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Three Years in the University: Learning Outcomes and Transition from Technical to Bachelor's

Mónica Mogollón Plazas

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Tres Años en la Universidad: Resultados de Aprendizaje y Transición desde el Programa Tecnológico al Profesional

Mónica Mogollón Plazas

Resumen

Este artículo analiza el efecto de la admisión a una universidad para un programa de formación tecnológica en el logro educativo, resultados de aprendizaje y transición hacia el programa de formación universitaria. Para estimar el efecto causal de la admisión, utilizo las reglas de admisión de la Universidad Distrital Francisco José de Caldas implementando la metodología de regresión discontinua. Para los aplicantes admitidos y no admitidos, se miden indicadores de matrícula y graduación en programas tecnológicos y universitarios usando los registros administrativos del sistema de educación superior. Los resultados de aprendizaje provienen de la prueba estandarizada Saber TyT, específicamente los módulos de competencias genéricas. En primer lugar, se muestra que la admisión incrementa la probabilidad de matrícula en programas de tecnología y no tiene efecto en la probabilidad de matrícula en programas universitarios. Segundo, la admisión incrementa el desempeño global en la prueba Saber TyT en 0.2 desviaciones estándar, principalmente ocasionado por incrementos en el componente de lectura crítica. Finalmente, este documento compara los ciclos terminales y propedéuticos ofrecidos en esta universidad. Se muestra que los estudiantes en el ciclo propedéutico tienen mayor probabilidad de continuar sus

estudios hacia la formación universitaria después de terminar el programa de formación tecnológica.

Palabras claves: educación superior, articulación y transición educativa, resultados de aprendizaje

Three Years in the University: Learning Outcomes and Transition from Technical to Bachelor's Degrees[1]

Mónica Mogollón Plazas[2]

Abstract

This paper examines the effect of admission to a technology degree program in a university on educational attainment, learning outcomes, and transition to the bachelor's program. I exploit the admission rule to the city university of Bogota in a regression discontinuity design to estimate the causal effects of admission. I follow applicants for the technology degree in this university at the administrative records tracking the entire higher education system. Also, I construct learning outcomes from the national standardized test assessing skills specifically for students

[1] The ideas and opinions in this document are exclusive property of the authors and do not represent the official view of Icfes. Jorge Rodríguez Arenas provided excellent research assistance. Thanks for the valuable comments of Mónica Ospina, Lorena Trujillo and Andrea Cuenca, as well as the researcher's team and participants in the internal seminar of the Office for research promotion at Icfes. I acknowledge the Icfes financial support of this project through the small grant for graduate students awarded in 2020. I thank the Ministry of Education and Icfes for the access of the data through the administrative agreements. All remaining errors are my own.

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graduating from technology programs. The findings show that admission increases the probability of enrollment in technology degrees with modest substitution from bachelor's degrees, thus offering an entry point for students who otherwise would not have accessed the higher education system. Second, admission increases overall score in the exit examination by 0.2SD, mainly driven by gains in critical reading skills. Lastly, this paper compares the terminal degree and the degree- by-cycles pathways offered within the same university. The finding suggests that students in the degree-by-cycles pathway are more likely to enroll in a bachelor's degree after finishing the technology degree.

Keywords: short-cycle higher education, articulation and transfers, learning outcomes

Contents

1 Introduction

Postsecondary career-technical education has gained a central role in developing a skilled workforce driving human capital accumulation in developing countries. These programs have the potential to provide a faster entrance to the labor market and also deliver training in specific skills demanded by employers. In Colombia, the supply of short-cycle programs substantially expanded in the last two decades, representing 30% of the country's total enrollment in higher education. However, the quick expansion of programs has not produced equally distributed returns in the labor market, with some students observing negative returns. Likely, the intricate system of degrees and certificates and the large variation in quality among institutions have undermined the promise of investments in short-tertiary education to translate into higher productivity and better employment opportunities.

One unique feature of Colombia's higher education system is that some universities offer short-cycle programs in addition to their traditional five-year college education. Technology degrees comprise a third of undergraduate enrollment in many public universities in the country, making it worth asking: Should universities offer short-cycle degrees? To what extent are the universities good for short-cycle education?

On the one hand, universities are more likely to be specialized in offering bachelor's degrees with an average duration of five years. Usually, the curriculum is developed over several years focusing on theoretical content. For universities emphasizing research, faculty and teaching personnel are dedicated to research and teaching output. These features might suggest that universities are not necessarily the best institutions to provide short-cycle degrees since these programs require training with a practical focus and the ability to adapt dynamically to the market demand changes.

On the other hand, universities might be better at providing high-quality education with recognition in the market compared to lesser-known institutions. Universities are also well-equipped to develop general skills like advanced numeracy and reading comprehension that employers demand. Finally, universities might provide an entry point for students starting their education at the short-degree level and facilitate a smooth transition toward a bachelor's degree. If existing universities can provide short-cycle education, that could be an avenue to improve the quality and reputation of these degrees in the market.

This paper examines how admission to technology degree programs taught in a flagship university affects educational attainment and learning. I employ the admission policies of the city university of Bogota, Universidad Distrital Francisco Jose de Caldas (UD), to estimate the causal effects of admission. In addition, I study how students transition from a technology degree to a bachelor's degree by comparing the two distinct pathways offered by this university. One pathway is the terminal degree and the second is the degree-by-cycles pathway. Comparing students that enter the same program, but different pathway provides additional insights into how starting a technology program at the university leads to college degree attainment.

I observe a rich set of outcomes for the applicants to this university. Drawing from administrative sources, I measure attendance at every higher education institution in the country. I measure learning gains using the results from the Saber TyT, the exit examination for Technical and Technology programs administered by the Colombian Institute for Evaluation and Assessment of Education (Icfes). Saber TyT is a standardized test measuring general and specific skills right before graduation, providing a precise measure of learning from this specific type of program.

The first set of results is enrollment outcomes. I find that being admitted to the university increases enrollment in technology degree programs by 12 percentage points. Admission to a technology degree does not have an effect on enrollment in five-year college programs. Gaining a seat for a technology degree program is not deviating students that could have gone into bachelor's programs in the first place instead of going to a short cycle program. The sizable effects in enrollment in technology programs with relatively modest to zero effects on bachelor's degrees suggest that admission increases overall access to students who otherwise would not have gotten any postsecondary education.

Secondly, being admitted to the university for a technology degree increases overall scores in the Saber TyT standardized test by 0.24 SD, mainly driven by the development of critical reading skills. There is no effect on quantitative reasoning skills. Students who do not receive admission and enroll in other programs attend highly specialized institutions such as National Learning Service (Servicio Nacional de Aprendizaje-SENA). These findings demonstrate that the university offers a degree with at least the same quality as its competing alternatives, with additional gains in reading comprehension skills.

The last part of the paper focuses on analyzing transition pathways from technical to bachelor's degrees. The higher education system in Colombia allows for a degree-by-cycle pathway3, consisting of programs that offer a transition curriculum in the lower levels, facilitating the transition to the upper-level cycles while allowing the students to get a certification along the way. The UD university offers both the traditional terminal degree and the degree-by cycles. The admission process for both pathways is similar in that there is a limited number of seats, and the same policies determine admission. Students declare the pathway in the application. I observe the applicants and admission results separately for both pathways, allowing a clean comparison between them. I find the degree-by cycles pathway offers a more successful transition toward the bachelor's degree. The evidence suggests that entering the university through the technology program has great potential to raise the proportion of students who complete five-year bachelor's programs.

This paper contributes to the nascent literature on short-cycle programs in Colombia. Most of the recent papers focus on the returns to short-cycle degrees finding substantial variation in returns, with some students even getting negative returns (Busso et al., 2020; Camacho et al., 2017; Ferreyra, Galindo, et al., 2021). Labor market results are better for the students holding a technology degree than students with an incomplete college degree (Ferreyra, Galindo, et al., 2021). Regarding educational achievement outcomes, recent papers find that being within a short distance of an institution offering a short-cycle technology program increases attendance by 30% relative to the average student in the high school senior cohort, mainly driven by students who substituted away from traditional college degree (Ferreyra et al., 2020). Finally, regarding the supply side of short-cycle programs, a recent paper finds that technology programs offered by specialized technical institutions respond faster to changes in market demand than technology programs offered by universities (Carranza et al., 2021).

There is also an increasing interest in understanding short-cycle tertiary education in other countries. Recent papers find that accessing an associate degree in the United States (equivalent to the technology degree in Colombia) increases attendance and graduation (Grosz, 2020). These programs also can increase upward social mobility by offering postsecondary education to students from low-income families (Mountjoy, 2019). Reducing the tuition cost for community colleges increases attendance, graduation, and even the transfer to colleges (Acton, 2021; Denning, 2017).

