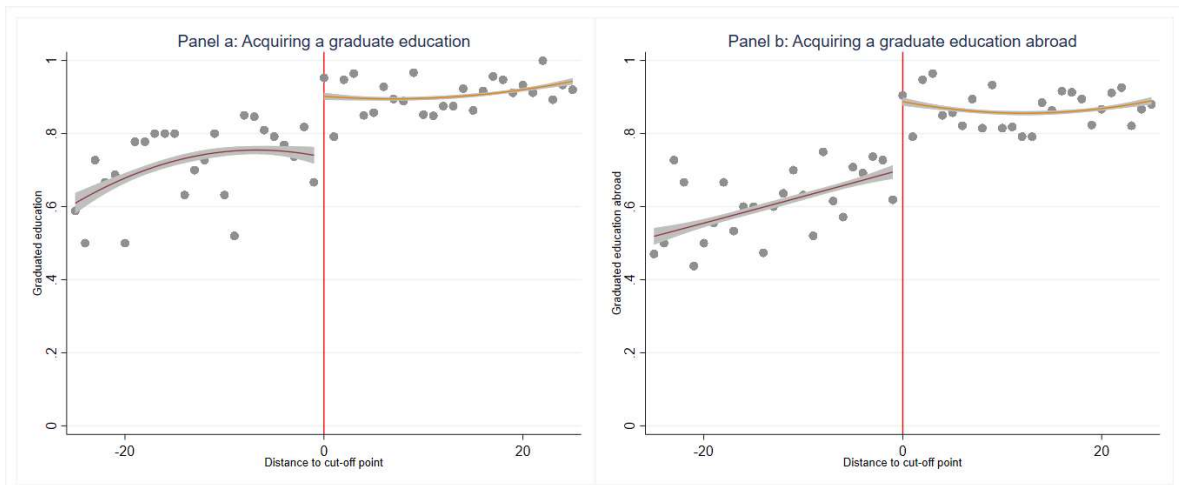
Finally, Table A3 in the appendix provides the results of the balance check of pretreatment variables around the treatment threshold. As observed, we cannot reject the null hypothesis that there is balance across all baseline characteristics. Particularly, both the level of education as well as wages earned just before the application are statistically identical for both eligible and ineligible candidates. This in turn 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 main purpose has been the sponsorship of talented professionals to acquire a graduate education in the best programs and universities around the world. Using a data-driven local-polynomial-based robust inference procedure proposed by Cattaneo et al. (2014), Figure 2 depicts how *CBC* has truly 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 end up obtaining a graduate degree, this probability increases by almost 20 percentage points – or 25% - for those just above the cutoff score. Panel b present the impact eligibility has on the quality of the academic programs eligible individuals were able to attend thanks to *CBC*. As observed, while around 60% of barely ineligible individuals obtain their graduate degrees abroad, this percentage increases in 25 percentage points or 40% for barely eligible ones.

discontinuity in the score's density. However, balance of baseline characteristics using the complete survey sample is obtained as observed in Table A5.

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 acquiring a graduate education abroad (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.

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 increase both their probability of acquiring a graduate degree and a graduate degree abroad in 22 and 28 percentage, 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 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. Most important outcomes with information 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 of 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) number of years of graduate education acquired. All estimations use Colfuturo score's as 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.

