Can Educational Voucher Programs Pay for Themselves?

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In the 1990s Colombia awarded private secondary school scholarships to socially disadvantaged students via lotteries. Using administrative data up to twenty years after the scholarship lottery, we document that lottery winners are less likely to repeat grades, more likely to graduate from secondary school on time or ever, and more likely to start and complete tertiary education. Tertiary education impacts are strongest among students who initially applied to attend vocational secondary schools. Scholarships reduce teen fertility although there is no significant effect on overall fertility at age 30. Social security data suggests that twenty years after the scholarship lottery, average annual formal earnings for lottery winners near age 33 are 8 percent greater than those for losers. Formal-sector earnings effects are entirely driven by vocational school applicants, among whom lottery winners earn 17 percent more than losers. Lottery winners, particularly those who applied to vocational schools have greater access to formal consumer credit, better credit scores, and are more likely to have taken out car loans, a sign of entry to the middle class. The expected net present value of increased net tax receipts due to the program likely exceeds its fiscal cost, implying that the program was welfare improving unless net externalities were large and negative.

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1.   Introduction

In many low-income countries access to primary education is becoming close to universal. As more students transition into secondary schooling, there is increasing pressure to expand capacity. Expanding public secondary schooling is expensive, however, and in many countries there has been considerable private sector growth. Some question how much of the new cohorts of primary school graduates from disadvantaged background are equipped for secondary education, and there is renewed interest in the potential for vocational education.

In this paper we present evidence from Colombia's experience in the 1990s to suggest that at least in that context the private sector was used to expand access to secondary education for disadvantaged populations at low or possibly negative fiscal cost to taxpayers. Participants greatly increased their chance of transitioning to the middle class, as defined by increased tertiary education, greater formal sector earnings, a higher fraction of formal earners above a middle-class earnings threshold, and a higher likelihood of having taken out a car loan. Our evidence indicates that access to private vocational education may have played a key role.

During the 1990s, Colombia's PACES program provided more than 125,000 scholarships to allow disadvantaged students to attend private schools. The program's goal was to expand capacity to accommodate large numbers of public elementary-school students for whom public secondary-school slots were limited.

In order to estimate the fiscal impact, we first need to assess the impact of the program on beneficiaries and on taxpayers. To do so, we take advantage of a lottery used to allocate scholarships, as well as a unique dataset compiled from five different sources of Colombian administrative data, to document the impact of receiving these scholarships on educational, family formation, and labor market outcomes up to 20 years after initial scholarship award, when applicants were near age 33. We then use these data to estimate the fiscal impact of the program. As in Bettinger, Kremer and Saavedra (2010), we pay close attention to impacts among the subpopulation of vocational school applicants.

In terms of impacts on beneficiaries, we find that lottery winners are more likely to have graduated from secondary school on schedule and more likely to have ever graduated from secondary school. They are also more likely to have attended tertiary education at some point. Scholarship impacts at the tertiary level are entirely driven by applicants who prior to the lottery had applied to attend vocational secondary schools. In this "vocational lottery applicants"

subpopulation, lottery winners are also more likely to complete tertiary education. There is also some heterogeneity by gender, as the secondary school increased women's enrollment primarily in five-year universities and men's enrollment in two-year vocational institutions.

Winning the lottery did not increase the probability of working in the formal sector or the number of formal-sector days worked per year, so there is no evidence that people moved from the informal to the formal sector. However, point estimates of the scholarship's impact on total formal sector earnings at around age 33 suggest that lottery winners have 8 percent greater formal sector earnings than scholarship lottery losers (p-value = 0.06). Impacts among vocational applicants entirely drive scholarship effects on formal earnings: vocational lottery winners have 17 percent greater formal sector earnings than vocational lottery losers. This is not completely surprising given that prior work (Bettinger, Kremer, Saavedra 2010) finds that short-run educational impacts were much larger among vocational lottery winners than the impacts among non-vocational lottery winners. An accounting exercise suggests that about 40 percent of the scholarship's impact on total formal sector earnings can be attributed to additional completed schooling among scholarship winners, with the remaining roughly 60 percent due to increased earnings conditional on years of completed schooling.

Effects seem concentrated in the upper quantiles of the earnings distribution, and we see no effect on eligibility for welfare benefits. At the top of the earnings distribution, scholarship winners are working in formal jobs XXXX. The probability of living in a neighborhood classified in one of Colombia's lower two strata falls, but the difference is not statistically significant. Since data on informal income is only available through a census of residents of these neighborhoods, we can only bound and not estimate differences in informal income, but accounting for informal income seems unlikely to change the overall picture.

Winning a scholarship also increases access to formal consumer credit, better credit ratings and a greater likelihood of obtaining a car loan, which is a good proxy for car ownership in Colombia. Similar to results on formal earnings, impacts among vocational applicants entirely drive scholarship effects on consumer credit.

We estimate tight bounds for the effect of winning a scholarship on teen fertility that indicate that winning the lottery reduces the incidence of teen childbearing, particularly among applicants to academic secondary schools. Bounds for the effect on total fertility are precisely estimated and consistent with the scholarship having no effect on total fertility as of age 30.

This result is consistent with the notion that the teen fertility effect we observe is mostly an "incarceration" or "delay" effect rather than an opportunity-cost effect.

After demonstrating the long-term impacts of the Colombian program, we turn our attention to measuring its fiscal and welfare impact. Welfare can be decomposed into three components: the impact on lottery winners, the impact on taxpayers, and any externality impacts. Although winners may have spent more resources on schooling or increased effort, it is possible to construct a lower bound on net benefits to lottery winners based on revealed preference, in which we assume winners incurred psychic costs from going to private schools and working harder that fully offset wage gains. Under this very conservative approach, we still find that winners benefited from the program. The impact on taxpayers is low, and likely negative, because the net present value of extra tax revenue generated by the program exceeds the cost.[1] This implies that taxpayers were made better off by the program since it more than paid for itself by increasing future tax revenue. These effects are concentrated among applicants to vocational schools. For the program to have been negative from a welfare point of view, net externalities on non-participants would have to be negative and greater than the sum of the fiscal benefits to taxpayers and the benefits to participants.[2]

We note that several design features might have contributed to reducing the program's fiscal cost. These included limiting scholarship value to about two-thirds of costs at the typical private participating school, while allowing families to top up scholarships with private funds; conditioning scholarship renewal on passing each grade (which holds down the costs of grade repetition); and limiting eligibility to residents of poor neighborhoods who had attended public primary schools (which avoids subsidizing students who would have paid for private secondary school out of pocket in the absence of the program).

The concentration of long-term effects among vocational school applicants helps shed light on potential channels although it is difficult to make definitive statements. In this subpopulation winners attend schools with peers who are less desirable on observables, casting doubt on the notion that peer quality is the only mechanism driving observed scholarship

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[1] The 90% confidence interval is bounded away from zero.
[2] The program could potentially have created positive externalities from human capital and reduced teen fertility, or negative externalities if gains for program winners reflect assignment to more favorable peers or signaling benefits in the labor market. In earlier work, a subset of the authors of this paper argues against the view that effects are entirely due to changes in peer assignment (Bettinger, Kremer and Saavedra 2010).

effects. One hypothesis is that improved labor market and credit outcomes of vocational scholarship winners are the result of increased tertiary education completion, although the implied return to a year of schooling in the sample is too large for this to be the only mechanism at work. A related hypothesis is that private vocational education is more responsive to labor market and advanced training opportunities than is public education such that returns stem from a combination of additional education and improved labor market matching. We find some empirical support for this hypothesis. Among vocational school applicants, effects are particularly strong and precisely estimated for applicants to schools with a commercial focus, even though we cannot reject equality of effects across applicants to different vocational curricula.

A complementary hypothesis relates to the fact that it was administratively difficult to retain the scholarship if a student switched schools. For this reason, applicants who applied to vocational private schools were more likely than losers to stay in vocational schools. This "stickiness" in application rules might have locked-in students in private vocational schools despite that fact that ex-ante parents might have preferred an academic path.

Our results should be interpreted as suggesting that, at least in the context of 1990s Bogotá, a suitably designed system of offering students from poor neighborhoods partial scholarships for private schools helped some students transition to the middle class at a low, and likely negative net fiscal cost. Identifying the impact of the PACES scholarship program "as implemented" is of considerable interest given the program's scale, and that many of its features are not uncommon among private school scholarship programs.

This paper contributes to several strands of the literature including research on the impacts of private-school voucher programs,[3] the long-term consequences of educational interventions,[4] the economic returns to interventions that target socially disadvantaged

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[3] For example, Helen Ladd 2002; Angrist, Bettinger and Kremer 2006; Hsieh and Urquiola 2006; Wolf, Gutmann, Puma, Kisida, Rizzo, Eissa and Carr 2010; Barrow and Rouse, 2008; Muralidharan and Sundararaman 2013.
[4] For example, Kemple 2004; Chetty, Friedman, Hilger, Saez, Schanzenbach and Yagan 2011; Deming, Hastings, Kane and Staiger 2011; Dynarski, Hyman and Schanzenbach, 2011; Cowen, Fleming, Witte, Wolf and Kisida 2012.

children,[5] the effects of education on fertility,[6] and recent developments in public finance employing reduced form causal estimates of labor-market behavioral responses to policy to measure welfare changes.[7]

The remainder of the paper is organized as follows. Section 2 provides a conceptual framework for the welfare analysis and presents relevant background information on the PACES program. Section 3 describes the sources of administrative data and the empirical strategy for analyzing long-run outcomes. Sections 4 and 5 discuss long-run educational and labor market outcomes. Section 6 discusses access to consumer credit. Section 7 discusses fertility. Section 8 analyzes fiscal and welfare outcomes. Section 9 concludes.

2.   Background

2.1 Welfare Analysis Framework

Before providing some background on Colombia and the PACES program, we start by outlining a framework for understanding the fiscal and welfare impacts of the PACES program. The welfare impact of the PACES program is the sum of impacts on students who received scholarships (B_s), on taxpayers (B_t), and on others (B_o).

$$\text{Total Welfare} = B_s + B_t + B_o$$

We separately estimate impacts on participants (B_s) and taxpayers (B_t), allowing us to determine how large would negative externalities (B_o) need to be in order to change welfare conclusions.

For participants, welfare impacts (B_s) can be measured in two different ways. First, we can measure the net present value of extra school expenditures, foregone earnings and future earnings for scholarship winners. Second, we can also use a revealed-preference methodology to estimate lower bounds on the welfare impact. Specifically, although winners may have spent

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[5] Some argue that interventions that target socially disadvantaged children have highest returns early in the life cycle, during key child-development windows (Cunha, Heckman, Lochner and Masterov 2006; Heckman and Masterov 2007; Heckman 2008). A stronger claim is that interventions in the teen years are doomed to have small impacts. Our findings demonstrate that secondary schooling interventions that target disadvantaged children have the potential to increase earnings and promote social mobility.

[6] In developing countries, in particular several, studies find a strong causal relationship between educational subsidies and teen fertility (e.g. Breireova and Duflo 2004; Cortés, Gallego and Maldonado 2010; Duflo, Dupas and Kremer 2012). In our setting, such effect is the result of people staying in school longer rather than an increase in the opportunity cost of time as a result of additional human capital.

[7] See, for example, Hendren 2013 and Baird, Hicks, Kremer and Miguel 2013.

more resources on schooling or increased effort, it is possible to construct a lower bound on net benefits to participants since payments to infra-marginal applicants who would have gone to private school in the absence of the program constitute a pure transfer.

For taxpayers, the welfare impact (B_t) is the net present value of future tax revenues that the program generates minus the fiscal cost of the program and of any additional expenditure it induced for example on tertiary education. The key outcome to estimate the program's impact on taxpayers is the additional contribution of participants to government revenue through increased payroll taxes, which are only levied on formal sector employment, and which we observe for the universe of applicants through administrative social security records.

Besides the impacts on participants and taxpayers, there may be other externalities (B_o), which may influence welfare calculations. We do not attempt to quantify these externalities directly. Instead, we calculate how large the negative externalities would have to be to offset the positive impacts we find elsewhere.

To provide context as we outline these costs and benefits, we start by describing the educational context in Colombia at the time of the inception of PACES.

2.2 Colombia's educational context

The Colombian education system comprises three levels: elementary school (grades 1-5), secondary (grades 6-11) and tertiary education. Children typically begin elementary school at age 6 or 7 and transition into secondary at around age 12 or 13. Students are legally required to attend school through grade 9 even though the entire secondary school cycle includes two additional grades. Students who complete secondary school on time typically do so by age 18.

Students who wish to continue on to tertiary education can enroll in either vocational colleges or universities. In 2012, the gross tertiary enrollment rate for Colombia was 45 percent (World Development Indicators 2014). Vocational programs typically last two or three years depending on whether they have a technical or technological focus. University programs — more prestigious, expensive and selective— last typically four or five years. Seventy-five percent of tertiary education students in Colombia attend a university and 25 percent attend a vocational college. Public universities are more prestigious and selective. With the exception of a few elite private universities, private tertiary education institutions serve those who do not obtain admission into public universities.

Although we study a large-scale national private secondary school scholarship program, we use data from Bogotá —Colombia's capital city. Colombian municipalities including Bogotá are responsible for the administration of public education, funded by transfers from the national government levied through income and value-added taxes (Barrera-Osorio et al. 2011). Nationally, 37 percent of the student population attended a private school when the PACES scholarship program was in place; in Bogotá, however, 58 percent of students did so (Angrist et al. 2002).

Curricula of vocational and academic secondary schools are the same for lower secondary grades (grades 6 through 9). For grades 10 and 11, the last two grades of secondary school, students either enroll in a vocational or academic program. Academic schools focus instruction in the fields of science, humanities or the arts and traditionally prepare students for university education. Vocational schools share core subjects with academic schools. However, in the last two grades of secondary school they have a stronger focus on preparing students for admission into vocational colleges or for participation in the labor market, through specialized curricula such in commercial, industrial, agrarian or pedagogical domains.

Within the category of vocational schools, public schools are more likely to teach industrial as opposed to commercial subjects. Among public vocational schools, 25 percent have an industrial curriculum and 62 percent have a commercial curriculum, whereas among private vocational schools only 4 percent have an industrial curriculum and 92 percent have a commercial focus (Bettinger, Kremer and Saavedra 2010). At the time, the mix of subjects taught by private vocational schools was better suited than that of public vocational schools to labor market requirements (Saavedra and Medina 2014).

Students attending grade 11 take the ICFES exam, and ICFES scores are the primary admission criteria in Colombia's tertiary education institutions. While it is not a binding graduation requirement, most schools enforce test taking and, in practice, over 95 percent of students take the test (ICFES 2013). Thus, we interpret taking the ICFES exam as a proxy for secondary school completion.

In order to facilitate targeted subsidies in public services, Colombia divides its population into six strata based on residential location. The poorest two strata —the target population of the PACES scholarship program— represent roughly 55 percent of Colombia's

population (49 percent in Bogotá). About 12 percent of students in strata 1 and 2 neighborhoods attend private schools in Bogotá (Encuesta Nacional de Calidad de Vida 2010).[8]

2.2 The PACES scholarship program

The PACES scholarship program was introduced in 1992 as a way of improving secondary school enrollment rates among disadvantaged students. Available slots in public secondary schools were limited when the program began in 1992. The program aimed at tapping the excess capacity in private schools by providing scholarships for private secondary schooling among strata 1 and 2 applicants from public elementary schools (King, Laura Rawlings, Gutierrez, Pardo, and Torres 1997).

Participating private schools served lower-income students and charged lower tuition fees than other private schools that chose not to participate. Teacher-pupil ratios were comparable between all public and participating private schools (King et al. 1997). While initially the scholarship covered most tuition fees, the government did not increase its monetary value to keep pace with inflation, and by 1998 the scholarship only covered about 56 percent of the tuition of the average participating school. Families made up for the difference (Angrist et al. 2002).

In order to receive an award, students needed to have applied and been accepted to a participating private school. Local governments awarded scholarships by lottery if demand exceeded scholarship availability. Students were between 12 and 13 years of age at the time of application. Renewal of the award through the end of students' secondary schooling was supposed to be contingent upon passing grades, but the extent to which this conditionality was enforced is unclear (Calderón 1996; Ribero and Tenjo 1997).

The design of the PACES program and the Colombian context included several features that likely reduce its fiscal cost. First, scholarships cost less than per pupil expenditure in public schools.

Second, scholarships could be augmented with household funds. To the extent that the program "crowded in" household funds for education, increasing winners' human capital and future taxable earnings, the government budget constraint improves. Allowing "top-ups" also

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[8] About 90 percent of public schools in Bogotá are secular and 10 percent have a religious affiliation. Of the 10 percent of religiously affiliated public schools, 73 percent are Catholic. Among private schools, 46 percent are secular and 54 percent have a religious affiliation. Of those private schools with a religious affiliation, 54 percent are Catholic.

avoids creating incentives for some families to trade down from higher cost private schools to private schools with fees at or below the value of the scholarship, which may have reduced human capital accumulation and future taxable income.