Many community colleges in the US intend for their students to transition to a bachelor's degree. Several state education policies and articulation arrangements have been implemented in recent decades. Recent literature examines the effectiveness of various articulation policies, with substantial variation in the success of these pathways (Carrell & Kurlaender, 2016; Shaat, 2020). Transparent transfer structures can increase enrollment in short-cycle degrees by increasing the opportunities to transfer to colleges (Baker, 2016).

This paper offers a new perspective by studying the transition from technical to bachelor programs within the same institution. Finally, this paper complements recent evidence of non-traditional postsecondary pathways in Colombia. Accessing vocational training programs, which are shorter certifications than technology degrees, increases the probability of attending and completing five-year bachelor's degrees (Kugler et al., 2015).

2 Background

Colombia has the largest share of students attending short-cycle tertiary education in Latin America (Ferreyra, Dinarte Díaz, et al., 2021). About 30% of students in higher education are enrolled in short-cycle programs, as defined by UNESCO-ISCED classification4. The number of institutions and programs offering short-cycle degrees has dramatically expanded, adding to the existing provision of programs by the National Learning Service (In Spanish Servicio Nacional de Aprendizaje - SENA), contributing to the rise in total higher education coverage. The country gross enrollment rates in higher education have increased from 37.05% in 2010 to 51.5 % in 2016, in part driven by short-cycle programs.

The fast rate of new institutions and programs has not always been followed by growth in quality standards and, consequently, by better jobs and employment (Busso et al., 2020; Camacho et al., 2017; Chaparro & Maldonado, 2022; Ferreyra, Galindo, et al., 2021). The heterogeneity in returns and value added of short-cycle tertiary education programs is mainly due to the variety of institutions offering these programs (Carranza et al., 2021; Dinarte Diaz et al., 2021).

First, SENA leads this sector as the largest institution offering short-cycle programs, covering almost 65% of the total enrollment. Next, private and public specialized technical institutes provide short-cycle degrees with duration ranging from two to three years. Similarly, colleges and universities5, both private and public, are permitted to provide short-cycle degrees. Finally, education institutes for career and human development are another type of institution offering short-cycle certificates, with a duration ranging from one to two years. The fast growth in the number of programs and institutions has not been accompanied by equally fast growth in supervision capabilities. While programs at SENA are widely recognized in the labor market, there is little external oversight and monitoring about the quality of SENAs programs, due to its position as a large institution independent of the Ministry of Education. For the other institutions, the regulatory framework is too complex and falls short in assuring the quality of education provided (Chaparro & Maldonado, 2022).

In this context, public and private universities have a significant portfolio of two and three-year programs. The fact that universities, whose strength is more on the traditional bachelor program, also offer two- and three-year degrees provides a distinct feature for this study. In developed countries, institutions tend to specialize.

For instance, in the US, community colleges and technical colleges are entirely separate institutions from 4-year colleges and universities. In Latin America, universities provide short-cycle degrees in countries like Brazil (Ferreyra, Dinarte Díaz, et al., 2021).

Universities are uniquely advantaged in their capacity to offer high-quality tertiary education because of their teaching personnel, their infrastructure, and market recognition. Universities are likely strong in designing steady curricula focusing on general skills and broadly defined knowledge fields. On the other hand, their disadvantage in offering short-cycle programs is primarily the inability to adapt fast enough to the changing market demands (Carranza et al., 2021). Finally, an important advantage is that starting a short-cycle program directly in the university could offer a smoother transition to the bachelor's degree. Because of these reasons, it remains an empirical question whether universities are well suited to provide short-cycle degrees.

This paper focuses on the three-year technology degrees provided by the UD university. The three-year technology degree is the more important of the short-cycle degrees in the country with a share of 58% of enrollment in this educational level by 2018. The university offers three-year technology programs exclusively in the field of engineering. The UD Engineering School is one of the most well recognized in the city. However, the three-year technology programs are taught by a different school, the School of Technology. The two schools are part of the same university and share teaching personnel and faculty. The School of Technology is located in a different campus, to serve population that lives in the peripheries far from city center.

Furthermore, the university offers two separate pathways for degree: the traditional terminal pathway and the degree-by-cycles pathway. The degree-by-cycles differ from the terminal degree pathway by offering courses at the end of the program that are part of the core courses of the engineering major. The degree-by-cycles pathway intents to provide a direct transition avenue to the engineering bachelor's degree but at the same time allow students to get a certificate they can already use in the labor market.

3 Data and Empirical Strategy

3.1 Data sources

I link the records of the applicants to the UD University to several administrative information records measuring learning outcomes and educational achievement. First, applicants are linked to their results in the national high school exit examination (Saber 11) and the technology degree exit examination (Saber TyT). In addition, applicants are linked to the information system tracking their progress in the higher education system (in Spanish: Sistema de Información de la Educación Superior SNIES). From here, I observe whether applicants enrolled and graduated from any program or institution in the country.

Admission records: As part of the admission process, students must declare their major in their application. For instance, they need to select the program: technology in manufacturing mechanics. Students can apply to more than one program per cycle but must file separate application forms. The university publishes the list of applicants to each program, the scores assigned in the application evaluation, and admission results. I collected from the admission webpage results to the three-year technology programs from 2015 to 20206. I include applications to the terminal degree pathway and the degree by-cycles pathway. Students apply separately to these two pathways, even if it leads to starting the same program. The list of applicants contains the identification information that allows me to link their records to the Saber 11 individual results. The list also contains their rank in their cohort, the selected program, and the admission cutoff. The availability of seats per program determines the cutoff in each admission cycle.

High school exit exam Saber 11: Saber 11 is a standardized test that every high school senior student must take before graduation, allowing me to rule out any concern about selection into the test. Saber 11 is a high-stakes test since it is a requirement by law to enroll in any tertiary education program in the country. Some colleges use the results for admission. The test evaluates students' skills in dimensions such as reading and quantitative reasoning. During the test administration, students complete a survey about socioeconomic background from which I construct the covariates. Observable pre-admission characteristics are gender, age, categorical family income, and parents' education attainment. Finally, since the schools register their students in the exam, I can also observe a rich set of high school characteristics.

Exit examination for Technical and Technology programs Saber TyT: Saber TyT is standardized test tailored to evaluate general skills development for short cycle programs. Saber TyT evaluates learning outcomes that is rarely measured for this educational level, thus providing distinctively unique information from other settings. Starting in 2016, these tests are now mandatory for graduation. The Saber TyT is standardized test tailored to evaluate general skills development for short cycle programs in areas such as reading comprehension and quantitative reasoning. The results in general skills allow comparison between educational levels, thus enabling valued added and contribution analysis.

The information registry of the national higher education system SNIES: Every higher education institution operating in the country must report semiannually to the Ministry of Education complete records of their enrolled students and students graduating for each program they offer. From the annual consolidation, I can construct indicators measuring enrollment in the UD university and any other higher education institution in the country. I also construct graduation outcomes and enrollment in different periods after initial admission..

3.2 Variables, sample, and summary statistics

Observations in the analysis are applications. The sample consists of 3,497 applications from 3,398 individuals to three-year technology programs in the university between 2015 to 2020. In total, the sample contains applicants from 12 programs in the traditional terminal pathway (See Table 1), and 1,568 applications to programs in the degree-by-cycles pathway from 2018 to 2020. While students can apply to many degrees at the same time or in different admission cycles, they can only enroll in one of them if admitted. I restrict the sample to programs with more than ten applications.

Table 1 presents the summary statistics of the analytical sample. About 67% of applicants are men, which is a pattern usually observed in the engineering field. All programs belong to the engineering school. The average age at admission is 19 years old, two years older than the average high school graduation rate. More than 60% of students come from families living in housing classified in the economic strata 1 and 2, usually associated with low income since these groups receive subsidies for public utilities and sanitation. Most applicants, about 55%, come from public high schools (Table 1 Panel demographics). In sum, the students applying for this university are primarily from low and middle-income families.

For postsecondary educational attainment, I construct indicators of enrollment in three-year technology programs and enrollment five-year bachelor’s programs. I construct an indicator measuring enrollment in technology program regardless of the institution and an indicator of enrollment in technology programs specifically in the UD university. Next, I construct an indicator of degree completion, but with the limitation that the cohorts in my sample are very recent (2016 to 2020) and likely still working towards a degree. About 35% of non-admitted students enroll in technology programs offered by other institutions.

To measure the transfer between the technical and the bachelor's degree, I construct enrollment measures in bachelor's degrees at two separate times after admission. The first one is to observe enrollment in five-year programs immediately after admission to a technology program. The second one is to observe enrollment after the expected graduation from the technology program. If the transition from one degree to another happens, we might observe students entering bachelor's degrees four years after admission to the technical degree. I compare these enrollment measures in the terminal pathway over time to indicators for the applicants to the degree-by cycles pathway.