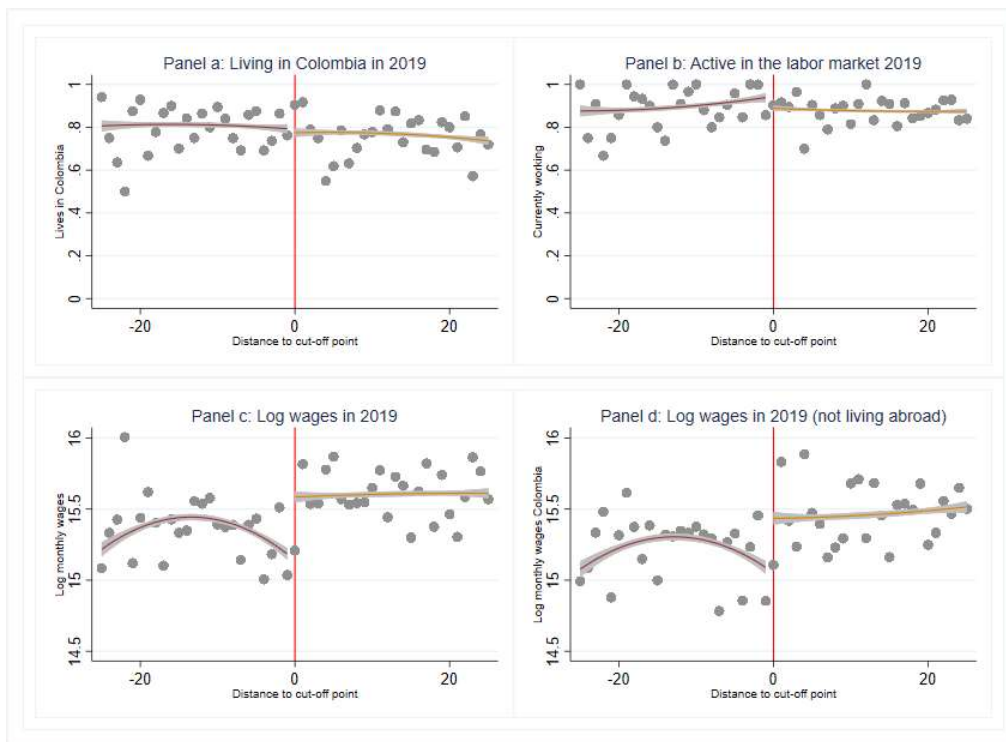
4.3 Impacts on labor market outcomes.

Is this higher postgraduate education attained by beneficiary individuals associated with higher wages? Causal evidence of the impacts of undergraduate scholarships on labor market outcomes is mixed. Even though positive impacts are found for some 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 impact are either imprecisely estimated or close to zero (Bettinger et al. 2019; Scott-Clayton, 2017). For developing countries, causal studies for Chile have shown that there are no significant positive returns in terms of labor income for students receiving scholarships or undergraduate study credits (Zimmerman, 2019; Bucarey, Contreras & Muñoz, 2018; Rau,

Rojas and Urzúa, 2013). Finally, studies for developed countries have shown that investing in postgraduate education may bring positive returns but only a handful of studies provide causal evidence on the impacts of such investments. (Casey, 2009; Dolton and Makepeace, 1990).

The information of the survey allows us to evaluate CBC's impact on labor market outcomes. We center our attention in four outcomes of interest: whether they 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 in the probability of being working in 2019 (panels a and b). Almost 80% of applicants to CBC end up living in Colombia and almost 90% are active in the labor market. However, the impact of CBC on the labor income is economically important. As observed in panels c and d, there is a clear discontinuity of around 30% in the labor income earned between eligible and non-eligible candidates using either the complete sample or only those who reside and work in Colombia, respectively.

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 score’s 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. As observed, even though almost 85% of eligible CBC candidates study their graduate programs overseas, the vast majority return to Colombia. Moreover, eligibility has no impact on the probability that they are active in the labor market, something 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 on 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 earn a labor income 45% higher than those who did not received this opportunity.

Table 2 – Impacts of CBC on place of 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 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 score's as 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 important. Education is undoubtedly a key determinant of wages, and in recent years the returns to higher education have increased worldwide. In economics there are two theories that explain the mechanisms through which these returns are generated. As stated in the seminal study by Spence (1973), in a first theory, education can increase the labor productivity of the individual and as a result raises the wages earned are observed. On the other hand, in a world of incomplete information, acquiring more education can become a sign of the intellectual abilities of the individual. 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 the explanation of 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 analyze 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. The author finds that reductions in the years of higher education of Colombian youth are associated with significant reductions in wages, even for students from the same university and academic program. 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, and; MacLeod et al., 2017).

To understand which channels could explain the impacts from 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 these returns are explained by the two complementary mediators. The first mediator analyzed is having a graduate education and, as previously shown, being eligible increases the probability of having attained this level of education. As specified in the lower seven rows of the table, the indirect effect that occurs through this improvement 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 are able to 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. Importantly, a graduate education abroad explains 40% of the income labor difference between barely eligible and ineligible individuals. This could be related with 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 are no difference between the ranking of academic programs individuals applied for CBC, average ranking of programs effectively attended is higher for eligible than non-eligible individuals. However, it is difficult to ascertain it is a productivity effect. Of course, other variables that may be impacted by the scholarship such as professional networks, self-confidence and/or the opportunity of living abroad might all have an impact on labor income too. These variables are however non observable restricting the possibility of using them as alternative plausible mediators. What the mediation analysis show is 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 in fact the case. For Colombian entrepreneurs, individuals who succeeded through Colfuturo's selection process can be characterized as determined, responsible and committed professionals.¹¹

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***		0.432***

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

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. Results from these qualitative analyses can be obtained in <https://impacto.colfuturo.org/apps/impacto/>.