Third, as is fairly standard in many scholarship programs, program rules made retention in the program conditional on satisfactory grade completion. Indeed, we find that on-time secondary graduation increased and grade retention fell as a result of the scholarship offers. To the extent that reduced repetition led to fewer years of schooling taking place in public schools, public expenditure in education fell.

Fourth, scholarships were targeted to the poor, reducing the extent to which the simply subsidized students who would have gone to private school anyway. (This poverty targeting will also of course make a distributional-weighted public finance calculation more favorable.)

Students could apply to either academic or vocational private schools. Vocational private schools were overrepresented among participating private schools.

Applicants to vocational schools tend to differ systematically from other applicants; they tend to come from families where the parents are less educated, they are also more likely to be living in the poorest of Colombian neighborhoods, and they typically applied to schools whose students attained lower than average scores on college entrance examinations (Bettinger, Kremer and Saavedra 2010).

After gaining acceptance to a participating school, students then submitted scholarship applications. Because it was administratively difficult to retain the scholarship if one switched schools, there was considerable stickiness in schools attended by scholarship winners. Less than 20 percent of students that transferred after the first year were able to retain their scholarship. Thus, among applicants who applied to vocational private schools, scholarship lottery winners were more likely to stay in vocational schools whereas applicants who did not win a scholarship were more likely to attend academic schools (for details, see Table 3 of Bettinger, Kremer, Saavedra 2010). This "stickiness" in program application rules might have locked-in students in private vocational schools despite that fact that ex-ante parents might have preferred an academic path.

Among applicants to vocational schools, relative to losers, scholarship winners attended schools where students were 33 percent more likely to drop out before completing secondary school and were 25 percent less likely to attend college. Despite not having observably more

desirable peers, among those who applied to vocational schools, scholarship lottery winners had significantly better educational outcomes than losers, including a 25 percent increase in the likelihood of graduating from high school and a one-third of a standard deviation increase in college entrance examination scores (Bettinger, Kremer, Saavedra 2010). The authors argue that the findings of better outcomes despite worse observable peers, casts doubt on the idea that scholarships improved outcomes for winners solely by matching them to better peers. Instead, they argue that effects are likely driven by private sector vocational schools' better ability to match labor market needs.

3.   Data and Empirical Strategy

In this section, we describe the various sources of administrative data we employ for our analyses (section 3.1) and the empirical strategy (section 3.2).

3.1 Data

We limit our analysis to individuals who applied in 1994 to enter, by lottery, a private school in sixth grade in Bogotá in 1995. This lottery and its records are the most complete and accurate of any of the annual voucher lotteries conducted in Colombia between 1992 and 1997 (Angrist, Bettinger, Kremer 2006). We refer the reader to the reference for additional details.

Covariates available from the PACES application are age, gender, whether the applicant had a phone at the time of application and the school applied to. Bettinger, Kremer and Saavedra (2010) matched 93 percent of applicant school names in the Bogota 1995 lottery to school types (vocational or academic) using data from the ICFES secondary graduation database, which we describe below. We are able to match 93 percent of applicants from the 1995 scholarship lottery to information on the school type to which they applied (academic or vocational). In the 1995 scholarship lottery, 43 percent of students applied to a private vocational secondary school, with no difference by lottery status (Panel A, Table 1).[9]

Application covariates are balanced across lottery winners and losers in the full sample and separately by type of school applied to, with the exception of age (Panel A, Table 1). At application, lottery winners in the full sample are 0.086 years younger than losers, for whom average age is 12.74 years. The age difference between winners and losers is more pronounced

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[9] In 1995, only 16 percent of secondary school graduates attended vocational schools, which underscores the overrepresentation of vocational schools among private schools participating in the program.

among vocational school applicants, where winners are 0.14 years younger than losers (column 6, Table 1).[10] All results we present control for age, gender and having a phone. As we document later, results are robust to alternative age specifications as well as to excluding application controls.

Among academic school applicants, 50 percent of students are male. Among vocational school applicants 45 percent of students are male. There are no differences in gender by lottery status either in the full sample or in the lotteries that are conditional on the type of school to which students applied.

We use the Bogotá 1995 lottery data and five additional administrative data sources. We used students' names, dates of birth and adult identification numbers from the national registrar to complete the matches with the five administrative datasets. In the scholarship applicant list, all applicants reported their full names (typically two first names, two last names) and 97.2 percent of them reported a valid youth identification number which contains their date of birth embedded in the first six digits. The remaining four digits in the youth identification number include an algorithm for determining the validity of a youth identification number, and there is no difference by lottery status in the probability of having a valid youth identifier in the full sample or separately by type of school applied to (Panel B, Table 1).

Tracking long-run outcomes in some datasets —particularly social security records— relies on having students' adult identification numbers which citizens obtain when they turn 18 years old. We obtained valid adult identification numbers for 97.1 percent of applicants, with no difference in the likelihood of having an adult identification number by win-loss status among all applicants or separately by gender (Panel B, Table 1).[11]

Colombia has comprehensive individual-level administrative data on secondary and tertiary education, female fertility, labor market, and credit market outcomes. The breadth and depth of the national data provide a unique opportunity to track PACES applicants across a variety of long-run outcomes with little to no attrition in the data. In particular, we use:

1. *The ICFES secondary school graduation/tertiary education entry exam database.* We update and improve the prior match conducted by Angrist et al. (2006) in two ways: i) by

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[10] Angrist, Bettinger, Bloom, King, and Kremer (2002) discuss this imbalance in applicant age in greater detail.
[11] Youth and adult identification numbers were linked using administrative data from Colombia's national registrar's office and the Department of National Planning.

matching on students' youth identification numbers, adult identification numbers, and names, (Angrist et al. 2006 did not have students' adult identification numbers), and ii) by matching students to the population of test takers through 2007 —7 years after students would have graduated with no grade repetition —whereas Angrist et al. (2006) was only able to match students through 2001.

2. *The tertiary education database.* We use data from Colombia's Education Ministry's *Sistema de Prevención y Análisis de la Deserción en Instituciones de Educación Superior (SPADIES)* to track scholarship applicants through collegiate pathways, including enrollment and completion. The tertiary education database is an individual-level panel dataset that tracks close to 95 percent of tertiary education students from their first year to their degree receipt beginning in 1998. We obtained data until the first semester of 2012. The tertiary education database is similar to the National Student Clearinghouse in the U.S. It includes information on the timing and institution of students' tertiary attendance. We also observe characteristics of the institution including whether it is a university or a vocational college and whether the institution was public or private. We construct outcomes characterizing students' trajectories throughout college (enrollment periods, continuation status and graduation).

3. Colombia's Social Protection Ministry's *Sistema Integral de Información de la Protección Social (SISPRO)* provides information on formal sector earnings and tax payments.[12] SISPRO is an individual-level panel dataset that is updated monthly, and that contains information on contributions to government social programs for health, employment, and retirement. For the purposes of this study we focus on the work module, which contains information on whether individuals have worked in the formal sector, the number of days of formal sector employment, monthly earnings, and social security contributions. We focus on outcomes from 2008 to 2014 —between eight and 14 years after on-time secondary school completion of scholarship applicants in the Bogotá 1995 sample—since SISPRO only began to cover the universe of formal sector workers in 2008. On average, scholarship applicants would have been around 33 years old at the end of this period.

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[12] The SISPRO database only includes people who worked for employers that register their workers or self-employed workers who register themselves. In Colombia and in Bogotá, respectively 50 percent and 55 percent of employment is formally registered (*Secretaría de Desarrollo Económico de Bogotá* 2012).

4. Colombia's financial comptroller's (*Superintendencia Financiera*) is a formal credit census. We focus on outcomes from 2004 to 2014, ten to 20 years after the lottery and four to 14 years after on-time secondary school completion of scholarship applicants in the Bogotá 1995 sample. These quarterly data contain formal credit information for more than 250 million consumer credit transactions, including credit cards and car loans. We focus on two extensive margin outcomes: access to credit card and to car loans, which we define as appearing in the credit data for these loan types. We also analyze credit risk, as measured by interest rates charged on loans.

5. *The SISBEN Census.* We use data from the SISBEN household census of 2010. Unlike the other administrative datasets we use that have national coverage, the SISBEN census only has partial coverage in that the government only surveys residents from households classified in the two lowest socioeconomic strata. For this reason, SISBEN 2010 covers only 57 percent of households in all of Colombia and 39 percent of households in Bogotá. The government uses a proxy means score based on the SISBEN questionnaire to determine eligibility for all government subsidy programs.[13] Since being surveyed and scored by the SISBEN formula is a requirement for government subsidy eligibility, the outcome of eligibility for various government programs is well defined for the entire population of scholarship applicants because those who do not appear in the census are not eligible. However, we are interested in two additional outcomes from the SISBEN survey, namely, teen fertility and self-reported earnings. Since these outcomes are not defined for the full scholarship applicant sample, we analyze them using a bounding approach described in the next section.

We estimate scholarship impacts on the probability of receiving *Familias en Acción* conditional cash transfers and on the probability of being eligible to receive benefits from the

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[13] Receipt of several government subsidies is determined by whether households have SISBEN scores below predetermined cutoff points that vary by subsidy. These subsidies include: early childhood care (*primera infancia)*, health care (*régimen subsidiado en salud*), tertiary education loan subsidies (*crédito access*), conditional cash transfers (*familias en acción*) and elderly care (*protección social al adulto mayor*) subsidies. For the healthcare subsidy the only eligibility criterion is SISBEN scores. Eligibility for the remaining subsidies requires additional demographic conditions such as having age-appropriate children (early childhood care and conditional cash transfers), being admitted or attending tertiary education (tertiary education loan subsidies) or living with an elderly relative (elderly care). We observe eligibility for these subsidies but not actual subsidy receipt. We define *Familias en Acción* receipt as whether applicants' SISBEN score is at or below the eligibility cutoff and whether they have children between 0 and 17 years of age. Take up of subsidized health care is nearly one hundred percent among eligible families so for subsidized health care eligibility and receipt is almost identical.

other three largest government subsidy programs available for urban households: the two tiers of subsidized health care and early childhood care.[14]

On the whole, we are able to match close to 95 percent of applicants to at least one of the five administrative datasets we use to track long-run outcomes.

3.2 Empirical strategy

Our main empirical strategy is based on an intent-to-treat (ITT) analysis that compares outcomes between scholarship lottery winners and losers, as follows:

$$Y_i = \alpha + \gamma Z_i + \beta X_i + \varepsilon_i$$

where Y_i is an outcome variable for scholarship applicant *i*, Z_i is an indicator variable for whether applicant *i* was awarded a private school scholarship through the lottery, X_i is a vector of baseline controls from the scholarship application form that includes age, gender and whether the applicant had a phone number at the time of application, and ε_i is an error term.

Because students applied to private schools prior to the lottery, we also estimate the main regression equation separately by the type of school to which they applied. The lottery could be viewed as two separate lotteries – a lottery for students who had applied to vocational schools and a lottery for students who applied to other schools.

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Credit risk, as measured by the interest rate charged on outstanding loans reported in the credit census are only observed for applicants that have a loan. Since interest rates are conditional on having a credit card or car loan, we can only estimate bounds on interest rates because winning a scholarship may affect the likelihood of having a credit card or car loan. Assuming that those without formal credit are the highest credit risk, the OLS winner-loser contrast conditional on having a loan provides a lower bound estimate of the impact of winning a scholarship on credit risk. We can estimate an upper bound through an OLS regression after trimming from the sample the additional fraction of scholarship winners with the highest credit risk among those that report having a loan (Angrist, Bettinger and Kremer 2006).

Similarly, for outcomes conditional on appearing in the SISBEN survey, namely self-reported earnings and fertility, we construct bounds on treatment effect estimates to the extent that lottery winners are less likely to appear in the SISBEN data in the long-run because they

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[14] In terms of budget and beneficiary population, subsidized health care is the largest government benefit program, followed by *Familias en Acción* and early childhood care.

moved to better neighborhoods, the SISBEN data will contain a higher fraction of applicant lottery losers than of lottery winners. Assuming that the additional proportion of winners who moved out of the low-income SISBEN neighborhoods due to receiving the scholarship had better outcomes (i.e. higher earnings, lower likelihood of bearing children as teenagers) than those who remained in neighborhoods covered by SISBEN the raw difference between SISBEN outcomes among winners and losers will be a lower bound on the voucher effect. We can estimate an upper bound by trimming the corresponding proportion among losers (Angrist, Bettinger, Kremer 2006).

4.   Scholarship Impacts on Long Run Educational Outcomes

4.1 Secondary education completion outcomes

In this subsection, we examine secondary school outcomes and in the next we examine tertiary education outcomes. We concentrate on on-time secondary school completion and the likelihood of ever completing secondary school.[15] Scholarship lottery winners are 17 percent (7.6 percentage points) more likely to complete secondary school on time relative to losers' on-schedule completion rate of 45.2 percent (Panel A of Table 2).[16] Point estimates of scholarship effects are slightly larger (both in percent and percentage point terms) among applicants to vocational schools, but differences are not statistically significant.

Scholarship lottery winners are 10 percent (5.4 percentage points) more likely to complete secondary school within six years after on-schedule completion relative to a base rate of 56.5 percent. During the six years following on-schedule completion, the difference between the proportion of scholarship lottery winners and losers who have completed secondary school declines with each year.[17]

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[15] We define on-schedule secondary school completion as having taken the tertiary education entry test no later than six years after applying for the scholarship, that is to say by 2001.

[16] With our updated matching strategy including adult identification numbers, we obtain substantially higher match rates than Angrist et al. (2006). Impact estimates in percentage points are similar.

[17] Three years after the lottery, scholarship lottery winners were less likely than lottery losers to repeat grades in secondary (Angrist et al. 2002). To analyze secondary school graduation, Angrist et al (2006) completed the match focusing on students' probable date of on-time graduation. With the benefit of more data, we observe that many lottery losers eventually complete secondary school, but it is taking them up to six years longer to do so.

4.2 Tertiary education outcomes

Table 2 reports scholarship impacts on tertiary education outcomes. Effects on tertiary education outcomes are particularly strong among students who applied to vocational schools. In this population, the base rate of ever enrollment in tertiary education is 19 percent and this increases by 7 percentage points (37 percent) among scholarship lottery winners. The scholarship impact difference across academic and vocational applicants in the probability of ever enrolling in tertiary education is statistically significant (Column 7, Table 2).[18] This ever-enrollment effect takes place both in vocational colleges and in universities. Within this group, the effects are particularly driven by males for whom there is a 10 percentage point gain in ever enrollment in tertiary education on the base of approximately 16 percent (Table A1).

Among vocational school applicants there is also evidence of gains in tertiary graduation rates and in total years of tertiary education.[19] Vocational scholarship winners are 2.4 percentage points more likely to graduate from tertiary education from a base rate of 4.9 percent among vocational scholarship losers. In this population, winners complete 0.19 additional years of tertiary education, which corresponds to a 45 percent increase relative to the base rate of 0.42 years among losers.[20] For tertiary graduation and additional years of tertiary education, the scholarship impact difference across academic and vocational applicants is statistically significant (Column 7, Table 2).

Among applicants to academic secondary schools, there is no evidence of an increase in ever enrolling. There is evidence, however, that among academic school applicants, scholarship winners were more likely to be enrolled as of 2012—our last year of tertiary education data—by approximately 3 percentage points on a base of 3 percent. However, this is also true to a lesser extent among vocational applicants and we cannot reject equality across academic and vocational samples (Column 7, Panel B, Table 2).

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[18] Within this group the effects are particularly driven by males for whom there is a 10 percentage-point gain in ever enrollment in tertiary education on the base of approximately 16 percent (see Table A1).

[19] We define tertiary graduation and tertiary years of schooling to be zero for those who never enroll. This way, these outcomes are well defined for the entire sample.

[20] Many vocational schools have agreements with universities and vocational institutes so that students can take college credits in their last year of secondary school, potentially easing the transition into tertiary for low-income students.

5.   Scholarship Impacts on Labor Market Outcomes

In this section, we first show that winning the lottery did not affect the intensive or extensive margin of formal sector labor participation (subsection 5.1), but that it nonetheless increased formal labor market earnings, and payroll taxes, with this effect concentrated among those applying to vocational schools. The effects on formal earnings and payroll taxes are concentrated at the top 40 percent of the distribution (subsection 5.2). We find no effects at the bottom of the distribution on eligibility for government subsidies (subsection 5.3). We then decompose formal earnings impacts into the portion accounted for by increased schooling and the portion accounted for by additional earnings conditional on schooling (subsection 5.4). Since data on informal income is only available through a census of residents of these neighborhoods, we can only bound and not estimate differences in informal income, but accounting for informal income does not change the overall picture (subsection 5.5).

5.1 Formal-sector participation and intensity

SISPRO data contains monthly earnings for all formal sector workers (i.e. those who pay payroll taxes) between 2008 and 2014.

