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The Intended and Unintended Impacts of a Merit-Based Financial Aid Program for the Poor: The Case of *Ser Pilo Paga**

Juliana Londoño-Vélez[†] Catherine Rodríguez[‡] Fabio Sánchez[§]

Abstract

We study a recent merit-based financial program for the poor in Colombia. We exploit sharp eligibility rules in household wealth and standardized test scores to identify the causal effect of financial aid on postsecondary enrollment and academic performance. We find large positive effects on postsecondary enrollment on both the extensive and intensive margins. Immediate enrollment doubled among eligible students, making the SES gap in enrollment disappear among top students. At the intensive margin, the program shifted students from low-quality institutions into higher-quality institutions, and from public to private colleges. We also observe significant general equilibrium effects in secondary and postsecondary education. The program promoted class diversity at top private schools, and significantly raised student quality at these institutions (but not public institutions). Demand for top private education shifted to the right, driving admission rates downward and increasing entry competition at these institutions, thus raising stratification by ability. However, program beneficiaries did not fully crowd out high-SES students from top private schools because supply also expanded. Finally, the program seems to have raised high school exit test performance among recent cohorts with relatively poor backgrounds.

Keywords: postsecondary enrollment, financial aid, inequality, Colombia, Ser Pilo Paga

JEL: H2, H3, H43, H52, I22, I23, I24

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Resultados Esperados e Inesperados de una Beca Estudiantil al Mérito para Jóvenes de Hogares de Bajos Ingresos: El caso de *Ser Pilo Paga**

Juliana Londoño-Vélez[†] Catherine Rodríguez[‡] Fabio Sánchez[§]

Abstract

Este trabajo evalúa los impactos del programa de becas-crédito *Ser Pilo Paga* en la educación superior en Colombia. Empleamos el método de regresión discontinua para identificar el efecto causal del programa sobre el acceso a la educación superior y el desempeño académico temprano de los estudiantes. Encontramos impactos importantes en acceso tanto en el margen extensivo como en el intensivo. La probabilidad de acceder inmediatamente a la educación superior se duplicó entre los estudiantes elegibles, eliminando la brecha en acceso por estrato socioeconómico entre los mejores estudiantes. En el margen intensivo, el programa desplazó a los estudiantes de instituciones de baja calidad hacia instituciones de mejor calidad. También observamos impactos no esperados en la educación secundaria y postsecundaria. El programa promovió la diversidad socioeconómica en las universidades privadas acreditadas y mejoró significativamente la calidad de los estudiantes en estas instituciones (pero no así en las instituciones públicas acreditadas). La mayor demanda por la educación privada acreditada redujo las tasas de admisión en estas universidades, volviendo más competitivo sus procesos de admisiones. No obstante, los beneficiarios del programa no desplazaron completamente a otros estudiantes del sistema educativo, pues la oferta educativa en estas universidades también aumentó. Por último, el programa parece haber mejorado el rendimiento de los estudiantes de las cohortes más recientes en la prueba SABER 11, especialmente entre los estudiantes de estratos más bajos.

Palabras clave: educación superior, ayuda financiera, desigualdad, Colombia, Ser Pilo Paga

JEL: H2, H3, H43, H52, I22, I23, I24

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1 Introduction

The rising higher education premium observed in many countries suggests that college is increasingly important to financial wellbeing. Overall, however, there is clear evidence that students from disadvantaged backgrounds are severely underrepresented in the post-secondary pipeline and particularly at top schools. Recent data from the United States show that only 3.8 percent of students in Ivy League colleges come from the lowest quintile of the income distribution (Chetty, Friedman, Saez, Turner and Yagan, 2017), even though nearly 17 percent of the top decile ACT or SAT I test-takers come from this income group (Hoxby and Avery, 2013). This underrepresentation of low-income students at top universities is also evident in developing countries. In Colombia, for instance, in 2014 less than 1.5 percent of low-SES students enrolled in quality postsecondary education immediately after graduating high school, compared to 44.2 percent of their high-SES counterparts.

This raises concerns about the role of higher education in promoting social mobility and reducing intergenerational inequality. Moreover, the underrepresentation of low-income, high-achievers in top colleges is puzzling for several reasons. Generous financial aid – which makes top institutions less costly than lower-quality alternatives – has not closed the socioeconomic status (SES) enrollment gap at top schools in developed countries. In fact, this gap has persisted despite a plethora of alternative initiatives, such as class-based affirmative action (Alon and Malamud, 2014; Kahlenberg, 2014), information provision (Hastings, Neilson and Zimmerman, 2015; Hoxby and Avery, 2013), intensive college counseling (Castleman and Goodman, 2017), aid in application processes (Bettinger, Long, Oreopoulos and Sanbonmatsu, 2012), reduction in application costs (Avery, Hoxby, Jackson, Burek, Pope and Raman, 2006; Pallais, 2015), and making college entry exams mandatory (Goodman, 2016). While the provision of financial aid has been a benchmark policy in the U.S. for decades, similar efforts are a recent phenomenon in the developing world. The scarce available evidence suggests that financial aid take-up is low among poor, high-achieving students and does not increase their attendance in top quality programs in these countries (Beyer, Hastings, Neilson and Zimmerman, 2015; Melguizo, Sanchez and Velasco, 2016).

In this paper, we explore the short-run causal impacts of a novel financial aid program that targets this specific group of low-income, high achieving students: *Ser Pilo Paga* (henceforth SPP) in Colombia. SPP is a publicly funded financial aid program that covers the full tuition cost of attending a four- or five-year undergraduate, degree-awarding program at any top-quality university in Colombia. To become eligible, applicants must fulfill three requirements. First, they must score at or above the 90th percentile in the national high school exit standardized test, SABER 11. Second, they must come from disadvantaged households, as measures by their SISBEN wealth index. Third, they must be accepted in any of the “high-quality” universities in the country, as accredited by the central government. The program was introduced by surprise in October 2014 and, since then, it has awarded almost 10,000 scholarship-loans on a yearly basis. This amounts to roughly one-third the 29,600 high school seniors who immediately accessed these “high-quality” universities in 2014, the year immediately prior to the implementation of the program. Its large scale, coupled with an immense advertisement campaign led by the government, has made SPP one of the most popular social programs in the country today.

Using administrative census data, we exploit SPP’s sharp eligibility rules in household wealth and standardized test scores to identify the program’s causal intended impacts on immediate postsecondary enrollment on eligible students and recipients. We find that SPP had significant positive impacts on both the extensive and intensive margins. Using SABER 11 as the run-

ning variable, the financial aid program almost doubled immediate enrollment in postsecondary education among eligible students. Impacts using the SISBEN score as the running variable are quantitatively smaller, at around 50 percent of the control mean. Given incomplete program take-up, local average treatment effects (LATE) estimates are substantially higher, at around 164 percent and 81 percent, respectively. Moreover, the program shifted enrollment from non-accredited to accredited institutions, which have the highest returns to schooling investments (Camacho, Messina and Uribe, 2016; MacLeod, Riehl, Saavedra and Urquiola, 2017). Enrollment in non-accredited schools fell between 55.6 and 58.3 percent among eligible students, while enrollment in accredited schools increased between 148.3 and 441.5 percent. Importantly, the program shifted students from public to private schools: enrollment in private institutions increased between 230.6 and 295.6 percent among eligible students, while that in public institutions fell between 37.1 and 51.8 percent. This is not explained by differential quality accreditation status. Instead, and consistent with previous literature (Riehl, Saavedra and Urquiola, 2016), our survey evidence suggests it is a result of students' perception of private institutions as being more prestigious and producing greater value added – broadly defined – for students.

To estimate the causal impact of SPP on student performance in college, we compare program beneficiaries with classmates of similar characteristics using data from the universe of postsecondary enrollees. We find that SPP recipients are 18 percent less likely to drop out during their freshmen year than others. These estimates are robust to instrumenting SPP reciprocity status with program eligibility. We also find that SPP recipients are 2.3 percent more likely to fail a course during their freshmen year (relative to a mean of 85.3 percent), a result that is robust to adjusting for selection bias due to differential attrition between treated and control groups (see Abdulkadiroglu, Pathak and Walters, 2017). These generally positive early academic outcomes are congruent with evidence for high-achieving, low-income students attending postsecondary institutions in other settings (Alon and Malamud, 2014; Angrist, Autor, Hudson and Pallais, 2016; Solis, 2017).

Further, the substantial expansion of immediate enrollment induced by the program had significant broader impacts in secondary and postsecondary education in Colombia. To explore these general equilibrium effects, we exploit this quasi-experiment and expand our analysis to the universe of high school test-takers and postsecondary attendees before and after the program was implemented. We find that the program generated substantial equity gains, with the SES enrollment gap virtually disappearing among students in the top test score decile in just one year. Not surprisingly, top private institutions also became substantially more diverse, with the share of low-SES students increasing by more than 100 percent at some institutions.

These equity gains might not translate into net social gains if seats at top universities were fixed. We find evidence inconsistent with the hypothesis that there is a zero-sum admission game at top quality universities in the short run. In fact, the newfound possibility of a tuition-free college experience skyrocketed applications at top-ranked private schools, driving admission rates down and making these institutions substantially more selective. Importantly though, the supply of private accredited education somewhat expanded in response to this shift in demand, so that low-SES students only partially crowded out higher SES students from high quality postsecondary education. We do observe however an important concentration of high performing students in these private institutions with a corresponding decrease in the ability of newly admitted students in public non-accredited institutions.

Finally, we find that the implementation of SPP has coincided with a rise in test performance

among younger, low-SES high school students. Since the program’s announcement, SABER 11 test score distribution has shifted to the right, with improvements concentrating in students belonging to the top and lowest socioeconomic strata. Yet, the impact has been strongest for low-SES individuals, implying that students from the bottom two socioeconomic strata have crowded out those from the richest strata at the top of the test score distribution. Although available data does not allow us to distinguish whether this increase in test performance is associated with overall improved learning or simply better preparation for the test, existing evidence suggests there is a positive correlation between SABER 11 scores and labor market outcomes – even after controlling for baseline individual and college characteristics (MacLeod et al., 2017). This suggests SPP could bring further positive impacts in the future.

Our work contributes to the burgeoning literature that evaluates the impact of need- and merit-based financial aid on outcomes related to enrollment and performance, both in developed countries (Angrist, Autor, Hudson and Pallais, 2014; Angrist et al., 2016; Bettinger, Gurantz, Kawano and Sacerdote, 2016; Castleman and Long, 2015; Fack and Grenet, 2015; Marx and Turner, 2015) and developing countries (Melguizo et al., 2016; Solis, 2017). Our policy experiment differs from these initiatives in two main manners. First, our potential eligible population ranks higher on the test score distribution than most students traditionally affected by financial aid. Second, through a careful program design, this financial aid program eliminated both the extensive and intensive socioeconomic gaps in postsecondary education among high-performing students, avoiding problems associated with mismatch (Bowen, Chingos and MacPherson, 2009; Dillon and Smith, 2017; Goodman, Hurwitz and Smith, 2017; Hoxby and Avery, 2013). Moreover, the effect size on the *type* of postsecondary institution attended (e.g., accredited versus non-accredited, public versus private) underlines the critical importance of analyzing institutional choice as an outcome of financial aid.

Unlike previous studies that only analyze the intended impacts that such programs have on their direct beneficiaries, we go a step further and analyze the unintended consequences it has brought to secondary and postsecondary education in Colombia. To the best of our knowledge, no study has thus far addressed the general equilibrium impacts that financial aid programs might bring. Our work is thus also related to the literature on school vouchers, particularly research analyzing the effect they have on benefited individuals as well as the impact of non-random migration of students from public to private schools on aggregate educational performance (Epple, Romano and Urquiola, 2017; Urquiola, 2016). We contribute to this literature by offering a case of a voucher in postsecondary education that leads to greater stratification by ability, pressuring some schools to become more efficient to attract high-ability students. Finally, our work is related to a nascent literature evaluating the causal effects of SPP on a range of outcomes, including high school students’ motivation and performance in standardized testing (Laaajaj, Moya and Sanchez, 2017), and college students’ redistributive preferences (Londono-Velez, 2016).

We caution that, although our magnitudes are similar to what previous studies have found in Latin America (Solis, 2017), this strong response to financial aid observed in Colombia might not translate to settings in more developed countries. We thus interpret our results as the consequence of relaxing credit constraints in a context of wide SES enrollment gaps with costly top-ranked private institutions and a shortage of access to credit for low-income individuals.¹

The remainder of this paper is organized as follows. Section 2 provides some institutional

¹The ratio in years of education between the top and bottom income quintiles is higher in Colombia than in any other Latin American country. See Figure A.1 in the Appendix.

background and describes in detail the financial aid program. Section 3 introduces the data. Section 4 discusses the short-run causal intended impacts of SPP using a regression discontinuity methodology. Section 5 discusses the general equilibrium effects of this program. Section 6 provides a cost-benefit analysis. Section 7 concludes.

2 Background

Higher Education in Colombia

The tertiary admissions process in Colombia starts with SABER 11, the national standardized high school exit exam. SABER 11 is generally analogous to the SAT in the U.S., but it is taken by more than 90 percent of high school seniors regardless of whether they intend to apply to postsecondary institutions. High school seniors take the exam in either the spring or the fall semester according to their graduation date (there are two graduating cohorts per year); public school seniors take the exam in the fall semester.² SABER 11 plays a larger role in admissions in Colombia than the SAT does in the U.S., with nearly four-fifths of tertiary institutions using SABER 11 as an admission criterion (OECD and The World Bank, 2012) and many schools awarding admission offers solely based on performance in this exam. College applications and admissions are decentralized and major-specific; prospective students apply to a college-major pair.

Colombian universities award the equivalent of U.S. bachelor degrees after four or five years of study. Higher education institutions, both public and private, are required to obtain a *Qualified Registry* from the Ministry of Education to provide their education services. This registry requires institutions to attain minimum quality standards. Institutions that wish to do so can apply for a certificate of *High Quality Accreditation*, which is awarded by the National Accreditation Council (CNA, for its Spanish acronym) after an evaluation that uses a set methodology with specific quality criteria which are higher than those present in the Qualified Registry. This accreditation can be program-specific (e.g., the Economics undergraduate program at Externado University) and/or institutional (e.g., Externado University); the latter encompassing the former. Importantly, this accreditation appears to proxy quality of education provision, as measured by the college exit tests, graduates' wage profiles, and official rankings of the institutions by the Ministry of Education.³

Out of the roughly 290 higher education institutions in Colombia, 32 had received High Quality Accreditation by October 1, 2014, the day SPP was announced. Of them, 12 were public institutions while the remaining 20 were private. In terms of the proportion of students, roughly one-third of students enrolled in higher education attend an institution with High Quality Accreditation. It must be noted that private universities in Colombia are expensive even by international standards (OECD and The World Bank, 2012), with tuition fees being more than eightfold that of their public counterparts (MEN 2016), which are heavily subsidized and offer substantial discounts to low-SES students. Thus, sorting into private colleges is strongly defined by the tuition rates they charge (Riehl et al., 2016).