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 having a 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.

4.4 Robustness checks and heterogeneous impacts using tax administrative records.

We use government's administrative tax data to carry out some robustness checks as well as some heterogeneous impacts. As described, 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 information in the survey are maintained when this alternative source of information is used.¹²

In the administrative records, each applicant is observed an average of nine years, implying a total of over sixty-one thousand observations. As observed in the first column of

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 A6 and A7, 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.

Administrative data allows us to estimate a placebo model that gives further credence on the results obtained. The second column in **Error! Not a valid bookmark self-reference.** presents the difference on the labor market income reported in PILA for all candidates *before* their application to the CBC. As observed, there are no significant differences between eligible and ineligible individuals' yearly labor income before they applied to the scholarship. This is also consistent with the balance obtained in baseline wages reported by individuals in Colfuturo's administrative records.

Table 4, despite the difference in the information source and the longer time span used with PILA's records, the impacts using administrative data are remarkably similar to those obtained using the survey data. On average, beneficiary CBC candidates earn 45.9% higher labor income than their peers. Moreover, the similarity of impacts also suggest 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 on the results obtained. The second column in **Error! Not a valid bookmark self-reference.** presents the difference on the labor market income reported in PILA for all candidates *before* their application to the CBC. As observed, there are no significant differences between eligible and ineligible individuals' yearly labor income before they applied to the scholarship. This is also consistent with the balance obtained in baseline wages reported by individuals in Colfuturo's administrative records.

Table 4 – Robustness checks and heterogeneous impacts

	Period of PILA information used		Yearly average labor income						
	2009 - 2019	Prior to application	By gender		By undergraduate university		By type of graduate program		
			Men	Women	Public	Private	MBA	MA	Ph.D.
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)
Number of observations	61,138	20,330	33,199	27,939	15,204	44,274	6,978	48,264	5,394
Number of individuals	11996	11359	6347	5649	3049	8614	1277	9671	959
Beta first stage	.589***	.67***	.585***	.648***	.681***	.576***	.781***	.596***	.526***
SE first stage	.018	.024	.024	.02	0.025	0.02	.027	.019	.043
Band width	12.90	12.90	13.21	20.48	23.10	13.65	20.17	14.74	26.07
Obs left	6434	2329	3627	4564	2546	5052	1322	5678	885
Obs right	9036	3498	5304	6669	4446	6995	1721	8321	1655
Control mean	17.1	16.6	17.1	17.0	17.0	17.1	17.3	17.0	17.4

Notes: The table presents the impact of CBC eligibility and 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 prior to Colfuturo application; c) yearly income by gender, and; d) yearly income by type of University where undergraduate studies were undertaken. All specifications use Colfuturo score's as 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.

The last columns in Administrative data allows us to estimate a placebo model that gives further credence on the results obtained. The second column in **Error! Not a valid bookmark self-reference.** presents the difference on the labor market income reported in PILA for all candidates *before* their application to the CBC. As observed, there are no significant differences between eligible and ineligible individuals' yearly labor income before they applied to the scholarship. This is also consistent with the balance obtained in baseline wages reported by individuals in Colfuturo's administrative records.

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 and their previous academic history. For example, Zimmerman (2019) finds that in Chile only men who studied in private schools have positive returns from studying in the 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 in fact 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 Administrative data allows us to estimate a placebo model that gives further credence on the results obtained. The second column in **Error! Not a valid bookmark self-reference.** presents the difference on the labor market income reported in PILA for all candidates *before* their application to the CBC. As observed, there are no significant differences between eligible and ineligible individuals' yearly labor income before they applied to the scholarship. This is also consistent with the balance obtained in baseline wages reported by individuals in Colfuturo's administrative records.

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 around 40%. This impact is reduced to 27% for graduates of 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.