One limitation of this analysis is the fact that, in the full sample, lottery winners are about two percentage points more likely to be enrolled in tertiary education in 2012—our last year of tertiary education data, which overlaps with the period of formal sector earnings data. This may limit their current earnings while increasing their future earnings. Thus current differences in formal sector earnings between winners and losers may understate future earnings differences. We explore this implication below in subsection 5.2.

There is no evidence that winning the lottery makes people more likely to work in the formal sector or to work more hours in the formal sector. Among scholarship lottery losers, we match 80 percent to the SISPRO government records of those paying payroll taxes, implying that 80 percent of losers ever show up in formal sector employment between 2008 and 2014. Point estimates suggest that lottery winners are 1 percent (0.8 percentage points) more likely to *ever* appear in formal employment records during this period. However, this difference is not statistically significant (Top Row, Table 3). Match rate correlates do not systematically differ between winners and losers in the full applicant sample or separately by vocational/academic school application status (Table A2).

We define formal sector intensity as the average number of months spent annually in formal sector employment. Both scholarship winners and losers spend about 5.5 months per year in formal sector employment. There are no statistically significant differences in formal sector employment intensity in the full sample, separately by vocational/academic school status or by gender (Table 3).

5.2 Formal-sector earnings

Formal sector earnings are the main source of government revenue in our welfare calculations because only formal sector workers pay payroll taxes, which are a fixed proportion of formal earnings. Current annual formal earnings for scholarship lottery losers are, on average, $2,470 (including zeros).[21] Scholarship lottery winners earn an additional $196 in formal annual earnings, an 8 percent increase (Panel A of Table 3). The p-value on this difference is 0.06.

Current annual formal earnings for scholarship lottery losers who applied to vocational schools are, on average, $ 2,568 (including zeros). Scholarship lottery winners from applicants to vocational schools earn an additional $427 in formal annual earnings, a 17 percent increase (column 6, Table 3). The scholarship impact difference across academic and vocational applicants for annual formal earnings has a p-value of 0.08 (Panel A, Column 7, Table 3). The effects among vocational school applicants are particularly strong for men. Male lottery losers earn $2,743 while winners earn $535.3 more per year, a 20 percent increase. For males, the scholarship impact difference across academic and vocational applicants for annual formal earnings has a p-value of 0.07 (Panel C, Column 7, Table 3). These results are robust to alternative age specifications as well as to excluding application controls (Table A3).

Another way of capturing the long-term labor market effect of winning scholarship is by measuring the proportion of scholarship applicants with formal earnings above the middle-class threshold, which in Colombia is PPP$10/day (PPP$3,600/year, Angulo et al. 2013). Near age 33, 44 percent of scholarship lottery losers have annual formal earnings at or above the

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[21] We compute annual formal sector earnings by adding inflation-adjusted monthly formal sector earnings during the period covered by our formal employment data (July 2008 to December 2014 or 78 months) including zeroes for months without reported formal sector earnings and dividing by the 6.5 years of coverage to get an annual average (Table 6). Since 19 percent of applicants never appear on formal employment records during this period, total formal earnings for them are zero. We report results based on formal earnings reported in health payroll accounts. Results are very similar if we use instead earnings from the pension payroll account.

middle-class threshold. Scholarship lottery winners are 3.7 percentage points (8.4 percent) more likely than losers to have earnings at or above the middle-class threshold. (Panel A of Table 3). There are no differences in the scholarship impact across academic and vocational applicants (Panel A, Column 7, Table 3).

One plausible hypothesis for the concentration of tertiary education and formal earnings results among vocational applicants is that private vocational education is more responsive to labor market and advanced training opportunities than is public education. We find some empirical support for this hypothesis. Among vocational school applicants, effects are particularly strong and precisely estimated for applicants to schools with a commercial focus, even though we do not sufficient power to identify differences across different vocational curricula (Table A4). Since formal-sector days are fairly similar between lottery winners and losers, the higher earnings seem to reflect greater earnings per formal-sector day, rather than more hours, contrary to a model in which education is used as a signaling device to ration formal sector jobs, but consistent with a human capital model.[22]

Power is limited to look at effects by quantile, but quantile regression results suggest that the effects of the scholarship on total formal sector earnings at age 33 are strongest at the top of the distribution for vocational school applicants. We see no gains at the top for applicants to academic schools, possibly because they are more likely to currently be enrolled in university (Figure 1).

In terms of formal job characteristics, while there are no differences between winners and losers in firm size, scholarship winners, are more likely to work in growing firms (as measured by new jobs) and firms that pay higher wages (Table A5).

We documented earlier that lottery winners are two to three percentage points more likely to be enrolled in tertiary education during the formal earnings period we analyze. This may limit winners' current earnings while increasing their future earnings. To bound what the future earnings difference is likely to be between winners and losers once the former complete tertiary education, we can assume that in the absence of a scholarship, earnings of applicants who attend and complete tertiary education are at the top of the earnings distribution. Under this assumption, we can bound the estimate for the effect of winning a scholarship on future

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[22] This result differs from recent evidence from Ghana in which authors find that scholarships for vocational secondary schooling increased labor force participation of lottery winners (Duflo, Dupas and Kremer 2017).

earnings by trimming the top two to three percent of formal earners in the scholarship loser group. Table A6 shows results for this bounding approach.

An upper bound estimate on scholarship lottery winners' future earnings is $490, a 23 percent increase (Column 2, Panel A, Table A6). Among academic applicants the bound on the scholarship effect on future winner earnings is $396, a 19 percent increase (Column 4, Panel A, Table A6). Among vocational applicants the bound on the scholarship effect on future winner earnings is $702, a 31 percent increase (Column 6, Panel A, Table A6).

Under different assumptions we can estimate a more conservative upper bound to lottery winners' if future earnings of lottery winners still enrolled in tertiary education would be equal to the current average earnings of lottery losers who ever attended but are no longer attending tertiary education. In this alternative bounding approach, an upper bound estimate of winners' future earnings is $206, an 8 percent increase statistically significant at the 5 percent level (Column 2, Panel A, Table A7). Among vocational applicants the bound on the scholarship effect on future winner earnings is $442.4, a 17 percent increase (Column 6, Panel A, Table A7). Alternatively, among vocational applicants the upper bound under this bounding approach could be as low as $368, a 14 percent increase, and still be statistically significant

To summarize, we find scholarship lottery winners have formal earnings twenty years after initial scholarship award that are 8 percent greater than those of losers, with the difference significant at the 6 percent level. Among applicants to vocational schools, winners' formal earnings twenty years later are 17 percent greater than those of losers, a difference that is statistically significant at the 5 percent level. After accounting for the additional proportion of lottery winners currently in tertiary education, we estimate that winning a scholarship may increase future earnings and payroll taxes by up to 23 percent in the full sample and by up to 30 percent among vocational applicants. Given that there are no effects on the extensive or intensive margin of formal sector employment, these earnings impacts suggest that—through their effects on various educational outcomes—scholarships may have raised productivity. Since we observe no change in formal sector hours, there is no particular reason to believe that increased formal sector earnings are due to a substitution of time away from the informal sector. Unfortunately, we do not have data on informal earnings in the full sample, and the data we have is on an endogenously selected subsample allowing us to create only bounds and not point estimates for the impact on earnings within a subpopulation.

5.3 Decomposition of formal earnings impacts

Scholarship winners accumulate more schooling and have greater earnings than scholarship losers. In this subsection we decompose the effect on formal earnings into an earnings differential attributed solely to additional years of schooling among scholarship winners and an earnings differential due to other factors conditional on years of schooling. To do so, we combine three estimates: i) The scholarship impact on completed years of schooling; ii) the scholarship impact on average annual formal sector earnings; and iii) the Mincerian return to an additional year of schooling among scholarship losers, controlling for characteristics from the application form.[23]

Scholarship winners complete 0.13 additional years of schooling and have annual formal earnings that are $196 greater than those of losers (Column 2, Table 4). We estimate the Mincerian return to a year of schooling in the sample of scholarship losers by running an OLS regression in which the dependent variable is average annual formal earnings and the independent regressors are years of schooling, age, gender and having a phone at the time of application. We estimate this OLS regression equation among all lottery losers and separately for academic and vocational lottery losers. From this regression we obtain that, among all scholarship losers, an additional year of schooling is associated with $642.8 greater earnings. The earnings differential attributed solely to additional years of schooling among scholarship winners is thus 0.13*$642.8=$83.6. The portion of the earnings increase due to winning a scholarship that is solely accounted for by additional schooling among scholarship winners is thus ($83.6/$196)*100=42.6%. The remaining 57.4% is due to other factors conditional on years of schooling. XX ADD DISCUSSION MENTION HIGH MINCERIAN RETURN HYPOTHESIS OF BETTER MATCHING?

In the sample of academic school applicants, 77 percent of the scholarship impact on total earnings is attributed to increased schooling and 23 percent is due to other factors conditional on years of schooling (Column 4, Table 4). Among vocational school applicants, 47 percent of the scholarship impact on total earnings is attributed to increased schooling and 53 percent is attributed to other factors conditional on years of schooling (Column 6, Table 4).

5.4 Eligibility for government subsidies

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[23] Using lottery status as an instrument for years of schooling is inappropriate because winning the lottery might have also enabled winners to trade-up to better schools, invalidating the exclusion restriction.

In the full sample of applicants, by type of school, or by gender, winning the scholarship does not affect government welfare receipt of *Familias en Acción*, subsidized health care programs or eligibility for early childhood care (Table A8). Since winning a scholarship did not affect the probability of receiving government transfers, there are no additional welfare costs to the government from increased welfare receipt.

5.5 Self-reported earnings in SISBEN data

The SISBEN survey covers low-SES neighborhoods and includes about 52 percent of the scholarship applicant population fifteen years after initial scholarship award (Table 5) SISBEN 2010 earnings are a cross-section of self-reported earnings for 2010.

Lottery winners are 5 percent (2.8 percentage points) less likely to ever appear in SISBEN data, indicating that they are less likely to reside in poor neighborhoods fifteen years after initial scholarship receipt. This difference is statistically significant at the 10% level (column 1, Table 5). To the extent that the approximately 5 percent of winners who moved out of the low-income SISBEN neighborhoods due to receiving the scholarship had better outcomes than those who remained in neighborhoods covered by SISBEN the win-loss contrast will be a lower bound on the scholarship effect. As explained in the methods section, we can estimate an upper bound by trimming the top 5 percent of earners among losers.

Table 6 reports bounds on the scholarship effect on self-reported total annual earnings from the SISBEN census of the poor. Over two thirds of SISBEN respondents report not paying payroll taxes, which implies that for them these total earnings are likely informal earnings. The upper bound is $366 on a base of $ 2,000, and statistically significant. The lower bound impact on annual self-reported total earnings is statistically insignificant. Together with the fact that we see no formal labor supply response as a result of winning a scholarship suggests that increased formal earnings are not merely the result of substitution from informal into formal employment among scholarship winners.

6. Scholarship Impacts on Formal Consumer Credit Access

In this section, we show that winning the lottery affects long-term access to formal credit through credit cards and car loans. Scholarship winners also have lower credit risk as measured by interest rates on loans. It also reduces both the risk and the cost of these types of credits.

In the full sample, fifty-six percent of scholarship losers have had a credit card at any point between 10 and 20 years after the lottery, which is the timespan covered by the credit

census data (Panel A, Column 1, Table 7). Scholarship winners are 3.8 percentage points more likely to have a credit card, a seven percent increase (Panel A, Column 2, Table 7).

This effect is driven by vocational applicants, among whom winning a scholarship increases credit card access by 5.4 percent, or close to 10 percent from a base of 56 percent (Panel A, Columns 5 and 6, Table 7). Within vocational applicants, scholarship impacts on credit card access are strongest among males (Panel C, Column 6, Table 7).

Winning a scholarship does not increase car loan access in the full sample (Panel A, Column 2, Table 7). However, among vocational applicants, winning a scholarship increases car loan access by 2.1 percentage points, a 55-percent difference from a base of 3.8 percent that is significant at the 10 percent level (Panel A, Column 6, Table 7). Within vocational applicants, male lottery winners are 5.1 percentage point more likely to have access to a car loan, a 142-percent increase from a base of 3.6 percent (Panel C, Column 6, Table 7). The pattern of results on formal credit access mimics that on formal sector earnings, with the strongest scholarship impacts among vocational school applicants, and within the vocational subpopulation, among males. Since the majority of people in Colombia use loans to buy a car (Fasecolda 2014), greater access to car loans suggests greater car ownership. This may enhance productive opportunities, for instance, enabling winners to access a greater number of jobs in the city or serving as an input in production.

[[Increased access to credit is likely not a direct effect of the scholarship but rather a consequence of improved educational and labor market opportunities that result from winning a scholarship. In a regression (not shown) of having a credit card or car loan line on secondary school graduation, tertiary enrollment, access to formal employment, formal earnings, appearance in the SISBEN dataset, age, gender, having a phone at baseline and an indicator for winning a scholarship, the coefficient on winning a scholarship is not statistically significant. What does the worst?]]

Scholarship winners also have lower credit risk, according to bound estimates on the interest rate paid on loans. Estimates of these bounds are negative in the full sample and in the sample of vocational applicants, particularly male applicants, suggesting that in these subpopulations, scholarship winners have lower credit risk (Table A9). A lower credit risk may

propitiate a virtuous cycle by improving employment opportunities in the future (e.g. Herkenhoff et al., 2016).

7. Scholarship Impacts on Teen Fertility

Fertility outcomes are only observed for applicants who show up in the SISBEN 2010 data. Scholarship lottery winners have a lower likelihood of appearing in SISBEN 2010 data. As explained in the methods section, estimated effects on teen fertility conditional on SISBEN appearance will be a lower bound on the true effect on teen fertility as long as lottery winners who moved out of low-SES neighborhoods covered by SISBEN as a consequence of winning the scholarship have a lower chance of being teenage parents than scholarship lottery winners who remained in neighborhoods covered by SISBEN. Under this assumption, we can compute upper bound estimates on fertility by trimming the top 5 percent of earners among losers. We report these bounds in Table 8.

Bounds on fertility effects of winning a scholarship are tight. Scholarship winners are between 18 and 19 percent (between 4.3 and 4.7 percentage points) less likely to have a child during their teenage years relative to the lottery losers' (untrimmed) mean of 23.4 percent. Among females, winning a scholarship reduces teen motherhood by between 17 and 19 percent (between 6.5 and 7.4 percentage points) relative to a base of 37.7 percent. The incidence of teen fatherhood is low in Colombia in part because women typically have partners that are older. Hence, for males we examine whether they have children with teen partners. Male lottery winners are between 32 and 34 percent (between 5.1 and 5.6 percentage points) less likely to have a spouse or partner who had a child as a teenager relative to a base rate of 16.1 percent (Panel A, Table 8.)

These effects are concentrated among applicants to academic schools. Column 4 of Table 8 shows the results for academic applicants while column 6 shows the results for vocational schools.

The reduction in teen fertility could be the result of an "incarceration" or "delay" effect by which winners stay in school longer and do not want to risk losing the scholarship, or it could be an opportunity cost effect by which additional human capital increases wages, making time valuable. If "delay" is the driving mechanism, we might not observe scholarship impacts on total fertility because there may be catch up fertility once schooling is completed. In

contrast, if the driving mechanism is opportunity cost, we should observe an effect on total fertility.

We find no evidence that winning a scholarship changed total fertility since both lower and upper bound estimates on the effect of winning a scholarship on total fertility include zero at the time of SISBEN 2010, in which applicants are about twenty-eight years old, the average scholarship lottery loser has one child. Lower and upper bound estimates on winning a scholarship on total fertility are close to each other and insignificant, although fairly precisely estimated. This pattern of results is consistent with the "delay" hypothesis by which winning a scholarship keeps a student in school longer without necessarily affecting her opportunity cost of time. One caveat is that impacts on total fertility may show up later in the potential childbearing years, so fertility gaps may appear later.

8.   Welfare Impacts

In this section we quantify the program's welfare impacts. Welfare impacts are the sum of: i) impacts on scholarship recipients (subsection 8.1) ii) impacts on taxpayers (subsection 8.2), and iii) externality impacts on others. We are not able to identify externality impacts on others; in subsection 8.3, however, we estimate how large net negative externalities would need to be to imply that the program is not welfare improving to society.[24] We quantify welfare impacts in the full sample of applicants and separately by applicants to academic and vocational schools and compute bootstrap confidence intervals for costs and benefits.