Despite progress in the past decades, educational credit markets and financial aid mechanisms

²Less than 15 percent of all high school graduates attend a school with the same calendar as the United States (Fall to Spring), most of which are elite private schools.

³The official ranking done by the Ministry of Education is available [here](#) [accessed January 12, 2017]. Institutional accreditation is closely related to university ranking: 19 of the top 20 institutions have high quality accreditation (MEN, 2016).

are substantially less developed in Colombia than in the U.S.; less than 10 percent of students have a loan in Colombia versus 35 percent in the U.S. (OECD and The World Bank, 2012; Sanchez and Velasco, 2014). Moreover, the well-known credit ACCES program reaches only a fraction of low-income students, which leaves the clear majority of students from disadvantaged backgrounds unable to afford attendance costs at postsecondary institutions. As a result, high direct college costs, coupled with limited mechanisms for financing the full cost of college, squeeze poor students out of collegiate opportunities, particularly at selective schools.

While gross enrollment rates have increased significantly, from 31.6 percent in 2007 to 49.4 percent in 2015, most of this increase has been due to the expansion of low-quality programs in non-accredited institutions, with questionable impacts on academic performance and future job prospects (Camacho et al., 2016). In practice, most low-income students resort to these low-quality institutions, leading to a severe de facto segregation in postsecondary education.

Ser Pilo Paga financial aid program

In light of this situation, the Santos administration created SPP, a merit-based financial aid program for the poor.⁴ Announced on October 1st, 2014, the administration vowed to benefit 10,000 students every year, for a total of 40,000 beneficiaries by 2018 (henceforth referred to as “Pilos”). The loans, which become forgivable upon graduation, cover tuition fees at any one of the 32 universities with High Quality Accreditation and in any major of their choice. The academic cost of each Pilo is transferred by the central government to the universities where they enroll.⁵ In addition, Pilos directly receive a biannual stipend of between one and four times the minimum wage, depending on whether or not they migrated to a different metropolitan area to attend college.⁶

To become eligible, applicants must satisfy three conditions. First, they must score in the top 9 percent of all high school seniors taking SABER 11 in the fall semester. In 2014, this meant obtaining a score of at least 310/500 (Figure 1, Panel A). This SABER 11 threshold would increase to 318/500 in 2015, and further 348/500 in 2016. Second, they must come from a disadvantaged household and have a SISBEN index – a household wealth index used to target social programs – below a cut-off, which varies with geographic location: 57.21 in the 14 main metropolitan areas;⁷ 56.32 in other urban areas; and 40.75 in rural areas (Figure 1, Panel B). Lastly, applicants must have an admission offer from a university with High Quality Accreditation, above detailed.

Two final remarks are worth noting. First, SPP was introduced by surprise in October 2014, that is, almost two months after 574,269 individuals had taken SABER 11, and only a couple

⁴The program’s name can be attributed two complementary meanings. For Colombians, the word “Pilo” is used to describe an individual who is bright or hardworking. “Paga” means to pay off. Hence, “Ser Pilo Paga” can roughly be translated as “it pays off to be bright or hardworking”.

⁵For private universities, the marginal cost per student closely resembles the tuition fee they charge. For students attending public institutions, significant government subsidies make tuition fees be significantly lower than the marginal cost. The government realized this situation and, starting from the second cohort of Pilos, transfers the public universities each student’s marginal cost. More details on this is provided in Section 6.

⁶In addition to this subsidy, Pilos may receive a biannual subsidy of COP \$800,000 pesos (2015 USD 1 = COP 3,174) awarded by the National Planning Department upon completion of the academic semester, and an additional COP \$200,000 per semester if their college GPA is 3.5/5.0 or above. Furthermore, Pilos often benefited from additional in-kind subsidies offered by receiving institutions (e.g. free photocopies, reduced lunch fees).

⁷The 14 main metropolitan areas are Bogotá, Medellín, Cali, Barranquilla, Cartagena, Cúcuta, Bucaramanga, Ibagué, Pereira, Villavicencio, Pasto, Montería, Manizales, and Santa Marta.

of weeks before most colleges' application deadlines. This explains the relatively low program take-up among eligible students (58.2 percent) and lesser preparation for college education among the first cohort of beneficiaries relative to later cohorts (DNP, CNC and de Los-Andes, 2016). Second, the program was remarkably large in scale. In Spring 2014, 101,337 students enrolled in a postsecondary institution immediately after taking SABER 11. Of these, 29,602 enrolled in an accredited institution (16,302 in a private accredited institution and 13,300 in a public accredited institution). Thus, by offering scholarship-loans to 10,000 students, the program aimed to benefit one in every three students attending an accredited postsecondary institution in the country.

Figure 1: SPP eligibility conditions

Sources: Authors' calculations based on ICFES, DNP, and MEN (2016).

3 Data

We use administrative data from five main sources and survey data specially collected for the impact evaluation of SPP. First, we use data from the *Instituto Colombiano para el Fomento de la Educación Superior* (ICFES, for its Spanish acronym), the institution in charge of standardized testing in Colombia. This dataset contains data from the universe of SABER 11 test takers in the fall semesters of 2013, 2014, and 2015. Specifically, it provides test scores results, as well as socioeconomic and demographic data (e.g., socioeconomic stratum, parental education, municipality of residence). ICFES data is then merged with data from the Department of National Planning (henceforth DNP), which contains SISBEN scores. Together, these two sources allow the identification of the eligible population, i.e., students with a test score above the cut-off and wealth index below the geographic thresholds.

Third, we use the Ministry of Education's *Sistema para la Prevención de la Deserción en la Educación Superior* (SPADIES, for its Spanish acronym), which tracks students along the postsecondary education system. We use SPADIES data from 2014 to 2016, which provides a wealth of information on student characteristics, including their socioeconomic and demographic characteristics, enrollment status, graduation or dropout date, major of study, and institution. These data cover roughly 90 percent of all postsecondary enrollees; information from a handful of institutions is omitted due to poor and inconsistent reporting. Using information from almost all postsecondary students allows us to overcome some of the econometric

problems by the literature on college persistence, which often uses information from a single institution or a restricted groups of institutions.

Fourth, we use data from ICETEX, the institution that manages national and international scholarships and grants for post-baccalaureate programs – including SPP – on behalf of public and private organizations. This data provides exact information on who the beneficiary Pilos are, as well as the academic program and college where they enrolled. Fifth, we use earnings records for formal sector workers during 2008-2013 from the Ministry of Educations *Observatorio Laboral para la Educación* (OLE, for its Spanish acronym). OLE uses data from the Ministry of Social Protections PILA database on contributions to pension and health insurance funds, and includes data on monthly wages, employment status, and four-digit economic activity codes for nearly all college graduates between 2001-2013 in Colombia.

The above sources of data comprise census information for the population of interest – SABER 11 test takers, SISBEN-eligible households, postsecondary students, and SPP beneficiaries, respectively. Our empirical analysis of the direct impact of SPP on postsecondary access and persistence uses these sources of information, focusing on fall 2014 test takers – the first cohort of Pilos – for reasons detailed below. We thus use information from almost 575,000 students, out of which 8,970 are SPP beneficiaries.

The analyses related with the unintended consequences of SPP use these same four sources of information pooled across the years 2012–2016, comprising more than 2.5 million individuals. Moreover, to understand the drivers of institutional choice, we use survey data collected from 1,479 SISBEN-eligible individuals who took SABER 11 in fall 2015, and scored slightly above or below the SABER 11 eligibility threshold. This data is a representative sample of this population of high-achieving, low-income students, and was collected considering a RD design using the second cohort of Pilos. Finally, to explore the unintended impact of SPP on college application and admissions processes, we use administrative data on application and admissions directly collected by us from a sample of High Quality Accredited universities in Colombia.⁸

4 Intended Short-Run Direct Impacts

4.1 RD Design

To estimate the causal impact of SPP on short-run outcomes (e.g., access to higher education), we exploit the SABER 11 and SISBEN cutoffs using a regression discontinuity (RD) design. Because the probability of receiving SPP needs not change from 0 to 1 at the eligibility thresholds, we will use a fuzzy RD.⁹

The basic setup is the following. Let $Z_i = 1(R_i > k)$ be an indicator for SPP eligibility, where k is the point of a discontinuous assignment rule (e.g., SABER 11 score, SISBEN). Denote D_i as an indicator for whether an individual is a beneficiary of SPP. Then the fuzzy RD design requires that $\lim_{r \uparrow k} P(D_i = 1 | R_i = r) \neq \lim_{r \downarrow k} P(D_i = 1 | R_i = r)$, that is, that there is a discontinuity in the probability of assignment, though this discontinuity need not result in full take-up of the treatment. The resulting RD-IV estimand can be written in simple Wald form as:

⁸We prefer to use admission rate data provided specially to us by selected institutions in lieu of that from the national higher education information system (SNIES), due to inconsistent reporting undermining data quality.

⁹The fuzzy RD design occurs when the discontinuous assignment rule does not result in perfect compliance – that is, when $P(D_i = 1 | Z_i = 1) < 1$ and/or when $P(D_i = 1 | Z_i = 1) > 0$.

$$\theta_{RD-IV} = \frac{\lim_{R \uparrow k} E(Y_i | R_i) - \lim_{R \downarrow k} E(Y_i | R_i)}{\lim_{r \uparrow k} E(D_i = 1 | R_i = r) - \lim_{r \downarrow k} E(D_i = 1 | R_i = r)}$$

The causal estimand identified by the RD-IV estimator is a type of LATE:

$$\theta_{RD-IV} = E[Y_i^1 - Y_i^0 | R_i = k, D_i^1 > D_i^0]$$

where the LATE is local not only to the group of compliers but the group who have $R_i = k$. Note that, since eligibility depends on both poverty and test score discontinuities, we can separately identify two types of compliers: SISBEN-eligible students around the SABER 11 cutoff (Figure 2, Panel A) and SABER 11-eligible students around the SISBEN cutoff (Figure 2, Panel B).

Figure 2: Illustration of the two types of compliers

To understand how the population directly affected by this policy compares to the typical high school senior in Colombia, Table A.1 and A.2 in the Appendix characterize the sample population as well as the subpopulations of compliers, always-takers, and never-takers using SABER 11 and SISBEN as the running variables, respectively (Abadie, 2002; Imbens and Rubin, 1997). Table A.1 shows that, relative to the universe of test-takers (Column 1), SISBEN-eligible students have more siblings, less educated parents, lower socioeconomic stratum, are less likely to attend high school full time, and are less likely to attend private high schools (Column 2). Using SABER 11 as the running variable, students scoring close to the SABER 11 cutoff (i.e., relatively high performers) are more likely to be male, young, and non-ethnic minorities (Column 3). They are more likely to be a full-time high school student at a private high school and come from a smaller, more educated, and relatively wealthier family. Compliers are very similar in observable characteristics to other students within the SABER 11 bandwidth (Column 4), but have somewhat more educated parents. Relative to compliers, never-takers are more likely to be male, employed, and attend private, full-day high schools (Column 5). Given there are no SPP recipients with test scores below the cutoffs, there are no always takers using SABER 11 as the running variable (Column 6).

We will focus our analysis on the first cohort of Pilos, that is, those who graduated high school late November or early December in 2014 and began college in Spring 2015. We avoid pooling different cohorts of SPP beneficiaries and focus on the first cohort of SPP instead for three main reasons. First, high school seniors sitting for SABER 11 *after* the announcement of SPP have

incentives to exert more effort and perform better in this test, as will be shown in Section 5. Second, anecdotal evidence suggests the number of households asking for SISBEN evaluations from local authorities has increased substantially since Spring 2015. Third, because public knowledge of SPP has increased over time, the program’s take-up rate (i.e., the share of eligible students who become SPP beneficiaries) is higher in the most recent cohorts (see DNP et al. (2016)). These three facts raise concern for endogeneity due to time-varying unobservables and complicate pooling different cohorts.

We use data-driven (that is, fully automatic) local-polynomial-based robust inference procedures through “rdrobust”. This command implements the bias-corrected inference procedure proposed by Cattaneo, Calónico and Titiunik (2014), which is robust to “large” bandwidth choices. It also offers robust bias-corrected confidence intervals for average treatment effects at the cutoff based on the recent work by Imbens and Kalyanaraman (2012) and Cattaneo et al. (2014).

Validity of the RD Design

Before we turn to our main results, we provide evidence that the discontinuities in SPP eligibility can serve to produce unbiased estimates of the effects of this financial aid program. The three key assumptions for the validity of the RD design are: (i) that the predicted discontinuity creates a large change in assignment to treatment as a function of the running variable; (ii) any observed differences in the neighborhood of the discontinuity occur only as a result of the differences in the running variables; and (iii) that there is no evidence of manipulation in assignment to treatment near the discontinuity. We address each of these assumptions in turn.

Figure 3 presents the first stage, that is, $E[D_i|R_i]$ against the running variable R_i , SABER 11 score for those eligible by SISBEN (Panel A), and SISBEN score for those eligible by SABER 11 (Panel B). The figure, which plots the coefficients from Table A.3 in the Appendix, shows the sharp eligibility rules; since no student below the cutoff was assigned to treatment, $P(D_i = 1|Z_i = 0) = 0$ (i.e., there are no always-takers). The eligibility cutoffs increase assignment to SPP by 54.1 percentage points when using SABER 11 as the running variable and 62.4 percentage points when using SISBEN as the running variable. Thus, although there is a discontinuity in the probability of assignment, the eligibility cutoffs do not deterministically predict treatment assignment because there is incomplete take-up of treatment. One-side non-compliance was due in large part to the short timespan between the announcement of SPP and the deadline to apply to accredited universities (in many cases, a couple of weeks), as suggested by qualitative field evidence from DNP et al. (2016).

Second, we expect the behavior of individuals to be correlated with Z_i only because of its correlation with D_i (i.e., the exclusion restriction necessary for Z_i to be a valid instrument for D_i). We test this possibility by examining whether observable covariates are different on either side of the discontinuity point (see Tables A.4 and A.6 in the Appendix). The results suggest there is balance in most of the 25 covariates. Specifically, using SABER 11 (SISBEN) as the running variable, there is balance in 23 (19) of the 25 baseline characteristics. To increase precision of the RD treatment effect estimator, we regression-adjust these differences by including the baseline characteristics where there is imbalance between treatment and control.¹⁰ As a robust-

¹⁰For regressions using SABER 11 as the running variable, the control vector includes dummies for mother’s higher education and stratum 4. For regressions using SISBEN as the running variable, the control vector includes family size and dummies for parental secondary and higher education, stratum 4, and weekend school schedule. See Calónico, Cattaneo, Farrell and Titiunik (2016) for a recent discussion of covariate-adjusted RD estimation.

ness check, we perform a dimension reduction exercise and confirm that imbalance in baseline covariates cannot explain the large impacts we see on access to postsecondary education (see Table A.8 in the Appendix).