Learning outcomes come from the results Exit examination for Technical and Technology programs Saber TyT, in the general skills of critical reading and quantitative reasoning. I observe the scores in levels and percentile distribution of all exam takers. For estimations, I standardized the score to have a mean zero and unit standard deviation with respect to our analytical sample. Since 35% of the non-admitted group sample enrolls in other institutions, I have enough sample size to compare scores around the cutoff of admission for UD university. Table 1 presents the mean percentile for admitted and non-admitted students, showing that admitted students rank 20 percentiles on average above the non-admitted in the total score for the exam.

3.3 Empirical strategy: Regression discontinuity design

I exploit the admission criteria of the UD university to estimate the causal impacts of admission to a three-year technology program on educational attainment and learning outcomes. Non-admitted students could either enroll in other programs or end up not attending any postsecondary institution. Then, I interpret the estimated effects as gains of the admission compared to the weighted average of the alternatives (other higher institutions and no postsecondary education). About 21% of non-admitted students enroll in the National Training Service (SENA), which leads to a good comparison between the two institutions.

I use a fuzzy regression discontinuity design since students can choose not to enroll in the university once admitted. Students apply to a specific major, and the university assigns a specific score, weighting the scores obtained in different test modules according to the skills required for each major. The weighted score is the running variable for the regression discontinuity design. The availability of seats in each program and cohort determines the admission cutoff. I stack all programs and cohorts, setting the cutoff at zero and standardizing the admission score around the cutoff. Individuals around the admission cutoff provide a good counterfactual, assuming that the potential outcomes functions are continuous conditional on the score.

The main specification is a reduced form version with local regressions with polynomial form z and observation in bandwidth i around the cutoff.

$$Y_{ipc} = \beta_0 + \beta_1 \times A_i + \sum_z S_i{}^z + \sum_z \alpha_i \times A_i \times S_i{}^z + \tau_{pc} + \varepsilon_{ipc} \qquad , z \in \{1,2,3\},\ i \in h \quad (1)$$

The coefficient β_1 next to the admission dummy A_i is the parameter of interest. S_i represents de admission score, τ_{pc} is the set of fixed effects by admission cohort c and program p. The local regression is estimated in an optimally selected window

h. The coefficient β_1 represents the causal effect of admission, after controlling for the score function in both sides of the cutoff. The functional form is flexible in the polynomial order by allowing lineal quadratic or cubic specification. I estimate the main specification using kernel-weighted local OLS regressions, including program and admission cohort fixed effects.

I employ the most recent methods for regression discontinuity design (Cattaneo et al., 2020). First, the bandwidth selection around the threshold is critical because of the tradeoff between bias and variance in estimating the target parameter. The larger the bandwidth, the more precise estimation but more bias since individuals farther to the cutoff are included. On the other hand, the continuity in the limit assumption implies that observations closer to the cutoff are more informative. To deal with the bias-variance tradeoff, I follow the mean squared error (MSE) optimal approach (Imbens & Kalyanaraman, 2012) and estimate and select a data-driven window using the most recent bandwidth selectors (Calonico et al., 2014). In addition, I present the bias-corrected coefficient and robust standard errors that adjust for the introduction of the bandwidth selection in the analysis.

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3.4 Regression discontinuity: Validity

In this section, I present the standard validity exercises for the regression discontinuity design (RDD). Using the potential outcomes framework, the RDD main assumption is that outcome function conditional on the score that would have observed in the absence of the treatment is continuous near the cutoff. Since individuals cannot influence or determine the admission assignment criteria, their observable and unobservable characteristics should not jump abruptly around the threshold, providing comparable control and treatment groups. While this assumption cannot be directly verified, I present the standard validation tests to support the validity of the design. First, I test whether the distribution of the running variable is continuous, to support the case of no manipulation of the score around the cutoff. The donut hole specifications examine whether the estimations are sensitive to observations right at the cutoff, even if manipulation is not visually or statistically evident.

<u>Continuity of the admission score:</u> I argue that there is no reason to believe that the density of the running variable is not continuous near the threshold. First, the exact cutoff for admission is unknown to students because the information on the number of seats is not public. Moreover, the demand for seats and competitiveness in each admission cycle is also very unpredictable. These factors will determine how many students apply and where the cutoff will be set. The score of the student occupying the last available seat determines the cutoff for each cycle. Figure 1 depicts the distribution of the scores in a histogram. There is a higher density of students around the cutoff. However, I found no statistical difference when performing the discontinuity test of the estimated distribution. The higher frequencies of students around the cutoff also reflect the stacking of all programs setting zero as the cutoff.

Balance of covariates: The continuity of the covariates around the threshold is also a piece of evidence supporting the assumption of continuity. I show that individuals are similar around the cutoff in variables not affected by the admission assignment, such as pre-application family and student characteristics. I estimate the in equation (1) to estimate the effect of admission on the covariates. Table 5 reports the point estimates for gender, family income, public high school, and parental education attainment covariates. Table 5 presents results for linear, quadratic, and cubic specification forms. Also, the table presents non-adjusted and bias-corrected coefficients, together with corresponding standard errors and p-values. While few coefficients are statistically significant, particularly in certain categories of mother education and economic strata, there is no consistent pattern. Figure 2 shows the graphical representation of the lineal specification continuity around the threshold for all the covariates. Overall, the results in this analysis support the claim of balance in the covariates near the cutoff.

Placebo cutoff: The falsification test looks for possible discontinuities in score ranges where the admission assignment should be constant. It provides further evidence that the treatment assignment only jumps at the cutoff, and byproduct, the outcomes should also jump at this point if one wants to attribute causal impacts to the treatment. Table 6 presents the estimation results for lineal specifications for different placebo cutoffs. Estimations for cutoff on the right side use the sample of only people on the right and similarly estimations for placebo cutoff on the left. Some coefficients are statistically significant at placebo cutoffs. For instance, the left cutoff of -3 points shows low p-values. One reason is that the university has a waiting list for admission. The waitlist could move the true cutoff to the right, leading to a multiple cutoff in the admission process. A second reason is that the analysis is at the level of application, then individuals can appear many times if they apply to several programs or re-apply in other cycles. The results are robust when using a sample of only the first application. These limitations imply that the estimations result could still be biased affecting the interpretation of the results.

Donut hole: The donut hole analysis excludes points in a radius closer to the cutoff. If the score is manipulated to get admission, points closer to the cutoff must drive most of the observed results. Table 7 presents the lineal specifications for several radius of sample exclusion. The point estimates remain similar and statistically significant across all the donuts. In sum, the results are robust to the donut hole sensitivity analysis, supporting the argument that individuals scoring close to the cutoff are not manipulating the admission assignment.

4 Results

This section presents the results of the reduced form specifications in Table 2 for postsecondary enrollment and completion, Table 3 for learning outcomes, and Table 4 for transition outcomes from technology degree to bachelor's degree. The coefficient of interest is the admission dummy, indicating the assignment of a seat in the university for individuals above the threshold. The tables present estimated results for the unadjusted and bias-corrected coefficients that adjust for the bandwidth selection, as explained in the previous section. Tables also present results for different functional forms: lineal, quadratic, and cubic.

I also present the visual evidence of discontinuity around the cutoff for the educational enrollment outcomes (Figure 3), learning outcomes (Figure 4), and transition outcomes (Figure 5). These figures visually represent the discontinuity, plotting bins for unconditional means by score intervals. On top, the figures depict the linear fit with a 95% confidence interval.

4.1 Enrollment and completion of technology degree program

Table 2 presents the point estimates for the first set of outcomes on enrollment and completion. Column 1 presents the estimates that indicate how being admitted to the 3-year technical program impacts the probability of enrollment in any postsecondary education institution. Table 2 panel 1 shows that being admitted to the university increases the probability of enrolling in a technology program in any institution by almost 11 percentage points, equivalent to an increase of 30% relative to the comparison group. This result is robust in the lineal and quadratic specifications. The coefficient in the cubic specification is half the size of the two other specifications and becomes statistically not significant. Still, the finding implies that an important share of students who potentially have other alternatives end up not enrolling in technology program. Figure 3, first row, presents the graphical representation of the lineal discontinuity of the enrollment in the technology program. The first-row right panel shows the same representation for enrollment specifically for the UD university. Both figures exhibit clear discontinuities, as evidence of the statistically significant effect of admission in enrollment.