8.1 Benefits to scholarship recipients

As explained in Section 2.1, welfare impacts on scholarship recipients can be measured in two different ways. First, we can measure the net present value of extra school expenditures, foregone earnings and future earnings for scholarship winners. Second, we can also use a revealed-preference methodology to estimate lower bounds on the welfare impact. Specifically, although winners may have spent more resources on schooling or increased effort, it is possible

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[24] The discount rate we use is 3.6 percent, which is average interest rate on new external government debt commitments for Colombia between 2002 and 2012 (World Development Indicators database). In all calculations that follow we estimate amounts per scholarship winner, separately for males and females, which assumes that the counterfactual situation is no scholarship program. Throughout the analysis, for each source of cost and revenue, we compute the NPVs converting into United States dollars (if not already) using the year-specific exchange rate (Dec. 31 of that year) between US dollars and Colombian pesos from the Colombian Central Bank, deflating nominal costs back to real value in base year (1995) using the US-CPI change between base year and incurrence of costs (or revenue), taking the present value of the cost and revenue stream. We express the NPV in US dollars for the year of analysis (2013) using US-CPI change between the analysis and the base year.

to construct a lower bound on net benefits to participants since payments to infra-marginal applicants who would have gone to private school in the absence of the program constitute a pure transfer. Here we focus solely on the more conservative revealed-preference approach. Recipients benefited as public school costs exceeded scholarship costs and over 85 percent of recipients would have attended private school anyway (89.7 percent of females and 85.7 percent of males). This implies that gains to infra-marginal recipients were about $249 per scholarship winner.[25] Hence, even if there were no increase in tax revenue to the government, the program would transfer to beneficiaries about 70 percent of what it cost taxpayers, even if one counted only benefits to infra-marginal recipients, thus implicitly treating any benefits of educational and economic gains to beneficiaries as fully offset by effort costs and financial costs to beneficiaries.

8.2 Costs and benefits to taxpayers

We calculate five cost sources for the government: scholarship costs net of savings from reduced expenditure on public education, cost-savings from reduced secondary school grade repetition, increased tertiary education costs, benefit costs, and foregone tax revenues due to reduced work time among scholarship winners to the extent that they spend more time in school.[26] [27]

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[25] The gain for infra-marginal recipients = (fraction of infra-marginal recipients)*(impact on scholarship amount)*(sum of year-by-year utilization rate). The fraction of lottery losers who attend private school in 6th grade is 0.897 among females and 0.857 among males. The impact on scholarship amount is $93.2 (from Angrist et al. 2002 Table 8, column 3 updated to 2013 dollars). We observe the fraction of winners in private school using the scholarship for grades 6th and 8th only. The 7th grade fraction is the linear combination of the 6th and 8th grade rates. For females the fraction of winners in private school using the scholarship is 0.953 (6th), 0.736 (7th) and 0.519 (8th). For males it is 0.933 (6th), 0.698 (7th) and 0.463 (8th). After 8th grade, we have no data on scholarship usage. We know that 32 percent of the overall lottery loser sample finished 11th grade in private school. We assume a constant deterioration from 8th grade to 11th grade in the fraction of losers attending private school. This implies a 40 percent reduction in the fraction attending private school, and we assume that deterioration in scholarship usage among winners follows a similar 40 percent decline from the 8th grade level. Under these assumptions, scholarship usage rates for females are 0.415 (9th), 0.310 (10th) and 0.206 (11th). For males the scholarship usage rates are 0.374 (9th), 0.284 (10th) and 0.195 (11th).

[26] Based on US evidence, an additional and sizeable source of cost savings to the government is reduced teen fertility (Saul Hoffman 2006). Estimates for Colombia on the monetary costs of teen fertility are only available for society as a whole and already include foregone earnings as a cost (Arturo José Parada-Baños 2005). It is not clear what fraction of these costs accrues to the government. We do not, therefore, account for cost-savings from reduced teen fertility and as such, these fiscal impact estimates err on the side of being conservative.

[27] After the passing of Law 100 of 1993, the pension system created two regimes: average premium (*Regimen de Prima Media)* and individual savings with solidarity (*Regimen de Ahorro Individual con Solidaridad).* In the average premium regime, employee and employer-side contributions go to a common pool of resources and pension benefits are obtained as a function of age, formal sector earnings and time in formal sector employment. There is no minimum pension amount in this regime. The individual savings regime is akin to individual retirement

8.2.a. Costs associated with secondary school of attendance

To estimate the first cost source to the government, namely, costs associated with secondary school attendance, we note that there are two competing impacts of the scholarship on public expenditures. First, for students who would have attended private school in the absence of the program, the scholarship increases public expenditure. For example, a substantial proportion (87.7 percent) of lottery losers attended private school in sixth grade. While the government did not have to pay for the fees of the lottery losers, it did have to pay for the scholarship value for students who won the lottery. Among these students, the average annual expenditure increase was $214 ($214 = scholarship value * percentage of lottery losers attending private school = $244 * .877). Note that the proportion of applicants who attended private school among lottery losers quickly deteriorated (53.9 percent by 8th grade).

We make two other adjustments to these estimates. Among lottery winners, not all private school attendees continued to use the scholarship. Even in the first year, 6 percent of private school attendees who had been offered the scholarship had discontinued using it. By 8th grade, 33 percent of lottery winners who were attending private school were not using the scholarship.[28] The second adjustment involves our assumptions about scholarship usage between 8th and 11th grade. After 8th grade, we have no data on scholarship usage. From prior data, we know that 54 percent of lottery losers were attending private school in 8th grade (Angrist et al. 2002 Table 3) and that 32 percent of them finished 11th grade in private school (Is this from Angrist et al. 2006 Table 2, other source?). We assume a constant (linear) deterioration from 8th grade to 11th grade in the fraction of losers attending private school. This implies a 40 percent relative reduction in the fraction attending private school, and we assume that deterioration in scholarship usage among winners follows a similar 40 percent decline from the 8th grade level.

We can compute the six-year increase in expenditure by taking the annual value of the PACES scholarships ($244) and multiplying it by the proportion of students who would have used the scholarship in grades 6 to 11 in the absence of the program (with these proportions computed in the aforementioned way). When we integrate over the usage patterns, we estimate

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accounts in the US in which accounts belong to the individual and pension benefits do not depend on age or other parameters; they only depend on the principal and interest earned. In neither case, therefore, are there government subsidies to retirees.

[28] These students may have repeated grades, transferred schools, or voluntary given up the scholarship.

that public expenditure increased by \$473 among all applicants (\$472 for academic school applicants and \$474 for vocational school applicants) as a result of the awarding of private school scholarships to students who intended to attend private schools regardless of the scholarship program (Row 3 of Table 9).

The scholarship, however, induced some public school attendees to attend private school. The scholarship's value (\$244) was considerably lower than the annual cost of public school (\$449). We assume that the marginal cost of public education equals the average cost (since this was a period of expanding school enrollment), and thus, for each student who moved from public to private school, the government saved \$205 per year.[29] To figure out the net impact on overall costs, we multiply this cost savings by the proportion of students who attended private schools as a result of the scholarship.[30] When aggregated across the six years after the scholarship, we compute that the scholarships reduced public expenditure by \$175 among all applicants as a result of the shift of students from public to private schools (Row 4).

8.2.b. Other government costs

We compute four other costs to the government. These include reduced expenditure as a result of fewer grade repetitions, increased tertiary education costs as a result of increased attendance, changes in welfare program expenditures, and foregone tax revenue for students who remain longer in school.

We defer a detailed explanation of the cost savings from reduced grade repetition among scholarship winners to Appendix B. In short, we assume that i) only public school repetitions cost the government money, ii) among applicants who finish on-schedule, there is no repetition; iii) among applicants who finish with delays, the delays are all a consequence of grade repetition and iv) among those who never finish secondary school, all dropouts happened in the transition from grade 8 to grade 9, so that total repetitions for this group are as reported Angrist et al. (2002) who measure applicants' academic trajectories until grade 8. Under these assumptions,

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[29] Angrist et al. (2002, p. 1537) reports the annual cost of public school to be \$350 and the average scholarship value to be \$190, both in 1998 dollars. We calculate that in 2013 prices, these figures correspond to \$449 and 244, respectively.

[30] We obtain these impacts on private school attendance for grades 6th through 8th from Table 4, column 2 (for males) and column 4 (for females). After 8th grade, we assume a constant change from the observed 8th grade effect to the eventual effect at graduation.

the cost savings from reduced grade repetition are $4 (Row 5).[31] The other three costs that we estimate take place after secondary school. Hence, we can combine the cost savings associated with repetition to our prior estimates to get the total secondary education costs. This total expenditure over the six-years of remaining school includes the costs for students who would have attended private schools in the absence of the program (Row 3), the net of savings from reduced expenditure on public education for students induced to transfer from public to private schools (Row 4), and cost savings from reduced grade repetition (Row 5). The overall total increase in secondary school costs per lottery winner is thus $293 (Row 6).

There are two sources of tertiary education costs to the government: additional public tertiary education costs and tertiary education loan subsidies.[32] Additional public tertiary education costs are estimated as annual per-pupil expenditures in public tertiary education multiplied by both the scholarship impact on years of tertiary education and the fraction of lottery winners attending a public tertiary institution (Row 7). Additional tertiary education loan subsidies are estimated as annual per-pupil tertiary education loan subsidy amounts multiplied by the scholarship impact on number of years of tertiary education (Row 8). Tertiary education costs (public education plus loan subsidies) are thus $15 (-$12 for academic school applicants and $55 for vocational school applicants, Row 9).

The program did not affect the probability of receiving government transfers, as explained in Section 5. Therefore, additional welfare costs to the government are close to zero ($0.1 for academic school applicants, -$2.33 for vocational school applicants, Row 10). To the extent that winners spent more time in school, the government may have foregone certain tax revenue while they were in school. Based on Table 7, we assume that there is no difference in informal sector earnings between scholarship winners and losers. Foregone VAT tax revenue, therefore, equals formal annual formal sector earnings of scholarship lottery losers' times the

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[31] We derive cost-savings estimates from data on public school costs, which we obtain for 1998 from Angrist et al. (2002, see footnote 29). We discount these to base year by using the US-CPI change between base year and incurrence of costs year (which we assume is 1998 in this case as we do not observe public school costs for any other year). We then express these costs in US dollars for the year of analysis (2013) using US-CPI change between the analysis and the base year.

[32] Annual tertiary education subsidy data is based on the ACCES loan program and come from ICETEX (2014). For low-income students (based on SISBEN and strata) who applied for a loan prior to 2011, the government subsidizes 25 percent of the loan amount which, on average, amounts to $708/year at the exchange rate used for year of analysis (see notes to Table 9 for details).

scholarship impact on years of education times the average VAT rate of 13.3 percent,[33] which equals $28 (Row 11).[34]

Foregone payroll taxes are annual payroll taxes for scholarship lottery losers' times the scholarship impact on additional years of education. Not all foregone payroll taxes, however, represent a net government transfer because a large fraction of these goes back to the worker, for instance, through the pension benefits formula. We estimate that at the margin forty percent of payroll taxes represents a net transfer to the government.[35] Foregone net government transfers from payroll taxes are $24 (Row 12). Total foregone revenue is the sum of foregone VAT taxes and the net transfer from foregone payroll taxes, which totals $52 ($51 for academic school applicants and $54 for vocational school applicants, Row 13).

Total expected scholarship costs are the sum of secondary education costs (6), additional tertiary costs (9), welfare costs (10) and foregone revenue (Row 13). Total expected scholarship costs are $360 ($333 for academic school applicants and $401 for vocational school applicants, Row 14). As a robustness check to these calculations, if instead of using the base discount rate of 3 percent we use a higher discount rate of 6 percent, scholarship costs to the government are $319 ($300 for academic school applicants and $348 for vocational school applicants, Row 14).

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[33]Jaramillo and Tovar (2008) Table 3 reports average VAT rates for five consumption groups: Transportation and Communications (15.19%), Food (8.01%), Culture and Entertainment (13.97%), Housing (14.66%) and Other (15.94%) We use data from Colombia's *Encuesta de Ingresos y Gastos* from 2006/2007 to estimate the distribution of consumption across these groups in the two lowest deciles of the consumption distribution, which are 7.4% for Transportation and Communication, 25.6% for Food, 1.5% for Culture and Entertainment, 39.5% for Housing and 25.9% for Other. The average VAT tax rate of 13.3% is a weighted average of the VAT rates across the different consumption groups, with the weights given by the share of consumption among the two lowest deciles in each category.

[34]The current difference in formal sector earnings and payroll taxes between scholarship winners and losers already accounts for foregone earnings due to any additional time in school between 2008 and 2012, which is the period that our formal sector earnings data covers. Evidence from Table 2 indicates that scholarship winners, however, already spent additional time in school prior to 2008, particularly finishing secondary school. Since we do not observe earnings that far back, the assumption that foregone earnings then are similar to those now is fairly conservative.

[35] Ten percent of payroll taxes are earmarked to finance Colombia's national job training agency (SENA) and the national institute for family welfare (ICBF) and therefore represent a net transfer to the government. Thirty percent of total payroll taxes are for health care services and also constitute a net government transfer because the mandatory health plan, known as POS, provides services that do not depend on the amount paid in the system so additional health payroll taxes among winners relax the government budget constraint. We conservatively assume that the pension scheme involves no redistribution.

8.2.c Government revenue

There are two sources of future additional government revenue: additional revenue from VAT taxes and additional government revenue from payroll taxes. This assumes that all formal sector earnings are spent on goods with VAT levied and that no informal sector earnings are. We use annual formal sector earnings (from Table 4). We project earnings for losers and winners over a 35-year work horizon allowing for a 3.02 annual growth rate.[36] The NPV of additional earnings is the difference between the NPV of earnings for winners and the NPV of earnings for losers. Multiplying the difference by the 13.3 percent VAT tax rate we get additional VAT tax revenue, which is $1,098 ($151 for academic school applicants and $2,417 for vocational school applicants, Row 16).

Government revenue from payroll taxes is proportional to formal earnings. Relative to losers, scholarship lottery winners pay $55.1, which at the losers' mean of $696/year on payroll taxes represents an increase of 8 percent (p-value 0.07, Panel A, Column 3, Table A3).

Among applicants to vocational schools, scholarship winners pay, on average, $125 more per year, which at the losers' mean of $724 represents an increase of 17 percent. Among applicants to academic schools, winners pay, on average, $3.9 more per year, a difference that is not statistically significant relative to the academic losers' mean of $694. The scholarship impact difference across academic and vocational applicants for annual payroll taxes paid has a p-value of 0.07 (Panel B, Column 3, Table A3).

We project annual payroll taxes for losers and winners over a 35-year work horizon allowing for a 3.02 annual growth rate. The NPV of additional payroll taxes is the difference between the NPV of payroll taxes for winners and the NPV of payroll taxes for losers. Expected additional government revenue from payroll taxes is this difference multiplied by 40 percent tax rate, since, as noted, at the margin forty percent of payroll taxes represents a net transfer to the government. This comes to $929 ($45 for academic school applicants and $2,135 for vocational school applicants, Row 17). Total expected additional government revenue is $2,027 ($196 for academic school applicants and $4,551 for vocational school applicants, Row 18). The scholarship impacts on formal sector earnings among the vocational school applicant sub-population entirely drive the positive expected additional government revenue, which we

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[36] The rate of 3.02 percent is the average annual growth in GDP per capita in Colombia between 2002 and 2012 (World Development Indicators database).

can reject to be zero in the full sample and among vocational school applicants with 95 percent confidence.

As noted earlier, effects on formal self-reported earnings are consistent with estimates from administrative data. Effects on informal self-reported earnings are likely zero or positive, but even if they were negative, they would not have a major effect on these calculations, since payroll taxes are not collected on informal earnings.

The point estimate of the net fiscal cost to taxpayers is -$1,667 ($136 for academic school applicants and -$4,151 for vocational school applicants, Row 21). The upper bound of the 95 percent confidence interval on the net fiscal cost per scholarship recipient is $304 ($2,913 for academic school applicants and -$372 for vocational school applicants) indicating that expected net fiscal costs to taxpayers are likely to be negative in the full sample, with a small probability that they are small and positive. Among vocational school applicants, the cost to taxpayers is strongly negative.[37]

Note that net fiscal costs are negative even if one assumes that any increase in formal sector earnings is offset by reduced informal earnings, so there are no gains in VAT revenue. Expected net costs for taxpayers are negative and equal to -$569 due solely to increased payroll tax receipt ($287 for academic school applicants, -$1,734 for vocational school applicants, Row 14 minus Row 20).[38] These gains are solely based on the tax revenue and ignore additional cost savings associated with teen-age pregnancy.

8.3 Externality impacts on others

While we can measure impacts on taxpayers and scholarship recipients, we are not able to identify potential externality impacts on others, and to the extent that such effects exist, they should be part of any welfare calculation. The calculation above implies that as long as any externalities are either positive, or negative but less than $1,916 per lottery winner (Row 23, Table 10), we can say with a high degree of confidence that the program is welfare improving since the lower bound of 95 percent confidence interval is -$54.9 (the 90 percent confidence

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[37] The conclusion that the expected cost to taxpayers is negative seems reasonably robust to changes in the assumptions. Expected net fiscal costs to taxpayers are also negative using a higher discount rate of 6 percent and equal to -$1,223.73 (Row 15 minus Row 19).

[38] Net fiscal costs are also negative for both females and males if we assume a discount rate of 6 percent instead of the 3.66 percent rate assumed in the text. Net fiscal costs using the 6 percent discount rate are -$235.38 for females and -$335.35 for males.

interval—not shown—is bounded away from zero). For vocational school applicants, we can say with 95 percent confidence that the program is welfare enhancing as long as externalities are either positive or negative but less than $4,400 per recipient. Although the mean estimate net benefit for academic school applicants is positive, it is small and has wide confidence bands (Row 23, Table 10).