Figure 3: Discontinuity in the probability of assignment to treatment

Note: Sample average within bin. Polynomial fit of order 4.

Sources: Authors' calculations based on ICFES, DNP, and MEN (2016).

Lastly, an additional assumption often employed in RD is no selective sorting across the treatment threshold. The skeptical econometrician might fear that students have control over test scores and/or wealth scores and behave strategically so as to ensure that they are just above or below the thresholds, thereby inducing self-selection or nonrandom sorting of students across the discontinuity point and into “control” and “treatment” status.

We argue against this concern in the case of SPP. First, SPP was announced in October 1, 2014, that is, almost two months *after* students took SABER 11. Thus, students did not know the eligibility cutoff –nor in fact the mere existence of this financial aid program– at the moment they sat for the exam. Moreover, once the program and eligibility conditions were announced, students could not go back in time and re-take SABER 11 to become eligible. Similar arguments regarding the SISBEN score can be brought forward: household SISBEN scores were assigned well before the program was announced. Even though reclassifications are possible, neither students nor their families had the time to ask for re-assessments before the SPP application deadline in November 2014 (this may no longer be the case for more recent cohorts). Finally, ICFES reformed SABER 11 in Fall 2014 such that students taking the exam that semester were not familiar with the scoring mechanism *ex-ante*. We thus conclude that our identifying assumption that the running variables are quasi-randomly assigned close to the SPP eligibility cutoffs is a plausible one.

To formally test for manipulation of the running variable, we use the recent local polynomial density estimator proposed by Cattaneo, Jansson and Ma (2016a,b). Unlike McCrary (2008), this estimator does not require pre-binning of the data, relying on simple weighting schemes (i.e., kernel functions). It also does not require preliminary tuning and smoothing parameter choices

when implemented, and reduces boundary bias.¹¹ The resulting robust-corrected p-values are 0.218 with SABER 11 as R_i , and 0.436 with SISBEN as R_i (see Table A.9 in the Appendix). This suggests there is no statistical evidence of systematic manipulation of the running variable.

We thus conclude that there is balance in baseline covariates along the eligibility discontinuities and that there is no manipulation of the running variable around these cutoffs. This gives strengths to our identifying assumption of having a valid RD design.

4.2 Results

Extensive and intensive margin impacts on access to higher education

Figure 4 shows the probability of immediate enrollment in any postsecondary institution using SABER 11 (Panel A) and SISBEN (Panel B) as the running variables. The dots are cell means, and the lines are fitted values from a regression of higher education enrollment on a fourth-order polynomial in the score estimated separately on either side of the passing cutoff. It is clear from both panels that, as expected, SPP had an important and significant impact on immediate postsecondary education enrollment rates of eligible students.

Figure 4: Enrollment in higher education

Sources: Authors' calculations based on ICFES, DNP, and MEN (2016).

Columns (1) and (3) of Table 1 report intent-to-treat (ITT) estimates of the enrollment effects of SPP using SABER 11 and SISBEN cutoffs, and Columns (2) and (4) report the corresponding instrumental variable estimates, which scale the ITT estimates by the first stage estimates. These estimates can be interpreted as local average treatment effects (LATE) for “compliers” – individuals who respond to SPP eligibility by becoming a beneficiary of this program. Moreover,

¹¹We perform McCrary tests on the sample SABER 11-eligible test-takers in Fall 2013 (placebo) and Fall 2014 (non-placebo), using SISBEN as R_i , and perform a t -test on the differenced outcomes. The resulting t -statistic is 0.224, which suggests there is no manipulation of SISBEN as result of SPP. However, when we attempt a similar comparison among SISBEN-eligible students using SABER 11 as the running variable, the resulting t -statistic is -7.365, which would point to manipulation of test scores among the treated cohort. The histograms in Panel a of Appendix A.2 show that this result is likely due to changes in score rounding rules in the most recent version of SABER 11 – which incidentally began in Fall 2014. The histograms thus give us confidence to conclude there was no manipulation of SABER 11 in 2014.

in the absence of always-takers, the average effect for compliers (LATE) is equal to the average effect for the treated (TOT), since any student receiving the treatment is by definition a complier (Bloom, 1984). At the SABER 11 threshold, reduced-form estimates show that the likelihood that a student enrolls in higher education immediately after graduating high school increased by 32.6 percentage points. The implied LATE results suggest a 60.5 percentage point increase in enrollment. At the SISBEN threshold, the ITT estimate suggests enrollment increased by 25.5 percentage points and the LATE estimate suggests a 41.2 percentage point increase. These are important impacts that amount to an increase in immediate enrollment of 90 percent for eligible students and 167 percent for compliers.

Table 1: Enrollment in higher education – IIT and LATE

	SABER 11		SISBEN	
	ITT (1)	LATE (2)	ITT (3)	LATE (4)
RD Estimate	0.326*** (0.010)	0.605*** (0.015)	0.255*** (0.022)	0.412*** (0.032)
Robust RD Estimate	0.323	0.596	0.253	0.412
Robust Std. Error	0.011	0.018	0.026	0.038
Mean Control	0.363	0.363	0.511	0.511
Observations	293,758	293,758	21,125	21,125
BW Loc. Poly.	32.713	32.713	10.643	10.643
Effect obs control	35,792	35,792	4,165	4,165
Effect obs treat	12,117	12,117	4,205	4,205

Notes: The running variable is SABER 11 score in columns (1) and (2), and SISBEN score in columns (3) and (4). Columns (1) and (2) include dummies for mother’s education and stratum 4 as controls, and columns (3) and (4) include controls for family size and dummies for parental secondary and higher education, morning school schedule and weekend school schedule. All results estimated with package rdrobust (Cattaneo et al., 2014). * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Sources: Authors calculations based on ICFES, DNP, MEN, and SPADIES (2016).

The estimates in Table 1 would be confounded by an effect of passing the 310-point SABER 11 threshold that is not purely due to SPP access – e.g., if students are more likely to be offered admission if they score above this test score threshold. A way to detect this kind of bias is to perform a placebo test by running the same regression in the pre-period sample. Intuitively, for RD design to identify the causal impact of SPP on the outcomes of interest, then the running variables R_i cannot affect the outcome of interest Y_i in the absence of SPP. Thus, we can test for a discontinuity in enrollment in higher education around the equivalent SABER 11 and SISBEN eligibility thresholds among students that took SABER 11 in Fall 2013, i.e., a year before SPP was created. The absence of a discontinuity in Figure 5 lends credence to the identifying assumption, that is, that the jump in enrollment in higher education seen in Figure 4 is caused by SPP.

A crucial characteristic of the SPP program is that it restricts institutional choice to colleges awarded government quality accreditation in an effort to gear students towards institutions that have higher returns to schooling investment (Camacho et al., 2016). Figure 6 plots enrollment in accredited (i.e., high quality) universities and non-accredited (i.e., low quality) universities by SABER 11 score (Panels A and C) and SISBEN score (Panels B and D). Results in Table 2 suggest SPP eligibility increased immediate enrollment in accredited institutions by 46.9 percentage points, using SABER 11 as the running variable. On a base of 10.3 percent, this implies an increase of 455 percent. The implied LATE estimates suggest an increase of 86.7

percentage points. In contrast, ITT estimates suggest enrollment in non-accredited institutions fell by 15.0 percentage points, while LATE estimates enrollment in these institutions fell by 27.7 percentage points. Results are quantitatively smaller but similar in statistical significance using SISBEN as the running variable.

Figure 5: Placebo test using pre-treatment period

Sources: Authors' calculations based on ICFES, DNP, and MEN (2016).

Table 2: Enrollment in accredited vs. non-accredited universities – ITT and LATE

	SABER 11				SISBEN			
	Accredited		Non-accredited		Accredited		Non-accredited	
	ITT	LATE	ITT	LATE	ITT	LATE	ITT	LATE
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
RD Estimate	0.469***	0.867***	-0.150***	-0.277***	0.398***	0.644***	-0.143***	-0.232***
	(0.010)	(0.011)	(0.010)	(0.017)	(0.022)	(0.028)	(0.018)	(0.028)
Robust RD Estimate	0.468	0.861	-0.154	-0.283	0.39	0.635	-0.138	-0.225
Robust Std. Error	0.012	0.014	0.011	0.02	0.025	0.032	0.021	0.032
Mean Control	0.106	0.106	0.264	0.264	0.263	0.263	0.248	0.248
Observations	293,758	293,758	293,758	293,758	21,125	21,125	21,125	21,125
BW Loc. Poly.	24.215	24.215	23.261	23.261	10.208	10.208	10.573	10.573
Effect obs control	23,295	23,295	22,184	22,184	4,032	4,032	4,145	4,145
Effect obs treat	10,509	10,509	10,314	10,314	4,050	4,050	4,185	4,185

Notes: The running variable is SABER 11 score in columns (1)-(4), and SISBEN score in columns (5)-(8). Columns (1)-(4) include dummies for mother's education and stratum 4 as controls, and columns (5)-(8) include controls for family size and dummies for parental secondary and higher education, morning school schedule and weekend school schedule. All results estimated with package rdrobust (Cattaneo et al., 2014). * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Sources: Authors calculations based on ICFES, DNP, MEN, and SPADIES (2016).

Figure 6: Enrollment in accredited vs. non-accredited universities

Sources: Authors' calculations based on ICFES, DNP, and MEN (2016).

Even though SPP required students to be admitted in an accredited university, there was no restriction on whether it should be a public or a private institution. To understand whether SPP had an impact in this (intensive) margin, Figure 7 further decomposes enrollment by type of institution – public versus private – using SABER 11 score as the running variable among SISBEN-eligible individuals. ITT (LATE) estimates in Table 3 confirm that enrollment increased in private accredited institutions by 46.9 (86.5) percentage points and decreased in private non-accredited institutions by 6.5 (12.0) percentage points. In addition, enrollment decreased in public non-accredited institutions 8.3 (15.3) percentage points, while enrollment in public accredited institutions was not affected. Results are quantitatively similar when using SISBEN as the running variable (Table 4) except that enrollment in public accredited institutions fell by 8.4 (13.5) percentage points.¹² This suggests that SPP induced eligible students to sort across institutions, particularly from non-accredited to accredited institutions – and possibly from public to private institutions.

¹²This preference for private institutions is also found among Cal Grant beneficiaries in California (Bettinger et al., 2016).

Figure 7: Enrollment in private vs. public and accredited vs. non-accredited institutions

Sources: Authors' calculations based on ICFES, DNP, and MEN (2016).

To explore what drives students to choose private institutions over public institutions in Colombia, we turn to survey data collected among SISBEN-eligible students who took SABER 11 in Fall 2015 and scored slightly above or below the SABER 11 eligibility cutoff. The data is a national representative sample of low-income, high-achieving high school seniors of 2015, as defined by SPP eligibility criteria. By Spring 2016 – the time of survey collection – around 68 percent of the 1,487 survey participants attended a postsecondary institution, and the survey asked them to report the main reasons they chose their institution.¹³

The data reveal that the most important factor driving institutional choice is prestige (47.4 percent), second only to availability of preferred major. This is consistent with models in which applicants have endogenous tastes for colleges with good reputation, i.e., those with high-ability peers, because firms set their wages by inferring skill levels from the reputation of the college attended (see MacLeod and Urquiola, 2015). Indeed, empirical evidence from Colombia suggests that college reputation determines initial wages as well as subsequent earnings growth (see Section 6 and MacLeod et al. (2017)).

¹³Table A.11 in the Appendix displays the summary statistics of the answers provided among the list of alternatives.

Importantly, prestige and academic quality are more frequent concerns for students attending private (55.7 percent and 42.4 percent, respectively) versus public (36.8 percent and 27.0 percent, respectively) institutions, as are better job prospects (36.1 percent versus 18.1 percent, respectively), and better contacts (6.7 percent versus 4.5 percent, respectively). This is consistent with empirical evidence suggesting graduates from top private schools enjoy a wage premium over selective public schools, even when controlling for individual-level characteristics (e.g., SABER 11 score, SES) and college-level characteristics (see [Riehl et al., 2016](#), and Section 6). In contrast, affordability appears to be one of the most attractive features of public institution (31.2 percent versus only 9.1 percent among private enrollees), thus giving support to the argument that college costs are an important determinant of student sorting across schools.¹⁴ In sum, a higher demand for private postsecondary education seems to respond to the perception that private institutions are more reputable and produce greater value added – broadly defined – for students.

Table 3: Enrollment in private vs. public and accredited vs. non-accredited institutions – SABER 11 as running variable

	<i>SABER 11 as the running variable</i>							
	Private				Public			
	Accredited		Non-accredited		Accredited		Non-accredited	
	ITT (1)	LATE (2)	ITT (3)	LATE (4)	ITT (5)	LATE (6)	ITT (7)	LATE (8)
RD Estimate	0.469*** (0.010)	0.865*** (0.010)	-0.065*** (0.006)	-0.120*** (0.010)	0.001 (0.006)	0.002 (0.011)	-0.083*** (0.008)	-0.153*** (0.014)
Robust RD Estimate	0.467	0.86	-0.065	-0.12	0.001	0.001	-0.086	-0.158
Robust Std. Error	0.011	0.012	0.007	0.012	0.007	0.013	0.009	0.016
Mean Control	0.032	0.032	0.105	0.105	0.072	0.072	0.157	0.157
Observations	293,758	293,758	293,758	293,758	293,758	293,758	293,758	293,758
BW Loc. Poly.	22.388	22.388	30.091	30.091	30.503	30.503	25.172	25.172
Effect obs control	20,671	20,671	32,596	32,596	32,596	32,596	24,929	24,929
Effect obs treat	10,014	10,014	11,811	11,811	11,811	11,811	10,791	10,791

Notes: The running variable is SABER 11 score. Controls include dummies for mother's higher education and stratum 4. All results estimated with package `rdrobust` ([Cattaneo et al., 2014](#)). * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Sources: Authors' calculations based on ICFES, DNP, MEN, and SPADIES (2016).

¹⁴The perception that “prestige” and “quality” is the most attractive feature of private institutions, while “affordable tuition” is the most attractive feature of public institutions is further supported by survey evidence and focus groups discussions with the of SPP beneficiaries ([Fundacion-Corona, 2015](#)).