Table 5- Impacts on the type of employment individuals work

	Yearly salary per employee (mean)		Ln mean employees		Selfemployed workers	
	ITT	LATE	ITT	LATE	ITT	LATE
Robust	-0.029 (0.071)	-0.038 (0.106)	0.444*** (0.163)	0.728*** (0.253)	-0.060** (0.024)	-0.095*** (0.037)
Number of observations	47,572	47,572	60,582	60,582	56,880	56,880
Number of individuals	10233	10233	11872	11872	11689	11689
Beta first stage	.	.629***	.	.588***	.	.594***
SE first stage	.	.019	.	.018	.	.018
Band width	12.90	12.90	12.90	12.90	12.902	12.902
Obs left	4983	4983	6373	6373	5961	5961
Obs right	6991	6991	8947	8947	8375	8375
Control mean	14.70	14.70	4.20	4.23	.269	.266

Notes: The table presents the impact of CBC eligibility and treatment on labor market outcomes using a regression discontinuity design and governmental administrative tax records. The dependent variables are: a) mean wages in firms where individuals work; b) mean number of employees in firms where individuals work ; c) probability of being a self employed worker. All specifications use Colfuturo score's as 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, Table 5 presents evidence on the type of jobs and firms eligible and ineligible individuals work. As observed in the first model, the higher wages eligible individuals earn are not explained by getting a job in firms with higher mean wages. They work in firms with the same average wage. There is however a difference in that eligible individuals have a lower probability of being self-employed and therefore work in firms with a lower number of employees.

5. Cost Benefit Analysis

The cost-benefit analysis enables us to identify the changes in welfare of the Colombian society through the measure and monetization of the impacts that the Colfuturo's scholarship program has on the different agents involved. To calculate the flows of benefits we use as parameters the impact estimators of the program on labor income obtained with the Regression Discontinuity methodology. Four main agents participate of 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 while the social benefits and costs comprise both these private ones and those perceived by Colfuturo as institution, the government, and the society in general. In addition, the benefits and costs can be divided between those susceptible of monetization and those that are not given the existing information.

Once the benefits and costs of the program are determined we calculate the different flow of funds and the returns indicators, particularly the Net Present Value (NPV), the Benefit-Cost ratio (BCR), and the Internal Rate of Return (IRR). For the estimations of the private NPV, BCR and IRR we use a 6.87%¹³ discount rate and for the social estimations we use a 9% social discount rate.

Some of the private positive benefits of the program are the following: labor income¹⁴, and some of the negative: the payment of loans to the Colfuturo and other sources of funds and the opportunity cost measured as the forgone labor income during the time of the studies abroad. The

¹³ This is the average real rate of interest beneficiaries pay on the loan.

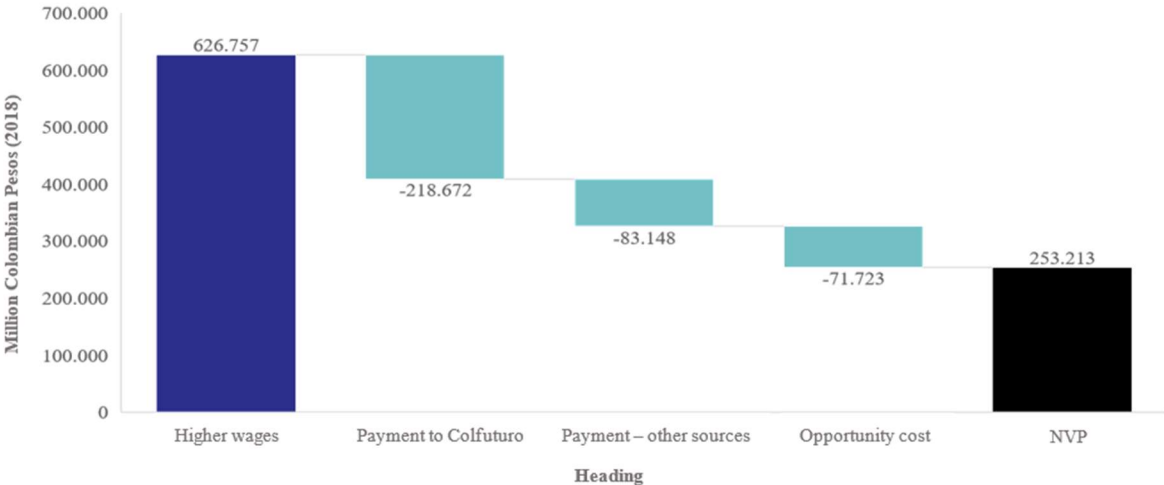
¹⁴ Higher wages and labor income comprise the largest proportion of the private benefits. The estimated impacts on those variables and their present values are the following:

Type of program	Impact on the log of wages	Number of returning beneficiaries	Projected time spell	Present value (in 2018 COL \$)
PhD	0.721	541	2005-2048	\$100,267
Master	0.293	7,410	2005-2054	\$456,704
MBA	0.347	743	2005-2049	\$69,785
Total Beneficio				\$626,757

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

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 \$ 626,757 million pesos whereas the cost reaches \$ 373,544 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 forgone 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 Survey applied to Colfuturo’s applicants (2019).

