**Can Educational Voucher Programs Pay for Themselves?**

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*A large-scale government program in Colombia used a lottery to distribute scholarships for private secondary school to socially disadvantaged students.  Based on administrative data up to seventeen 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 vocational school applicants. Scholarships reduce teen fertility, although there is no significant effect on overall fertility at age 30. Administrative data up to twenty years after the scholarship lottery suggest that average annual formal earnings for lottery winners near age 30 are 8 percent greater than those for losers, a difference that is significant at the 6% level. Formal-sector earnings effects are entirely driven by vocational school applicants, among whom lottery winners earn 17 percent more than losers. The expected net present value of increased net tax receipts due to the program likely exceeds the program’s fiscal cost and the program is welfare improving as long as externalities on non-recipients are positive, zero, or negative but smaller than $1,916 per scholarship recipient.*

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1. **Introduction**

In many developing countries access to primary education is 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.

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

Several design features reduced 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).

We take advantage of a lottery used to allocate scholarships, as well as a unique data-set 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.

Lottery winners are about 7 percentage points more likely to have graduated from secondary school on schedule (on a 44 percent base) and 5 percentage points more likely to have ever graduated from secondary school (on a 55 percent base). Secondary school graduation impacts are similar for applicants to vocational schools and to the more traditional academic schools. Lottery winners were also 3 percentage points more likely to have attended college at some point, a 16 percent relative increase in attendance. They are 58 percent more likely to be currently enrolled in tertiary education (Base rate is 4 percent.). Scholarship impacts at the tertiary level are entirely driven by applicants who applied to vocational schools. In this subpopulation, lottery winners are 7 percentage points more likely to have attended college at some point—a 38 percent relative increase—and 2.4 percentage points more like to graduate—a 49 percent relative increase. There is also some heterogeneity by gender, as the secondary school scholarships 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. However, point estimates of the scholarship’s impact on total formal sector earnings at around age 30 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 our 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.)

Winning a scholarship also reduces teen fertility. Among female applicants, lottery winners are 6 percentage points less likely to have had a child as a teen, a 16 percent relative decrease in teen fertility. These effects are driven by applicants to academic secondary schools. We find no effect on total fertility as of age 30, consistent with the notion that the teen fertility effect we observe is mostly an “incarceration” or “delay” effect rather than an opportunity-cost effect.

Our fiscal and welfare estimates indicate that the net fiscal cost of the program is likely negative because the net present value of extra tax revenue generated by the program exceeds the cost.[[1]](#footnote-2) 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 driven by applicants to vocational schools. Although winners may have spent more on schooling or increased effort, it is possible to construct a lower bound on net benefits to lottery winners based on revealed preference, since payments to intra-marginal applicants who would have gone to private school in any case constitute a pure transfer. 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]](#footnote-3)

The concentration of long-term effects among vocational school applicants helps shed light on potential channels although it is difficult to make definitive statements. Scholarship impacts for tertiary education outcomes and formal earnings near age 30 are greater for vocational school applicants than those on academic school applicants. 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 effects. One plausible hypothesis is that private vocational education is more responsive to labor market and advanced training opportunities than is public education.

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 had a low, and likely negative net fiscal cost. We take no stand on whether changes at the margin to make the program more generous and expansive —increasing the value of the scholarship, removing the conditionality on grade progression, or expanding eligibility further up the socio-economic ladder— would at the margin have passed a cost-benefit test.  Our data and identification strategy do not allow us to answer such questions. What is clear is that Colombia was able to implement a scholarship program to allow poor children to attend private secondary schools that made both program participants and taxpayers better off than they would have been in the absence of the program. Identifying the impact of the PACES scholarship program “as implemented” is also of considerable interest given the program’s scale, the fact that 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]](#footnote-4) the long-term consequences of educational interventions,[[4]](#footnote-5) the economic returns to interventions that target socially disadvantaged children,[[5]](#footnote-6) the effects of education on fertility,[[6]](#footnote-7) and recent developments in public finance employing reduced form causal estimates of labor-market behavioral responses to policy to measure welfare changes.[[7]](#footnote-8)

The remainder of the paper is organized as follows. Section 2 provides relevant background information. 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 fertility. Section 7 presents fiscal impacts. Section 8 concludes.

1. **Background**

In this section, we provide background on Colombia’s educational context, the structure of the PACES scholarship program, and prior evidence on short-term scholarship impacts and mediating channels.

***2.1 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 attending grade 11 of secondary school are compelled by law to take the ICFES exam, and ICFES scores are the primary admission criteria in Colombia’s tertiary education institutions. Since over 95 percent of students take the test (ICFES 2013), we interpret taking the ICFES exam as a proxy for secondary school completion.

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 —Bogotá included—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).

Data from Colombia’s Education Evaluation Institute (ICFES) show that only 16 percent of secondary school graduates attend vocational schools. By contrast, 25 percent of scholarship winners in our sample applied only to vocational schools and an additional 23 percent applied to schools with both vocational and academic tracts. While academic schools instruct students in the fields of science, humanities or the arts, vocational schools prepare students primarily for participation in the labor market, either in the production sector or the service sector. They typically focus on commercial, industrial, agrarian or pedagogical skills and their curricula exhibit considerable heterogeneity.

The focus of public and private vocational schools is very different. Of public schools, 25 percent have an industrial curriculum and 62 percent have a commercial one, whereas only 4 percent of private vocational schools have an industrial curriculum and 92 percent have a commercial focus (Bettinger, Kremer and Saavedra 2010).

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). Close to 12 percent of students in strata 1 and 2 neighborhoods attend private schools in Bogotá (Encuesta Nacional de Calidad de Vida 2010).[[8]](#footnote-9)

***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. Scholarships were awarded 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 contingent upon passing grades. The extent to which this conditionality was at all 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 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. 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 (Bettinger, Kremer, Saavedra 2010).

Among applicants to vocational schools, 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).[[9]](#footnote-10)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.

1. **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 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. 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).

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 among vocational school applicants, where winners are 0.14 years younger than losers (column 6, Table 1).[[10]](#footnote-11) All results we present control for age, gender and having a phone.

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 four 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 four 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]](#footnote-12)

Colombia has comprehensive individual-level administrative data on secondary and tertiary education, female fertility, and labor market experiences. 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.