Table 4: Enrollment in private vs. public and accredited vs. non-accredited institutions – SISBEN as running variable

	<i>SISBEN as the running variable</i>							
	Private				Public			
	Accredited	LATE	Non-accredited	LATE	Accredited	LATE	Non-accredited	LATE
	ITT		ITT		ITT		ITT	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
RD Estimate	0.483*** (0.017)	0.778*** (0.020)	-0.061*** (0.012)	-0.098*** (0.020)	-0.084*** (0.016)	-0.135*** (0.027)	-0.083*** (0.014)	-0.135*** (0.022)
Robust RD Estimate	0.481	0.776	-0.058	-0.094	-0.089	-0.144	-0.082	-0.132
Robust Std. Error	0.021	0.024	0.014	0.023	0.019	0.031	0.016	0.026
Mean Control	0.073	0.073	0.109	0.109	0.192	0.192	0.14	0.14
Observations	21,125	21,125	21,125	21,125	21,125	21,125	21,125	21,125
BW Loc. Poly.	12.429	12.429	11.033	11.033	10.998	10.998	11.003	11.003
Effect obs control	4,721	4,721	4,300	4,300	4,287	4,287	4,290	4,290
Effect obs treat	4,837	4,837	4,353	4,353	4,335	4,335	4,339	4,339

Notes: The running variable is SISBEN. Controls include family size, and dummies for parental secondary and higher education, morning school schedule and weekend school schedule. All results estimated with package `rdrobust` (Cattaneo et al., 2014).

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Sources: Authors' calculations based on ICFES, DNP, MEN, and SPADIES (2016).

Academic performance of Pilos versus their classmates

The first cohort of Pilos began their undergraduate studies spring 2015. With the average length of a program being 4.5 years, degree completion outcomes will not become available before 2020. Instead, we observe two shorter-run measures of academic performance and persistence: the fraction of courses approved in freshman year, and whether the student dropped out by spring 2016. It should be noted that persistence during the first year is a strong predictor of completion: one in two college dropouts does so during freshman year in university (MEN, 2016).

We compare academic outcomes of Pilos and their classmates using the following OLS regression:

$$y_{imj} = \alpha + \beta Pilo_{imj} + \delta_{mj} + \mathbf{X}'_{imj}\Gamma + \varepsilon_{imj} \quad (1)$$

where y_{imj} is outcome y for student i in major m in institution j , $Pilo_{imj}$ is a dummy variable that turns 1 if a student is SPP beneficiary and 0 otherwise, δ_{mj} are major-by-institution fixed effects, $\mathbf{X}_{imj}$ is a vector of 25 baseline characteristics, and ε_{imj} is a student-specific error term. Standard errors are clustered at the institution-by-major level.

Columns (1)–(4) in Table 5 show that, on average 22.6 percent of students are absent one year after beginning their undergraduate studies (standard deviation 41.8).¹⁵ Pilos are 12.0 percentage points less likely to be absent than their classmates (Column 1). Because retention rates are higher in colleges attended by Pilos, Column 2 includes major-by-institution fixed effects. This reduces the magnitude of this coefficient, but not its statistical significance. Controlling for SABER 11 score further reduces the magnitude of the coefficient (Column 3). Finally, including baseline covariates - our preferred specification - suggests that Pilos are 4.0 percentage

¹⁵The first-year retention rate in Colombia varies significantly by type of higher education institution, and is lower than the average retention rate in the United States. In 2015, the percentage of first-time, degree-seeking undergraduates retained was 77.1 percent at 4-year institutions in Colombia, 82.2 percent at accredited institutions, 75.4 percent at non-accredited institutions, 84.5 percent at private accredited institutions, and 78.6 percent at public accredited institutions (see Figure A.3, Panel B, in the Appendix). In the U.S., data from the U.S. Department of Education suggest the percentage of first-time, full-time degree-seeking undergraduates retained at 4-year institutions was 80 percent from 2013 to 2014. For selective institutions (i.e., acceptance rate of 25 percent or below), this share is 96 percent at both public and private non-profit institutions.

points less likely to drop out than their classmates (Column 4). On a mean of 22.1 percent, this implies Pilos are 18.1 percent less likely to drop out during their first year. This is likely partly a result of the program design, which requires beneficiaries to graduate from their program for the loan to become forgivable.

Columns (5)–(8) in Table 5 use as dependent variable the cumulative share of courses passed by spring 2016. On average, freshmen students in Spring 2015 passed 85.2 percent of their courses (standard deviation 19.8 percent). This share is 0.5 percentage points higher for Pilos than for their classmates (Column 5). Including major-by-college fixed effects reduces the magnitude of this coefficient (Column 6). Further, controlling for SABER 11 makes this coefficient switch sign and become significant (Column 7). Including a rich set of baseline controls suggests Pilos are 2.0 percentage points more likely to fail a course during their freshman year (Column 8). On a base of 85.3 percent, this implies a 2.3 percent drop in performance.

The second row in Table 5 treats SPP reciprocity status as endogenous and instruments it using program eligibility (i.e., scoring above 310/500 in SABER 11 and having a SISBEN score below the cutoff). The resulting 2SLS estimates suggest that selection on unobservables does not drive our main results, namely that Pilos are less likely to drop out but more likely to fail courses. However, by construction, we observe course-passing information only for retained students. The differential non-random attrition from postsecondary education documented in Columns (1)–(4) may thus compromise the course-passing comparability of SPP recipients and non-recipients, possibly generating selection bias. To deal with this issue, we follow [Abdulkadiroglu et al. \(2017\)](#) and [Lee \(2009\)](#) and formally assess the robustness of our results to selected attrition by constructing non-parametric bounds on the 2SLS estimate under a monotonicity assumption on the attrition process. The third row in Table 5 displays estimated bounds on 2SLS estimates for compliers. These bounds are tight around 2SLS estimates and suggest that adjustments for differential attrition do not overturn the conclusion that Pilos are 2 percent more likely to fail courses in their first year of college.

Table 5: Short-term academic outcomes: dropout and course-passing rates during freshmen year

	<i>Dependent variable</i>							
	(1)	Absent by Spring 2016 (2)	(3)	(4)	Cumulative share of courses passed by Spring 2016			
					(5)	(6)	(7)	(8)
OLS	-0.120*** (0.018)	-0.050*** (0.005)	-0.019*** (0.005)	-0.040*** (0.006)	0.005 (0.011)	0.001 (0.003)	-0.018*** (0.002)	-0.020*** (0.003)
2SLS	-0.138*** (0.019)	-0.060*** (0.007)	-0.007 (0.006)	-0.036*** (0.007)	0.013 (0.011)	0.013*** (0.003)	-0.020*** (0.003)	-0.023*** (0.003)
Bounds (LB; UB)					-0.055 (0.004)	0.014 (0.003)	-0.020 (0.003)	-0.024 (0.003)
Major-by-college FE		Yes	Yes	Yes		Yes	Yes	Yes
SABER 11 score			Yes	Yes			Yes	Yes
Other controls				Yes			Yes	Yes
N	109,148	109,016	109,016	100,643	84,247	84,052	84,052	78,015
R ²	0.006	0.207	0.223	0.237	0	0.486	0.519	0.531
Dep Mean	0.226	0.225	0.225	0.221	0.852	0.852	0.852	0.853
Dep SD	0.418	0.418	0.418	0.415	0.198	0.198	0.198	0.197

Note: Sample restricted to fall 2014 SABER 11 test-takers who immediately enrolled in any postsecondary institution in spring 2015. The dependent variable in Columns (1)–(4) is a dummy for whether a student registered in spring 2015 is absent by spring 2016, and in Columns (5)–(8) it is the cumulative share of courses passed by spring 2016. Each row represents a separate regression. Robust standard errors in parentheses clustered at the first major-by-college pair in rows 1 and 2. Row 3 reports non-parametric bounds on LATE of SPP eligibility and standard errors using 100 bootstrap replications. Controls include 25 baseline characteristics. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Sources: Authors' calculations based on ICFES, DNP, MEN, and SPADIES (2016).

5 Unintended Short-Run General Equilibrium Impacts

To estimate the general equilibrium effects that SPP brought to the higher education system in Colombia, we no longer use the RD design as our identification strategy, but instead compare outcomes for the universe of test-takers before and after the program was implemented. Specifically, we use information from SABER 11 test-takers in the fall semesters of 2012, 2013, 2014, 2015 and 2016 – which amounts to more than 2.5 million students – and postsecondary students, and this natural policy quasi-experiment to estimate SPP’s impacts on the Colombian education system.

5.1 SPP: A zero-sum admission game?

The significant intended impacts SPP had on postsecondary access and persistence might have no impact on society if the program induced a zero-sum admission game in which SPP beneficiaries simply displaced other prospective students in high quality accredited institutions. In this subsection, we present evidence against this argument, with SPP inducing an expansion of supply of high-quality private education.

College applications and admissions

Not surprisingly, the newfound possibility of a tuition-free college education skyrocketed applications at accredited universities. Figure 8, Panel A, plots the number college applicants at several private accredited institutions from Spring 2011 to Spring 2016 (normalized to equal 1 in Spring 2014) in the three largest metropolitan areas in Colombia: Los Andes, Javeriana and Jorge Tadeo Lozano universities in Bogota, and EAFIT and EIA in Medellin, and Javeriana in Cali. The number of applicants increased between 19 percent (EAFIT) and 52 percent (EIA) between 2014 and 2015. One year later, this fraction had further increased to 80 percent (Los Andes, Javeriana – Bogota) and 97 percent (Jorge Tadeo Lozano).¹⁶ Importantly, this fall in admission rates at private accredited institutions stands in stark contrast with their public counterparts. For instance, at UNAL, Colombia’s flagship public university, the number of applicants *fell* by 5 percent between 2014 and 2015.

Consequently, admission rates plummeted at most accredited institutions, with the fall being particularly severe at top-ranked universities: at Los Andes and Javeriana, admission rates fell by almost 50 percent and 35 percent in just two years, respectively (Figure 8, Panel C).¹⁷ In contrast, the undergraduate admission rate at UNAL, Colombia’s top public institution, *increased* from 8.3 percent in 2014 to 10.1 percent in 2015.

Importantly, though, private colleges expanded supply as a response to this shift in demand. Panel B in Figure 8 shows that the size of the entering cohort increased between 8.4 and 44.7 percent between 2014 and 2016. Note, however, that the slope of the curves flattens after 2015, suggesting a possible conscientious attempt on behalf of some elite colleges to restrict this in-

¹⁶Using admissions microdata from a private accredited university in Bogota, [Londono-Velez \(2016\)](#) shows that the documented rise in applications after SPP is driven exclusively by low-SES applicants from the bottom socioeconomic strata.

¹⁷Note also that universities are generally more selective in Bogota than elsewhere in the country: the admission rate in Spring 2014 was 57 percent in the University of Los Andes and 58 percent in Javeriana University versus 92 percent in EAFIT and 96 percent in EIA.

crease in supply (see MacLeod and Urquiola, 2015).¹⁸ In any case, aggregate data suggest the number of high school seniors immediately enrolling in postsecondary education increased by 12.2 percent between 2014 and 2016, with private accredited schools capturing 63.4 percent of that increase. This suggests SPP did not induce a sum-zero admission game but rather promoted an increase of the national enrollment rate in high quality academic institutions in the country.

Figure 8: Admissions at selected private accredited institutions

Source: Authors' calculations using administrative data.

A change in college access induced by SPP

Administrative information allows us to directly estimate the specific impact SPP had on overall immediate postsecondary enrollment among high school seniors. Specifically, we turn to census information from SABER 11 and SPADIES for the years 2012-2016 and estimate the change in enrollment rates by SABER 11 decile and type of postsecondary institution for students who graduated from high school before and after SPP was in place.¹⁹ We do this by estimating the

¹⁸ MacLeod and Urquiola (2015) offer a model to explain why elite colleges have restricted supply despite increasing college applications. In their setup, asymmetric information about individual innate ability leads firms to set wages to expected skill conditional upon college reputation and an individual-specific measure of skill. As a response, college applicants display an endogenous taste for abler peers and colleges with good reputation. This provides schools with incentives to be selective and remain small.

¹⁹ We henceforth restrict the sample of test-takers to individuals aged 14 to 23, as they are more likely to be high school seniors at the time of taking SABER 11.

following difference-in-differences specification by OLS:

$$r_{ij} = \alpha + 1(After)_i + \sum_{d=2}^{10} \delta_d \cdot T_i^d + \sum_{d=2}^{10} \beta_d \cdot T_i^d \cdot 1(After)_i + \epsilon_{ij} \quad (2)$$

where $r_{ij} = 1$ if student i enrolled in postsecondary institution type j immediately after presenting SABER 11 and 0 otherwise;²⁰ $T_i^d = 1$ if student i scored in SABER 11 decile d and 0 otherwise; $1(After)_i = 1$ if student i took SABER in fall 2014 and 0 otherwise; and ϵ_{ij} is an individual-specific error term. The coefficient of interest β_d thus identifies the percentage point difference in the likelihood of immediately accessing each type of postsecondary institution (or not immediately enrolling in higher education) by SABER 11 decile between students who graduated from high school before and after SPP was in place.

Figure 9 plots the β coefficients for each decile d of the SABER 11 distribution obtained from specification (2) using data from test-takers aged 14–23 in fall 2013 and 2014 and immediately accessed postsecondary education in spring 2014 (before SPP) and spring 2015 (after SPP), respectively. The figure suggests, not surprisingly, the biggest change occurred for the top decile students. Specifically, the probability of enrolling in a private and accredited institution increased by 12.4 percentage points for the top decile (see also Table A.12 in the Appendix for the results of the specification). More than 71 percent of this increase comes from a decrease in the probability of not attending higher education while more than 26 percent is due to lower enrollment in non-accredited institutions.

Figure 9: Difference in the probability of attending or not attending postsecondary education before and after SPP by SABER 11 decile

Notes: The figure presents the coefficients obtained from specification (2), which represent the difference in the probability of immediately accessing higher education among students taking SABER 11 in Fall 2013 and Fall 2014
 $-p < 0.1$, $+p < 0.05$, $*p < 0.01$. Source: Authors calculations based on ICFES, DNP, MEN, and SPADIES (2016). See Table A.12 in the Appendix.

Top decile students were not the only ones impacted by SPP; the probability of not enrolling

²⁰Note that j can either be private accredited, public accredited, private non-accredited, public non-accredited, or none.

in any postsecondary institution significantly decreased for all but the bottom decile. Such changes are particularly important in magnitude for students scoring in deciles 5 through 9, who saw a decrease in this probability of more than 2 percentage points in each group. Most of these students enrolled in non-accredited institutions; indeed, these institutions seem to have reacted to top performers' shift out of non-accredited institutions by substituting them with bottom 90 percent test-takers, thus expanding postsecondary access among lesser-performing students.