I also measure whether students enrolled in bachelor's degrees in the subsequent years after admission. Specifically, for the admission cohorts of 2015 to 2018, I observe enrollment from 2015 to 2020. The goal is to examine whether the admission to the technology degree creates a deviation effect for students who could have access directly to the five-year bachelor's degree program. I also examine if entering postsecondary education through the technology program leads to a terminal degree or eases the transition to the bachelor's degree. In Table 2 column 3, I show that there is no statistically significant effect of admission to the technology degree on the probability of enrolling in a bachelor's program. The coefficients for all specifications in column 3 are small, sometimes fairly close to zero. It is also important to point out that the estimates do not overlap with the range of the point estimates for enrollment in column 1. Figure 3, second row, presents the graphical depiction of no discontinuity in the bachelor enrollment outcome. From these results, it is difficult to conclude any deviation effect. So far, students at the margin for admission to the technology program do not initially intend to enroll in a bachelor's degree.

Finally, I estimate the impact on graduation from technology degrees, finding no statistically significant estimates. While, on average, 25% of applicants have graduated with three-year technology degrees, the estimated gain between admitted and non-admitted is not more than 2pp. In this analysis, I am not conditioning for the students who effectively attended the technology program. The sample always includes both students who attended technology programs and the ones who never enrolled. Figure 3, second row, also presents the graphical depiction of no discontinuity in graduation. With our sample size and timeframe, students in our cohort are likely to be working toward their degrees, we cannot precisely observe graduation and estimate the impacts. In sum, I cannot conclude about substantial degree completion gains in my study period.

4.2 Learning outcomes from the technology degree program in the university

The results on learning outcomes are unique to the Colombian setting because of a compulsory examination at the end of technology degrees specifically tailored to measure skills change from this educational level. Table 3 presents the results for the scores in the exit exam examination for technology programs Saber TyT. For this paper, I standardize the scores to have mean zero and a standard deviation of one relative to the distribution in the analytical sample. Table 3 column 1 presents the point estimates for the quantitative reasoning component. The estimated coefficients are small and not statically significant across all specifications. Figure 4 panel 1 shows the graphical depiction of binned averages of quantitative reasoning scores in levels against the admission score. There is no visual discontinuity of this outcome around admission, as presented by the linear fit.

Interestingly, the figure presents a clear linear correlation between the quantitative reasoning scores in the technology degree exam and the high school exit examination scores. This fact is consistent with findings in previous literature in the country, showing performance in high school as one of most important predictors of performance in college.

Column 2 presents the results for reading comprehension. Admission to the university for a technology degree program increases skills for reading comprehension by 0.24 SD. This is a sizable gain of getting a seat in UD university vs. other alternatives. The results remain robust to functional form and bias correction. Figure 4 panel B presents the graphical representation of the discontinuity of the reading scores in levels around the admission cutoff. These results support the idea that the university has the advantage in training core general skills such as critical reading.

Column 3 presents the results for the total score in the exit examination exam. Besides reading and quantitative reasoning, the exam includes components in writing skills, English (as a second language) and civic and citizenship skills. Being admitted to the university for a technology degree increases the total test score by 0.25 SD. The point estimate has an upper limit of 0.4SD depending on the functional form. However, it remains statistically the same across specifications and is robust to bias correction from the RDD resign. Figure 4 Panel C presents the graphical representation of the discontinuity of the Saber TyT total score. In sum, students admitted to the three-year program in this university achieve higher scores in the Saber TyT standardized test demonstrating the effect of admission on improving skills for these students.

4.3 Transition from technology degree to the bachelor's degree

The UD university offers a unique setting to examine whether entering the university through a technology degree can lead to a bachelor's degree. For many students, the technology program might be the only opportunity to get a postsecondary degree. Many of them would have been better-off by taking a bachelor's degree, but financial and informational barriers limit their access to college education. In this case, accessing a technology degree could ease those students' entrance to postsecondary education and increase college education access.

The university offers two pathways toward a college degree. One is the traditional pathway, where students apply and complete one degree. There are no shared curricula or smooth transition to the next educational level. The second pathway is the degree-by cycles pathway. This pathway has been growing in the country in the last decade as a solution offering an explicit transition curriculum between the technical and the bachelor's degree while letting the students obtain a certificate in the short term.

I compare the admission cohorts applying separately to the traditional and degree-by-cycles pathways. For the traditional pathway, I measure enrollment in the bachelor's degree immediately after admission and four years later. With the immediate measure, I approach the deviation effect, whether the students applying to the technology degree could have gone directly to the bachelor's degree. On the other hand, I measure whether students in the traditional pathway for the technology program continue at the end of their degree to the bachelor's program.

In the degree-by -cycles pathway, I measure the enrollment in the technology degree and the enrollment in the bachelor program for students that apply to the bachelor cycle after ending the technical cycle.

Table 4 presents the results of this analysis. Column 1 reports the same coefficients of Table 2, focused on the traditional pathway sample, for comparison. Being admitted to the traditional pathway increases enrollment by 12.7 percentage points. Being admitted to the degree-by-cycles have a similar gain in enrollment. However, the degrees-by-cycle sample is smaller compared to the traditional pathway sample limiting the precision of the estimates in this sample. Figure 6 left side panel presents the visual representation for the discontinuity in probability of enrollment for the degree-by-cycle path. In addition, being admitted to the traditional pathway decreases the probability of enrollment in the bachelor's degree by around 5 percentage points in the preferred bias corrected specification (Table 4, column 2). This point estimate, however, is not statistically significant. The deviation effect is at most moderate given the size and precision of this set of estimates.

Similarly, students admitted to the traditional technology degree are less likely to enroll in the bachelor's degree in the years after expected graduation from the technology program, but coefficients are imprecisely estimated (Table 4, column 3). Finally, being admitted to the degree by-cycles pathway increases the probability of bachelor's degree enrollment by 13 percentage points from the preferred bias corrected specification. Figure 6 right side panel presents the visual representation for the discontinuity in probability of enrollment for the degree-by-cycle path. This finding is not robust in all specifications. The sample size for the degrees-by-cycle pathway limits the precision of these estimates. However, this evidence suggests that the degrees-by-cycles program might have a higher potential to provide transition channels for students toward a college degree.

5 Conclusion

The findings indicate that admission to a technical certificate program at the UD university increases enrollment into technology programs by 10 percentage points and increases overall exit exam scores by 0.2SD, driven mainly by gains in critical reading skills. There are no effects on timely graduation nor differences in quantitative reasoning. Using the case of a flagship university in Bogota, I show that offering admission to a technology degree in the university provides an entry point for students who otherwise would not have accessed any other alternative. Even more, students admitted to the university have demonstrated skills gains compared to those who enrolled in other institutions.

Moreover, students entering the degree-by-cycles pathway are more likely to continue their studies toward a bachelor's degree. The students entering the traditional pathway are not more likely than their peers in other institutions to enroll in bachelor's degrees after finishing the technical certificate. This paper provides suggestive evidence that offering a well-defined transition pathway leads students to a five-year college degree.

This evidence demonstrates that the quality of the technology degree in the university is at least as good as the alternatives, which are usually institutions highly specialized in short-cycle education. The university training is effectively improving general skills, which is precisely the university strength. The general skills have the prepare students to acquire more specific skills. Most importantly, the general skills prepare the students to continue towards a bachelor's degree. However, more research is needed to understand in deep what elements in the curricula and training in the university explain the difference, specifically in critical reading.

This paper presents a comparative perspective of the traditional and degrees-by-cycles transfer pathways, suggesting the latter is relatively more successful in helping students continue towards their bachelor's degrees. The degrees-by-cycles pathway incorporates a curriculum that allows students to take credits valid for the engineering degree. In addition, this pathway offers a degree that students can use to get a job while finishing their undergraduate studies.

This evidence illuminates alternatives for reform in the short-cycle tertiary education system. A comprehensive diagnosis carried out as part of the strategy mission for employment in Colombia identifies key shortcomings of the current system (Chaparro & Maldonado, 2022). First, the complex regulatory framework has diminished the capacity to guarantee quality standards among newly created programs. Second, the multiplicity of degrees and institutional types has failed to deliver clear information to employers and students about the skills of each program, hindering their recognition in the market. The employment mission recommends a reform to the regulatory framework addressing those problems. This paper adds to these recommendations by arguing that universities can be strengthened instead of incentivizing the proliferation of smaller specialized institutions. Universities already offering technology programs in their portfolio are uniquely positioned to expand their efforts because of their advantage in providing high-quality training in general skills and the potential to offer a smoother transition toward five-year degrees.

Declaration of interest statement

The authors have declared no conflict of interest.