The program is, thus, welfare-increasing unless it generates large negative externalities. This seems unlikely since reduced teen fertility and the opening up of an avenue for social mobility may generate positive externalities. There is little evidence for potential negative externalities, for example, through labor market signaling or job rationing. Bettinger et al (2010) suggests effects are not driven by improved peer quality for scholarship winners, which could have been interpreted as generating a reduction in peer quality for non-participants. The net negative externalities would have to be fairly large relative to program costs and to winners' earnings gains—particularly among applicants to vocational schools—to change the conclusions.

9.   Conclusion

We present evidence on the long run educational, labor market, welfare, access to credit, family and fiscal impacts of Colombia's PACES scholarship program, one of the largest private school scholarship programs in the world. As such, it is the first paper that explores the impact of private school scholarships on long-run labor market outcomes and, ultimately, the government's budget constraint. We are able to take advantage of a setting in which: a) there is exogenous variation in private school access due to random assignment of PACES scholarships when demand exceeded availability; b) administrative data provides credible evidence of impacts; c) we are examining an "as is" implementation of a large-scale government program; and d) program rules enable us to examine program effects in a subpopulation of scholarship applicants to vocational schools, amongst whom effects are unlikely to be primarily the result of student re-sorting.

Winning a scholarship for private secondary schooling increases on-time secondary school completion by 17 percent and ever completion by 10 percent (base rates are 45 percent and 56.5 percent respectively). It increases tertiary education access by 13 percent and current enrollment or graduation rates by 64 and 12 percent respectively (base rates are 19, 4 and 5 percent respectively). As a result, scholarship lottery winners accumulate 0.006 additional years

of tertiary education. Tertiary education effects are overwhelmingly concentrated in the population of vocational school applicants.

Winning a scholarship increases the estimated amount that applicants pay in future payroll taxes and earnings by 8 percent. Among vocational school applicants, winning a scholarship increases earnings by 17 percent and payroll taxes by 16 percent. Higher earnings likely reflect more than just a quantity of schooling effect, as the hypothesis that the effect was due solely to increases in the quantity of schooling would imply implausibly large rates of return to an additional year of education, particularly among vocational applicants.

A scholarship also increases access to formal consumer credit, in particular to card and vehicle credit, both in the intensive and extensive margins, and it also leads to better credit records and low credit costs. Effects on formal credit are mostly explained by winner applicants to vocational schools, and in particular, to male applicants to vocational schools. This result reinforces that on formal earnings on this same population.

Winning a scholarship reduces females' teen fertility by at least 17 percent or 6.5 percentage points (base rate is 38 percent) while not affecting overall fertility.

With a single experiment, it is impossible to fully disentangle the channels of program impact. However, gains at the tertiary education level and the labor market, particularly among the sub-population of vocational school applicants, suggest that the impact of the program on secondary completion was not simply due to schools gaming of the system by lowering the standards for grade progression. Instead, our results suggest that private vocational education may improve long-term outcomes by helping students to more effectively transition from secondary school into advanced training and the labor force.

The scholarship program combined elements of a private school scholarship program with elements of a merit scholarship program insofar as renewal of the scholarship was conditional on grade progression. However, as noted, it is not clear how strongly the later requirement was enforced in practice. If the effects of the program were solely due to its merit scholarship component, then one would expect the strongest impacts to occur among those who are near the boundary of failing grades. In fact, it seems that many of the strongest impacts are at the top of the distribution, such as on tertiary enrolment—which only 19 percent of lottery losers ever accomplish—and on tertiary graduation—which only 5 percent of losers accomplish. Effects on formal sector earnings are also relevant at the top of the distribution.

Moreover, we do not observe any effects on the fraction of applicants who are eligible to receive government subsidies. The main place we see an effect that might be at the bottom of the distribution is on teen fertility.

Our results paint a more favorable picture of private school scholarships relative to many of the results coming out of the US school choice literature. One possible explanation is program design, as PACES allowed households to augment scholarship amounts, potentially helping some students who would have attended private schools to trade up to better private schools. Another explanation is contextual differences. Since the program only partially covered costs, it attracted students whose families were willing to pay something for private school and the treatment effect of moving from public to private education in the subpopulation of those willing to pay for private education may be greater than in the population at large.

Our fiscal calculations suggest that the net fiscal cost of the program is negative due to the indirect effect of scholarship receipt on government expenditure and revenue. Some features of the program design minimized the fiscal cost of the program. First, scholarships covered only part of the cost of private school and applicants had to cover the rest of the costs. Indeed, the scholarships crowded-in educational expenses as households invested more total resources in education (Angrist et al 2002). The conditioning of scholarship renewal created incentives that reduced grade repetition (Angrist et al 2002). The scholarship program was targeted to the poor and the poor typically don't obtain admission to public universities. The increased tertiary education induced by the scholarship was mainly at the expense of households themselves rather than the Colombian treasury. Additional financial (as opposed to time) investments by households in education generate positive fiscal externalities if the additional human capital of scholarship lottery winners increases long-run earnings. Moreover, there is no offsetting reduction on short-run labor supply (and hence short-run tax collection).[39] The fiscal estimates do not consider the potential welfare improving expenditures and investment that could arise from the better access to formal credit markets generated by winning the scholarship.

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[39] By contrast, other educational subsidy programs such as state merit aid programs in the US that pay for additional years of school and keep students in school longer (see for example Dynarski 2000; Kane 2003) will have offsetting effects. They reduce short-run tax revenue by delaying labor market entry and increase long-run revenue by boosting later earnings, with the overall impact on the NPV of tax revenue unclear.

The Colombian government has a number of transfer programs designed to support people at the bottom of the income distribution, such as *Familias en Acción*. One natural question is whether it costs more or less to redistribute to strata 1 and 2 households through the PACES private school scholarship program than through alternative means. It seems reasonable to assume that the social cost of transferring one dollar per household through conditional cash transfers is more than one dollar because such programs may distort labor supply or the economic activity among those taxed to pay for the program and among beneficiaries who may seek to remain eligible. The evidence presented here suggests that it likely costs substantially less than a dollar to transfer one dollar in net present value to children born in strata one and two households through private scholarships.

The results on vocational school applicants suggest that, at least in the Colombian context, private vocational schools are a potentially promising and cost-effective educational alternative to improve educational attainment, employability and school-to-work transitions. Colombian private vocational schools, if anything, complement tertiary education investments and the needs of the formal labor market (see also Kugler, Kugler, Saavedra and Herrera 2015, and Attanasio, Guarín, Medina and Meghir 2017). (Of course one cannot draw the policy conclusion that a program limited to vocational schools would have effects similar to that we estimate for the effect of PACES on applicants to vocational schools since such a program might well have induced very different types of students to apply to vocational schools). Bear in mind though, that results found for vocational applicant are not necessarily transferable to academic applicants since the lottery took place after the choice of the type of school had been made.

The external validity of our results to other Colombian cities, or other cities in other countries of the region, would heavily rely on the variation of the quality of public and private education. Guarín, Medina and Posso (2017) show there are large variations in the quality of public and private education across Colombian cities, based on which one could expect that besides Bogotá, our results are likely to hold in cities like Medellín and Cartagena, but less likely to hold in others like Bucaramanga, Tunja or Pasto, which have much higher quality public schools.

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Table 1. Descriptive statistics of the Bogotá 1995 PACES scholarship applicant cohort

	All			Academic Applicants		Vocational Applicants	
	Loser's Mean	Won Scholarship	Won Scholarship, Valid School Type Info	Loser's Mean	Won Scholarship	Loser's Mean	Won Scholarship
	(1)	(2)	(3)	(4)	(5)	(7)	(8)
A. Data from PACES Application							
Has Phone	0.882	0.009	0.009	0.869	0.013	0.899	0.003
		(0.011)	(0.011)		(0.015)		(0.016)
Age at time of application	12.74	-0.086	-0.086	12.78	-0.033	12.63	-0.144
	(1.327)	(0.045)*	(0.046)*	(1.333)	(0.062)	(1.287)	(0.068)**
Male	0.49	0.011	0.018	0.504	0.008	0.457	0.033
		(0.017)	(0.017)		(0.023)		(0.026)
Applied to Vocational School	0.433	0.017	0.017				
		(0.017)	(0.017)				
B. National Identification Data							
Valid youth identification number	0.967	0.001	0.002	0.959	0.013	0.976	-0.011
		(0.006)	(0.006)		(0.009)		(0.009)
Valid adult identification number	0.978	-0.003	-0.004	0.979	-0.008	0.979	0.001
		(0.005)	(0.005)		(0.007)		(0.007)
N	1519	3661	3413	803	1901	613	1512

Notes: Table reports OLS scholarship lottery loser's means and estimated effects of winning a scholarship. Numbers in parentheses are standard deviations in columns of means and standard errors in columns of estimated scholarship effects. Results in Panel A are the same as those in Angrist et al. (2006) for having a phone, age at the time of application and gender, and as those in Bettinger et al. (2010) for having applied to a vocational school.

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5   Table 2. Scholarship impacts on long run educational outcomes

	All		Academic Applicants		Vocational Applicants		Vocational-Academic Difference
	Loser's Mean	Won Scholarship	Loser's Mean	Won Scholarship	Loser's Mean	Won Scholarship	Difference (6) - (4) (p-value)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
A. Secondary school completion (ICFES secondary graduation exam database)							
Graduated on schedule	0.452	0.076	0.455	0.071	0.473	0.083	0.012
	(0.498)	(0.016)***	(0.498)	(0.021)***	(0.5)	(0.025)***	(0.715)
Graduated with up to a two-year delay	0.527	0.063	0.519	0.061	0.566	0.066	0.005
	(0.499)	(0.015)***	(0.5)	(0.021)***	(0.496)	(0.024)***	(0.867)
Graduated with up to a four-year delay	0.552	0.055	0.544	0.051	0.587	0.065	0.014
	(0.497)	(0.015)***	(0.498)	(0.021)**	(0.493)	(0.024)***	(0.655)
Graduated with up to a six-year delay	0.565	0.054	0.552	0.055	0.605	0.060	0.006
	(0.496)	(0.015)***	(0.498)	(0.021)***	(0.489)	(0.024)**	(0.858)
B. Tertiary enrollment and persistence (Tertiary education database)							
Ever enrolled in tertiary education	0.189	0.024	0.194	0.000	0.188	0.070	0.069
	(0.392)	(0.013)*	(0.396)	(0.018)	(0.391)	(0.021)***	(0.012)**
Ever enrolled in a vocational college	0.066	0.014	0.071	0.006	0.064	0.028	0.021
	(0.248)	(0.009)*	(0.257)	(0.012)	(0.244)	(0.014)**	(0.238)
Ever enrolled in a university	0.131	0.014	0.130	-0.002	0.135	0.046	0.048
	(0.338)	(0.011)	(0.336)	(0.015)	(0.342)	(0.019)**	(0.044)**
Enrolled in tertiary as of 2012	0.036	0.023	0.030	0.031	0.039	0.021	-0.010
	(0.185)	(0.007)***	(0.17)	(0.009)***	(0.194)	(0.011)*	(0.502)
Graduated from tertiary as of 2012	0.050	0.006	0.054	-0.008	0.049	0.024	0.032
	(0.218)	(0.007)	(0.225)	(0.01)	(0.216)	(0.012)**	(0.042)**
Years of tertiary education	0.420	0.064	0.428	-0.019	0.423	0.191	0.210
	(1.19)	(0.04)	(1.202)	(0.054)	(1.2)	(0.067)***	(0.014)**

6   *Notes:* Table reports scholarship lottery loser's means and estimated effects of winning a scholarship with application controls. Controls include age, male and
7   whether the applicant had a phone number at the time of scholarship application. Estimates in columns 2,4 and 6 are from linear probability models. Numbers in
8   parentheses are robust standard errors in columns of estimated scholarship effects. Graduated on schedule is if the applicant took the college entry test in 2001 or
9   before; graduated with up to a two-, four- or six-year delay is if the applicant took the college entry test on or before 2003, 2005 and 2007, respectively. *
10   significant 10%, ** significant 5%, *** significant 1%.
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12 Table 3. Scholarship impacts on formal sector employment intensity, earnings and payroll taxes 2008-2014

	All		Academic Applicants		Vocational Applicants		Vocational-Academic Difference
	Loser's Mean (s.d)	Won Scholarship (s.e)	Loser's Mean (s.d)	Won Scholarship (s.e)	Loser's Mean (s.d)	Won Scholarship (s.e)	Difference (6) - (4) (p-value)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	A. All applicants						
Matched to formal sector earnings data	0.801	0.008	0.797	0.009	0.811	0.012	-0.169
		(0.013)		(0.018)		(0.020)	(0.55)
Average annual formal sector tenure (months)	5.52	0.23	5.57	0.22	5.59	0.28	0.07
	(4.40)	(0.15)	(4.40)	(0.20)	(4.42)	(0.23)	(0.83)
Average Annual Formal Sector Earnings	2,470.5	196.0	2,462.5	31.4	2,568.3	427.0	395.6
	(3,019.9)	(104.7)*	(2,986.2)	(132.7)	(3,147.3)	(184)**	(0.08)*
Average Annual Earnings at or Above Middle-Class Threshold	0.443	0.037	0.455	0.033	0.445	0.041	0.01
	(0.497)	(0.017)**	(0.498)	(0.023)	(0.497)	(0.026)	(0.83)
	B. Females						
Average annual formal sector tenure (months)	5.17	0.26	5.22	0.29	5.32	0.12	-0.17
	(4.410)	(0.200)	(4.380)	(0.280)	(4.490)	(0.320)	(0.69)
Average Annual Formal Sector Earnings	2,264.1	240.6	2,238.0	121.6	2,422.4	328.8	207.2
	(2,826.9)	(143.4)*	(2,810.2)	(182.3)	(2,941.1)	(248.4)	(0.5)
Average Annual Earnings at or Above Middle-Class Threshold	0.4	0.042	0.413	0.035	0.41	0.035	0.00
	(0.490)	(0.023)*	(0.493)	*(0.032)*	(0.493)	(0.035)	(1.00)
	C. Males						
Average annual formal sector tenure (months)	5.9	0.19	5.91	0.11	5.91	0.46	0.35
	(4.350)	(0.210)	(4.390)	(0.290)	(4.320)	(0.330)	(0.43)
Average Annual Formal Sector Earnings	2,687.7	146.9	2,685.8	-64.7	2,743.0	535.3	600.0
	(3,198.1)	(152.7)	(3,139.2)	(191.9)	(3,375.0)	(272.7)**	(0.07)*
Average Annual Earnings at or Above Middle-Class Threshold	0.489	0.031	0.497	0.029	0.487	0.048	0.02
	(0.500)	(0.024)	(0.501)	(0.033)	(0.501)	(0.039)	(0.72)

13   *Notes:* Annual average earnings are for the period July 2008 to December 2014. Monetary values are expressed in 2013 USD. Numbers in parentheses are

14   standard deviations in columns of means and standard errors in columns of estimated scholarship effects. Controls include age, male and whether the applicant

15   had a phone number at the time of scholarship application. Formal sector earnings estimates use the health payroll account. Middle-class earnings threshold is

16   PPP $3,600/year (Angulo et al. 2013). Formal sector earnings data begins in July 2008 and end in December 2014 and is restricted to applicants with valid adult

17   identification number that have complete application controls. In Panel A the sample of all applicant has 3574 observations, the sample of academic school

18   applicants has 1852 observations and the sample of vocational school applicants has 1481 observations. In Panel B, the full female sample has 1807

19   observations; the sample of academic school female applicants has 912 observations and the sample of vocational school female applicants has 779 observations.

20   In Panel C, the full male sample has 1767 observations; the sample of academic school male applicants has 940 observations and the sample of vocational school

21   male applicants has 702 observations.* significant 10%, ** significant 5% *** significant 1%.