Once we compare the direct benefits and costs in Figure 4 the estimated private IRR of the Colfuturo’s scholarship equals 15.7% while the private BCR reaches 1.68 which indicate that for each Colombian pesos each beneficiary spends to pursue a graduate degree abroad obtains a 1.68 Colombia peso benefit.

As said the social benefits and costs comprise both the private and those generated for the government, Colfuturo as institution and the society in general, including among the latter remittances¹⁵ sent to Colombia by the beneficiaries that stayed abroad, and the additional tax

¹⁵ The present value of the remittances equals COL\$ 1583 million comprising 0.3% of the total social benefits.

revenues¹⁶ levied on the beneficiaries that returned to the country. Nonetheless, several social benefits are not susceptible of 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 18.8% while the BCR equals 1.65 indicating that for each pesos the society spends in the Colfuturo's scholarship program obtains 1.65 pesos of monetizable benefits.

6. Conclusions

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

Through regression discontinuity design we find that the impacts of these programs are important. Credit constraints for this population are binding and thus eligible individuals are able to attain more and probably 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 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 thus reaching the goals that it was created for. Indeed, the number of graduate professionals in the country is increasing thanks to the program and most beneficiaries come back to the country and apply their knowledge in the national labor market contributing to its economic growth. However, areas of improvement or concern

¹⁶ The present value of the tax revenues equals COL\$ 68134 million comprising 13.7% of the total social benefits.

regarding the impacts it is bringing remain. The most important ones are that all the labor income impacts are explained by the impact on men, as we find no difference on wages of eligible and ineligible women. This in turn is not explained by the type of program they apply too. 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 resent, could improve too.

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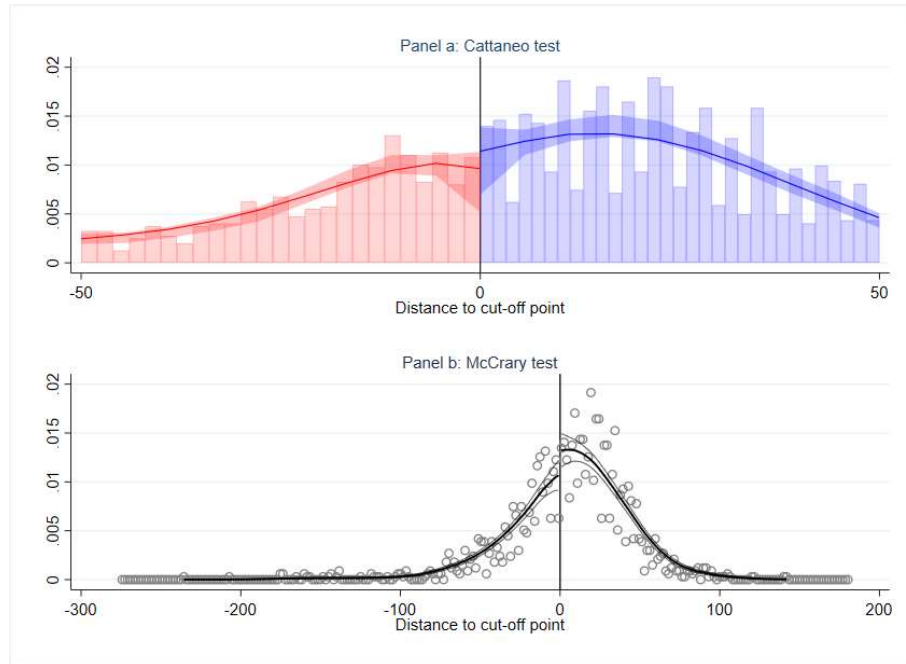
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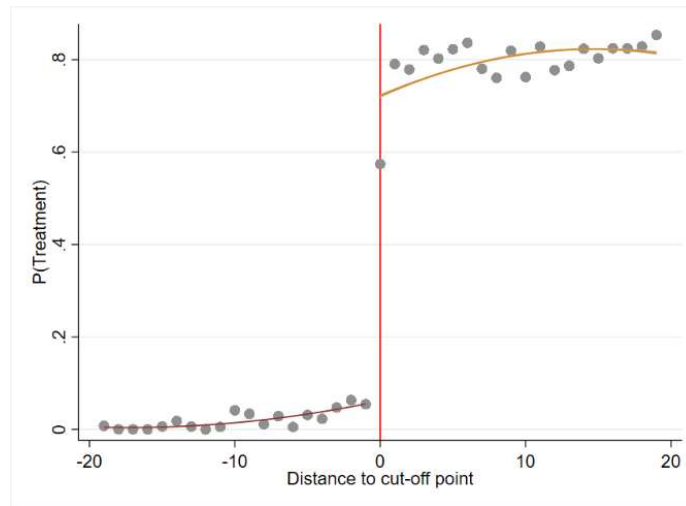
Appendix