As a robustness check, we reproduce the above estimation using the subsample of test-takers from fall 2012 and fall 2013 (a placebo test). Figure A.4 in the Appendix shows that the probability of immediately accessing postsecondary education did not change significantly for fall 2013 test-takers (i.e., before SPP). In stark contrast, fall 2014 test-takers –the first cohort exposed to SPP– were significantly more likely to immediately access higher education. Specifically, the probability of accessing private and accredited college education increased by 12.7 percentage points relative to the cohort two years prior (Panel B). This trend was reinforced again for Fall 2015 test-takers in the top decile: relative to Fall 2012 test-takers, they were 10.6 percentage points more likely to access postsecondary education and 14.3 percentage points more likely to enroll in a private and accredited institution (Panel C).

Where did displaced applicants enroll?

Even though SPP fostered an increase in the total college enrollment in the country, with admission thresholds rising due to higher competition, marginal students were displaced from top schools. In the country's top-ranked university, 1,047 applicants whose test scores would have granted them admission in Spring 2014 were rejected in Spring 2015 as a result of the more selective cutoffs. Figure 10 tracks where these displaced students enrolled in spring 2015, i.e., the semester immediately after presenting SABER 11. Panel A shows that around 30 percent of displaced students did not immediately enroll in any higher education institution in Colombia, with the remainder enrolling at institutions with significantly lower-quality students, according to their mean SABER 11 score before SPP.²¹ Specifically, 17 percent of displaced students attended Bogota's second-best private institution, whose mean normalized SABER 11 score is 1.97 (i.e., a loss in peer quality of 1.09 points). Roughly 7 percent of displaced students attended an institution with a score of 1.87 (i.e., a loss in peer quality of 1.19 points). One-quarter of all displaced students belong to relatively wealthy households, i.e., strata 4, 5, or 6. Panel B restricts the sample to these relatively wealthy students and shows that 33.3 percent of them opted not to immediately enroll in higher education in Colombia, while 27.2 percent opted for the 7th ranked institution in the country.

How does this compare to successful applicants who would not have been admitted the following year due to the increase in cutoffs, that is, the would-be marginal applicants? Indeed, comparing the two cohorts is important because not all those who are admitted enroll. Specifically, [Londono-Velez \(2016\)](#) suggests that on average roughly 30 percent of admitted applicants enrolled at this university before SPP, and that those from strata 4–6 were twice as likely to enroll as those from strata 1–3. Thus, Figure 11 presents the difference in the frequency of marginal and would-be marginal applicants enrolled at each institution before and after SPP.²² The Figure suggests an increase in the number of students that did not immediately enroll in

²¹One third of those (immediately) crowded out from higher education re-applied to this same university, the overwhelming majority to no avail. By fall 2016 (i.e., 1.5 years later), 70 percent were attending higher education, with all but three students attending lower-ranked schools.

²²There are 249 such would-be marginal applicants in Spring 2014.

higher education and that enrolled in a lower-ranked institution.²³

Figure 10: Institutions where marginal applicants immediately enrolled

(a) All marginal applicants

(b) Relatively wealthy marginal applicants

Note: Values represent institutional mean normalized SABER 11 test score of Spring 2014 entering cohort. Panel B restricts the sample to applicants from strata 4, 5, and 6. *Sources:* Authors' calculations based on university administrative data, ICFES, DNP, MEN, and SPADIES (2016).

Figure 11: Difference in frequency of marginal and would-be marginal applicants before and after SPP

Note: Values represent institutional mean normalized SABER 11 test score of Spring 2014 entering cohort. *Sources:* Authors' calculations based on university administrative data, ICFES, DNP, MEN, and SPADIES (2016).

5.2 Compositional changes in postsecondary student quality

The rise in postsecondary enrollment brought about by SPP directly affected student quality at receiving institutions, as measured by mean SABER 11 percentile of freshmen students. Figure

²³Note that 40 percent of would-be marginal applicants come from relatively wealthy households (i.e., strata 4-6).

12 plots the difference in mean SABER 11 percentile among freshmen students before and after SPP by accredited postsecondary institution. The figure suggests that average student quality significantly increased for most private accredited institutions (Panel A), with the magnitude of the impact being inversely proportional to the institutional ranking, as measured by the average quality of admitted students before SPP.²⁴ In contrast, average student quality *decreased* for many public accredited institutions (Panel B).²⁵

Figure 12: Difference in mean percentile of freshmen students

Note: The figures plot the difference between spring 2014 and 2015 in the mean SABER 11 percentile of the entering cohort for students taking SABER 11 in fall 2013 and 2014, respectively, aged 14 to 23. Institutions are ordered by mean SABER 11 score of their spring 2014 entering cohort. $-p < 0.1$, $+p < 0.05$, $*p < 0.01$.

Sources: Authors' calculations based on ICFES, DNP, MEN, and SPADIES (2016).

Panel A in Table 6 presents, by type of institution, the difference in the mean SABER 11 percentile of freshmen students who took the exam in fall 2013 and fall 2014 aged 14–23, and immediately enrolled in postsecondary education. The table suggests student quality increased significantly by 4.9 percent (4.0852/82.87) at private accredited institutions, but was unaffected at public accredited institutions. Student quality fell by 1.7 percent ($-1.1543/68.04$) at public non-accredited institutions, but increased by 1.3 percent (0.8174/62.97) at private non-accredited institutions. As robustness checks, Panels B and C in Table 6 present the coefficients of interest comparing average quality of freshmen students between 2012/2013 and 2012/2015 test-takers, respectively. Results suggest there was no significant change in average student quality pre-SPP in private accredited institutions, and smaller than 1 percent changes in other institutions (Panel B). The gains in student quality at private accredited schools continued, becoming stronger and more significant, into 2015 (Panel C).

Together, these results provide evidence of important compositional effects from non-random sorting of students across no postsecondary education, non-accredited education, and private accredited institutions. As private accredited schools “cream skim” the most able students away from non-education and non-accredited institutions, increased sorting by ability raises stratification and widens the quality gap in equilibrium. Moreover, we can expect a positive peer externality for students attending private accredited institutions. The adverse peer effects on public non-accredited institutions are likely to be non-negligible as well.

²⁴Some researchers use the distribution of skill among graduates or average quality admitted students as a measure of college “reputation” (see MacLeod and Urquiola, 2015; MacLeod et al., 2017).

²⁵Figure A.5 in the Appendix plots the difference in the proportion of freshmen scoring in the top SABER 11 decile before and after SPP by postsecondary institution.

Table 6: Difference in mean SABER 11 percentile of freshmen students by type of institution

	Private		Public	
	Accredited (1)	Non-accredited (2)	Accredited (3)	Non-accredited (4)
Panel A: SPP (2013-2 to 2014-2)				
	4.0852*** (0.2063)	0.8174*** (0.1785)	0.0712 (0.2372)	-1.1543*** (0.2296)
N	1,077,724	1,077,724	1,077,724	1,077,724
R2	0.143	0.143	0.143	0.143
Mean pre	82.87	62.97	85.17	68.04
Panel B: Pre SPP (2012-2 to 2013-2)				
	0.3073 (0.2334)	-0.5262*** (0.1816)	0.8475*** (0.2447)	-0.6553*** (0.2395)
N	1,064,711	1,064,711	1,064,711	1,064,711
R2	0.128	0.128	0.128	0.128
Mean pre	82.54	63.47	84.30	68.67
Panel C: Post SPP (2012-2 to 2015-2)				
	5.2213*** (0.2098)	1.4907*** (0.1787)	1.2613*** (0.2475)	-0.6532*** (0.2350)
N	1,023,641	1,023,641	1,023,641	1,023,641
R2	0.150	0.150	0.150	0.150
Mean pre	82.54	63.47	84.30	68.67

Note: This table presents, by type of postsecondary institution, the difference in mean SABER 11 percentile among freshmen students aged 14–23 who took the exam in fall 2013 and 2014 (Panel A), fall 2012 and 2013 (Panel B), and fall 2012 and 2015 (Panel C), and enrolled in postsecondary education immediately thereafter.

5.3 Class diversity at top-ranked private accredited institutions and equity gains

The large influx of low-SES students at private accredited institutions promoted class diversity at top-ranked institutions. Figure 13 plots the distribution of freshmen by socioeconomic stratum in 2014–2016 spring semesters at selected accredited institutions. At a flagship private and selective university in Bogota (Panel A), the share of freshmen in the bottom two strata skyrocketed from 7.0 percent in 2014 to 27.2 percent in 2015 and 32.6 percent in 2016, that is, an increase of 363 percent over the course of just two years. At Medellin’s flagship elite institution (Panel B), the share of freshmen students from the bottom two strata increased by 292.2 percent, from 6.2 percent in 2014 to 24.4 percent in 2016. In fact, the overwhelming majority of private accredited institutions experienced a significant shift in class diversity. In contrast, the share of low-SES freshmen students was relatively unaffected at public accredited

institutions, whose traditional population is composed mostly of lower- and middle-class students. Specifically, the share of students from the bottom two strata *decreased* by 3.0 percent at a top-ranked Bogota campus (Panel C), while it increased by only 6.3 percent at another flagship public institution (Panel D).

Figure 13: Freshmen socioeconomic stratum at selected accredited institutions

Sources: Authors' calculations based on SPADIES (2016) and administrative record from universities.

Importantly, the program leveled access to postsecondary education – and especially quality postsecondary education – for high-performing students from different SES backgrounds. Panel A in Figure 14 presents the immediate enrollment rate by strata among SABER 11-eligible students in spring 2014 (before SPP) and 2015 (after SPP). The figure suggests the equalizing impact of SPP is significant: the program increased the enrollment rate from 43.5 percent to 63.7 percent for the poorest individuals (stratum 1), that is, an increase of 46.4 percent. Moreover, the large SES gap in enrollment among top decile students in 2014 virtually disappears after only one year.²⁶ The results are even more striking when focusing on access to accredited postsecondary education, with the likelihood of attending increasing by 182.1 and 97.4 percent for strata 1 and 2, respectively (Panel B).

²⁶Table A.13 in the Appendix decomposes the change in enrollment rates for each stratum by type of institution before and after SPP. Overall, the table suggests that some relatively wealthy students might have been immediately displaced from private quality postsecondary education in Colombia.

Figure 14: The enrollment gap disappeared among top students

Note: Sample restricted to SABER 11 test-takers in fall 2013 and 2014 aged 14–23 who are SABER 11-eligible. *Sources:* Authors' calculations based on ICFES, DNP, MEN, and SPADIES (2016).

5.4 Institutional response: accreditation status and tuition fees

As with many other voucher programs, institutions that are left out of the program are pressured to become more efficient. In the case of SPP, the requirement that students enroll at accredited institutions may put pressure on non-accredited institutions to receive this type of accreditation from the Ministry of Education (but whether or not this reflects an actual improvement in the quality of education provided remains to be seen). Figure 15 plots the number of accredited higher education institutions in the quarters leading to and after the announcement of SPP (the x-axis has been re-centered at 2014q3). The figure provides no evidence of a change in the trend after the announcement of SPP.

Figure 15: Evolution of the number of accredited institutions

Sources: Authors' calculations based on MEN and SPADIES (2016).

A final concern is whether the expansion of government-provided financial aid and the resulting higher demand for education has been captured (partly or entirely) by schools via tuition hikes,

as predicted by the so-called Bennett Hypothesis.²⁷ Private institutions would be especially prone to have this behavioral response, as they have significantly more flexibility in setting their own tuition fees than their public counterparts. Interestingly, however, real tuition fees for entering, full-time undergraduate students at private accredited institutions have remained relatively stable throughout the period, increasing by 4.8 percent in 2010-11, 4.3 percent in 2011-12, 1.8 percent in 2012-13, 3.0 percent in 2013-14, 3.1 percent in 2014-15, and 2.1 percent in 2015-16. We therefore do not *yet* find empirical evidence that aid increases feed tuition increases.²⁸

5.5 Increasing performance among younger test takers

We find evidence that newfound possibility of a tuition-free college education brought about by SPP may have boosted low-SES students' performance in SABER 11. Panel A in Figure 16, which plots the probability distribution of socioeconomic strata for the top SABER 11 decile each year, suggests that the share of top performers from the lowest strata increased from 12.3 percent in Fall 2014 (before SPP) to 15.2 percent in Fall 2015 (after SPP), and further 17.8 percent in Fall 2016. This represents a 44.3 percent increase in the presence of the poorest students at the top of the SABER 11 distribution in just two years.

Figure 16: An increase in test performance for low-SES students

Note: Panel A plots the distribution of socioeconomic strata for the SABER 11 top 10% of performing students in the Fall semesters between 2012 and 2016. The sample is restricted test-takers aged 14–23. Panel B plots the percentage change in the share of students in each stratum that score in the top SABER 11 decile in Fall 2013, 2014, 2015, and 2016, using Fall 2012 as baseline. *Sources:* Authors' calculations based on ICFES (2016).

To account for time-varying changes in the SES distribution of test-takers, Panel B plots the percentage change in the share of students in each stratum that score in the top SABER 11 decile between Fall 2012 and Fall 2013–2016. The figure suggests that the share of students in stratum 1 and 2 scoring in the top decile increased by 34.1 and 13.1 percent, respectively,

²⁷In February 18, 1987, then-Secretary of Education William J. Bennett famously wrote in his opinion piece in the New York Times: “increases in financial aid in recent years have enabled colleges and universities blithely to raise their tuitions, confident that Federal loan subsidies would help cushion the increase.”

²⁸DNP et al. (2016) find that, after SPP, many accredited institutions incorporated new academic and financial aid complementary programs available to all their student body with the aim of reducing dropout rates and providing a smoother transition into postsecondary education.

between Fall 2012 and 2016. Moreover, it appears that students from the bottom two strata have crowded out higher-SES students in the last two years: the shares of top decile performers from strata 3, 4, 5, and 6 *decreased* by 2.6, 3.0, 2.4, and 4.5 percent, respectively.

6 Cost-Benefit Discussion

Using data on total payments in tuition fees to universities and maintenance subsidies to beneficiaries, Appendix Table A.14 presents the annual cost for the first cohort of Pilos in 2015, which amounted to 135.4 billion pesos (USD 42.7 million) or 14.8 million pesos per capita (USD 4,657). This is around 4.2 percent of annual central government spending on higher education. Assuming the annual dropout rate stabilizes at 2.32 percent after 2016, and given the average program is 9.5 semesters long, the cost of the full 4.5 years of study for the first cohort of Pilos reaches 598.9 billion pesos (USD 188.7 million), or 78.4 million (USD 24,691) per beneficiary. After this first cohort, and as a response to complaints that resources were disproportionately benefitting private institutions, the government appeased critics by paying public universities the marginal student cost instead of their tuition fee (artificially lower after public subsidies). This shrank the per student resource gap between public and private institutions, but raised the cost of the program to 913.8 billion (USD 287.9 million) pesos for this second cohort, that is, 94.7 million pesos per beneficiary (USD 29,845).