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30   Table 4. Decomposition of formal earnings impacts

	All		Vocational Applicants		Academic Applicants	
	Loser's Mean (s.d)	Won Scholarship (s.e)	Loser's Mean (s.d)	Won Scholarship (s.e)	Loser's Mean (s.d)	Won Scholarship (s.e)
	(1)	(2)	(3)	(4)	(5)	(6)
1. Scholarship impact on completed years of schooling (A)	10.42 (1.61)	0.13 (0.05)**	10.43 (1.64)	0.04 (0.07)	10.49 (1.61)	0.27 (0.08)***
2. Scholarship impact on Average Annual Formal Sector Earnings 2008-2014 (B)	2,470.5 (3019.9)	196.0 (104.7)*	2,462.5 (2986.2)	31.4 (132.7)	2,568.3 (3147.3)	427.0 (184)**
3. Mincerian return to a year of schooling in sample of scholarship losers (C)	642.8 (80.3)***		608.4 (108.6)***		740.8 (128.1)***	
4. Earnings differential attributed solely to additional years of schooling among scholarship winners (A*C)		$83.6		$24.3		$200.0
5. Percent of annual formal sector earnings scholarship impact due to increased years of schooling among winners (A*C)/B		42.6%		77.4%		46.8%
6. Percent of annual formal sector earnings scholarship impact due to other factors conditional on years of schooling (1- [A*C]/B)		57.4%		22.6%		53.2%

31   *Notes:* Table reports a decomposition of earnings impacts into portion due to additional completed years of schooling among scholarship winners and a portion
32   due to other factors conditional on years of schooling. Sample is all Bogotá 1995 lottery applicants with complete application covariate data (see Table 1). The
33   first row reports the effect on completed years of schooling. The second row reproduces the result on average annual formal earnings from Table 4. The third row
34   reports a coefficient of completed years of schooling from an OLS regression in the sample of lottery losers in which the dependent variable is average annual
35   formal earnings in 2008-2014 controlling for PACES application covariates. * significant 10%, ** significant 5%. *** significant 1%.
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38   Table 5. Match rates to SISBEN data

	All Applicants		Academic School Applicants		Vocational School Applicants	
	(1)	(2)	(3)	(4)	(5)	(6)
Won a scholarship	-0.028	0.051	-0.029	-0.008	-0.032	0.300
	(0.017)*	(0.169)	(0.023)	(0.235)	(0.026)	(0.264)
Age * won a scholarship		-0.001		0.007		-0.029
		(0.013)		(0.017)		(0.020)
Phone * won a scholarship		-0.078		-0.127		0.026
		(0.053)		(0.07)*		(0.087)
Male * won a scholarship		0.009		0.000		0.020
		(0.034)		(0.046)		(0.053)
Loser's mean	0.515		0.504		0.524	
p-value on F-stat of joint test of interactions		0.525		0.327		0.508
N	3661	3661	1901	1901	1512	1512

39 *Notes:* Table reports scholarship lottery loser's means and estimated effects of winning a scholarship on the probability of being matched SISBEN 2010 data
40 using linear probability models. Additional controls, not shown in the table include, age, male and whether the applicant had a phone number at the time of
41 scholarship application.
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53   Table 6. Bounds on total self-reported annual earnings' scholarship impacts

	All		Academic Applicants		Vocational Applicants	
	Loser's Mean	Won Scholarship	Loser's Mean	Won Scholarship	Loser's Mean	Won Scholarship
	(1)	(2)	(3)	(4)	(5)	(6)
A. All applicants						
Lower bound	2,517.9	-139.6	2,699.6	-311.6	2,359.6	14.2
		(218.4)		(399.1)		(165.5)
Upper bound	2,000.2	365.8	2,041.0	331.8	2,064.9	315.8
		(80.1)***		(113.5)***		(125.4)**
B. Females						
Lower bound	1,944.1	0.5	1,894.0	31.6	2,082.1	-71.9
		(138.6)		(166.6)		(251.6)
Upper bound	1,696.3	247.7	1,702.9	223.5	1,736.6	283.6
		(112.7)**		(158.9)		(175.2)
C. Males						
Lower bound	3,198.5	-311.7	3,567.6	-765.8	2,749.0	154.4
		(446.3)		(845.0)		(183.1)
Upper bound	2,439.6	440.5	2,461.0	366.7	2,581.7	324.5
		(111.8)***		(158.1)**		(175.8)*

54   Notes: Table reports scholarship lottery loser's means and bounds of the effects of winning a scholarship on total self-reported annual earnings expressed in 2013
55   USD. Lower bound earnings are obtained from an OLS regression of SISBEN self-reported earnings, with missing values for those not in the SISBEN census.
56   Upper bound earnings from an OLS regression in which SISBEN earnings from the top 5 percent of scholarship winners are trimmed from the sample. Controls
57   include age, male and whether the applicant had a phone number at the time of scholarship application. Robust standard errors in parentheses. * significant 10%,
58   ** significant 5%.

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61   Table 7. Scholarship impacts on formal credit access

	All		Academic Applicants		Vocational Applicants		Vocational-Academic
	Loser's Mean (s.d)	Won Scholarship (s.e)	Loser's Mean (s.d)	Won Scholarship (s.e)	Loser's Mean (s.d)	Won Scholarship (s.e)	Difference (6) - (4) (p-value)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
A. All applicants							
Has Credit Card	0.564	0.038 (0.016)**	0.568	0.034 (0.023)	0.560	0.054 (0.025)**	0.020 (0.034)
Has Car Loan	0.041	0.006 (0.007)	0.042	-0.003 (0.009)	0.038	0.021 (0.011)*	0.024 (0.014)*
B. Females							
Has Credit Card	0.542	0.030 (0.023)	0.543	0.042 (0.032)	0.550	0.023 (0.035)	-0.018 (0.048)
Has Car Loan	0.037	-0.001 (0.009)	0.035	0.005 (0.013)	0.039	-0.006 (0.014)	-0.011 (0.019)
C. Males							
Has Credit Card	0.586	0.045 (0.023)*	0.593	0.026 (0.032)	0.571	0.087 (0.037)**	0.062 (0.048)
Has Car Loan	0.044	0.013 (0.010)	0.049	-0.010 (0.013)	0.036	0.051 (0.018)***	0.061 (0.022)***

62   Notes: Table reports scholarship lottery loser's means and estimated effects of winning a scholarship on access to formal consumer credit (credit cards and car
63   loans). Numbers in parentheses are standard deviations in columns of means and standard errors in columns of estimated scholarship effects. Controls include
64   age, male and whether the applicant had a phone number at the time of scholarship application. Credit data is collected quarterly and it begins in the first quarter
65   of 2004 and end in the last quarter of 2014 and is restricted to applicants with valid adult identification number that have complete application controls. In Panel
66   A the sample of all applicant has 3661 observations, the sample of academic school applicants has 1901 observations and the sample of vocational school
67   applicants has 1512 observations. In Panel B, the full female sample has 1845 observations; the sample of academic school female applicants has 933
68   observations and the sample of vocational school female applicants has 792 observations. In Panel C, the full male sample has 1816 observations; the sample of
69   academic school male applicants has 968 observations and the sample of vocational school male applicants has 720 observations.* significant 10%, ** significant
70   5%, *** significant 1%.
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Table 8. Bounds on scholarship effects on fertility

		All		Academic Applicants		Vocational Applicants		Vocational-Academic Difference
		Loser's Mean (s.d)	Won Scholarship (s.e)	Loser's Mean (s.d)	Won Scholarship (s.e)	Loser's Mean (s.d)	Won Scholarship (s.e)	Difference (6) - (4) (p-value)
		(1)	(2)	(3)	(4)	(5)	(6)	(7)
					A. All applicants			
Had any child as a teen	LB	0.234 (0.424)	-0.043 (0.018)**	0.240 (0.427)	-0.064 (0.025)**	0.224 (0.418)	-0.023 (0.029)	0.041 (0.286)
	UB	0.242 (0.429)	-0.047 (0.019)**	0.249 (0.433)	-0.070 (0.026)***	0.228 (0.421)	-0.025 (0.030)	0.045 (0.252)
Spouse/partner had a child as a teen	LB	0.106 (0.308)	-0.030 (0.014)**	0.111 (0.315)	-0.034 (0.020)*	0.087 (0.283)	-0.019 (0.020)	0.015 (0.589)
	UB	0.108 (0.310)	-0.032 (0.014)**	0.113 (0.317)	-0.036 (0.020)*	0.093 (0.291)	-0.025 (0.021)	0.011 (0.697)
Total number of children	LB	1.061 (1.034)	-0.040 (0.045)	1.047 (1.022)	-0.016 (0.063)	1.006 (0.981)	0.013 (0.067)	0.029 (0.751)
	UB	1.082 (1.045)	-0.049 (0.046)	1.064 (1.026)	-0.022 (0.064)	1.033 (0.991)	-0.003 (0.069)	0.019 (0.842)
					B. Females			
Had any child as a teen	LB	0.377 (0.485)	-0.065 (0.031)**	0.402 (0.492)	-0.105 (0.045)**	0.337 (0.474)	-0.035 (0.047)	0.071 (0.273)
	UB	0.387 (0.488)	-0.074 (0.032)**	0.418 (0.495)	-0.121 (0.046)***	0.337 (0.474)	-0.034 (0.047)	0.087 (0.183)
Spouse/partner had a child as a teen	LB	0.056 (0.231)	-0.011 (0.015)	0.055 (0.229)	-0.007 (0.021)	0.043 (0.204)	-0.010 (0.020)	-0.003 (0.923)
	UB	0.059 (0.236)	-0.014 (0.015)	0.058 (0.235)	-0.010 (0.022)	0.046 (0.209)	-0.012 (0.020)	-0.002 (0.940)

Total number of children	LB	1.355	-0.023	1.367	0.019	1.250	0.021	0.002
		(1.031)	(0.065)	(1.021)	(0.092)	(0.993)	(0.095)	(0.990)
	UB	1.399	-0.061	1.413	-0.024	1.280	0.001	0.025
		(1.026)	(0.065)	(1.015)	(0.093)	(0.992)	(0.097)	(0.851)

					C. Males			
Had any child as a teen	LB	0.078	-0.020	0.083	-0.022	0.073	-0.007	0.015
		(0.268)	(0.018)	(0.276)	(0.024)	(0.261)	(0.028)	(0.682)
	UB	0.081	-0.024	0.087	-0.026	0.075	-0.008	0.017
		(0.274)	(0.018)	(0.282)	(0.025)	(0.264)	(0.028)	(0.643)
Spouse/partner had a child as a teen	LB	0.161	-0.051	0.165	-0.058	0.146	-0.031	0.028
		(0.368)	(0.024)**	(0.372)	(0.033)*	(0.354)	(0.038)	(0.581)
	UB	0.166	-0.056	0.173	-0.066	0.149	-0.034	0.032
		(0.372)	(0.024)**	(0.380)	(0.034)**	(0.358)	(0.039)	(0.531)
Total number of children	LB	0.740	-0.061	0.738	-0.033	0.679	0.003	0.037
		(0.939)	(0.062)	(0.926)	(0.086)	(0.865)	(0.092)	(0.770)
	UB	0.742	-0.060	0.750	-0.041	0.687	-0.002	0.040
		(0.947)	(0.063)	(0.941)	(0.088)	(0.871)	(0.093)	(0.756)

Notes: Table reports scholarship lottery loser's means and estimated bounds on the effects of winning a scholarship fertility outcomes based on SISBEN 2010 data. Lower bound (LB) earnings are obtained from an OLS regression of SISBEN self-reported earnings, with missing values for those not in the SISBEN census. Upper bound (UB) earnings from an OLS regression in which SISBEN earnings from the top 5 percent of scholarship losers are trimmed from the sample. Numbers in parentheses are robust standard errors with the exception of total number of children in columns 1, 3 and 5, which are standard deviations of the loser's mean. Controls include age, male and whether the applicant had a phone number at the time of scholarship application. * significant 10%, ** significant 5%.

Table 9. Fiscal and welfare impacts of scholarships

Row #		All Applicants		Academic Applicants		Vocational Applicants		Notes
		Estimate	95% C.I.	Estimate	95% C.I.	Estimate	95% C.I.	
A. Government Costs								
	Secondary Education Costs							
1	Annual per-pupil cost of public school	$ 449.1		$ 449.1		$ 449.1		From Angrist et al. (2002), converted to 2013 dollars
2	Annual value of PACES scholarship	$ 243.8		$ 243.8		$ 243.8		From Angrist et al. (2002), converted to 2013 dollars
3	Expenditure from scholarship costs for students who would have enrolled in private school, aggregated over 6 years	$ 473.0		$ 472.4		$ 473.9		Row (2)*Proportion of lottery winners attending private school*proportion of winners continuing to use scholarships; computed annually and summed over the six years
4	Expenditure resulting from transfers from public to private schools, aggregated over 6 years	-$ 175.3		-$ 175.2		-$ 175.4		(Row (2) – Row (1))*Scholarship Effect on Private School Attendance; computed annually and summed over the six years
5	Cost savings from reduced grade repetition	-$ 4.3	($-4.9 - $-3.5)	-$ 4.2	($-4.9 - $-3.1)	-$ 4.0	($-5.2 - $-2.5)	See Appendix B
6	Total secondary education costs to the government	$ 293.5	($292.9 - $294.3)	$ 293.1	($292.3 - $294.1)	$ 294.6	($293.3 - $296.0)	Row (3) + Row (4) + Row (5)
	Tertiary Education Costs							
7	Additional public tertiary education costs	$ 10.9	($-4.1 - $26.1)	-$ 5.9	($-26.6 - $14.2)	$ 36.8	($8.0 - $75.1)	Annual per-pupil expenditure in public tertiary education * Scholarship impact on years of tertiary education (Panel B, Table 2, cols. 4 & 6)* Fraction of lottery winners attending a public institution

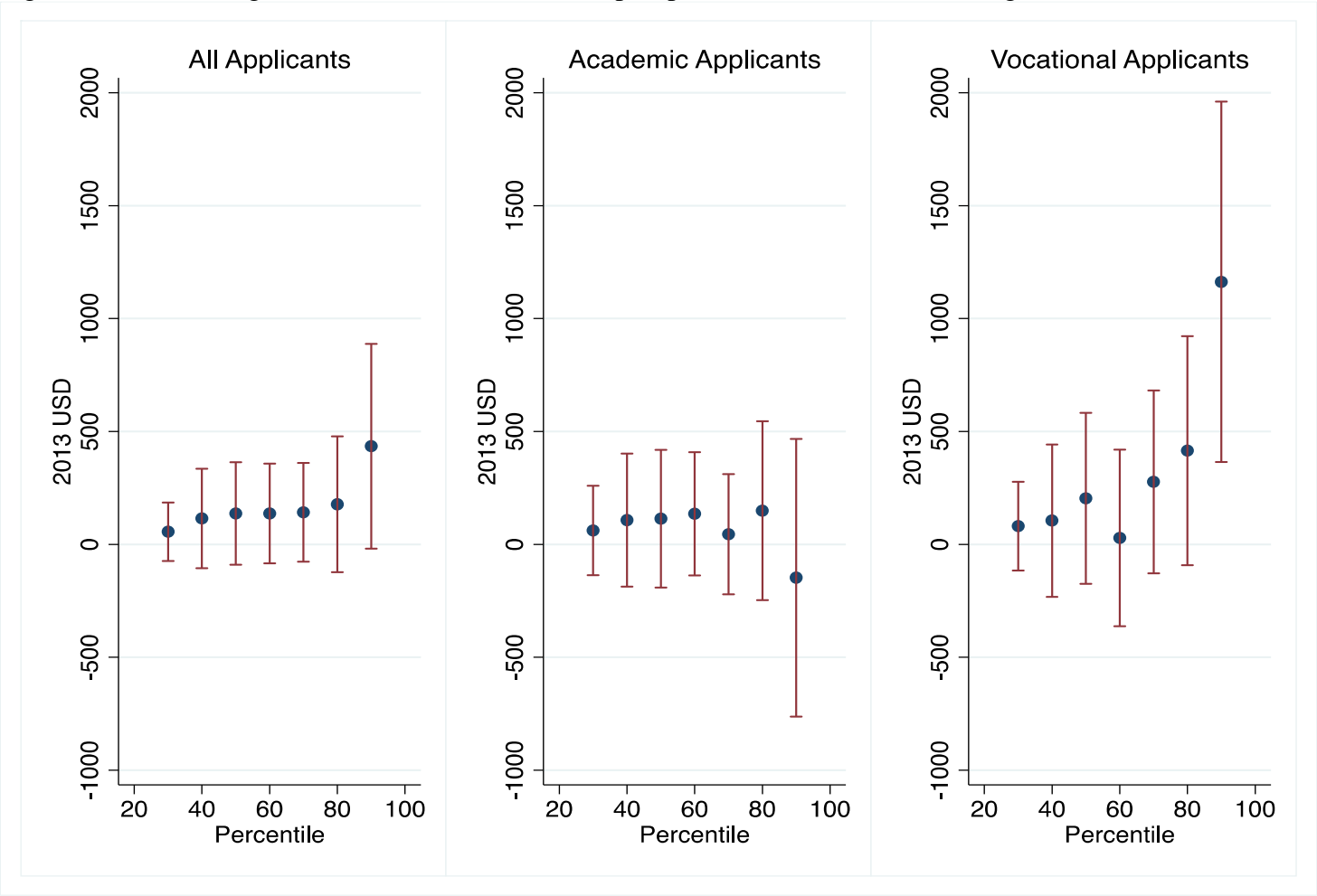|								
								(Panel B, Table 2, col. 1 + col. 3)
8	Additional tertiary education loan subsidies	$ 4.3	($-7.1 - $15.4)	-$ 5.8	($-19.7 - $7.6)	$ 17.9	($-2.9 - $37.7)	Annual per-pupil tertiary education subsidy * Scholarship impact on number of years of subsidy receipt (Panel B of Table 2, cols. 4 & 6)
9	Additional tertiary education costs (public education + loan subsidies)	$ 15.2	($-6.7 - $36.6)	-$ 11.7	($-38.1 - $15.3)	$ 54.7	($14.4 - $98.3)	Row (7) + Row (8)
	Welfare Receipt Costs							
10	Additional CCT receipt costs	-$ 0.4	($-4.4 - $3.5)	$ 0.1	($-4.8 - $5.0)	-$ 2.3	($-8.1 - $3.3)	Annual CCT subsidy amount (see notes below) * Scholarship impact on CCT receipt (Table 6, cols. 4 & 6)
	Foregone Revenue							
11	Foregone tax revenue from VAT tax	$ 27.9	($26.2 - $29.6)	$ 27.8	($25.6 - $30.2)	$ 29.1	($26.3 - $31.9)	Formal annual earnings of losers* Scholarship impact on years of education *VAT tax of 13.3%
12	Foregone net government transfers through payroll taxes	$ 23.7	($22.1 - $25.1)	$ 23.6	($21.6 - $25.8)	$ 24.6	($22.3 - $27.1)	Annual payroll taxes of losers* Scholarship impact on years of education *0.4
13	Total foregone revenue	$ 51.6	($48.3 - $54.7)	$ 51.4	($47.2 - $56.0)	$ 53.7	($48.6 - $58.9)	Row (11) + Row (12)
14	**Expected scholarship costs to government**	**$ 359.8**	**($338.3 - $381.8)**	**$ 332.9**	**($308.1 - $359.1)**	**$ 400.6**	**($361.4 - $445.2)**	Row (6) + Row (9) + Row (10) + Row (13)
15	Expected scholarship costs to government, 6% discount rate	$ 319.4	($304.4 - $334.6)	$ 300.5	($282.9 - $318.7)	$ 348.1	($320.9 - $379.9)	Same calculations as above using 6% discount rate
	B. Government Revenue							
16	Additional VAT tax revenue	$ 1,098.0	($41.2 - $2,254.2)	$ 151.5	($-1,310.5 - $1,576.8)	$ 2,416.8	($432.0 - $4,498.2)	Additional earnings of scholarship winners (see notes below) * VAT tax of 13.3%