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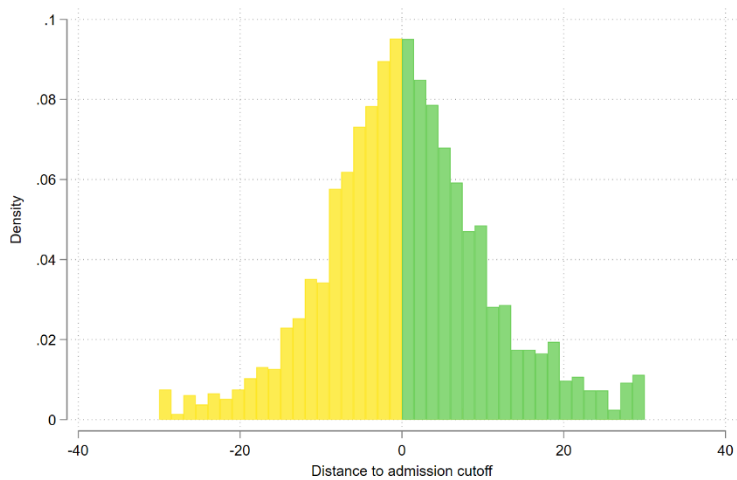
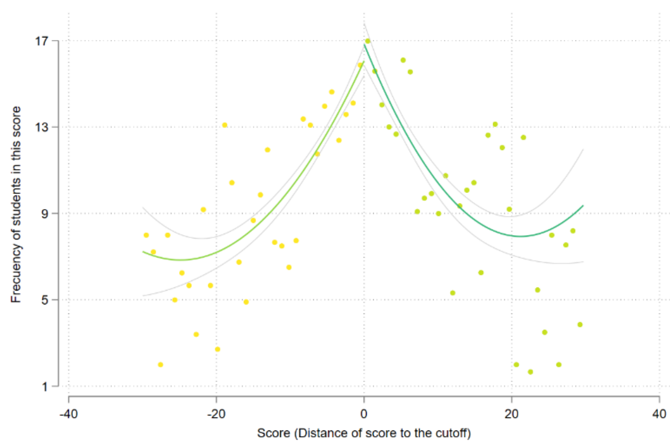
Figures

Figure 1: Score distribution



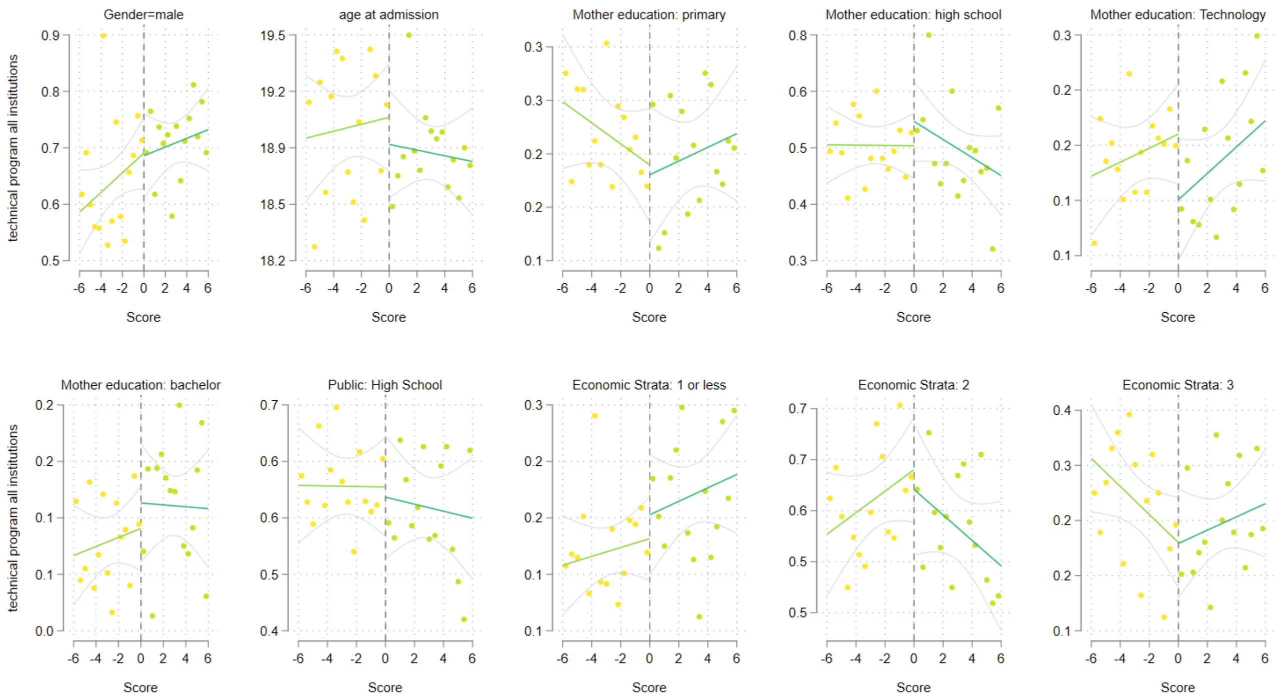
Score distribution



Local density estimation

Notes: Sample includes applicants to 3-year technology programs in the cohorts from 2018 to 2020 to the university. Figures plot the estimated density of the score around the cutoff. The score is assigned by the university to the application

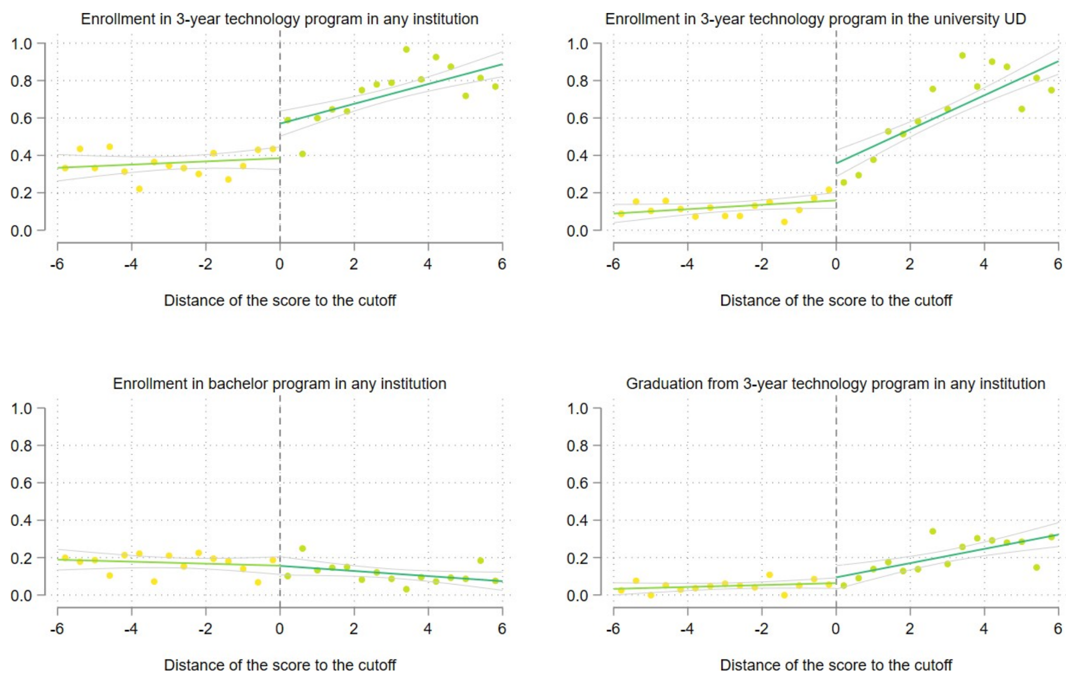
Figure 2: Covariates Balance



Notes: Figure presents the binned average covariates and a linear fit for both sides of the cutoff with 95% confidence intervals. Sample includes applicants to 3-year technology programs in the cohorts from 2018 to 2020 to the university.

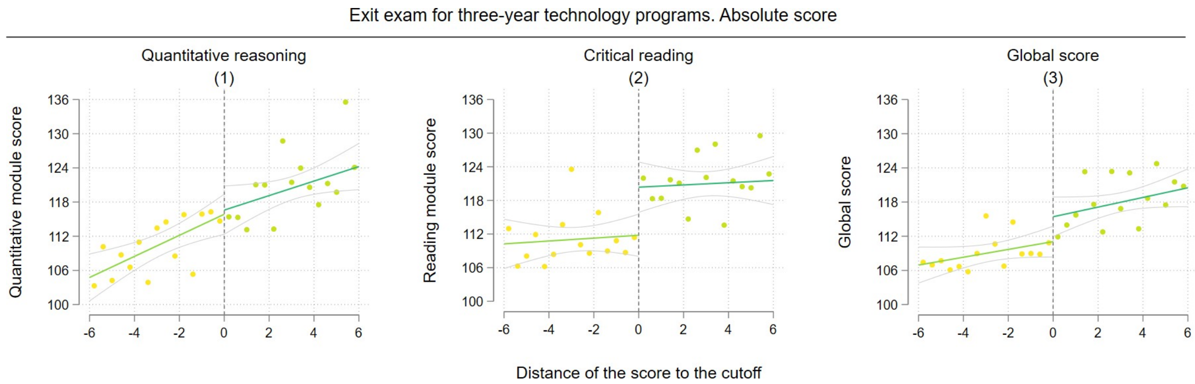
Running variable is the admission score assigned by the University to the applicant by program and cohort, stacked and standardized around zero to represent the distance to the cutoff.