Since earnings are unavailable for our sample because Pilos have not yet graduated college, we project earnings impacts using income data from household surveys and social security contributions. We caution that our projections will produce reliable estimates of earnings impacts if the relationship between (type of) college attendance and earnings is causal, a strong assumption that is not likely to hold due to selection into (type of) college. We complement our analysis with literature estimates that relate the *type* of college attended with later life outcomes, but this still leaves the important caveat that the treated populations from SPP are very different from that of previous studies, both in terms of SES and test scores. This becomes particularly relevant in contexts where elite colleges produce high-end labor market outcomes, but only for students from wealthy households (Zimmerman, 2016).²⁹ Moreover, the large unintended impacts documented in Section 5 could potentially also affect labor market outcomes for these cohorts. This implies that our cost-benefit discussion will be necessarily speculative, as the only way to be sure of SPP’s long-run effects is to directly measure long-run outcomes for SPP participants.

Our reduced form point estimate is that SPP eligibility raises enrollment in postsecondary education by 25.8 to 34.5 percentage points. Consider the strong assumption that the only impact of the program is to raise 30 of each 100 students from “no postsecondary education” to “accredited postsecondary education”, thus ignoring any graduate degree or other unobserved effects.³⁰ We estimate that the average college graduate from an accredited institution in Colombia will earn 1.37 billion in 2015 pesos (USD 432,625) over the course of his/her lifetime, while the average high school graduate will earn 448,891,226 pesos (USD 141,428).³¹ To

²⁹Indeed, Appendix Figure A.7, which plots earnings profiles for graduates by socioeconomic stratum, suggests that, even controlling for a degree from an accredited private institution, there is a positive correlation between baseline SES and earnings after college. Moreover, not only do higher-SES graduates enjoy a wage premium over their lower-SES classmates, but this wage gap roughly doubles six years after college graduation.

³⁰See Appendix B for the list of assumptions made to obtain our estimates of earnings gain.

³¹The average wage of a college graduate from an accredited institution is taken from the average monthly wage in 2013 of an individual graduating college in 2012, as recorded in OLE, weighted by the frequency of the institutions where Pilos enrolled and converted to 2015 pesos.

calculate the earnings gain of Pilos, we take into account the foregone earnings of attending a 4.5-year college (the average duration of a program attended by Pilos), as well as the monetary subsidies received by Pilos over the course of their studies.³² We thus estimate that SPP might raise earnings by an annuity of 16,309,969 pesos (USD 5,139) for forty years for a net present value of around 382,703,013 pesos (USD 120,574) at a 5 percent interest rate. This significant premium reflects the fact that Colombia has the largest return to college education in Latin America, and the second largest wage gap between college- and high school-educated workers in the region.³³

Moreover, we documented how students sorted into accredited postsecondary institutions, and especially top private institutions. Previous literature has shown that graduates from top private institutions enjoy a significant wage premium over both non-accredited institutions and selective public universities (Camacho et al., 2016; MacLeod and Urquiola, 2015; Riehl et al., 2016). To estimate how much more are Pilos likely to earn by switching to top private accredited schools, we turn to administrative OLE data for 2008–2013 formal employees’ wages for 2001–2013 college graduates.³⁴

Figure 17 plots the earnings profiles of college graduates by type of institution. Panel A plots mean log monthly real earnings separately for graduates from accredited and non-accredited institutions, while Panel B plots earnings profiles separately for college graduates from private and public accredited institutions.³⁵ Panel A illustrates the magnitude of the earnings gap between graduates from accredited and non-accredited institutions. It also shows that the slope of workers’ earnings-experience profiles is higher for accredited than for non-accredited institutions, with the earnings gap more than doubling over the first nine years of experience. Moreover, there is a significant gap between earnings from private and public accredited college graduates that stays roughly constant across time (Panel B).³⁶

Although the correlation depicted in Figure 17 cannot be interpreted as the causal effect of college type on earnings, we can use it to feed our back-of-the-envelope calculation of the benefits of SPP for Pilos. Thus, moving a college graduate from non-accredited to accredited education might raise earnings by an annuity of 2,455,573 pesos (USD 774) for forty years for a net present value of around 127.3 million pesos (USD 21,172) at a 5 percent interest rate.³⁷

³²Our calculations likely underestimate the total amount of subsidies received by Pilos. First, the government’s *Departamento para la Prosperidad Social* provided additional subsidies upon completion of the academic semester as well as for good academic performance. Second, some private institutions provided in-kind subsidies (e.g., food, photocopies, transportation).

³³The coefficient from the college dummy in a Mincer regression for men is 1.053 in Colombia compared to 1.004 in Costa Rica, 0.857 in Brazil, 0.851 in Chile, 0.719 in Mexico, 0.559 in Peru, and 0.417 in Argentina. Also, the ratio of hourly wages between workers with tertiary and secondary education is 2.82 in Brazil, 2.72 in Colombia, 2.61 in Mexico, 2.60 in Chile, 2.28 in Costa Rica, 1.7 in Peru, and 1.49 in Argentina (SEDLAC – CEDLAS and The World Bank).

³⁴We restrict our sample by excluding the following observations: (i) self-employed workers (whose wages we do not observe) and other non-employees; (ii) non-university degrees (e.g., technical or technological, specialization, masters, PhD); (iii) distance learning degrees; (iv) earnings after obtaining a second undergraduate degree or a graduate degree; (v) ages below 18 or above 35; (vi) more than 9 years of experience (there are very few individuals in our data with 10 or more years of experience, making these estimates very noisy); (vii) graduates from the National Apprenticeship Service (SENA), a public vocational training school; and (viii) graduates from military or police academies, as they would typically be outside of the traditional labor market.

³⁵We define accreditation status by status on October 1, 2014, i.e., the day SPP was announced.

³⁶Appendix Figure A.6 compares the average formal earnings profiles plotted in Figure 17 with those of college graduates that are similar to Pilos in two observable characteristics, namely SES (strata 1–3) and SABER 11 score (top decile). These students enjoy a wage premium compared to an average graduate.

³⁷We multiply OLE’s monthly averages by twelve to obtain annual estimates.

Moreover, moving a college graduate from non-accredited to *private* accredited education raises earnings by an annuity of 3,941,820 pesos (USD 1,242) for forty years for a net present value of around 174.4 million pesos (USD 29,482) at a 5 percent interest rate.³⁸ Note that these returns reflect not only higher wages, but also lower unemployment and informality rates.

Figure 17: Earnings profiles of college graduates

Notes: The figures include 2001–2013 graduates from 234 different college campuses with earnings observations in 2008–2013. Lines depict the mean log monthly real earnings (in 2015 pesos) for university graduates from accredited and non-accredited tertiary institutions (Panel A) and accredited private and public institutions (Panel B). We define experience as earnings year minus graduation year. Wages with a value of zero (the unemployed) are excluded. The dashed gray line parallels the non-accredited (Panel A) and public accredited (Panel B) profiles starting from the accredited (Panel A) and private accredited (Panel B) intercept. *Source:* Author's calculations using OLE and ICFES (2016).

These back-of-the-envelope calculations suggest that SPP's costs are more than offset by the increased earnings of beneficiaries. The private internal rate of return of SPP is 44.5 percent, while the social rate of return—which takes into account the opportunity cost of other social investments, an expanded income tax base, positive externalities from an educated workforce, lower public spending on subsidized healthcare, and lower crime rates (see Appendix B)—is 16.1 percent.

An argument, often voiced by critics of SPP, sustains that resources for SPP could have been used to benefit a larger number of students at public accredited universities. Our estimations reveal that the biannual marginal student cost is roughly similar in accredited private and public universities (see Table A.14). However, tuition fees at public institutions are significantly lower because they are subsidized by the central government. A direct implication is that such an argument is not entirely accurate. In fact, if the program had restricted students to enroll in the top accredited public university in the country, our calculations suggest only around 16,000 students could have been benefited, instead of the close to 20,000 served by the first and second round of SPP.

Granted, this section presents a highly simplistic analysis. A more careful analysis would include the potential societal gains from promoting class diversity at elite colleges, the positive peer effects at private accredited institutions (and potentially negative peer effects at public non-accredited institutions), as well as the wage loss of displaced marginal applicants from not

³⁸These calculations assume wages stabilize after the ninth year of experience.

attending top elite schools.³⁹⁴⁰ We leave that exercise for future work.

7 Conclusions

The Colombian higher education system is characterized by a severe segregation due to costly tuition fees and a dearth of financial support for low-SES students. In this context, we explore the intended and unintended impacts of a recent large-scale, merit-based financial aid program for the poor. We exploit sharp eligibility rules in household wealth and standardized test scores to identify the causal effect of financial aid on postsecondary enrollment and academic performance. We find large positive effects on postsecondary enrollment on both the extensive and intensive margins. Immediate enrollment doubled among eligible students, making the SES gap in enrollment disappear among top students. At the intensive margin, the program shifted students from low-quality institutions into higher-quality institutions (which have the largest returns to educational investment), and from public to private colleges. Moreover, we find that SPP beneficiaries are 18 percent less likely to drop out of college, although they are somewhat more likely to fail a course.

We also observe significant general equilibrium effects in secondary and postsecondary education in Colombia. The program promoted class diversity at top private schools, and significantly raised student quality at these institutions (with a smaller loss in non-accredited institutions). Demand for top private education shifted rightward, driving admission rates downward and increasing entry competition at these institutions, thus raising stratification by ability. However, program beneficiaries did not fully crowd out high-SES students from top private schools because supply of private and accredited college education also expanded. Finally, the program seems to have raised high school exit test performance among recent cohorts with relatively poor backgrounds.

Our cost-benefit analysis suggests the program had large positive net social gains. However, we caution that our analysis is necessarily speculative, as the only way to be sure of SPP's long-run effects is to directly measure long-run outcomes for SPP participants. This is particularly important in light of recent evidence for developing countries suggesting elite college education generates high-end labor market outcomes only for students from wealthy families (Jia and Li, 2017; Zimmerman, 2016), although evidence for Colombia suggests lower-SES students benefit disproportionately from attending Bogota's flagship private university (Saavedra, 2009). Thus, it is imperative that future research evaluate the impact this program will have on social mobility and explore its effects on longer-term outcomes such as college exit test scores, employment probabilities, and earnings, when such outcomes become available.

³⁹Indeed, Section 5 documented how a Pilo who is admitted to and attends a top school instead of a lower-ranked college reaps a lifetime benefit, but that student displaces another student from attending that top school, who then attends a slightly less prestigious school. That displaced student in turn displaces another student at that school, and so on.

⁴⁰The empirical literature suggests that the long-term effects of not attending a top-ranked institution are substantial. Exploiting discontinuities in entry into the University of Los Andes, Saavedra (2009) estimates admitted applicants are 18 percent more likely to be formally employed and earn 20 percent more one year after graduation. Moreover, admitted applicants who enroll are 30 percent more likely to have a formal job and earn 35 percent more after graduation. Importantly, the effects on exit exam scores and formal employment are larger for low-SES students than for high-SES students.

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Appendices

A Tables and Figures

Figure A.1: Education gap by equivalized income quintile

Note: This figure plots the ratio of top to bottom equivalized income quintile in years of education, restricted to adults aged 25 to 65. *Source:* SEDLAC (CEDLAS and The World Bank), version May 2016.

Table A.1: Characterization of compliers, always takers, and never takers:
SABER 11 as the R_i

	<i>SABER 11 as the running variable</i>					
	All	SISBEN-eligible	Bandwidth	Compliers	Never takers	Always takers
	(1)	(2)	(3)	(4)	(5)	(6)
Female	0.547	0.575	0.480	0.458	0.424	-
Age	17.914	17.968	16.690	16.376	16.994	-
Ethnic minority	0.132	0.139	0.089	0.076	0.070	-
Employed	0.136	0.136	0.096	0.053	0.144	-
Family size	4.688	4.871	4.618	4.601	4.520	-
Mother education: Primary	0.369	0.449	0.261	0.204	0.243	-
Mother education: Secondary	0.431	0.436	0.489	0.485	0.465	-
Mother education: T&T	0.090	0.067	0.129	0.157	0.132	-
Mother education: Higher	0.110	0.048	0.114	0.152	0.160	-
Father education: Primary	0.434	0.525	0.356	0.319	0.320	-
Father education: Secondary	0.385	0.375	0.430	0.429	0.411	-
Father education: T&T	0.072	0.051	0.102	0.115	0.105	-
Father education: Higher	0.110	0.049	0.118	0.137	0.163	-
Household SES: Stratum 1	0.424	0.559	0.365	0.337	0.318	-
Household SES: Stratum 2	0.349	0.340	0.442	0.439	0.443	-
Household SES: Stratum 3	0.177	0.093	0.180	0.210	0.210	-
Household SES: Stratum 4	0.035	0.007	0.014	0.016	0.023	-
Household SES: Stratum 5	0.010	0.001	0.003	0.003	0.005	-
Household SES: Stratum 6	0.004	0.000	0.000	0.000	0.001	-
School hours: Full day	0.196	0.139	0.194	0.208	0.224	-
School hours: Morning	0.513	0.548	0.605	0.607	0.594	-
School hours: Evening	0.070	0.076	0.015	0.007	0.011	-
School hours: Afternoon	0.156	0.164	0.174	0.171	0.161	-
School hours: Weekends	0.064	0.074	0.012	0.008	0.010	-
Private school	0.254	0.156	0.165	0.171	0.206	-
N	574,269	299,475			6,453	-

Sources: Authors' calculations based on ICFES, DNP, MEN, and SPADIES (2016).