17	Additional government transfers through payroll taxes	$ 928.7	($-11.2 - $1,962.7)	$ 45.0	($-1,275.0 - $1,305.1)	$ 2,134.5	($324.3 - $3,931.7)	Additional payroll taxes of scholarship winners (see notes below) * 0.4
18	**Additional government revenue**	**$ 2,026.8**	**($62.5 - $4,213.6)**	**$ 196.5**	**($-2,588.0 - $2,898.8)**	**$ 4,551.3**	**($764.4 - $8,415.3)**	Row (16) + Row (17)
19	Additional government revenue, 6% discount rate	$ 1,543.1	($47.6 - $3,208.1)	$ 149.6	($-1,970.5 - $2,207.1)	$ 3,465.2	($582.0 - $6,407.2)	Same calculations as above using 6% discount rate
20	Additional government revenue, no VAT revenue	$ 928.7	($-11.2 - $1,962.7)	$ 45.0	($-1,275.0 - $1,305.1)	$ 2,134.5	($324.3 - $3,931.7)	Assume VAT revenue is zero
21	**Expected net fiscal cost to taxpayers**	-$ 1,666.9	($-3,857.5 - $303.9)	$ 136.5	($-2,559.2 - $2,913.0)	-$ 4,150.7	($-7,997.0 - $-372.2)	Row (14) - Row (18)
	C. Gains to Recipients							
22	**Net gains to scholarship recipients**	**$ 249.0**		**$ 248.7**		**$ 249.6**		Fraction of infra-marginal recipients*impact on scholarship amount*sum of year-by-year utilization rate. See notes below
23	**Net Benefits to society**	**$ 1,916.0**	**($-54.9 - $4,106.5)**	**$ 112.2**	**($-2,664.4 - $2,807.9)**	**$ 4,400.3**	**($621.8 - $8,246.6)**	Additional revenue to government (Row 18)+ Net gains to scholarship recipients (Row 21) - Scholarship costs to government (Row 14)

Notes: We express all figures in 2013 dollars per scholarship winner. For annual per-pupil costs of public school and scholarship impact on scholarship value three years after the lottery: Angrist et al. (2002) report the cost of public schooling in 1998 to be $350 and the scholarship cost to be $190. We follow order of operations described in text to obtain values in analysis year. <u>For Expenditure from scholarship costs for students who would have enrolled in private school, aggregated over 6 years:</u> The fraction of females that attend private school is 0.897 (6th), 0.699 (7th) and 0.535 (8th). For males it is 0.857 (6th), 0.646 (7th) and 0.543 (8th). We do not observe private school attendance for grades 9th or 10th. We observe private school graduation, which is 0.322 for males and 0.314 for males. We interpolate linearly between the 8th grade rate and the graduation rate to obtain the private school attendance rates for grades 9th and 10th, which we estimate to be 0.464 (9th) and 0.393 (10th) for females and 0.469 (9th) and 0.396 (10th) for males. We observe the fraction of winners in private school using the scholarship for grades 6th and 8th only. The 7th grade fraction is the linear combination of the 6th and 8th grade rates. For females the fraction of winners in private school using the scholarship is 0.953 (6th), 0.736 (7th) and 0.519 (8th). For males it is 0.933 (6th), 0.698 (7th) and 0.463 (8th). After 8th grade, we have no data on scholarship usage. We know that 32 percent of the overall lottery loser sample finished 11th grade in private school. We assume a constant deterioration from 8th grade to 11th grade in the fraction of losers attending private school. This implies a 40 percent reduction in the fraction attending private school, and we assume

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that deterioration in scholarship usage among winners follows a similar 40 percent decline from the 8th grade level. Under these assumptions, scholarship usage rates for females are 0.415 (9th), 0.310 (10th) and 0.206 (11th). For males the scholarship usage rates are 0.374 (9th), 0.284 (10th) and 0.195 (11th). For cost-savings from reduced grade repetition: See Appendix B. For tertiary costs: Average per-pupil government expenditure in tertiary education is COP 3,280,000 in 2010 (Ministry of Education 2010). We use the exchange rate of COP 1913.98/USD (Dec 31, 2010) to convert to nominal USD and follow order of operations described in text to obtain NPV in USD of analysis year. Tertiary education subsidies are COP 682.432 per semester in COP of 2013 (ICETEX 2014). We use the exchange rate of COP 1926.83/USD (Dec 31, 2013) to convert to nominal USD and follow order of operations described in text to obtain NPV in USD of analysis year. Costs of welfare receipt: To obtain annual cost we assume one child, which is the mean number of children of scholarship applicants at age 28 (see Table 7). We assume child is between zero and seven years of age in 2013, so can receive health transfer but no education transfer. We assume applicant resides in Bogotá so monthly health subsidy amount is that for Group 1 municipalities, COP 61,200/month (see: http://www.dps.gov.co/Ingreso_Social/FamiliasenAccion.aspx, retrieved October 28, 2014). We obtain annual CCT transfer amount by multiplying by 12. We follow order of operations above to obtain NPV in USD of analysis year. We only assume one year of costs since there is no difference by scholarship status in total fertility, indicating simply a difference in the probability of having age-appropriate children. Therefore, CCT cost is annual cost * impact on receipt. Foregone earnings: We estimate annual foregone revenue from average annual formal sector earnings of scholarship losers in Panel A of Table 5, columns 3 and 5. We follow order of operations above to obtain NPV in USD of analysis year. Earnings: Annual earnings are projected annual earnings from Panel A, Table 5.. We project earnings for losers and winners over a 35-year horizon allowing for a 3.02% annual growth in earnings per annum, which is the average annual growth in GDP per capita in Colombia between 2002 and 2012, obtained from the World Development Indicators database). US-CPI for years after 2013 is that for 2013. We then follow remaining order of operation to obtain NPV of earnings for winners and losers. Payroll taxes: Annual payroll taxes are from Panel A, Table 5. We follow the same procedure as for earnings to obtain the NPV of payroll taxes in analysis year. Benefits to recipients: The fraction of infra-marginal recipients is the fraction of lottery losers who attend private school in 6th grade, 0.897 among females and 0.857 among males. The impact on scholarship amount is $93.2 (from Angrist et al. 2002 Table 8, column 3 updated to 2013 dollars). For utilization rates see notes above for expenditure from scholarship costs for students who would have enrolled in private school, aggregated over 6 years. We obtain 95% confidence intervals for each calculation using the bootstrap.

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130 Figure 1. Quantile regression estimates of scholarship impacts on formal sector earnings

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132 *Notes:* Figure reports estimated scholarship effects for various percentiles of the annual total formal sector earnings distribution. Monetary values are expressed
133 in 2013 USD. Controls include age, male and whether the applicant had a phone number at the time of scholarship application. Formal sector earnings estimates
134 use the health payroll account. Formal sector earnings data begins in July 2008 and end in December 2014 and is restricted to applicants with valid adult

135   identification number that have complete application controls. The sample of all applicants has 3574 observations, the sample of academic school applicants has
136   1852 observations and the sample of vocational school applicants has 1481 observations.

137   Appendix A. Additional results
138   Table A1. Scholarship impacts on long run tertiary education outcomes by gender

Outcome	All Applicants		Academic Applicants		Vocational Applicants	
	Loser's Mean	Won Scholarship	Loser's Mean	Won Scholarship	Loser's Mean	Won Scholarship
	(1)	(2)	(3)	(4)	(5)	(6)
A.Females						
Ever enrolled in tertiary education	0.203	0.023	0.204	0.007	0.213	0.043
		(0.019)		(0.026)		(0.029)
Ever enrolled in a vocational college	0.074	-0.002	0.083	-0.004	0.069	-0.002
		(0.012)		(0.018)		(0.018)
Ever enrolled in a university	0.139	0.025	0.128	0.015	0.159	0.038
		(0.016)		(0.022)		(0.027)
Enrolled in tertiary as of 2012	0.039	0.027	0.033	0.033	0.048	0.022
		(0.01)***		(0.014)**		(0.017)
Graduated from tertiary as of 2012	0.057	0.012	0.053	0.004	0.066	0.017
		(0.011)		(0.015)		(0.019)
Years of tertiary education	0.463	0.093	0.455	0.035	0.489	0.165
	(1.25)	(0.06)	(1.228)	(0.08)	(1.293)	(0.098)*
N	775	1845	398	933	333	792
B. Males						
Ever enrolled in tertiary education	0.175	0.025	0.185	-0.007	0.157	0.098
		(0.018)		(0.024)		(0.03)***
Ever enrolled in a vocational college	0.058	0.031	0.059	0.016	0.057	0.061
		(0.012)**		(0.016)		(0.021)***
Ever enrolled in a university	0.122	0.003	0.131	-0.019	0.107	0.054
		(0.016)		(0.021)		(0.026)**
Enrolled in tertiary education as of 2012	0.032	0.019	0.027	0.029	0.029	0.02
		(0.009)**		(0.012)**		(0.014)
Graduated from tertiary education as of 2012	0.043	0.000	0.054	-0.02	0.029	0.032
		(0.01)		(0.014)		(0.015)**
Years of tertiary education	0.375	0.033	0.402	-0.074	0.343	0.217
	(1.124)	(0.054)	(1.177)	(0.071)	(1.076)	(0.091)**
N	744	1816	405	968	280	720

139   *Notes:* Table reports scholarship lottery loser's means and estimated effects of winning a scholarship with application controls. Controls include age, male and
140   whether the applicant had a phone number at the time of scholarship application. Estimates in columns 2,4 and 6 are from linear probability models. Numbers in
141   parentheses are robust standard errors in columns of estimated scholarship effects. * significant 10%, ** significant 5%, *** significant 1%.

142   Table A2. Match rates to SISPRO formal earnings data

	All applicants		Academic Applicants		Vocational Applicants		Vocational - Academic Difference (p-value)
	(1)	(2)	(3)	(4)	(5)	(6)	(8)
Won a scholarship	0.008	-0.086	0.009	-0.052	0.012	-0.221	-0.169
	(0.013)	(0.137)	(0.018)	(0.197)	(0.020)	(0.206)	(0.552)
Age * won a scholarship		0.005		0.003		0.017	0.015
		(0.010)		(0.015)		(0.016)	(0.505)
Phone * won a scholarship		0.041		0.053		0.015	-0.038
		(0.041)		(0.054)		(0.065)	(0.656)
Male * won a scholarship		-0.022		-0.041		0.002	0.043
		(0.026)		(0.037)		(0.040)	(0.425)
Loser's mean	0.801		0.797		0.811		
p-value on F-stat of joint test of interactions		0.609		0.545		0.733	
N	3661	3661	1901	1901	1512	1512	

143   *Notes*: Table reports scholarship lottery loser's means and estimated effects of winning a scholarship on the probability of being matched to SISPRO data using
144   linear probability models. Additional controls, not shown in the table include, age, male and whether the applicant had a phone number at the time of scholarship
145   application. SISPRO sample is from July 2008 to 2014.
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150   Table A3. Scholarship impacts on formal sector earnings and payroll taxes, 2008-2014, various age specifications

		Coefficient on winning a scholarship, various specifications			
Outcome	Loser's Mean	No controls	Application controls, linear age	Application controls, age indicators	Entropy weights
	(1)	(2)	(3)	(4)	(5)
		A. All applicants			
Average Annual Formal Sector Earnings	2,470.5	250.4	196.0	200.2	197.8
		(107.163)**	(104.719)*	(104.403)*	(106.572)*
Average Annual Payroll Taxes	695.9	71.0	55.1	56.3	55.6
		(31.168)**	(30.445)*	(30.367)*	(31.023)*
		B. Vocational Applicants			
Average Annual Formal Sector Earnings	2,568.3	516.0	427.0	425.2	419.4
		(185.022)***	(183.980)**	(183.060)**	(189.095)**
Average Annual Payroll Taxes	723.5	152.3	125.3	124.3	123.9
		(53.816)***	(53.313)**	(53.025)**	(54.984)**
		C. Academic Applicants			
Average Annual Formal Sector Earnings	2,462.5	58.8	31.4	39.0	37.9
		(137.2)	(132.7)	(132.7)	(133.5)
Average Annual Payroll Taxes	694.2	11.9	3.9	6.1	5.5
		(39.9)	(38.7)	(38.7)	(39.0)

151   *Notes:* Table reports scholarship lottery loser's means and estimated effects of winning a scholarship on total formal sector earnings and annual payroll taxes
152   under various age specifications. Annual averages are for the period July 2008 to December 2014. Monetary values are expressed in 2013 USD. Total payroll
153   taxes include employer and employee contributions. Numbers in parentheses are standard deviations in columns of means and standard errors in columns of
154   estimated scholarship effects. Application controls include age, male and whether the applicant had a phone number at the time of scholarship application.
155   Formal sector earnings estimates use the health payroll account. Formal sector earnings data begins in July 2008 and end in December 2014 and is restricted to
156   applicants with valid adult identification number that have complete application controls. The sample of all applicants with application controls has 3574
157   observations, for academic school applicants it has 1852 observations and for vocational school applicants it has 1481 observations. Entropy weights uses the
158   Hainmueller (2012) re-weighting approach to impose equal first and second moments of the covariate distribution across scholarship winners and losers. *
159   significant 10%, ** significant 5% *** significant 1%.
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161   Table A4. Scholarship impacts on formal annual earnings for applicants to vocational schools of various curricula

	Vocational Applicants		Applicants to Commercial Curriculum		Applicants to Other Curricula	
	Loser's Mean (s.d)	Won Scholarship (s.e)	Loser's Mean (s.d)	Won Scholarship (s.e)	Loser's Mean (s.d)	Won Scholarship (s.e)
	(1)	(2)	(3)	(4)	(5)	(6)
	A. All applicants					
Average Annual Formal Sector Earnings	2,568.3	427.0	2,252.5	554.2	2,789.2	341.7
	(3147.3)	(184)**	(2686.7)	(254.2)**	(3419.4)	(260.2)
Average Annual Payroll Taxes	723.5	125.3	640.1	158.2	781.8	103.0
	(908.4)	(53.3)**	(775.3)	(73.8)**	(987.9)	(75.5)
N	600	1481	247	637	353	844
	B. Females					
Average Annual Formal Sector Earnings	2,422.4	328.8	2,501.7	136.0	2,365.3	491.2
	(2941.1)	(248.4)	(3034.7)	(360.6)	(2878.3)	(346.9)
Average Annual Payroll Taxes	665.1	93.3	701.2	26.3	639.1	148.3
	(833.4)	(70.7)	(874.3)	(102.5)	(803.9)	(99.1)
N	327	779	137	354	190	425
	C. Males					
Average Annual Formal Sector Earnings	2,743.0	535.3	1,942.2	1,119.1	3,283.5	151.0
	(3375)	(272.7)**	(2150.6)	(348)***	(3909.4)	(384.4)
Average Annual Payroll Taxes	793.3	160.8	563.9	333.9	948.2	47.1
	(987.9)	(80.5)**	(626.3)	(103.8)***	(1146.6)	(113.3)
N	273	702	110	283	163	419

162   *Notes:* Table reports scholarship lottery loser's means and estimated effects of winning a scholarship on formal sector earnings and payroll taxes in USD of 2013
163   among applicants to vocational schools of various curricula. Columns 1 and 2 replicate results for vocational applicants from Table 4 in the main text. Columns
164   3 and 4 show results for applicants to vocational schools with a commercial curriculum. Columns 5 and 6 show results for applicants to schools with other
165   curricula, which includes industrial, agricultural, pedagogical and those without curriculum information. Controls include age, male and whether the applicant
166   had a phone number at the time of scholarship application. Formal sector earnings estimates use the health payroll account. Formal sector earnings sample is
167   restricted to begin in July 2008 and is restricted to applicants with valid adult identification number (3926) that have complete application controls (3903).*
168   significant 10%, ** significant 5%.