To track students’ educational outcomes, 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 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, whether the institution was public or private, and its selectivity measured by average percentile scores on the tertiary education entrance exam. Using the data, we can construct outcomes characterizing students’ trajectories throughout college (enrollment periods, dropout status and graduation). It also contains information on government financial aid receipt.

To track government subsidies’ eligibility, informal sector earnings and family formation outcomes we use:

3. *The SISBEN Census.* We use data from the SISBEN household census of 2010. Data from the SISBEN 2010 survey is used to construct and index score to determine eligibility for government subsidies.[[12]](#footnote-13) SISBEN 2010 covers 57 percent of households in all of Colombia and 39 percent of households in Bogotá.

To estimate scholarship impacts on earnings we complement SISBEN data with:

4. Colombia’s Social Protection Ministry’s *Sistema Integral de Información de la Protección Social­* (*SISPRO)*.[[13]](#footnote-14) SISPROis 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 SISPROonly 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. We use SISPRO data to examine additional outcomes, including: extensive and intensive margins of formal sector employment, formal sector earnings and payroll taxes.

On the whole, we are able to match close to 95 percent of applicants to any of the four 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:

where is an outcome variable for scholarship applicant *i,*  is an indicator variable for whether applicant *i* was awarded a private school scholarship through the lottery, 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 is an error term. Because students applied to private schools prior to the lottery, we can also estimate the main regression equation separately by the type of school to which they applied. Technically, 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.

1. **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.[[14]](#footnote-15) Scholarship lottery winners are 17 percent (7.6 percentage points) more likely to complete secondary school on time relative to the loser’s on-schedule completion rate of 45.2 percent (Panel A of Table 2).[[15]](#footnote-16) Point estimates of scholarship effects are slightly larger (both in percent and percentage point terms) among applicants to vocational schools.

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.[[16]](#footnote-17)

***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 lottery winners.[[17]](#footnote-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 (Appendix A Table).

Among vocational school applicants there is also evidence of gains in tertiary graduation rates and in total years of tertiary education.[[18]](#footnote-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.

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 by approximately 3 percentage points on a base of 3 percent. This seems to be taking place primarily in universities, private universities in particular rather than vocational colleges or public institutions.

1. **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, but that it nonetheless increased formal labor market earnings, and with it, payroll taxes with this effect concentrated among those applying to vocational schools. Data on self-reported earnings are only available for a subsample selected on the endogenous variable of location, as we discuss in subsection 5.3. In subsection 5.4 we discuss government subsidies receipt.

***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 lottery winners are about two percent more likely to be still enrolled in tertiary education during the periods we analyze, and 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.

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 (0.008 percentage points) more likely to *ever* appear in formal employment records during this period. However, this difference is not statistically significant (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 3).

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 4).

***5.2 Formal-sector earnings and payroll taxes***

Current annual formal earnings for scholarship lottery losers are, on average, $2,470 (including zeros).[[19]](#footnote-20),[[20]](#footnote-21) Scholarship lottery winners earn an additional $196 in formal annual earnings, an 8 percent increase (Panel A of Table 4). 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 4). 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.

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.

Relative to losers, scholarship lottery winners pay higher annual payroll taxes at around age 30. The OLS scholarship impact on payroll taxes is $55.1, which at the losers’ mean of $695.9 represents an increase of 8 percent (p-value 0.07).

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. Effects on payroll taxes among vocational applicants are stronger for males. Male losers pay $793 in annual payroll taxes at age 30 and winners pay $161 more, an increase of 20 percent.

The point estimates on formal earnings increases in Table 4 are too large to plausibly be explained fully by additional years of education. For instance, among vocational school applicants, lottery winners accumulate additional 0.19 years of tertiary education. Under the hypothesis that the wage gain was due entirely to additional years of education, this would imply an annual rate of return to a year of tertiary education of 89 percent, which is implausibly high. This suggests that education quality or labor-market matching may also have played a role. (It is also inconsistent with a Spence-type model in which years of schooling act as a signal).

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. 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 SISBEN and informal earnings***

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. The self-reported earnings are an aggregated measure that includes both formal and informal earnings. However, over two thirds of SISBEN respondents do not pay payroll taxes, so their total earnings are informal earnings.

Among scholarship lottery losers, we match 52 percent to SISBEN data. 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. The implication for bounding earnings effects of the scholarship is that adding in the approximately 5 percent of winners who moved out of the low-income SISBEN neighborhoods due to receiving the scholarship would likely increase reported earnings in the SISBEN, making the raw difference between SISBEN earnings among winners and lowers a lower bound on the voucher effect. We estimate an upper bound by trimming the top 5% of earners among losers.

Table 6 reports bounds on the scholarship effect on self-reported total 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 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.

***5.4 Government subsidies’ receipt***

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 other three largest government subsidy programs available for urban households: the two tiers of subsidized health care and early childhood care (Appendix B Table).[[21]](#footnote-22) Eligibility for subsidized health care is equivalent to utilization because take up is almost one hundred percent.

Eligibility for these programs is based on SISBEN scores and demographic characteristics such as having age-appropriate children.[[22]](#footnote-23) Applicants without SISBEN scores are not eligible to receive these subsidies so for applicants who do not show up in SISBEN 2010 subsidy receipt is zero.

We find no evidence suggesting that, in the full sample of applicants, by type of school, or by gender, winning the scholarship affects government welfare receipt of *Familias en Acción* and subsidized health care programs or eligibility for early childhood care.

1. **Scholarship Impacts on Teen Fertility**

Fertility outcomes are only observed for applicants who show up in the SISBEN 2010 data. As noted earlier, scholarship lottery winners have a lower likelihood of appearing in SISBEN 2010 data. We cannot, however, reject the null hypothesis that the variables that predict students showing up in SISBEN 2010 are the same for winners and losers in the full sample (Table 5). 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.[[23]](#footnote-24)

Conditional on showing up in the SISBEN 2010 dataset, winners are 18 percent (4.3 percentage points) less likely to have a child during their teenage years relative to the lottery losers’ mean of 23.4 percent. Among females, winning a scholarship reduces teen motherhood by at least 17 percent (6.5 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 32 percent (5.1 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 (Table 9, Panel A.)