Figure A5 – No manipulation tests (Colfuturo’s survey subsample)



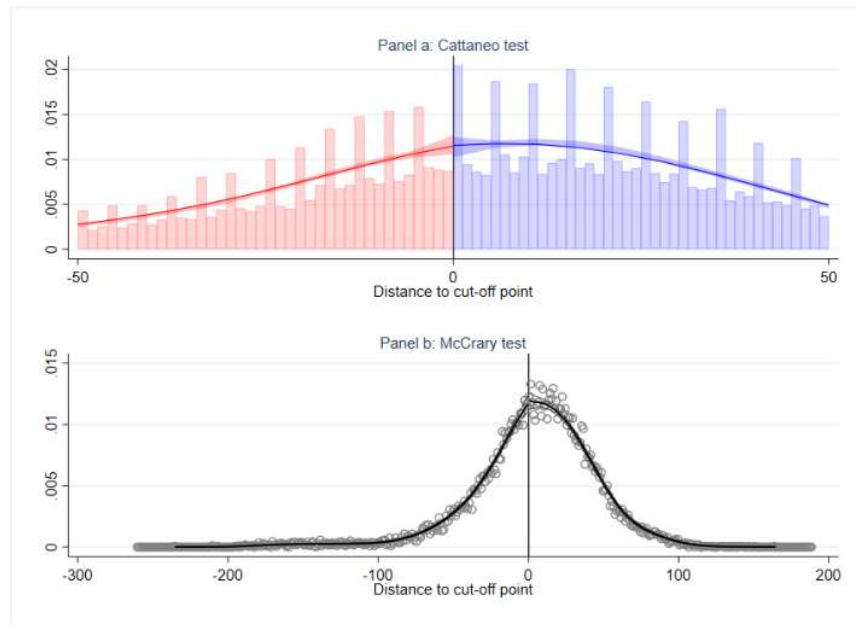
Note: The figure presents the results obtained when both Cattaneo, Jansson, and Ma (2019) and McCrary’s tests of no manipulation are performed using information from random subsample of the Colfuturo Survey. Source: Authors’ calculations based on Colfuturo’s administrative data and survey.

Figure A6 - Discontinuity in the Probability of Receiving CBC for all Colfuturo's applicants between 2003-2016



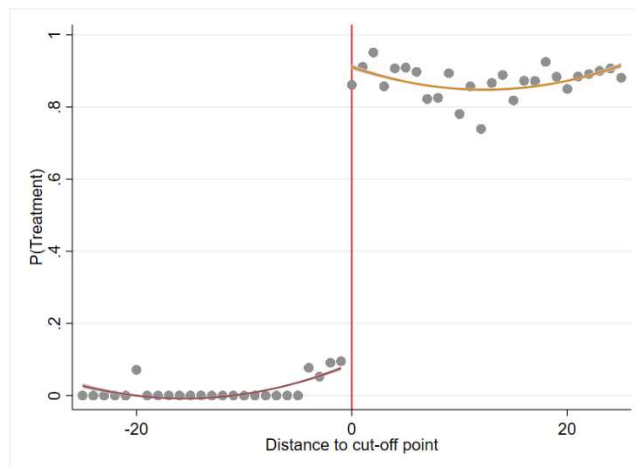
Note: The figure plots the take-up rate, that is, the probability of receiving CBC as a function of the distance to the Colfuturo score's eligibility cutoff using information from all Colfuturo applicants between 2003 and 2016. Source: Authors' calculations based on Colfuturo's administrative data.