Figure 3: Effects of university admission for 3-year technology programs on enrollment and completion.



Notes: Figure presents the binned average enrollment outcomes and a linear fit for both sides of the cutoff with 95% confidence intervals. Sample includes applicants to 3-year technology programs in the cohorts from 2018 to 2020 to the university. Running variable is the admission score assigned by the University to the applicant by program and cohort, stacked and standardized around zero to represent the distance to the cutoff.

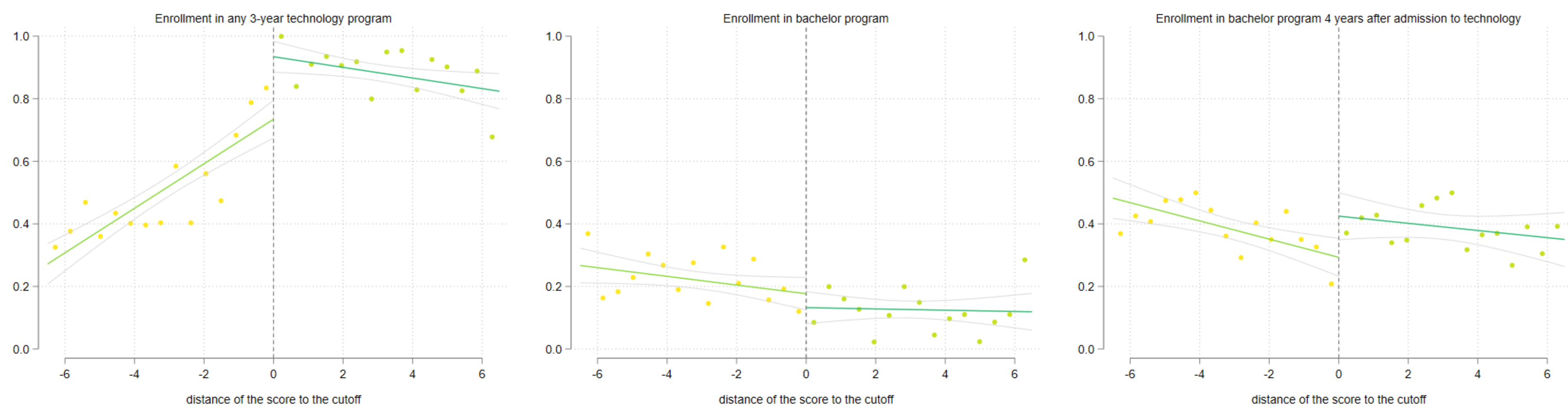
Figure 4: Effects of university admission for 3-year technology programs on learning outcomes.



Notes: Figure presents the binned average of scores in the exit exam from the 3-year technology programs and a linear fit for both sides of the cutoff with 95% confidence intervals. Sample includes applicants to three-years technical programs in the cohorts from 2015 to 2020 to the university.

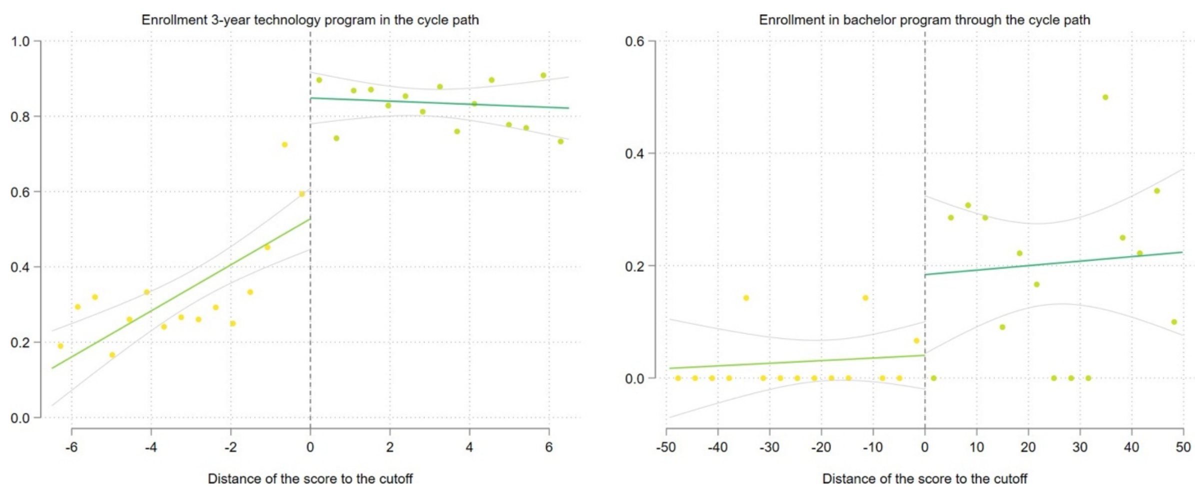
Running variable is the admission score assigned by the University to the applicant by program and cohort, stacked and standardized around zero to represent the distance to the cutoff.

Figure 5: Effects of university admission for technical programs on transition to bachelor.



Notes: Figure presents the binned average of scores in the exit exam from the technical programs and a linear fit for both sides of the cutoff with 95% confidence intervals. Sample includes applicants to 3-year technology programs in the cohorts from 2018 to 2020 to the university. Running variable is the admission score assigned by the University to the applicant by program and cohort, stacked and standardized around zero to represent the distance to the cutoff.

Figure 6: Effects of university admission for 3-year technology programs in degree-by-cycle



Notes: Figure presents the binned average of scores in the exit exam from the technical programs and a linear fit for both sides of the cutoff with 95% confidence intervals. Sample includes applicants to 3-year technology programs in the cohorts from 2018 to 2020 to the university. Running variable is the admission score assigned by the University to the applicant by program and cohort, stacked and standardized around zero to represent the distance to the cutoff.

Tables

Table 1: Descriptive Statistics

	Traditional path		Degrees-by-cycles path	
	Admitted	No Admitted	Admitted	No Admitted
	(1)	(2)	(3)	(4)
Panel A: Covariates				
Male	0.67	0.63	0.75	0.63
	(0.47)	(0.48)	(0.43)	(0.48)
Age at admission	19.13	19.04	19.00	19.16
	(2.22)	(2.37)	(2.10)	(2.17)
Public high school	0.55	0.62	0.58	0.63
	(0.50)	(0.49)	(0.49)	(0.48)
Mother education:				
Primary	0.18	0.22	0.16	0.15
	(0.39)	(0.41)	(0.36)	(0.36)
High school	0.53	0.55	0.49	0.55
	(0.50)	(0.50)	(0.50)	(0.50)
Technical	0.15	0.15	0.19	0.18
	(0.36)	(0.36)	(0.39)	(0.38)
Bachelor	0.13	0.08	0.17	0.12
	(0.34)	(0.27)	(0.37)	(0.33)
Economic Strata:				
1	0.17	0.16	0.17	0.17
	(0.38)	(0.37)	(0.38)	(0.37)
2	0.56	0.57	0.57	0.55
	(0.50)	(0.49)	(0.50)	(0.50)
3 or more	0.27	0.27	0.26	0.28
	(0.44)	(0.44)	(0.44)	(0.45)
Panel B: Enrollment				
3-year technology program	0.75	0.34	0.67	0.21
any institution	(0.43)	(0.48)	(0.47)	(0.41)
3-year technology program	0.69	0.07	0.60	0.02
in Universidad Distrital	(0.46)	(0.26)	(0.49)	(0.13)
Degree completion	0.20	0.26	0.80	0.53
	(0.40)	(0.44)	(0.40)	(0.50)
Panel C: Exit Exam scores				
total score percentile	84.65	66.50	80.76	59.33
	(17.47)	(22.43)	(20.54)	(24.58)
quantitative score percentile	85.27	68.64	81.48	58.55
	(17.70)	(23.55)	(20.17)	(25.93)
reading score percentile	80.61	62.54	77.21	54.51
	(20.78)	(25.13)	(23.24)	(21.18)
applications	2,065	1,545	810	385
individuals	2,002	1,502	801	380

Notes: Full Sample is the list of applicants to technical programs (two years degree) to the Public University from 2015-2020. The RD sample is the sample for the regression discontinuity specifications within a symmetric optimal MSE selected bandwidth (closer to 5 points around the cutoff). Observations are applications. Individuals could apply more than once.