These effects are concentrated among applicants to academic schools. Table 9, Panel B shows the results for academic applicants while panel C 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, although since our effects conditional on appearance in SISBEN are lower bounds, one should not conclude that there was no effect on fertility. At the time of SISBEN 2010, in which applicants are about twenty-eight years old, the average scholarship lottery loser has one child. Estimates on winning a scholarship are small and statistically insignificant although fairly precisely estimated. We also do not find any evidence of scholarship effects on total fertility when we examine the probability of have at least one, two or three children. 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. In addition to the caveat on bounds discussed above, another caveat to this finding is that impacts on total fertility may show up later in the potential childbearing years, so fertility gaps may appear later.

1. **Welfare Impacts**

In this section we quantify the program’s welfare impacts. Welfare impacts are the sum of: i) impacts on taxpayers (subsection 7.1),[[24]](#footnote-25) ii) impacts on scholarship recipients (subsection 7.2), and iii) externality impacts on others. We are not able to identify externality impacts on others; in subsection 7.3, however, we estimate how large net negative externalities would need to be to imply that the program is not welfare improving to society.[[25]](#footnote-26) 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.

***7.1 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]](#footnote-27) [[27]](#footnote-28)

**7.1.a. Costs associated with secondary school of attendance**

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 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]](#footnote-29) 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 and that 32 percent of them 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 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. As before, we assume constant deterioration over time.

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 in grades 6 to 11 who would have used the scholarship in the absence of the program (with these proportions computed in the aforementioned way). When we integrate over the usage patterns, we estimate 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 8).

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]](#footnote-30) 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]](#footnote-31) 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).

**7.1.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 C. 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 9th grade, so that total repetitions for this group are as reported Angrist et al. (2002). Under these assumptions, the cost savings from reduced grade repetition are $4 (Row 5).[[31]](#footnote-32) 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 student 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]](#footnote-33) 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 subsidy receipt (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 subsection 5.4. Therefore, additional welfare costs to the government are zero (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 6 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 scholarship impact on years of education times the average VAT rate of 13.3 percent,[[33]](#footnote-34) which equals $28 (Row 11).[[34]](#footnote-35)

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 represent a net transfer to the government.[[35]](#footnote-36) 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).

**7.1.c Government revenue**

There are two sources of future additional government revenue: additional revenue from VAT taxes and additional government revenue from payroll taxes. 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]](#footnote-37) 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).

Annual payroll taxes come from Table 4. 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. The NPV of additional government revenue from payroll taxes is this difference multiplied by 40 percent tax rate (see footnote 34). 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 NPV of additional government revenue, which we can reject to be zero in the full sample and among vocational school applicants with 90 percent confidence.

As noted earlier, effects on self-reported total earnings—which for over two thirds of SISBEN respondents who do not pay payroll taxes are informal 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 90 percent confidence interval on the net fiscal cost is $130 ($2,372 for academic school applicants and -$1,053 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]](#footnote-38)

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 ($256 for academic school applicants, -$1,786 for vocational school applicants, Row 15 minus Row 20).[[38]](#footnote-39) These gains are solely based on the tax revenue and ignore additional cost savings associated with teen-age pregnancy.

***7.2 Benefits to scholarship recipients***

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.[[39]](#footnote-40) 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 partially offset by effort costs and financial costs to beneficiaries.

***7.3 Benefits to society***

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 scholarship recipient (Row 23 of Table 8), we can say that the program is welfare improving for all applicants over a 90 percent confidence interval that is bounded away from zero. For vocational school applicants, we can say with 90 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 (see Row 23, Table 8).

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 the earnings gains to winners—particularly among applicants to vocational schools—to change the conclusions.

1. **Conclusion**

We present evidence on the long run educational, labor market, welfare, 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 0.06 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.

Winning a scholarship reduces females’ teen fertility by at least 17 percent or 6.5 percentage points. (The base rate is 38 percent).

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).[[40]](#footnote-41)

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 1 and 2 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). (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.)

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 (2016) 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 School Applicants | |  | Vocational School Applicants | | |
|  | Loser's Mean | Winning Voucher | Winning Voucher, Valid School Type Info |  | Loser's Mean | Winning Voucher |  | Loser's Mean | Winning Voucher |
|  | (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.