Figure A7 – No manipulation tests for all Colfuturo’s applicants between 2003-1016



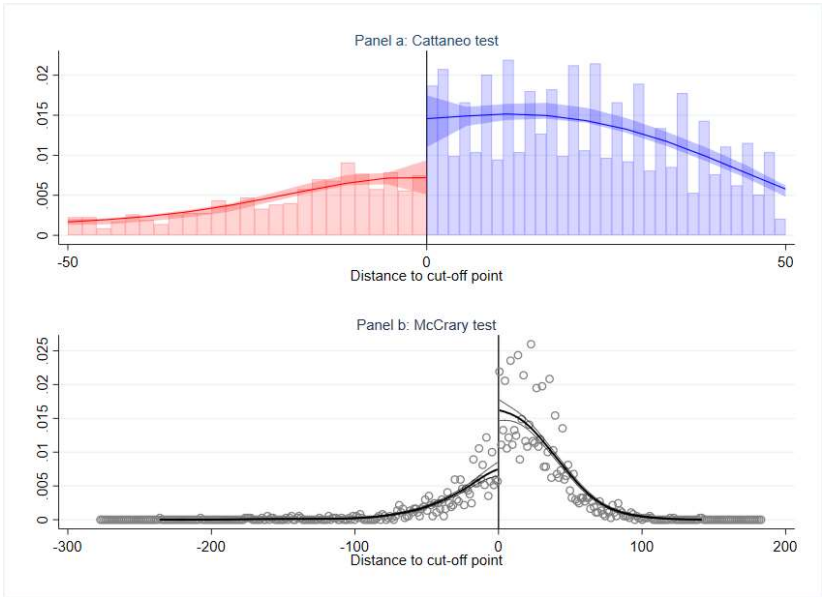
Note: The figure presents the results obtained when both Cattaneo, Jansson, and Ma (2019) and McCrary’s tests of no manipulation are performed using information from *all* Colfuturo Applicants between 2003 and 2016. Source: Authors’ calculations based on Colfuturo’s administrative data.

Figure A8 - Discontinuity in the Probability of Receiving CBC (Colfuturo’s Survey complete information)



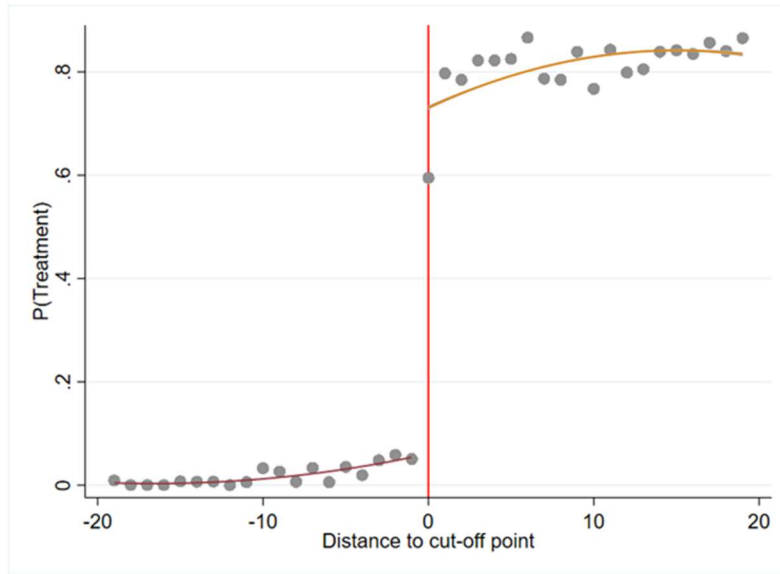
Note: The figure plots the take-up rate, that is, the probability of receiving CBC as a function of the distance to the Colfuturo score's eligibility cutoff using information from Colfuturo's survey complete information. Source: Authors' calculations based on Colfuturo's administrative data and complete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

Figure A9 – No manipulation tests (Colfuturo's Survey complete information)



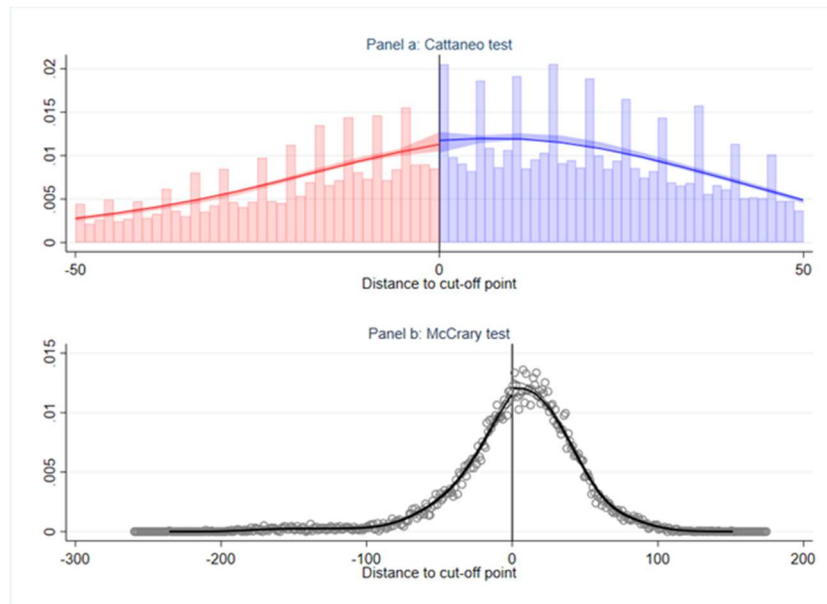
Note: The figure presents the results obtained when both Cattaneo, Jansson, and Ma (2019) and McCrary's tests of no manipulation are performed using information from Colfuturo's complete survey information. Source: Authors' calculations based on Colfuturo's complete survey.