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Table 2: Effects of university admission for three-year technology programs on educational achievement

	Enrollment			Graduation
	technology any institution (1)	technology at UD (2)	bachelor any institution (3)	technology degree completion (4)
Panel A: Lineal				
Admitted (non adjusted)	0.127***	0.122***	0.006	0.022
	(0.045)	(0.047)	(0.031)	(0.039)
	[0.005]	[0.009]	[0.857]	[0.569]
Admitted (bias-corrected)	0.109**	0.098*	0.017	0.013
	(0.049)	(0.051)	(0.034)	(0.043)
	[0.026]	[0.055]	[0.625]	[0.762]
bandwidth	6.7	5.4	7.9	11.4
effective obs 1531	1287	1714	2151	
total obs	3031	3031	3031	3031
Panel B: quadratic				
Admitted (non adjusted)	0.137***	0.166***	0.028	0.007
	(0.047)	(0.045)	(0.036)	(0.046)
	[0.004]	[0.000]	[0.441]	[0.881]
Admitted (bias-corrected)	0.123**	0.147***	0.038	-0.001
	(0.051)	(0.050)	(0.039)	(0.048)
	[0.017]	[0.004]	[0.323]	[0.981]
bandwidth	14.3	15.1	11.5	17.3
effective obs	2357	2416	2154	2505
total obs	3031	3031	3031	3031
Panel C: cubic				
Admitted (non adjusted)	0.066	0.111*	0.041	-0.015
	(0.059)	(0.063)	(0.039)	(0.053)
	[0.264]	[0.078]	[0.294]	[0.769]
Admitted (bias-corrected)	0.053	0.097	0.048	-0.020
	(0.063)	(0.070)	(0.041)	(0.055)
	[0.395]	[0.164]	[0.242]	[0.713]
bandwidth	15.7	17.4	16.8	20.1
effective obs	2429	2507	2469	2611
total obs	3031	3031	3031	3031
mean control	0.345	0.074	0.155	0.258

Notes: Columns 1 to 4 present reduced form estimates from a local regression around the admission cutoff. Column 1 reflects enrollment in any institution. In column 2, I restrict enrollment only the Universidad Distrital (UD). In column 3, the dependent variable is enrollment in bach- elor degree programs in any institution. Admitted represents a dummy for being above the cutoff. The first row in each panel presents the conventional estimates from a regression with no corrections for bias and variance. The robust row present bias-corrected coefficients with robust errors. Observations are applications to three-year programs from 2015 to 2020. Esti- mations use the optimal MSE selected bandwidth and include major, and admission cycle fixed effects. Standard errors are clustered at score le9vel in parentheses. P-values in square brackets. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 3: Effects of university admission for three-year technology programs on learning outcomes

	Exit exam scores for technology programs		
	Quantitative module (1)	Reading module (2)	global score (3)
Panel A: Lineal			
Admitted	0.090	0.245**	0.258**
(non adjusted)	(0.120)	(0.117)	(0.109)
	[0.451]	[0.036]	[0.018]
Admitted	0.073	0.224*	0.257**
(bias-corrected)	(0.144)	(0.133)	(0.126)
	[0.612]	[0.093]	[0.041]
bandwidth	8.0	10.6	9.6
effective obs	687	804	769
total obs	1116	1116	1114
Panel B: quadratic			
Admitted	0.079	0.435**	0.337**
(non adjusted)	(0.158)	(0.182)	(0.155)
	[0.619]	[0.017]	[0.030]
Admitted	0.085	0.480**	0.376**
(bias-corrected)	(0.179)	(0.203)	(0.171)
	[0.634]	[0.018]	[0.028]
bandwidth	10.5	8.9	9.8
effective obs	801	736	771
total obs	1116	1116	1114
Panel C: cubic			
Admitted	0.102	0.483**	0.388**
(non adjusted)	(0.184)	(0.205)	(0.186)
	[0.580]	[0.018]	[0.037]
Admitted	0.099	0.487**	0.410**
(bias-corrected)	(0.199)	(0.222)	(0.202)
	[0.618]	[0.028]	[0.042]
bandwidth	13.8	12.5	12.3
effective obs	890	858	852
total obs	1116	1116	1114
exam score mean	113.2	114.9	112.2
exam score sd	20.1	20.0	15.1

Notes: Columns 1 to 3 present reduced form estimates from a local regression around the admission cutoff. Outcomes are standardized scores from the national exit exam for two and three-year technical and technology programs. Global score is the average score for all exam modules. Admitted represents a dummy for being above the cutoff. The first row in each panel presents the conventional estimates from a regression with no corrections for bias and variance around the threshold. The robust row present bias- corrected coefficients with robust errors. Observations are applications. Estimations use the optimal MSE selected bandwidth and include major, and admission cycle fixed effects. Standard errors are clustered at sc1o0re level in parentheses. P-values in square brackets. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 4: Effects of university admission for technology programs on transition to bachelor.

	Enrollment by path type				
	Traditional path			Degree-by-cycles path	
	technical	bachelor after admission	bachelor after 4 years	technical	bachelor
	(1)	(2)	(3)	(4)	(5)
Panel A: Lineal					
Admitted (non adjusted)	0.127***	-0.061*	-0.029	0.123	0.204***
	(0.045)	(0.031)	(0.041)	(0.079)	(0.055)
	[0.005]	[0.052]	[0.484]	[0.118]	[0.000]
Admitted (bias-corrected)	0.109**	-0.054	-0.027	0.085	0.137*
	(0.049)	(0.035)	(0.047)	(0.087)	(0.083)
	[0.026]	[0.124]	[0.573]	[0.334]	[0.098]
bandwidth	6.7	9.8	11.2	3.1	18.5
effective obs	1296	1483	2254	497	112
total obs	3031	3031	3031	1189	373
Panel B: quadratic					
Admitted (non adjusted)	0.137***	-0.040	-0.027	0.085	0.098
	(0.047)	(0.038)	(0.048)	(0.087)	(0.077)
	[0.004]	[0.292]	[0.577]	[0.329]	[0.200]
Admitted (bias-corrected)	0.123**	-0.033	-0.026	0.057	0.063
	(0.051)	(0.042)	(0.052)	(0.092)	(0.069)
	[0.017]	[0.435]	[0.617]	[0.534]	[0.359]
bandwidth	14.3	13.4	18.2	6.3	18.5
effective obs	2357	2303	2545	833	112
total obs	3031	3031	3031	1189	373
Panel C: cubic					
Admitted (non adjusted)	0.066	-0.025	-0.031	0.044	0.084
	(0.059)	(0.043)	(0.060)	(0.111)	(0.069)
	[0.264]	[0.570]	[0.603]	[0.695]	[0.228]
Admitted (bias-corrected)	0.053	-0.018	-0.030	0.049	0.178***
	(0.063)	(0.046)	(0.064)	(0.121)	(0.032)
	[0.395]	[0.695]	[0.638]	[0.688]	[0.000]
bandwidth	15.7	17.7	18.7	6.3	18.5
effective obs	2429	2510	2549	833	112
total obs	3031	3031	3031	1189	373
mean control	0.34	0.14	0.39	0.21	0.09

Notes: The outcome in column 1 is the enrollment in three-year technology program for the students applying trough the traditional path. Column 2 and 3 measures the enrollment of these same students in bachelor's degree -five-year programs in two moments: right after admission and 4 years after admission cycle. Columns 4 and 5 present enrollment measures for students applying through the degrees-by-cycles path. The first row in each panel presents the conventional estimates from a regression with no corrections for bias and variance around the threshold. The robust row present bias-corrected coefficients with robust errors. Observations are applications. Estimations use the optimal MSE selected bandwidth and include major, and admission cycle fixed effects. Standard errors are clustered at score level in parentheses. P-values in square brackets. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Balance of covariables