Table 2. Scholarship impacts on long run educational outcomes

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |
|  | All Applicants | |  | Academic School Applicants | |  | Vocational School Applicants | |
| **Outcome** | Loser's Mean | Won a Scholarship |  | Loser's Mean | Won a Scholarship |  | Loser's Mean | Won a Scholarship |
|  | (1) | (2) |  | (3) | (4) |  | (5) | (6) |
| *A. Secondary school completion (ICFES secondary graduation exam database)* | | | | | | | | |
| Applicant graduated on schedule | 0.452 | 0.076 |  | 0.455 | 0.071 |  | 0.473 | 0.083 |
|  |  | (0.016)\*\*\* |  |  | (0.021)\*\*\* |  |  | (0.025)\*\*\* |
| Applicant graduated with up to a two-year delay | 0.527 | 0.063 |  | 0.519 | 0.061 |  | 0.566 | 0.066 |
|  |  | (0.015)\*\*\* |  |  | (0.021)\*\*\* |  |  | (0.024)\*\*\* |
| Applicant graduated with up to a four-year delay | 0.552 | 0.055 |  | 0.544 | 0.051 |  | 0.587 | 0.065 |
|  |  | (0.015)\*\*\* |  |  | (0.021)\*\* |  |  | (0.024)\*\*\* |
| Applicant graduated with up to a six-year delay | 0.565 | 0.054 |  | 0.552 | 0.055 |  | 0.605 | 0.06 |
|  |  | (0.015)\*\*\* |  |  | (0.021)\*\*\* |  |  | (0.024)\*\* |
| *N* | 1519 | 3661 |  | 803 | 1901 |  | 613 | 1512 |
| *B. Tertiary enrollment and persistence (Tertiary education database)* | | | | | | | | |
| Ever enrolled in tertiary education | 0.189 | 0.024 |  | 0.194 | 0.000 |  | 0.188 | 0.07 |
|  |  | (0.013)\* |  |  | (0.018) |  |  | (0.021)\*\*\* |
| Ever enrolled in a vocational college | 0.066 | 0.014 |  | 0.071 | 0.006 |  | 0.064 | 0.028 |
|  |  | (0.009)\* |  |  | (0.012) |  |  | (0.014)\*\* |
| Ever enrolled in a university | 0.131 | 0.014 |  | 0.13 | -0.002 |  | 0.135 | 0.046 |
|  |  | (0.011) |  |  | (0.015) |  |  | (0.019)\*\* |
| Enrolled in tertiary education as of 2012 | 0.036 | 0.023 |  | 0.03 | 0.031 |  | 0.039 | 0.021 |
|  |  | (0.007)\*\*\* |  |  | (0.009)\*\*\* |  |  | (0.011)\* |
| Enrolled in vocational college as of 2012 | 0.009 | 0.003 |  | 0.01 | 0.002 |  | 0.007 | 0.006 |
|  |  | (0.003) |  |  | (0.005) |  |  | (0.005) |
| Enrolled in university as of 2012 | 0.027 | 0.02 |  | 0.02 | 0.03 |  | 0.033 | 0.016 |
|  |  | (0.006)\*\*\* |  |  | (0.008)\*\*\* |  |  | (0.01) |
| Enrolled in private institution as of 2012 | 0.03 | 0.018 |  | 0.025 | 0.027 |  | 0.038 | 0.012 |
|  |  | (0.006)\*\*\* |  |  | (0.009)\*\*\* |  |  | (0.011) |
| Enrolled in a public institution as of 2012 | 0.005 | 0.006 |  | 0.005 | 0.006 |  | 0.002 | 0.01 |
|  |  | (0.003)\*\* |  |  | (0.004) |  |  | (0.004)\*\* |
| Graduated from tertiary education as of 2012 | 0.05 | 0.006 |  | 0.054 | -0.008 |  | 0.049 | 0.024 |
|  |  | (0.007) |  |  | (0.01) |  |  | (0.012)\*\* |
| Years of tertiary education | 0.42 | 0.064 |  | 0.428 | -0.019 |  | 0.423 | 0.191 |
|  | (1.19) | (0.04) |  | (1.202) | (0.054) |  | (1.2) | (0.067)\*\*\* |
| Ever received government financial aid | 0.014 | 0.005 |  | 0.015 | 0 |  | 0.013 | 0.013 |
|  |  | (0.004) |  |  | (0.006) |  |  | (0.007)\* |
| *N* | 1519 | 3661 |  | 803 | 1901 |  | 613 | 1512 |

*Notes:* Table reports scholarship lottery loser’s means and estimated effects of winning a scholarship with application controls. Controls include age, male and 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 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 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. \* significant 10%, \*\* significant 5%, \*\*\* significant 1%.

Table 3. Match rates to SISPRO formal earnings data

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |
|  |  | | | | |  |
|  | All Applicants | | Academic School Applicants | | Vocational School Applicants | |
|  | (1) | (2) | (3) | (4) | (5) | (6) |
| Won a scholarship | 0.008 | -0.086 | 0.009 | -0.052 | 0.012 | -0.221 |
|  | (0.013) | (0.137) | (0.018) | (0.197) | (0.020) | (0.206) |
| Age \* won a scholarship |  | 0.005 |  | 0.003 |  | 0.017 |
|  |  | (0.010) |  | (0.015) |  | (0.016) |
| Phone \* won a scholarship |  | 0.041 |  | 0.053 |  | 0.015 |
|  |  | (0.041) |  | (0.054) |  | (0.065) |
| Male \* won a scholarship |  | -0.022 |  | -0.041 |  | 0.002 |
|  |  | (0.026) |  | (0.037) |  | (0.040) |
| 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 |

*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 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 application. SISPRO sample is from July 2008 to 2014.

Table 4. Scholarship impacts on formal sector employment intensity, earnings and payroll taxes

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |
|  | All | | Academic School Applicants | | Vocational School Applicants | |
|  | Loser's Mean (s.d) | Won a Scholarship, Application Controls (s.e) | Loser's Mean (s.d) | Won a Scholarship, Application Controls (s.e) | Loser's Mean (s.d) | Won a Scholarship, Application Controls (s.e) |
|  |  |  |  |  |  |  |
|  | (1) | (2) | (3) | (4) | (5) | (6) |
|  |  |  |  |  |  |  |
|  | *A. All applicants* | | | | | |
| Average annual formal sector tenure 2008-2014 (months) | 5.52 | 0.23 | 5.57 | 0.22 | 5.59 | 0.28 |
|  | (4.4) | (0.15) | (4.4) | (0.2) | (4.42) | (0.23) |
| Average Annual Formal Sector Earnings 2008-2014 | 2,470.5 | 196.0 | 2,462.5 | 31.4 | 2,568.3 | 427.0 |
|  | (3019.9) | (104.7)\* | (2986.2) | (132.7) | (3147.3) | (184)\*\* |
| Average Annual Payroll Taxes 2008-2014 | 695.9 | 55.1 | 694.2 | 3.9 | 723.5 | 125.3 |
|  | (880.1) | (30.4)\* | (878.6) | (38.7) | (908.4) | (53.3)\*\* |
|  | *B. Females* | | | | | |
| Average annual formal sector tenure 2008-2014 (months) | 5.17 | 0.26 | 5.22 | 0.29 | 5.32 | 0.12 |
|  | (4.41) | (0.2) | (4.38) | (0.28) | (4.49) | (0.32) |
| Average Annual Formal Sector Earnings 2008-2014 | 2,264.1 | 240.6 | 2,238.0 | 121.6 | 2,422.4 | 328.8 |
|  | (2826.9) | (143.4)\* | (2810.2) | (182.3) | (2941.1) | (248.4) |
| Average Annual Payroll Taxes 2008-2014 | 617.8 | 67.0 | 609.5 | 30.8 | 665.1 | 93.3 |
|  | (803.1) | (40.9)\* | (803.1) | (52.1) | (833.4) | (70.7) |
|  | *C. Males* | | | | | |
| Average annual formal sector tenure 2008-2014 (months) | 5.90 | 0.19 | 5.91 | 0.11 | 5.91 | 0.46 |
|  | (4.35) | (0.21) | (4.39) | (0.29) | (4.32) | (0.33) |
| Average Annual Formal Sector Earnings 2008-2014 | 2,687.7 | 146.9 | 2,685.8 | -64.7 | 2,743.0 | 535.3 |
|  | (3198.1) | (152.7) | (3139.2) | (191.9) | (3375) | (272.7)\*\* |
| Average Annual Payroll Taxes 2008-2014 | 778.1 | 41.9 | 778.5 | -24.5 | 793.3 | 160.8 |
|  | (948) | (45.2) | (941.2) | (57) | (987.9) | (80.5)\*\* |