169   Table A5. Scholarship impacts on formal employment characteristics

	All		Academic Applicants		Vocational Applicants		Vocational - Academic Difference
	Loser's Mean (s.d) (1)	Won Scholarship (s.e) (2)	Loser's Mean (s.d) (3)	Won Scholarship (s.e) (4)	Loser's Mean (s.d) (5)	Won Scholarship (s.e) (6)	Difference (6) - (4) (p-value) (7)
All applicants							
Firm size (mean number of workers)	2,001.6	77.6	2078.5	-39.4	1943.8	261.3	300.8
		(138.4)		(193.0)		(221.0)	(0.30)
Firm's mean number of new jobs	69.0	22.0	70.7	20.1	67.8	28.6	8.5
		(9.8)**		(12.3)		(18.3)	(0.70)
Firm's mean number of job terminations	31.9	2.6	31.5	3.6	32.1	2.8	-0.8
		(3.4)		(4.7)		(5.3)	(0.91)
Firm productivity (mean monthly earnings)	512.9	9.4	528.6	-28.5	507.8	53.5	82.1
		(18.4)		(30.7)		(20.9)	(0.03)**
Percent of firm's employees earning less than 1.05 times minimum wage	42.2	-1.9	42.3	-1.0	41.1	-3.1	-2.1
		(1.2)		(1.6)		(1.8)*	(0.38)
Percent of firm's employees earning between 1.05 and 3 times minimum wage	45.8	0.8	45.6	1.2	46.3	0.7	-0.5
		(1.0)		(1.4)		(1.5)	(0.81)
Percent of firm's employees earning 3 and 5 times minimum wage	5.9	0.6	6.0	0.1	6.1	1.2	1.1
		(0.28)**		(0.4)		(0.5)***	(0.06)*
Percent of firm's employees earning 5 and 10 times minimum wage	3.7	0.5	3.7	0.1	3.9	0.9	0.8
		(0.25)*		(0.3)		(0.4)**	(0.13)
Percent of firm's employees earning more than 10 times minimum wage	1.2	0.3	1.2	0.2	1.3	0.5	0.4
		(0.13)***		(0.2)		(0.2)**	(0.20)

170   Notes: Table reports scholarship lottery loser's means and estimated effects of winning a scholarship on formal firm characteristics. Averages are for the period
171   July 2008 to December 2014. Monetary values are expressed in 2013 USD. Controls include age, male and whether the applicant had a phone number at the time
172   of scholarship application. Formal sector earnings data begins in July 2008 and end in December 2014 and is restricted to applicants with valid adult
173   identification number that have complete application controls. The sample of all applicants has 3574 observations, the sample of academic school applicants has
174   1852 observations and the sample of vocational school applicants has 1481 observations. * significant 10%, ** significant 5% *** significant 1%.

175 Table A6. Upper bound estimates (trimming) of the scholarship impact on future formal earnings

	All		Academic Applicants		Vocational Applicants		Vocational-Academic Difference
	Loser's Mean (s.d) (1)	Won Scholarship (s.e) (2)	Loser's Mean (s.d) (3)	Won Scholarship (s.e) (4)	Loser's Mean (s.d) (5)	Won Scholarship (s.e) (6)	Difference (6) - (4) (p-value) (7)
A. All applicants							
Percent of top-earning scholarship losers trimmed from sample	*2.4 %*		*3.3%*		*2.2%*		
Average Annual Formal Sector Earnings	2,172.7	490.2	2,086.6	395.9	2,297.5	701.5	305.7
	(2239)	(91.2)***	(2082.4)	(110.9)***	(2423.7)	(164.4)***	(0.12)
B. Females							
Percent of top-earning scholarship losers trimmed from sample	*2.8%*		*3.3%*		*2.2%*		
Average Annual Formal Sector Earnings	2,009.6	490.1	1,877.1	475.4	2,198.2	552.1	76.6
	(2191.3)	(128.8)***	(1921.6)	(151.6)***	(2428.6)	(231.7)**	(0.78)
C. Males							
Percent of top-earning scholarship losers trimmed from sample	*2.0%*		*3.3%*		*2.1%*		
Average Annual Formal Sector Earnings	2,383.4	449.7	2,314.3	291.4	2,418.4	864.2	572.8
	(2346.1)	(130.2)***	(2241.5)	(161.7)*	(2422.7)	(231.7)***	(0.04)**

176 *Notes:* Table reports scholarship lottery loser's means and estimated effects of winning a scholarship on average annual, annual total formal sector earnings and
177 annual payroll taxes after trimming the stated percent of top-earnings scholarship losers from each sample. Annual averages are for the period July 2008 to
178 December 2014. Monetary values are expressed in 2013 USD. Total payroll taxes include employer and employee contributions. Numbers in parentheses are
179 standard deviations in columns of means and standard errors in columns of estimated scholarship effects. Controls include age, male and whether the applicant
180 had a phone number at the time of scholarship application. Formal sector earnings estimates use the health payroll account. Formal sector earnings data begins in
181 July 2008 and end in December 2014 and is restricted to applicants with valid adult identification number that have complete application controls.* significant
182 10%, ** significant 5% *** significant 1%.
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185   Table A7. Upper bound estimates (imputation) of the scholarship impact on future formal earnings

	All		Academic Applicants		Vocational Applicants		Vocational-Academic Difference
	Loser's Mean (s.d)	Won a Scholarship (s.e)	Loser's Mean (s.d)	Won a Scholarship (s.e)	Loser's Mean (s.d)	Won a Scholarship (s.e)	Difference (6) - (4) (p-value)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
A. All applicants							
Average Annual Formal Sector Earnings	2,470.5 (3019.9)	206.4 (104.7)**	2,462.5 (2986.2)	38.4 (132.6)	2,568.3 (3147.3)	443.4 (183.8)**	404.959 (0.07)*
B. Females							
Average Annual Formal Sector Earnings	2,264.1 (2826.9)	244.4 (143.4)*	2,238.0 (2810.2)	121.6 (182.3)	2,422.4 (2941.1)	337.5 (248.3)	215.900 (0.48)
C. Males							
Average Annual Formal Sector Earnings	2,687.7 (3198.1)	161.7 (152.5)	2,685.8 (3139.2)	-53.3 (191.8)	2,743.0 (3375)	558.2 (272.3)**	611.519 (0.07)*

186 Notes. Table reports scholarship lottery loser's means and estimated effects of winning a scholarship on annual formal sector earnings in USD of 2013 imputing
187 the average of losers' earnings with incomplete tertiary education to winners who are enrolled in higher education as of 2012 and have no earnings in the formal
188 sector. Total payroll taxes include employer and employee contributions. Numbers in parentheses are standard deviations in columns of means and standard
189 errors in columns of estimated scholarship effects. Controls include age, male and whether the applicant had a phone number at the time of scholarship
190 application. Formal sector earnings estimates use the health payroll account. Formal sector earnings sample is restricted to begin in July 2008 and is restricted to
191 applicants with valid adult identification number (3926) that have complete application controls (3903).* significant 10%, ** significant 5%
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201 Table A8. Scholarship impacts on government subsidy receipt

	All		Academic Applicants		Vocational Applicants	
	Loser's Mean	Won Scholarship (s.e)	Loser's Mean	Won Scholarship (s.e)	Loser's Mean	Won Scholarship (s.e)
	(1)	(2)	(3)	(4)	(5)	(6)
Familias En Acción CCT program	0.074	-0.003 (0.009)	0.072	0.001 (0.012)	0.073	-0.008 (0.013)
Subsidized Health Care Level 1	0.196	-0.012 (0.013)	0.196	-0.024 (0.018)	0.188	-0.003 (0.02)
Subsidized Health Care Level 2	0.243	0.000 (0.014)	0.24	-0.008 (0.02)	0.228	0.014 (0.022)
Early childhood care (ICBF)	0.27	-0.004 (0.015)	0.265	-0.006 (0.02)	0.258	0.004 (0.023)

202 *Notes:* Table reports scholarship lottery loser's means and estimated effects of winning a scholarship with application controls. Controls include age, male and
203 whether the applicant had a phone number at the time of scholarship application. Estimates in columns 2,4 and 6 are from linear probability models. Numbers in
204 parentheses are robust standard errors in columns of estimated scholarship effects. Receipt of Familias en Acción CCT program is based on having SISBEN 2010
205 scores below the eligibility cutoff and children under the age of 18. Receipt of subsidized health care levels 1 and 2, and early childhood care is based on having
206 SISBEN 2010 scores below the eligibility cutoff. Applicants who are not in SISBEN 2010 cannot receive these subsidies so for them receipt is zero.
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220   Table A9. Bounds on interest rates paid on loans

		All		Academic Applicants		Vocational Applicants	
		Loser's Mean (s.d)	Won Scholarship (s.e)	Loser's Mean (s.d)	Won Scholarship (s.e)	Loser's Mean (s.d)	Won Scholarship (s.e)
		(1)	(2)	(3)	(4)	(5)	(6)
A. All applicants							
Percent of top-interest rate scholarship winners trimmed from sample		4.9%		3.3%		8.8%	
Quarterly average of the weighted interest rate	UB	24.62 (4.87)	-0.52 (0.22)**	24.30 (5.35)	0.13 (0.31)	24.86 (4.31)	-1.45 (0.32)***
	LB	24.62 (4.87)	-0.20 (0.22)	24.30 (5.35)	0.35 (0.31)	24.86 (4.31)	-0.85 (0.32)***
B. Females							
Percent of top-interest rate scholarship winners trimmed from sample		4.6%		7.2%		3.5%	
Quarterly average of the weighted interest rate	UB	24.53 (4.93)	-0.65 (0.33)**	24.42 (5.18)	-0.38 (0.47)	24.57 (4.65)	-1.07 (0.48)**
	LB	24.53 (4.93)	-0.35 (0.32)	24.42 (5.18)	0.07 (0.47)	24.57 (4.65)	-0.83 (0.48)*
C. Males							
Percent of top-interest rate scholarship winners trimmed from sample		4.9%		0.0%		13.1%	
Quarterly average of the weighted interest rate	UB	24.70 (4.82)	-0.38 (0.29)	24.20 (5.50)	0.58 (0.42)	25.19 (3.88)	-1.75 (0.41)***
	LB	24.70 (4.82)	-0.06 (0.29)	24.20 (5.50)	0.58 (0.42)	25.19 (3.88)	-0.86 (0.41)**

221   Notes: Table reports bounds on interest rates paid on formal consumer loans. Controls include age, male and whether the applicant had a phone number at the
222   time of scholarship application. Credit data is collected quarterly and it begins in the first quarter of 2004 and end in the last quarter of 2014 and is restricted to
223   applicants with valid adult identification number that have complete application controls.* significant 10%, ** significant 5%, *** significant 1%.

224   Appendix B. Calculation of cost-savings to the government from reduced grade repetition

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226   This appendix explains how we calculate cost savings to the government from reduced

227   grade repetition. We observe public school attendance and repetitions through grade 8 from

228   Table 4 in Angrist et al. (2002) and whether the applicant finished secondary school on time,

229   with delays or did not finish (Table 2 in main text).

230   To calculate the cost-savings from reduced grade repetition, we assume that: i) only

231   public school repetitions cost the government money, ii) among applicants who finish on-

232   schedule, there is no repetition; ii) among applicants who finish with delays, the delays are all

233   a consequence of grade repetition and iii) among those who never finish secondary school, all

234   dropouts occurred in 9th grade, so that total repetitions for this group are the ones reported in

235   Table 4 columns 2 and 4 of Angrist et al. 2002. This last assumption understates the cost

236   savings given that we ignore additional costs the government would have incurred if dropout

237   had occurred later.

238   There are three types of students: those who finish on time; those who finish with delays;

239   and those who never finish. For those who finish on time, the government receives no cost

240   savings. For those who pass with delays, the government saves from reduced grade repetition

241   in the public sector. We multiply public school costs by the fraction in public schools and by

242   the overall reduction in grade repetitions to estimate these cost benefits. For those who never

243   graduate, we only record the savings from grade repetition after three years. As before, we

244   multiply public school costs by the fraction in public by the effect of the scholarship on

245   repetitions after three years. We use data from Angrist et al (2002) to compute these effects

246   and the fractions in public. Again, we underestimate the likely savings given that we know that

247   more attrition from private schools happened after 8th grade and hence might have increased

248   the probability that post-8th grade retention occurred in public rather than private schools.

249   Based on estimates from Table 2, Table B1 shows the distribution of secondary school

250   completion outcomes for scholarship winners and losers, separately by gender:

251   For those who complete secondary school with delays, since we assume that the delay

252   is all a consequence of grade repetition, the reduction in grade repetition as a consequence of

253   winning the scholarship is $0.093 - 0.102 = -0.01$ for females and $0.090 - 0.123 = -0.033$ for

254   males. Annual cost-savings from reduced grade repetition in this group is annual per-pupil

255 public school costs (from Table 10), times the fraction of lottery losers who attend public

256 school, times reduction in the probability of grade repetition. For females this is: $449.08 *

257 0.284 * (-0.01) = - $1.28 and for males it is $449.08 * 0.300 * (-0.03) = - $4.44. Note that the

258 figures are reported as negative numbers indicating negative costs (i.e. cost savings).

259

260 Table B1. Distribution of secondary school completion outcomes

	Losers		Winners	
	Female	Male	Female	Male
Completed secondary school on time	0.486	0.415	0.558	0.495
Completed secondary school with delays	0.105	0.123	0.095	0.090
Never completed	0.409	0.462	0.347	0.415

261 Notes: Completed with delays is completed with up to a six-year delay. We assume that the fraction of applicants
262 who never complete secondary school is 1 – (fraction who complete on time + fraction who complete with
263 delays).

264

265 We need to multiply these annual amounts by the number of extra years that it takes for

266 winners to graduate from secondary school among those that graduate with delays. Table B2

267 shows the distribution of delayed graduation, which we obtain from Table 2 in the main text.

268 Using the distribution of delayed graduation in Table B2 and the annual cost-savings from

269 reduced grade repetition, we get the cost savings from grade repetition among scholarship

270 winners who complete secondary school with delays. For females this is: - [$1.28*2 years*0.67

271 (conditional on delay, the fraction who completes with a two-year delay) + $1.28*4 years*0.16

272 (fraction who completes with 4-year delay) + $1.28*6 years*0.17 (fraction who completes with

273 a 6-year delay)] = - $3.84. For males it is: - [$4.44*2 years*0.69 + $4.44*4 years*0.21 +

274 $4.44*6 years*0.10] = - $12.52.

275 For scholarship winners who never complete secondary school, we assume that they

276 dropped out in 9th grade so the reduction in the total number of repetitions is the one reported

277 by Angrist et al (2002) in Table 4 for the Bogotá sample with controls, which is -0.031 for

278 females and -0.101 for males. Therefore, cost-savings for those who never complete is

279 $449.08*0.284*(-0.031) = -$3.95 for females and $449.08*0.300*(-0.101) = -$13.61 for males.

280   Total cost-savings from reduced grade repetition among scholarship winners is the

281   weighted sum of the cost-savings among those who complete secondary school with delays and

282   those who never complete. The weights are given by the fraction of scholarship winners who

283   complete secondary school with delays and who never complete, from Table B1. For females,

284   we have that total cost-savings are [-$3.84* 0.095 - $3.95*0.347] = -$1.76. For males, total

285   cost-savings from reduced grade repetition are [-$12.52*0.090 -$13.61*0.415] = -$6.78.

286

287   Table B2. Distribution of delayed secondary school completion for scholarship winners

	Females		Males	
	Percentage points	Percent	Percentage points	Percent
Fraction of winners who complete secondary school with delays	0.095	100%	0.090	100%
Fraction who complete with up to a two-year delay	(0.555+0.067)-0.558 = 0.064	67%	(0.499+0.058)-0.495 = 0.062	69%
Fraction who complete with a 2- to 4-year delay	(0.574+0.063)-0.622 = 0.015	16%	(0.530+0.046)-0.557 = 0.019	21%
Fraction who complete with a 4- to 6-year delay	(0.095-0.064-0.015) = 0.016	17%	(0.093-0.066-0.017) = 0.009	10%

288   Notes: The first row is from Table B1. The remaining rows are from Table 2 in the main text.