Table A.2: Characterization of compliers, always takers, and never takers:
SISBEN as the R_i

	<i>SISBEN as the running variable</i>					
	All	SABER 11-eligible	Bandwidth	Compliers	Never takers	Always takers
	(1)	(2)	(3)	(4)	(5)	(6)
Female	0.547	0.448	0.434	0.459	0.424	-
Age	17.914	16.751	16.568	16.276	16.994	-
Ethnic minority	0.132	0.060	0.061	0.067	0.070	-
Employed	0.136	0.082	0.075	0.043	0.144	-
Family size	4.688	4.238	4.307	4.278	4.520	-
Mother education: Primary	0.369	0.106	0.157	0.105	0.243	-
Mother education: Secondary	0.431	0.336	0.445	0.422	0.465	-
Mother education: T&T	0.090	0.172	0.176	0.204	0.132	-
Mother education: Higher	0.110	0.386	0.220	0.269	0.160	-
Father education: Primary	0.434	0.148	0.215	0.195	0.320	-
Father education: Secondary	0.385	0.321	0.416	0.380	0.411	-
Father education: T&T	0.072	0.140	0.151	0.191	0.105	-
Father education: Higher	0.110	0.391	0.218	0.232	0.163	-
Household SES: Stratum 1	0.424	0.122	0.149	0.102	0.318	-
Household SES: Stratum 2	0.349	0.306	0.504	0.518	0.443	-
Household SES: Stratum 3	0.177	0.349	0.307	0.347	0.210	-
Household SES: Stratum 4	0.035	0.148	0.025	0.030	0.023	-
Household SES: Stratum 5	0.010	0.052	0.005	0.005	0.005	-
Household SES: Stratum 6	0.004	0.023	0.001	0.000	0.001	-
School hours: Full day	0.196	0.454	0.317	0.329	0.224	-
School hours: Morning	0.513	0.428	0.509	0.483	0.594	-
School hours: Evening	0.070	0.006	0.007	0.006	0.011	-
School hours: Afternoon	0.156	0.108	0.159	0.171	0.161	-
School hours: Weekends	0.064	0.004	0.005	0.001	0.010	-
Private school	0.254	0.525	0.329	0.383	0.206	-
N	574,269	53,632			6,453	-

Sources: Authors' calculations based on ICFES, DNP, MEN, and SPADIES (2016).

Table A.3: First stage

	<i>Dependent variable: SPP recipient</i>	
	SABER 11	SISBEN
	(1)	(2)
RD Estimate	0.541*** (0.009)	0.624*** (0.013)
Robust RD Estimate	0.543	0.621
Robust Std. Error	0.011	0.015
Mean Control	0	0
Observations	293,758	21,125
BW Loc. Poly.	23.562	17.426
Effect obs control	22,184	5,931
Effect obs treat	10,314	6,494

Note: Column (1) restricts the sample to SISBEN-eligible students, uses SABER 11 as the running variable, and includes dummies for mothers higher education and stratum 4 as controls. Column (2) restricts the sample to SABER 11-eligible students, uses SISBEN as the running variable, and controls for family size, parental secondary and higher education, morning school schedule and weekend school schedule. All results estimated with package rdrobust (Cattaneo et al., 2014).

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Sources: Authors' calculations based on ICFES, DNP, and MEN (2016).

Table A.4: Covariate balance test around SABER 11 cutoff

Female	Age	Ethnic minority	Employed	Family size	Mother education: Primary (6)	Mother education: Secondary (7)	Mother T&T (8)	Mother education: Higher (9)	Father education: Primary (10)	Father education: Secondary (11)	Father education: T&T (12)	Father education: Higher (13)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
RD Estimate	-0.017 (0.013)	0 (0.006)	-0.006 (0.006)	-0.042 (0.033)	-0.009 (0.012)	-0.011 (0.012)	0.001 (0.007)	0.019** (0.008)	0 (0.011)	-0.003 (0.011)	0.002 (0.008)	0.004 (0.008)
Robust RD Estimate	-0.022 (0.015)	0 (0.007)	-0.007 (0.008)	-0.043 (0.043)	-0.014 (0.014)	-0.01 (0.014)	0.002 (0.008)	0.023 (0.009)	-0.002 (0.013)	-0.005 (0.009)	0.003 (0.003)	0.006 (0.01)
Robust Std. Error	0.473 (0.473)	0.079 (0.079)	0.085 (0.085)	4.601 (4.601)	0.252 (0.252)	0.504 (0.504)	0.134 (0.134)	0.11 (0.11)	0.343 (0.343)	0.429 (0.429)	0.103 (0.103)	0.122 (0.122)
Mean Control	299,475 (299,475)	299,475 (299,475)	299,475 (299,475)	298,122 (298,122)	293,758 (293,758)	293,758 (293,758)	293,758 (293,758)	293,758 (293,758)	285,576 (285,576)	285,576 (285,576)	285,576 (285,576)	285,576 (285,576)
Observations	21,891 (21,891)	32,94 (32,94)	27,314 (27,314)	32,597 (32,597)	19,848 (19,848)	27,804 (27,804)	34,549 (34,549)	26,666 (26,666)	28,496 (28,496)	34,054 (34,054)	23,204 (23,204)	23,719 (23,719)
BW Loc. Poly.	26,344 (26,344)	36,290 (36,290)	28,198 (28,198)	36,189 (36,189)	16,746 (16,746)	27,829 (27,829)	39,324 (39,324)	26,087 (26,087)	28,605 (28,605)	38,039 (38,039)	21,443 (21,443)	21,443 (21,443)
Effect obs control	19,382 (19,382)	36,290 (36,290)	28,198 (28,198)	36,189 (36,189)	16,746 (16,746)	27,829 (27,829)	39,324 (39,324)	26,087 (26,087)	28,605 (28,605)	38,039 (38,039)	21,443 (21,443)	21,443 (21,443)
Effect obs treat	9,808 (9,808)	12,264 (12,264)	11,363 (11,363)	12,230 (12,230)	9,168 (9,168)	11,225 (11,225)	12,411 (12,411)	10,973 (10,973)	11,043 (11,043)	11,979 (11,979)	9,955 (9,955)	9,955 (9,955)

(continued on next table)

(continued from previous table)

	Household SES: Stratum 1 (14)	Household SES: Stratum 2 (15)	Household SES: Stratum 3 (16)	Household SES: Stratum 4 (17)	Household SES: Stratum 5 (18)	Household SES: Stratum 6 (19)	School hours: Full day (20)	School hours: Morning (21)	School hours: Evening (22)	School hours: Afternoon (23)	School hours: Weekends (24)	Private school (25)
	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)
RD Estimate	-0.002 (0.010)	-0.013 (0.011)	0.01 (0.009)	0.007** (0.003)	0 (0.001)	-0.001 (0.001)	-0.002 (0.009)	-0.002 (0.011)	0.003 (0.002)	-0.001 (0.008)	0.003 (0.002)	-0.002 (0.008)
Robust RD Estimate	-0.005 (0.012)	-0.012 (0.014)	0.011 (0.011)	0.008 (0.003)	0 (0.002)	-0.001 (0.001)	-0.002 (0.002)	-0.001 (0.013)	0.002 (0.003)	-0.001 (0.01)	0.002 (0.003)	-0.002 (0.01)
Robust Std. Error	0.473 (0.473)	0.079 (0.079)	0.085 (0.085)	4.601 (4.601)	0.252 (0.252)	0.504 (0.504)	0.134 (0.134)	0.11 (0.11)	0.343 (0.343)	0.429 (0.429)	0.103 (0.103)	0.122 (0.122)
Mean Control	299,475 (299,475)	299,475 (299,475)	299,475 (299,475)	299,475 (299,475)	298,122 (298,122)	293,758 (293,758)	293,758 (293,758)	293,758 (293,758)	285,576 (285,576)	285,576 (285,576)	285,576 (285,576)	285,576 (285,576)
Observations	21,891 (21,891)	32,94 (32,94)	27,314 (27,314)	32,597 (32,597)	19,848 (19,848)	27,804 (27,804)	34,549 (34,549)	26,666 (26,666)	28,496 (28,496)	34,054 (34,054)	23,204 (23,204)	23,719 (23,719)
BW Loc. Poly.	26,344 (26,344)	36,290 (36,290)	28,198 (28,198)	36,189 (36,189)	16,746 (16,746)	27,829 (27,829)	39,324 (39,324)	26,087 (26,087)	28,605 (28,605)	38,039 (38,039)	21,443 (21,443)	21,443 (21,443)
Effect obs control	19,382 (19,382)	36,290 (36,290)	28,198 (28,198)	36,189 (36,189)	16,746 (16,746)	27,829 (27,829)	39,324 (39,324)	26,087 (26,087)	28,605 (28,605)	38,039 (38,039)	21,443 (21,443)	21,443 (21,443)
Effect obs treat	9,808 (9,808)	12,264 (12,264)	11,363 (11,363)	12,230 (12,230)	9,168 (9,168)	11,225 (11,225)	12,411 (12,411)	10,973 (10,973)	11,043 (11,043)	11,979 (11,979)	9,955 (9,955)	9,955 (9,955)

Notes: All results estimated with package rdrobust (Cattaneo et al., 2014). * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Source: Authors' calculations based on ICES, DNP, and MEN (2016).

Table A.6: Covariate balance test around SISBEN cutoff

Female	Age	Ethnic mi- nority	Employed	Family size	Mother education: Primary (6)	Mother education: Secondary (7)	Mother T&T (8)	Mother education: Higher (9)	Father education: Primary (10)	Father education: Secondary (11)	Father education: T&T (12)	Father education: Higher (13)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
RD Estimate	-0.004 (0.026)	-0.007 (0.011)	-0.002 (0.012)	-0.132** (0.064)	0.01 (0.016)	-0.073*** (0.026)	0.005 (0.019)	0.054** (0.021)	0.014 (0.020)	-0.052** (0.022)	-0.011 (0.018)	0.051** (0.022)
Robust RD Estimate	-0.01 (0.026)	-0.01 (0.011)	-0.004 (0.012)	-0.149 (0.064)	0.01 (0.016)	-0.08 (0.026)	0.006 (0.019)	0.062 (0.021)	0.007 (0.020)	-0.053 (0.022)	-0.015 (0.018)	0.06 (0.022)
Robust Std. Error	0.031	0.012	0.014	0.075	0.02	0.031	0.023	0.024	0.024	0.027	0.021	0.025
Mean Controls	16.393	0.066	0.073	4.378	0.13	0.486	0.178	0.207	0.184	0.444	0.173	0.198
Observations	23.132	23.132	23.132	23.073	22.878	22.878	22.878	22.878	22.166	22.166	22.166	22.166
BW Loc. Poly.	8.13	10.983	10.568	9.099	10.381	8.206	9.067	8.996	8.794	11.102	9.6	7.836
Effect obs control	3.506	4.616	4.469	3.894	4.366	3.495	3.837	3.813	3.646	4.482	3.960	3.256
Effect obs treat	3.483	4.714	4.548	3.928	4.431	3.475	3.875	3.844	3.619	4.551	3.967	3.214

(continued on next table)

(continued from previous table)

	Household SES: Stra- tum 1 (14)	Household SES: Stra- tum 2 (15)	Household SES: Stra- tum 3 (16)	Household SES: Stra- tum 4 (17)	Household SES: Stra- tum 5 (18)	Household SES: Stra- tum 6 (19)	School hours: Full day (20)	School hours: Morning (21)	School hours: Evening (22)	School hours: Afternoon (23)	School hours: Weekends (24)	Private school (25)
RD Estimate	-0.013 (0.015)	-0.003 (0.021)	0.008 (0.020)	0.011 (0.007)	-0.003 (0.003)	0	0.035 (0.023)	-0.049* (0.029)	0.001 (0.003)	0.019 (0.021)	-0.006* (0.003)	-0.002 (0.008)
Robust RD Estimate	-0.015 (0.015)	0	0.009 (0.024)	0.01 (0.008)	-0.003 (0.004)	0	0.043 (0.026)	-0.061 (0.033)	0.001 (0.004)	0.026 (0.024)	-0.008 (0.004)	-0.002 (0.01)
Robust Std. Error	0.017	0.025	0.024	0.008	0.004	0.001	0.026	0.033	0.004	0.024	0.004	0.01
Mean Controls	0.131	0.516	0.326	0.02	0.007	0.001	0.286	0.548	0.006	0.154	0.008	0.172
Observations	23073	23073	23073	23073	23073	23073	22141	22141	22141	22141	22141	288428
BW Loc. Poly.	11.589	12.635	11.658	11.961	11.183	7.782	9.066	6.498	10.874	7.378	9.401	34.026
Effect obs control	4837	5146	4865	4958	4666	3355	3759	2784	4419	3108	3929	38446
Effect obs treat	4942	5333	4973	5114	4792	3328	3784	2660	4515	3035	3931	12028

Notes: All results estimated with package rdrobust (Cattaneo et al., 2014). * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Source: Authors' calculations based on ICFES, DNP, and MEN (2016).

Table A.8: Robustness check: Dimension reduction exercise

	Dependent variable: Predicted access by type of postsecondary institution														
	Any		Accredited		Non-accredited				Private accredited				Public accredited		Public non-accredited
	SABER 11 (1)	SISEN (2)	SABER 11 (3)	SISEN (4)	SABER 11 (5)	SISEN (6)	SABER 11 (7)	SISEN (8)	SABER 11 (9)	SISEN (10)	SABER 11 (11)	SISEN (12)	SABER 11 (13)	SISEN (14)	
Estimate	0.006 (0.004)	0.02 (0.008)	0.004 (0.002)	0.01 (0.004)	0.002 (0.002)	0.01 (0.004)	0.002 (0.001)	0.009 (0.003)	0.002 (0.002)	0.01 (0.003)	0.001 (0.001)	0.002 (0.001)	0.001 (0.001)	0 (0.001)	
Realized access	0.323	0.253	0.468	0.39	-0.154	-0.138	0.467	0.481	-0.065	-0.058	0.001	-0.089	-0.086	-0.082	
Dep mean control	0.363	0.511	0.106	0.263	0.264	0.248	0.032	0.073	0.105	0.109	0.072	0.192	0.157	0.14	

Note: The table plots the ITT coefficient on a regression of predicted access to postsecondary education that uses 25 baseline characteristics from the universe of test-takers in fall 2013. The first row presents the bias-corrected local-polynomial RD estimate, while the second row presents the robust standard error of the local-polynomial RD estimator. The third and forth row reproduce the bias-corrected RD estimates and control means from Tables 1, 2, 3, and 4. All results estimated with package rdrobust (Cattaneo et al., 2014).
Sources: Authors calculations based on ICFES, DNP, and MEN (2016).

Table A.9: Manipulation testing based on density discontinuity

	<i>Running variable</i>	
	SABER 11 (1)	SISBEN (2)
Robust Bias-Corrected p -value	0.2179786	0.4364368
Robust Bias-Corrected SE	0.0001818	0.0017997
Number of obs - left	284052	7709
Number of obs - right	15423	15423
Eff. number of obs - left	6042	2731
Eff. number of obs - right	6122	3692
Order loc. poly. (p)	2	2
Order BC (q)	3	3
Bandwidth values - left	8.705387	6.21869
Bandwidth values - right	10.00451	8.619373

Notes: All results estimated with package `rddensity` (Cattaneo et al., 2016a) using an unrestricted model and a triangular kernel function, and employing the jackknife standard errors estimator. Column (1) restricts the sample to SISBEN-eligible individuals. Column (2) restricts the sample to SABER 11-eligible individuals.