*Notes:* Table reports scholarship lottery loser’s means and estimated effects of winning a scholarship on average annual months in formal sector employment, annual total formal sector earnings and annual payroll taxes. Monetary values are expressed in 2013 USD. Total payroll taxes include employer and employee contributions. Numbers in parentheses are standard deviations in columns of means and standard errors in columns of estimated scholarship effects. Controls include age, male and whether the applicant 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 July 2008 and end in December 2014 and is restricted to applicants with valid adult identification number that have complete application controls.\* significant 10%, \*\* significant 5% \*\*\* significant 1%.

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 |

*Notes:* Table reports scholarship lottery loser’s means and estimated effects of winning a scholarship on the probability of being matched SISBEN 2010 data 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 scholarship application.

Table 6. Bounds on self-reported earnings’ scholarship impacts

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |
|  | All | | Academic School Applicants | | Vocational School Applicants | |
|  | Loser's Mean | Won a Scholarship, Application Controls | Loser's Mean | Won a Scholarship, Application Controls | Loser's Mean | Won a Scholarship, Application Controls |
|  | (1) | (2) | (3) | (4) | (5) | (6) |
|  |  |  |  |  |  |  |
|  | *A. All applicants* | | | | | |
| Lower bound on self-reported annual earnings (without trimming losers) | 2,517.9 | -139.6 | 2,699.6 | -311.6 | 2,359.6 | 14.2 |
|  | (218.4) |  | (399.1) |  | (165.5) |
| Upper bound on self-reported annual earnings (trimming top 5% of losers) | 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 on self-reported annual earnings (without trimming losers) | 1,944.1 | 0.5 | 1,894.0 | 31.6 | 2,082.1 | -71.9 |
|  | (138.6) |  | (166.6) |  | (251.6) |
| Upper bound on self-reported annual earnings (trimming top 5% of losers) | 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 on self-reported annual earnings (without trimming losers) | 3,198.5 | -311.7 | 3,567.6 | -765.8 | 2,749.0 | 154.4 |
|  | (446.3) |  | (845.0) |  | (183.1) |
| Upper bound on self-reported annual earnings (trimming top 5% of losers) | 2,439.6 | 440.5 | 2,461.0 | 366.7 | 2,581.7 | 324.5 |
|  | (111.8)\*\*\* |  | (158.1)\*\* |  | (175.8)\* |

Notes: Table reports scholarship lottery loser’s means and bounds of the effects of winning a scholarship on informal annual earnings expressed in 2013 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. Upper bound earnings from an OLS regression in which SISBEN earnings from the top 5 percent of scholarship losers are trimmed from the sample. Controls include age, male and whether the applicant had a phone number at the time of scholarship application. Robust standard errors in parentheses. \* significant 10%, \*\* significant 5%.

Table 7. Scholarship effects on fertility

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |
|  | All | | Academic School Applicants | | Vocational School Applicants | |
|  | Loser's Mean (s.d) | Won a Scholarship, Application Controls (s.e) | Loser's Mean (s.d) | Won a Scholarship, Application Controls (s.e) | Loser's Mean (s.d) | Won a Scholarship, Application Controls (s.e) |
|  |  |  |  |  |  |  |
|  | (1) | (2) | (3) | (4) | (5) | (6) |
|  |  |  |  |  |  |  |
|  | *A. All applicants* | | | | | |
| Had any child as a teen | 0.234 | -0.043 | 0.240 | -0.064 | 0.224 | -0.023 |
|  | (0.424) | (0.018)\*\* | (0.427) | (0.025)\*\* | (0.418) | (0.029) |
| Spouse/partner had a child as a teen | 0.106 | -0.030 | 0.111 | -0.034 | 0.087 | -0.019 |
|  | (0.308) | (0.014)\*\* | (0.315) | (0.02)\* | (0.283) | (0.02) |
| Total number of children | 1.061 | -0.040 | 1.047 | -0.016 | 1.006 | 0.013 |
|  | (1.034) | (0.045) | (1.022) | (0.063) | (0.981) | (0.067) |
| One or more children | 0.634 | -0.013 | 0.627 | -0.011 | 0.629 | 0.003 |
|  | (0.482) | (0.022) | (0.484) | (0.031) | (0.484) | (0.034) |
| Two or more children | 0.321 | -0.021 | 0.316 | -0.007 | 0.299 | -0.017 |
|  | (0.467) | (0.021) | (0.466) | (0.03) | (0.459) | (0.032) |
| Three or more children | 0.081 | -0.004 | 0.084 | -0.002 | 0.059 | 0.020 |
|  | (0.272) | (0.012) | (0.278) | (0.018) | (0.236) | (0.017) |
|  | *B. Females* | | | | | |
| Had any child as a teen | 0.377 | -0.065 | 0.402 | -0.105 | 0.337 | -0.035 |
|  | (0.485) | (0.031)\*\* | (0.492) | (0.045)\*\* | (0.474) | (0.047) |
| Spouse/partner had a child as a teen | 0.056 | -0.011 | 0.055 | -0.007 | 0.043 | -0.010 |
|  | (0.231) | (0.015) | (0.229) | (0.021) | (0.204) | (0.02) |
| Total number of children | 1.355 | -0.023 | 1.367 | 0.019 | 1.250 | 0.021 |
|  | (1.031) | (0.065) | (1.021) | (0.092) | (0.993) | (0.095) |
| One or more children | 0.778 | -0.011 | 0.784 | 0.004 | 0.755 | -0.009 |
|  | (0.416) | (0.027) | (0.413) | (0.039) | (0.431) | (0.042) |
| Two or more children | 0.433 | -0.025 | 0.437 | -0.013 | 0.386 | -0.020 |
|  | (0.496) | (0.031) | (0.497) | (0.045) | (0.488) | (0.047) |
| Three or more children | 0.108 | 0.010 | 0.111 | 0.017 | 0.082 | 0.038 |
|  | (0.31) | (0.02) | (0.314) | (0.03) | (0.274) | (0.028) |
|  | *C. Males* | | | | | |
| Had any child as a teen | 0.078 | -0.020 | 0.083 | -0.022 | 0.073 | -0.007 |
|  | (0.268) | (0.018) | (0.276) | (0.024) | (0.261) | (0.028) |
| Spouse/partner had a child as a teen | 0.161 | -0.051 | 0.165 | -0.058 | 0.146 | -0.031 |
|  | (0.368) | (0.024)\*\* | (0.372) | (0.033)\* | (0.354) | (0.038) |
| Total number of children | 0.740 | -0.061 | 0.738 | -0.033 | 0.679 | 0.003 |
|  | (0.939) | (0.062) | (0.926) | (0.086) | (0.865) | (0.092) |
| One or more children | 0.477 | -0.015 | 0.476 | -0.022 | 0.460 | 0.020 |
|  | (0.5) | (0.034) | (0.501) | (0.047) | (0.5) | (0.055) |
| Two or more children | 0.198 | -0.017 | 0.199 | 0.008 | 0.182 | -0.013 |
|  | (0.399) | (0.027) | (0.4) | (0.038) | (0.388) | (0.042) |
| Three or more children | 0.051 | -0.019 | 0.058 | -0.017 | 0.029 | -0.003 |
|  | (0.22) | (0.014) | (0.235) | (0.021) | (0.169) | (0.017) |