Figure A10 - 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 A11 – 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 A6 – Pre-treatment characteristics of CBC’s applicants and survey respondents

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Colfuturo Applicants (2003 - 2016)		Colfuturo Survey		Total applicants vs. Colfuturo Survey		Subsample of survey		Total applicants vs. Subsample Survey		
	N	Mean	N	Mean	Diff	P-value	N	Mean	Diff	P-value	
Application year 2003-2007	17,603	0.11	2,859	0.04	0.07	0.00	1,994	0.05	0.06	0.00	1
Application year 2008-2012	17,603	0.41	2,859	0.35	0.05	0.00	1,994	0.35	0.06	0.00	1
Application year 2013-2016	17,603	0.48	2,859	0.60	-0.12	0.00	1,994	0.60	-0.13	0.00	1
Colfuturo score	17,603	4.17	2,859	4.26	-0.11	0.00	1,994	4.21	-0.03	0.00	1
% Eligible applicants	17,603	0.59	2,859	0.74	-0.18	0.00	1,994	0.62	-0.01	0.49	1
% PhD applicants	17,603	0.07	2,859	0.09	-0.02	0.00	1,994	0.08	-0.01	0.28	1
% Medical specialization applicants	17,603	0.01	2,859	0.00	0.00	0.16	1,994	0.00	0.00	0.12	1
% Master applicants	17,603	0.82	2,859	0.83	-0.01	0.31	1,994	0.83	-0.01	0.12	1
% MBA applicants	17,603	0.10	2,859	0.08	0.02	0.00	1,994	0.09	0.02	0.01	1
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	1
Women	17,603	0.47	2,859	0.46	0.01	0.43	1,994	0.45	0.02	0.06	1
Born in capital city	17,603	0.32	2,859	0.30	0.02	0.04	1,994	0.29	0.03	0.00	1

Married	17,603	0.18	2,859	0.19	-0.02	0.01	1,994	0.18	-0.01	0.57	1
Work	17,603	0.94	2,859	0.94	0.00	0.37	1,994	0.93	0.00	0.50	1
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	1
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	1
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	1
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	1
Undergraduate program Colombia	17,603	0.97	2,859	0.98	-0.01	0.00	1,994	0.98	-0.01	0.00	1
Undergraduate private university	17,032	0.71	2,797	0.68	0.03	0.00	1,950	0.68	0.03	0.00	1
Undergraduate high quality university	17,032	0.95	2,797	0.95	-0.01	0.23	1,950	0.95	-0.01	0.28	1

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 sub sample of survey respondents, respectively.

Table A7 – Eligible and ineligible 2019 characteristics of CBC’s survey 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 union	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 A8 – Balance around the cutoff point of baseline characteristics in the Colfuturo Subsample

	Age at application	Women	Born in one of the 13 main cities (DANE)	Married or with couple	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
Colfuturo Subsample												
Robust	-0.095	-0.037	-0.118	0.061	-0.067	-0.049	0.083	0.081	-0.048	0.030	0.034	0.002
	(0.772)	(0.121)	(0.113)	(0.090)	(0.059)	(0.090)	(0.112)	(0.100)	(0.071)	(0.024)	(0.109)	(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	.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, Calonico and Titiunik, 2014).

Table A9 – Balance around the cutoff point of baseline characteristics using all administrative Colfuturo 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 band	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 survey subsample and the running variable is Colfuturo score. All results are estimated with package rdrobust (Cattaneo, Calonico and Titiunik, 2014).

Table A10 – Balance around the cutoff point of baseline characteristics using 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 ba	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).