Sources: Authors' calculations based on ICFES, DNP, and MEN (2016).

Figure A.2: Histograms of SABER 11 and SISBEN scores in the Fall 2013 and 2014

(a) SABER 11

(b) SISBEN

Note: The SABER 11 score plotted above is the product of a linear combination of exam category sub-scores. Before Fall 2014, the formula is

$$score_i^{pre-20142} = \frac{N_{i,chem} + N_{i,bio} + N_{i,phys} + 2N_{i,sosci} + N_{i,philo} + 3N_{i,lang} + 3N_{i,math} + N_{i,eng}}{13}$$

Starting Fall 2014, the formula is

$$score_i^{post-20142} = \frac{500}{1300} \times (3N_{i,reading} + 3N_{i,maths} + 3N_{i,natsci} + 3N_{i,sosci} + N_{i,eng})$$

Sources: Authors' calculations based on ICFES, DNP, and MEN (2016).

Table A.10: Enrollment in private vs. public institutions – ITT and LATE

	<i>SABER 11</i>				<i>SISBEN</i>			
	Private		Public		Private		Public	
	ITT	LATE	ITT	LATE	ITT	LATE	ITT	LATE
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
RD Estimate	0.404*** (0.010)	0.747*** (0.014)	-0.083*** (0.010)	-0.153*** (0.017)	0.421*** (0.019)	0.677*** (0.026)	-0.168*** (0.020)	-0.272*** (0.032)
Robust RD Estimate	0.402	0.741	-0.086	-0.159	0.422	0.68	-0.172	-0.28
Robust Std. Error	0.012	0.017	0.011	0.02	0.023	0.031	0.023	0.038
Mean Control	0.136	0.136	0.232	0.232	0.183	0.183	0.332	0.332
Observations	293,758	293,758	293,758	293,758	21,125	21,125	21,125	21,125
BW Loc. Poly.	26.493	26.493	24.356	24.356	12.374	12.374	10.772	10.772
Effect obs control	26,087	26,087	23,295	23,295	4,706	4,706	4,199	4,199
Effect obs treat	10,973	10,973	10,509	10,509	4,822	4,822	4,265	4,265

Notes: The running variable is SABER 11 score in columns (1)-(4), and SISBEN score in columns (5)-(8). Columns (1)-(4) include dummies for mother's education and stratum 4 as controls, and columns (5)-(8) include controls for family size and dummies for parental secondary and higher education, morning school schedule and weekend school schedule. All results estimated with package rdrobust (Cattaneo et al., 2014). * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Sources: Authors' calculations based on ICFES, DNP, MEN, and SPADIES (2016).

Table A.11: Reason student chose to attend her institution, by type

	Type of postsecondary institution		
	Any	Private	Public
It offers the major I want	58.1%	62.0%	52.4%
It's prestigious	47.4%	55.7%	36.8%
It's better academically	35.2%	42.4%	27.0%
It offers better job prospects	28.5%	36.1%	18.1%
It's public	24.1%	1.4%	62.7%
It's affordable	20.3%	9.1%	31.2%
I liked the curriculum there better	17.1%	13.5%	8.6%
It's private	6.9%	10.7%	1.1%
I have friends or relatives there	6.5%	6.3%	5.8%
It provides better contacts	5.5%	6.7%	4.5%
It's the only one that admitted me	4.5%	4.9%	3.9%
It's the only one available in my region	3.5%	3.0%	3.9%
<i>N</i>	1012	571	359

Note: The data is based on a survey collected from 1,487 SISBEN-eligible individuals that took SABER 11 in Fall 2015 and scored just below or above the SABER 11 eligibility cutoff. 82 observations did not match with an institution.

Source: Authors calculations based on survey data.

Figure A.3: Percentage of first-time undergraduates retained at 4-year institutions, by institution type: 2010 to 2015 entering cohorts

Source: Authors calculations based on SPADIES (2016).

Table A.12: Change in enrollment rates by SABER 11 decile and type of higher education institution

	No higher education	Higher education by type of institution			
		Private		Public	
		Accredited	Non-accredited	Accredited	Non-accredited
Decile 1	0.0085*** (0.0012)	0.0003 (0.0003)	-0.0059*** (0.0009)	-0.0004** (0.0002)	-0.0025*** (0.0007)
Decile 2	-0.0057*** (0.0019)	0 (0.0005)	0.002 (0.0015)	0.0004 (0.0003)	0.0033*** (0.0011)
Decile 3	-0.0108*** (0.0020)	0.0004 (0.0005)	0.0039** (0.0016)	0.0003 (0.0004)	0.0062*** (0.0012)
Decile 4	-0.0170*** (0.0022)	-0.0007 (0.0006)	0.0102*** (0.0017)	0.0006 (0.0004)	0.0068*** (0.0013)
Decile 5	-0.0249*** (0.0024)	-0.0001 (0.0006)	0.0140*** (0.0018)	0.0017*** (0.0005)	0.0093*** (0.0014)
Decile 6	-0.0263*** (0.0025)	-0.0007 (0.0008)	0.0136*** (0.0020)	0.001 (0.0006)	0.0124*** (0.0015)
Decile 7	-0.0283*** (0.0027)	-0.001 (0.0009)	0.0158*** (0.0021)	0.0027*** (0.0008)	0.0108*** (0.0016)
Decile 8	-0.0231*** (0.0029)	-0.0027** (0.0011)	0.0128*** (0.0022)	0.0029*** (0.0009)	0.0101*** (0.0017)
Decile 9	-0.0239*** (0.0031)	-0.0056*** (0.0014)	0.0127*** (0.0023)	0.0024* (0.0013)	0.0145*** (0.0019)
Decile 10	-0.0882*** (0.0033)	0.1241*** (0.0025)	-0.0079*** (0.0022)	-0.0033 (0.0021)	-0.0247*** (0.0020)
N	1,077,724	1,077,724	1,077,724	1,077,724	1,077,724
R2	0.15	0.119	0.019	0.064	0.02
Mean 20132	0.815	0.03	0.081	0.024	0.049
SD 20132	0.388	0.171	0.273	0.154	0.216

Notes: This table plots the coefficients from specification (2) using data from test-takers aged 14 to 23 in fall 2013 and fall 2014. Each column represents a separate regression. Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Sources: Authors' calculations based on ICFES, DNP, MEN, and SPADIES (2016).

Table A.13: Change in enrollment rates by strata and type of higher education institution

	No higher education	Higher education by type of institution			
		Private		Public	
		Accredited	Non-accredited	Accredited	Non-accredited
Stratum 1	-0.0157*** (0.0009)	0.0097*** (0.0003)	0 (0.0006)	0.0011*** (0.0003)	0.0049*** (0.0006)
Stratum 2	-0.0062*** (0.0016)	0.0086*** (0.0006)	0.0024** (0.0011)	-0.001 (0.0006)	-0.0037*** (0.0010)
Stratum 3	-0.0065*** (0.0023)	0.0017 (0.0012)	0.0062*** (0.0017)	0.0019* (0.0010)	-0.0033*** (0.0012)
Stratum 4	0.0227*** (0.0052)	-0.0179*** (0.0041)	0.0011 (0.0039)	0.0016 (0.0024)	-0.0075*** (0.0023)
Stratum 5	0.0233** (0.0094)	-0.0383*** (0.0088)	0.0124* (0.0066)	0.0098** (0.0041)	-0.0072** (0.0028)
Stratum 6	0.0503*** (0.0149)	-0.0502*** (0.0146)	0.0081 (0.0099)	-0.0035 (0.0052)	-0.0048 (0.0030)
N	1,060,752	1,060,752	1,060,752	1,060,752	1,060,752
R ²	0.073	0.084	0.027	0.008	0.001
Mean 20132	0.815	0.030	0.081	0.024	0.049
SD 20132	0.388	0.171	0.273	0.154	0.216

Notes: Sample restricted to test-takers aged 14 to 23 in fall 2013 and fall 2014. Each column represents a separate regression. Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Sources: Authors' calculations based on ICFES, DNP, MEN, and SPADIES (2016).

Figure A.4: Difference in the probability of attending or not attending postsecondary education

Note: The figure presents the difference in the probability of immediately accessing higher education among students aged 14 to 23 taking SABER 11 in Fall 2012/2013 (Panel A), Fall 2012/2014 (Panel B), and Fall 2012/2015 (Panel C).
 $-p < 0.1$, $+p < 0.05$, $*p < 0.01$. Source: Authors' calculations based on ICFES, DNP, MEN, and SPADIES (2016).

Figure A.5: Difference in share of freshmen in the top SABER 11 decile

Note: The figures plot the difference between Spring 2014 and 2015 in the share of freshmen with SABER 11 test scores in the top cohort decile. Institutions are ordered by mean SABER 11 score of their Spring 2014 entering cohort.

$-p < 0.1$, $+p < 0.05$, $*p < 0.01$.
 Sources: Authors' calculations based on ICFES, DNP, MEN, and SPADIES (2016).

Table A.14: Cost of SPP tuition fees and maintenance subsidies (in pesos)

	First cohort			Second cohort		All 4 cohorts	
	2015-1	2015-2	2016-1	Expected total	2016-1	Expected total	Expected total
Total tuition fees							
Total (in million pesos)	51,714	51,569	53,767	457,162	83,050	709,920	2,586,922.59
<i>N</i>	9,205	9,110	8,899	7,642	11,912	9,646.95	36,582.55
Per capita	5,618,051	5,660,747	6,041,968	59,824,651	6,971,921	73,590,110	280,594,981.45
<i>Public institutions</i>							
Subtotal (in million pesos)	3,421	3,423	3,651	30,876	11,426	97,675	323,900.15
<i>N</i>	2,018	1,941	1,906	1,637	1,879	1,521.71	6,201.84
Per capita	1,695,403	1,763,677	1,915,689	18,864,798	6,081,107	64,187,381	211,426,940.88
<i>Private institutions</i>							
Subtotal (in million pesos)	48,293	48,146	50,116	426,285	71,289	609,390	2,254,454.81
<i>N</i>	7,187	7,169	6,993	6,005	9,985	8,086.37	30,264.09
Per capita	6,719,471	6,715,875	7,166,619	70,988,599	7,139,612	75,360,128	297,068,984.36
Maintenance subsidies							
Total (in million pesos)	16,132	15,949	16,658	141,717	23,856	203,926	753,495.35
Per capita	1,752,485	1,750,744	1,871,884	18,545,258	2,002,698	21,138,909	81,961,985.22
TOTAL (in million pesos)	67,846	67,519	70,425	598,879	106,906	913,846	3,340,418.08
Per capita	7,370,536	7,411,490	7,913,852	78,369,909	8,974,619	94,729,024	91,311,785

Notes: 2015 USD 1 = COP 3174.

Figure A.6: Earnings profiles of college graduates

Notes: The figures include 2002–2013 graduates from 234 different college campuses with earnings observations in 2008–2013. Lines depict the mean log monthly real earnings (in 2015 pesos) for university graduates from accredited and non-accredited tertiary institutions (Panel A) and accredited private and public institutions (Panel B). The red lines restrict the sample to high school graduates from strata 1, 2, and 3 scoring in the top SABER 11 decile. We define experience as earnings year minus graduation year. Wages with a value of zero (the unemployed) are excluded. The dashed gray line is parallel to the non-accredited (Panel A) and public accredited (Panel B) profiles starting from the accredited (Panel A) and private accredited (Panel B) intercept. *Source:* Author's calculations using OLE and ICFES (2016).

Figure A.7: Earnings profiles of college graduates

Notes: The figures include 2002–2013 graduates from 234 different college campuses with earnings observations in 2008–2013. Lines depict the mean log monthly real earnings (in 2015 pesos) for university graduates from accredited private tertiary institutions by socioeconomic stratum. We define experience as earnings year minus graduation year. Wages with a value of zero (the unemployed) are excluded. *Source:* Author's calculations using OLE and ICFES (2016).

B Assumptions in the cost-benefit calculation

1. *Work life expectancy*: 40 years after graduating from university. We also assume that all college graduates are 25 years old at the time of graduation and experience no unemployment spells.
2. *Expected wages*: Mincerian regressions are used to derive wage profiles for high school and college graduates. The coefficient for an additional year of experience is 0.0386 and the curvature on age is -0.0008 (based on [Sanchez and Nunez \(2003\)](#), and [Sanchez and Alvarez \(2011\)](#)).
3. *Duration of study*: The average duration of study for Pilos is 9.5 semesters. We assume Pilos complete their undergraduate studies by the end of this period.
4. *Entry wage*: The entry wage for college graduates, taken from OLE, is 1,971,317 pesos. It is based on the observed wages in 2013 for students that graduated college in 2012, converted to 2015 pesos. To account for the fact that graduates from private and accredited universities have higher average wages than those from public and non-accredited institutions, we weight OLE observations by the frequency of Pilos enrolled in each institution. Wages for high school graduates are 612,152.48 pesos, based on household survey data (GEIH).
5. *Dropout rate*: Note that although the average drop out rate is 50 percent (SPADIES, 2016), it is much lower for students with financial aid. Based on first-year retention rates among Pilos, we estimate that the overall dropout rate for Pilos is 10 percent.
6. *Student cost for colleges*: Tuition fee before financial aid (“sticker price”) roughly reflects average student cost at private accredited universities in Colombia. Because 15.8 percent of Pilos enrolled in public institutions, whose student costs are significantly lower than sticker prices, we assume average student costs for colleges receiving Pilos are 80 percent.
7. *Maintenance subsidies provided by the government*: Average annual maintenance subsidies provided by the government to Pilos are 4,000,000 pesos. See Table [A.14](#).

To calculate the social rate of return, we use the following additional assumptions:

1. *Opportunity cost*: We assume the opportunity cost for other social investments is 10 percent.
2. *Additional taxes collected*: The average additional income tax due to lower informality and higher wages is assumed to be 16 percent.
3. *Education externalities*: This is assumed to be 8 percent of the difference in average wages between high school and college graduates.
4. *Subsidized healthcare*: The rate of informality is 22 percent among college-educated workers and 55 percent among high school graduates (DANE, 2016), which thus translates into lower government healthcare subsidies (616,849.20 pesos per person, equivalent to the *UPC-Régimen Subsidiado* established by Resolution 5593 of 2015).
5. *Lower crime rate*: The annual cost of an incarcerated individual is 2015 pesos 13,122,078 (IN-PEC, 2012). We assume that the probability of committing a crime is 0 for college-educated workers, and 0.003171571 for high-school educated workers (this is the share of incarcerated individuals over population aged 16 and above in 2012).