*Notes:* Table reports scholarship lottery loser’s means and estimated effects of winning a scholarship fertility outcomes based on SISBEN 2010 data. Estimates in columns 2, 4, and 6 are from linear probability models. 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 8. Fiscal impacts of scholarships

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |
|  |  | **All Applicants** | | **Academic School Applicants** | | **Vocational School Applicants** | | **Notes** |
|  |  | **Estimate** | **90% C.I.** | **Estimate** | **90% C.I.** | **Estimate** | **90% C.I.** |  |
| Row # | *A. Government Costs* |  |  |  |  |  |  |  |
|  | *Secondary Education Costs* |  |  |  |  |  |  |  |
| 1 | Annual per-pupil cost of public school | $ 449 |  | $ 449 |  | $ 449 |  | From Angrist et al. (2002), converted to 2013 dollars |
| 2 | Annual value of PACES scholarship | $ 244 |  | $ 244 |  | $ 244 |  | 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 |  | $ 472 |  | $ 474 |  | 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 |  | -$ 175 |  | -$ 175 |  | (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 | (-$ 5 , $ 4) | -$ 4 | (-$5 , -$3) | -$ 4 | (-$5 , -$3) | See Appendix C |
| 6 | Total secondary education costs to the government | $ 293 | ($ 293 , $ 294) | $ 293 | ($ 292 , $ 294) | $ 295 | ($ 294 , $ 296) | Row (3) + Row (4) + Row (5) |
|  | *Tertiary Education Costs* |  |  |  |  |  |  |  |
| 7 | Additional public tertiary education costs | $ 11 | (-$2 , $ 24) | -$ 6 | (-$24 , $ 11) | $ 37 | ($ 12 , $ 68) | 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 | (-$6 , $ 14) | -$ 6 | (-$18 , $6) | $ 18 | ($ 1 , $ 35) | 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 | ($ 5 , $ 34) | -$ 12 | (-$35 , $ 12) | $ 55 | ($ 21 , $ 92) | Row (7) + Row (8) |
|  | *Welfare Receipt Costs* |  |  |  |  |  |  |  |
| 10 | Additional CCT receipt costs | $ 0 | (-$4 , $ 3) | $ 0 | (-$4 , $ 4) | -$ 2 | (-$7 , $ 2) | 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 | $ 28 | ($ 27 , $ 29) | $ 28 | ($ 26 , $ 30) | $ 29 | ($ 27 , $ 31) | Formal annual earnings of losers\* Scholarship impact on years of education \*VAT tax of 13.3% |
| 12 | Foregone net government transfers through payroll taxes | $ 24 | ($ 22 , $ 25) | $ 24 | ($ 22 , $ 25) | $ 25 | ($ 23 , $ 27) | Annual payroll taxes of losers\* Scholarship impact on years of education \*0.4 |
| 13 | Total foregone revenue | $ 52 | ($ 49 - $ 54) | $ 51 | ($ 48 - $ 55) | $ 54 | ($ 49 - $ 58) | Row (11) + Row (12) |
| 14 | **Expected scholarship costs to government** | **$ 360** | **($ 340 , $ 378)** | **$ 333** | **($ 312 , $ 356)** | **$ 401** | **($ 367 , $ 436)** | Row (6) + Row (9) + Row (10) + Row (13) |
| 15 | Expected scholarship costs to government, 6% discount rate | $ 319 | ($ 305 , $ 332) | $ 300 | ($ 286 , $ 316) | $ 348 | ($ 324 , $ 374) | Same calculations as above using 6% discount rate |
|  | *B. Government Revenue* |  |  |  |  |  |  |  |
| 16 | Additional VAT tax revenue | $ 1,098 | ($ 136 , $ 2,125) | $ 151 | (-$1,065 , $ 1,438) | $ 2,417 | ($ 766 , $ 4,176) | Additional earnings of scholarship winners (see notes below) \* VAT tax of 13.3% |
| 17 | Additional government transfers through payroll taxes | $ 929 | ($ 94 , $ 1,813) | $ 45 | (-$1,037 , $ 1,156) | $ 2,135 | ($ 672 , $ 3,657) | Additional payroll taxes of scholarship winners (see notes below) \* 0.4 |
| 18 | **Additional government revenue** | **$ 2,027** | **($ 226 , $ 3,952)** | **$ 196** | **(-$2,040 , $ 2,583)** | **$ 4,551** | **($ 1,451 , $ 7,811)** | Row (16) + Row (17) |
| 19 | Additional government revenue, 6% discount rate | $ 1,543 | ($ 172 , $ 3,009) | $ 150 | (-$1,553 , $ 1,967) | $ 3,465 | ($ 1,105 , $ 5,947) | Same calculations as above using 6% discount rate |
| 20 | Additional government revenue, no VAT revenue | $ 929 | ($ 94 , $ 1,813) | $ 45 | (-$1,037 , $ 1,156) | $ 2,135 | ($ 672 , $ 3,657) | Assume VAT revenue is zero |
| 21 | **Expected net fiscal cost to taxpayers** | -$ 1,667 | (-$3,596 , $ 130) | $ 136 | (-$2,236 , $ 2,372) | -$ 4,151 | (-$7,409 , -$1,053) | Row (14) - Row (18) |
|  | *C. Gains to Recipients and Society* |  |  |  |  |  |  |  |
| **22** | **Net gains to scholarship recipients** | **$ 249** |  | **$ 249** |  | **$ 250** |  | 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** | **($ 119 , $ 3,845)** | **$ 112** | **(-$2,124 , $ 2,484)** | **$ 4,400** | **($ 1,303 , $ 7,659)** | Row (22) - Row (21) |