			Mother education					Economic Strata		
	Male	age at exam	Primary	High school	Some college	College degree	Public high school	one	two	three or more
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: lineal										
Admitted	0.05	-0.08	-0.03	0.06	-0.05**	0.03	0.01	0.07***	-0.06	-0.01
(non-adjusted)	(0.04)	(0.17)	(0.03)	(0.04)	(0.03)	(0.02)	(0.03)	(0.03)	(0.04)	(0.03)
	[0.25]	[0.65]	[0.32]	[0.13]	[0.05]	[0.25]	[0.83]	[0.01]	[0.11]	[0.74]
Admitted	0.04	-0.06	-0.04	0.07*	-0.06**	0.02	0.02	0.08**	-0.06	-0.01
(bias−corr)	(0.05)	(0.19)	(0.04)	(0.04)	(0.03)	(0.03)	(0.04)	(0.03)	(0.04)	(0.03)
	[0.40]	[0.74]	[0.31]	[0.09]	[0.04]	[0.35]	[0.64]	[0.01]	[0.16]	[0.79]
window	11.7	11.7	11.8	10.6	10.7	12.7	9.8	14.9	11.2	10.7
eff obs	2155	2149	2108	2005	2010	2170	1981	2342	2109	2042
total obs	3011	3010	2921	2921	2921	2921	3031	2954	2954	2954
Panel A: quadratic										
Admitted	0.04	-0.08	-0.04	0.07	-0.07**	0.02	0.02	0.06*	-0.06	-0.00
(non-adjusted)	(0.05)	(0.20)	(0.04)	(0.04)	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)
	[0.46]	[0.69]	[0.29]	[0.10]	[0.03]	[0.41]	[0.61]	[0.09]	[0.17]	[0.89]
Admitted	0.04	-0.09	-0.04	0.08*	-0.08**	0.02	0.03	0.06	-0.06	-0.00
(bias−corr)	(0.06)	(0.22)	(0.04)	(0.05)	(0.04)	(0.03)	(0.04)	(0.04)	(0.05)	(0.04)
	[0.50]	[0.70]	[0.30]	[0.09]	[0.03]	[0.41]	[0.52]	[0.16]	[0.21]	[0.97]
window	13.9	17.1	15.6	18.1	14.5	15.2	15.1	14.9	16.6	15.3
eff obs	2300	2485	2347	2458	2288	2339	2415	2339	2109	2375
total obs	3011	3010	2921	2921	2921	2921	3031	2954	2954	2954
Panel A: Cubic										
Admitted	0.04	-0.07	-0.03	0.08*	-0.08**	0.02	0.00	0.06	-0.06	-0.00
(non-adjusted)	(0.06)	(0.22)	(0.04)	(0.05)	(0.04)	(0.03)	(0.05)	(0.04)	(0.05)	(0.04)
	[0.56]	[0.76]	[0.43]	[0.09]	[0.03]	[0.62]	[0.94]	[0.17]	[0.25]	[0.98]
Admitted	0.03	-0.08	-0.03	0.09*	-0.09**	0.01	-0.00	0.05	-0.06	0.00
(bias−corr)	(0.06)	(0.23)	(0.04)	(0.05)	(0.04)	(0.03)	(0.05)	(0.04)	(0.05)	(0.04)
	[0.60]	[0.72]	[0.46]	[0.08]	[0.04]	[0.67]	[0.98]	[0.21]	[0.27]	[0.98]
window	17.0	27.1	20.9	23.2	19.8	19.3	16.8	17.6	16.5	15.4
eff obs	2455	2723	2531	2590	2503	2500	2469	2535	2535	2642
total obs	3011	3010	2921	2921	2921	2921	3031	2954	2954	2954

Notes: Covariates measured in a survey at the high school exam examination, before admission. Admitted represents a dummy for being above the cutoff. The first row in each panel presents the conventional estimates from a regression with no corrections for bias and variance around the threshold. The robust row present bias-corrected coefficients with robust errors. Sample includes ap- plications to three-year programs from 2015 to 2020. Local regressions are estimated in the symmetric optimal MSE selected bandwidth for each outcome. Regressions include major, year, and semester of admission fixed effects. Standard errors are clustered at score level in parentheses. P-values in square brackets. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Placebo test: university admission for three-year technology programs.

	Educational achievement		Learning outcomes		
	Technology enrollment (1)	technology degree (2)	quantitative score (3)	reading score (4)	global score (5)
Cutoff 0	0.10*	0.01	0.07	0.22*	0.26**
	[0.06]	[0.76]	[0.61]	[0.09]	[0.04]
Cutoff -1	0.05	0.10*	-0.09	-0.34*	-0.38**
	[0.19]	[0.09]	[0.53]	[0.06]	[0.01]
Cutoff -2	-0.03	0.06	0.03	-0.16	-0.07
	[0.43]	[0.30]	[0.85]	[0.31]	[0.65]
Cutoff -3	-0.03	0.10*	0.31**	0.40*	0.51***
	[0.38]	[0.07]	[0.04]	[0.10]	[0.01]
Cutoff -4	-0.04	-0.14**	0.10	-0.01	0.10
	[0.35]	[0.02]	[0.60]	[0.98]	[0.63]
Cutoff -5	-0.00	-0.04	-0.44**	-0.00	-0.24
	[0.99]	[0.58]	[0.03]	[0.99]	[0.23]
Cutoff 1	-0.03	0.12	-0.23	-0.52	-0.07
	[0.88]	[0.36]	[0.64]	[0.31]	[0.91]
Cutoff 2	-0.06	0.08	-0.26	-0.20	-0.31
	[0.49]	[0.33]	[0.23]	[0.33]	[0.19]
Cutoff 3	0.01	-0.08	-0.15	-0.60***	-0.29
	[0.87]	[0.36]	[0.46]	[0.00]	[0.23]
Cutoff 4	-0.10*	-0.05	-0.08	0.92***	0.34
	[0.07]	[0.63]	[0.79]	[0.00]	[0.22]
Cutoff 5	0.01	-0.10	-0.03	0.00	-0.24
	[0.85]	[0.23]	[0.87]	[1.00]	[0.26]

Notes: Each row present reduced form estimates from a lineal local regression around the placebo admission cutoff. Column1 presents the results for the enrollment in a Three-year technology program. Column 2 present the outcome of graduation from the three-year technology program. Columns 3 to 5 presents the results on the scores from the exit exam for two and three-year technical and technology programs. Estimates in each row are the robust bias-corrected coefficients with robust errors. Observations are applications. Estimations use the optimal MSE selected bandwidth and include major, and admission cycle fixed effects. P- values in square brackets. * p < 0.1, ** p < 0.05, *** p < 0.01

Table 7: Donut hole test: university admission for three-year technology programs.

	Educational achievement		Learning outcomes		
	technology enrollment (1)	technology degree (2)	quantitative score (3)	reading score (4)	global score (5)
Donut 0	0.14**	-0.02	0.08	0.42***	0.33**
	(0.06)	(0.05)	(0.15)	(0.16)	(0.14)
	[0.01]	[0.73]	[0.59]	[0.01]	[0.02]
Donut 0.1	0.11*	-0.03	-0.03	0.58***	0.40**
	(0.06)	(0.05)	(0.17)	(0.18)	(0.17)
	[0.05]	[0.53]	[0.86]	[0.00]	[0.02]
Donut 0.2	0.11*	-0.06	-0.06	0.56***	0.37**
	(0.06)	(0.06)	(0.17)	(0.20)	(0.18)
	[0.07]	[0.30]	[0.72]	[0.00]	[0.03]
Donut 0.3	0.10	-0.03	-0.11	0.62***	0.35**
	(0.06)	(0.06)	(0.18)	(0.21)	(0.17)
	[0.10]	[0.55]	[0.54]	[0.00]	[0.05]
Donut 0.4	0.11*	-0.03	-0.08	0.45**	0.38**
	(0.06)	(0.06)	(0.17)	(0.21)	(0.18)
	[0.07]	[0.68]	[0.63]	[0.03]	[0.04]
Donut 0.5	0.16**	-0.04	-0.04	0.33	0.27
	(0.06)	(0.07)	(0.17)	(0.21)	(0.18)
	[0.01]	[0.53]	[0.82]	[0.11]	[0.13]

Notes: Each row present reduced form estimates from a lineal local regression excluding a sample of applicants in a radius (donut hole) closer to the admission cutoff. Column 2 present the outcome of graduation from the three-year technology program. Columns 3 to 5 presents the results on the scores from the exit exam for two and three-year technical and technology programs. Estimates in each row are the robust bias-corrected coefficients with robust errors. Observations are applications. Estimations use the optimal MSE selected bandwidth and include major, and admission cycle fixed effects. P-values in square brackets. * p < 0.1, ** p < 0.05, *** p < 0.01

Table 8: Technology Degree programs in Analytical Sample

Technology Degree	Observations
Manufacturing operations manager	176
Construction	24
Electronics	269
Environmental and public utilities	289
Industrial systems	918
Topography and land surveying	407
Industrial mechanics	655
Environmental sanitation	400
Database analysis and management	481
Total Sample	3,619
Total first year cohort	5358
Share sample	0.68

Notes: Three-year technology degree programs in the School of Technology at Universidad Distrital. Numbers correspond to individuals in our sample from 2015 to 2018 admission cycles, in the traditional pathway. * p < 0.1,** p < 0.05, *** p < 0.01