*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. For Expenditure from scholarship costs for students who would have enrolled in private school, aggregated over 6 years: 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 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 1923.83/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 confidence interval for each calculation using the bootstrap.

Appendix A. Scholarship impacts on long run tertiary education outcomes by gender

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | All Applicants | |  | Academic School Applicants | |  | Vocational School Applicants | |
| **Outcome** | Loser's Mean | Won a Scholarship |  | Loser's Mean | Won a Scholarship |  | Loser's Mean | Won a 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 education as of 2012 | 0.039 | 0.027 |  | 0.033 | 0.033 |  | 0.048 | 0.022 |
|  |  | (0.01)\*\*\* |  |  | (0.014)\*\* |  |  | (0.017) |
| Enrolled in vocational college as of 2012 | 0.012 | -0.002 |  | 0.013 | -0.005 |  | 0.012 | 0 |
|  |  | (0.005) |  |  | (0.007) |  |  | (0.008) |
| Enrolled in university as of 2012 | 0.027 | 0.029 |  | 0.02 | 0.039 |  | 0.036 | 0.022 |
|  |  | (0.009)\*\*\* |  |  | (0.012)\*\*\* |  |  | (0.015) |
| Enrolled in private institution as of 2012 | 0.034 | 0.024 |  | 0.028 | 0.029 |  | 0.045 | 0.019 |
|  |  | (0.01)\*\* |  |  | (0.013)\*\* |  |  | (0.016) |
| Enrolled in a public institution as of 2012 | 0.005 | 0.004 |  | 0.005 | 0.004 |  | 0.003 | 0.003 |
|  |  | (0.004) |  |  | (0.005) |  |  | (0.005) |
| Graduated from tertiary education 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)\* |
| Ever received government financial aid | 0.017 | 0.008 |  | 0.018 | 0.004 |  | 0.015 | 0.015 |
|  |  | (0.007) |  |  | (0.009) |  |  | (0.01) |
| *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) |
| Enrolled in vocational college as of 2012 | 0.005 | 0.007 |  | 0.007 | 0.008 |  | 0.000 | 0.011 |
|  |  | (0.004)\* |  |  | (0.007) |  |  | (0.005)\*\* |
| Enrolled in university as of 2012 | 0.027 | 0.011 |  | 0.02 | 0.021 |  | 0.029 | 0.009 |
|  |  | (0.008) |  |  | (0.011)\* |  |  | (0.014) |
| Enrolled in private institution as of 2012 | 0.027 | 0.012 |  | 0.022 | 0.025 |  | 0.029 | 0.003 |
|  |  | (0.008) |  |  | (0.011)\*\* |  |  | (0.013) |
| Enrolled in a public institution as of 2012 | 0.005 | 0.008 |  | 0.005 | 0.008 |  | 0.000 | 0.018 |
|  |  | (0.004)\* |  |  | (0.006) |  |  | (0.006)\*\*\* |
| 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)\*\* |
| Ever received government financial aid | 0.011 | 0.003 |  | 0.012 | -0.003 |  | 0.011 | 0.011 |
|  |  | (0.005) |  |  | (0.007) |  |  | (0.009) |
| *N* | 744 | 1816 |  | 405 | 968 |  | 280 | 720 |

*Notes:* Table reports scholarship lottery loser’s means and estimated effects of winning a scholarship with application controls. Controls include age, male and 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 parentheses are robust standard errors in columns of estimated scholarship effects. \* significant 10%, \*\* significant 5%, \*\*\* significant 1%.

Appendix B. Scholarship impacts on government subsidy receipt

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

*Notes:* Table reports scholarship lottery loser’s means and estimated effects of winning a scholarship with application controls. Controls include age, male and 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 parentheses are robust standard errors in columns of estimated scholarship effects. Receipt of Familias en Acción CCT program is based on having SISBEN 2010 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 SISBEN 2010 scores below the eligibility cutoff. Applicants who are not in SISBEN 2010 cannot receive these subsidies so for them receipt is zero.

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

This appendix explains how we calculate cost savings to the government from reduced grade repetition. We observe public school attendance and repetitions through grade 8 from Table 4 in Angrist et al. (2002) and whether the applicant finished secondary school on time, with delays or did not finish (Table 2 in main text).

To calculate the cost-savings from reduced grade repetition, we assume that: i) only public school repetitions cost the government money, ii) among applicants who finish on-schedule, there is no repetition; ii) among applicants who finish with delays, the delays are all a consequence of grade repetition and iii) among those who never finish secondary school, all dropouts occurred in 9th grade, so that total repetitions for this group are the ones reported in Table 4 columns 2 and 4 of Angrist et al. 2002. This last assumption understates the cost savings given that we ignore additional costs the government would have incurred if dropout had occurred later.

There are three types of students: those who finish on time; those who finish with delays; and those who never finish. For those who finish on time, the government receives no cost savings. For those who pass with delays, the government saves from reduced grade repetition in the public sector. We multiply public school costs by the fraction in public schools and by the overall reduction in grade repetitions to estimate these cost benefits. For those who never graduate, we only record the savings from grade repetition after three years. As before, we multiply public school costs by the fraction in public by the effect of the scholarship on repetitions after three years. We use data from Angrist et al (2002) to compute these effects and the fractions in public. Again, we underestimate the likely savings given that we know that more attrition from private schools happened after 8th grade and hence might have increased the probability that post-8th grade retention occurred in public rather than private schools.

Based on estimates from Table 2, Table C1 shows the distribution of secondary school completion outcomes for scholarship winners and losers, separately by gender:

For those who complete secondary school with delays, since we assume that the delay is all a consequence of grade repetition, the reduction in grade repetition as a consequence of winning the scholarship is 0.093 – 0.102 = -0.01 for females and 0.090 – 0.123 = -0.033 for males. Annual cost-savings from reduced grade repetition in this group is annual per-pupil public school costs (from Table 8), times the fraction of lottery losers who attend public school, times reduction in the probability of grade repetition. For females this is: $449.08 \* 0.284 \* (-0.01) = - $1.28 and for males it is $449.08 \* 0.300 \* (-0.03) = - $4.44. Note that the figures are reported as negative numbers indicating negative costs (i.e. cost savings).

Table C1. 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 |

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

We need to multiply these annual amounts by the number of extra years that it takes for winners to graduate from secondary school among those that graduate with delays. Table C2 shows the distribution of delayed graduation, which we obtain from Table 2 in the main text. Using the distribution of delayed graduation in Table C2 and the annual cost-savings from reduced grade repetition, we get the cost savings from grade repetition among scholarship winners who complete secondary school with delays. For females this is: - [$1.28\*2 years\*0.67 (conditional on delay, the fraction who completes with a two-year delay) + $1.28\*4 years\*0.16 (fraction who completes with 4-year delay) + $1.28\*6 years\*0.17 (fraction who completes with a 6-year delay)] = - $3.84. For males it is: - [$4.44\*2 years\*0.69 + $4.44\*4 years\*0.21 + $4.44\*6 years\*0.10] = - $12.52.

For scholarship winners who never complete secondary school, we assume that they dropped out in 9th grade so the reduction in the total number of repetitions is the one reported by Angrist et al (2002) in Table 4 for the Bogotá sample with controls, which is -0.031 for females and -0.101 for males. Therefore, cost-savings for those who never complete is $449.08\*0.284\*(-0.031) = -$3.95 for females and $449.08\*0.300\*(-0.101) = -$13.61 for males.

Total cost-savings from reduced grade repetition among scholarship winners is the weighted sum of the cost-savings among those who complete secondary school with delays and those who never complete. The weights are given by the fraction of scholarship winners who complete secondary school with delays and who never complete, from Table C1. For females, we have that total cost-savings are [-$3.84\* 0.095 - $3.95\*0.347] = -$1.76. For males, total cost-savings from reduced grade repetition are [-$12.52\*0.090 -$13.61\*0.415] = -$6.78.

Table C2. 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% |

Notes: The first row is from Table C1. The remaining rows are from Table 2 in the main text.

1. The 90% confidence interval is bounded away from zero. [↑](#footnote-ref-2)
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). [↑](#footnote-ref-3)
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. [↑](#footnote-ref-4)
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. [↑](#footnote-ref-5)
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. However, the concentration of effects at the top of the distribution is consistent with the hypothesis of complementarity with initial human capital. [↑](#footnote-ref-6)
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. [↑](#footnote-ref-7)
7. See, for example, Hendren 2013 and Baird, Hicks, Kremer and Miguel 2013. [↑](#footnote-ref-8)
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. [↑](#footnote-ref-9)
9. The finding that scholarship winners have lower peer quality is not unique to Colombia. Hoxby (2003) makes a similar point in reviewing the literature on school choice and competition in the US. Participants in school choice programs often have lower peer quality after exercising choice. [↑](#footnote-ref-10)
10. Angrist, Bettinger, Bloom, King, and Kremer (2002) discuss this imbalance in applicant age in greater detail. [↑](#footnote-ref-11)
11. Youth and adult identification numbers were linked using administrative data from Colombia’s national registrar’s office and the Department of National Planning. [↑](#footnote-ref-12)
12. We observe actual receipt of tertiary education loan subsidies in the tertiary education database. For the other subsidies we only observe eligibility as 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). [↑](#footnote-ref-13)
13. 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). [↑](#footnote-ref-14)
14. 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. [↑](#footnote-ref-15)
15. 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. [↑](#footnote-ref-16)
16. 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. [↑](#footnote-ref-17)
17. 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 Appendix A). [↑](#footnote-ref-18)
18. 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. [↑](#footnote-ref-19)
19. 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. [↑](#footnote-ref-20)
20. 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. [↑](#footnote-ref-21)
21. 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. [↑](#footnote-ref-22)
22. 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. [↑](#footnote-ref-23)
23. Evidence from Angrist et al. (2002) supports the notion that the teenage childbearing effects among female applicants are likely a lower bound. Among applicants to the Bogotá 1995 lottery cohort, lottery winners were close to 30 percent less likely to have had a child three years after the lottery, although the effect was not statistically significant at conventional levels. Selection, however, was also a concern in their sample. Surveys were conditional on applicants having a phone and the Angrist et al. (2002) sample had a two-percentage point difference in survey response rates between scholarship lottery winners and losers—55 percent response rate for lottery winners and 53 percent for losers—which is similar to what we find in the SISBEN sample (Table 3). The fact that results in samples with different potential sources of selection are consistent yields additional credence to our fertility findings. [↑](#footnote-ref-24)
24. For example, see Hendren 2013; Baird et al. 2013. [↑](#footnote-ref-25)
25. 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. [↑](#footnote-ref-26)
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. [↑](#footnote-ref-27)
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 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. [↑](#footnote-ref-28)
28. These students may have repeated grades, transferred schools, or voluntary given up the scholarship. [↑](#footnote-ref-29)
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. [↑](#footnote-ref-30)
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. [↑](#footnote-ref-31)
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. [↑](#footnote-ref-32)
32. Annual tertiary education subsidy data come from ICETEX (2014). [↑](#footnote-ref-33)
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. [↑](#footnote-ref-34)
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. [↑](#footnote-ref-35)
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. [↑](#footnote-ref-36)
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). [↑](#footnote-ref-37)
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). [↑](#footnote-ref-38)
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. [↑](#footnote-ref-39)
39. 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). [↑](#footnote-ref-40)
40. 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. [↑](#footnote-ref-41)