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Experimentally Estimated Impacts of School Voucher on Educational Attainments of Moderately and Severely Disadvantaged Students

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Abstract

Estimates of school voucher impacts on educational attainment have yet to explore heterogeneities in socioeconomic status among disadvantaged minority students. We theorize reasons for these heterogeneities and then estimate experimentally the differential impacts of voucher offers on college enrollment and graduation rates for minority and non-immigrant students from moderately and severely disadvantaged backgrounds. The findings are obtained from a privately sponsored, lottery-based voucher intervention in New York City that began in 1997. College enrollment and degree attainment as of the fall of 2017 were obtained from the National Student Clearinghouse. We find no significant effects of offers on minority students from severely disadvantaged backgrounds but significant effects of six to eight percentage points on those from moderately disadvantaged households. Similar results are obtained for students born of non-immigrant mothers. Some policy implications are discussed.

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Experimentally Estimated Impacts of School Vouchers on Educational Attainments of Moderately and Severely Disadvantaged Students

The eligibility criteria for most school choice interventions in the United States are usually broad enough to include students from both moderately and extremely disadvantaged households. Educational outcomes for students differ widely across these two populations. For instance, college enrollment and degree attainment rates for students from households in the second quartile of the income distribution are about two times higher than for those in the bottom quartile (Bailey and Dynarski 2011). Wilson (1991; 2012) and others have drawn clear distinctions between the moderately and "truly" disadvantaged, while critiques of school vouchers have suggested that choice schools "cream" the relatively advantaged within the low-income population (Wells and Scott, 2001). Yet prior research on private-school vouchers has generally not reported long-term impacts on educational attainment separately for different segments of the low socioeconomic status (SES) population.

In this paper we build on Author DATE by estimating heterogeneous school voucher effects on college enrollment and completion for moderately and extremely disadvantaged segments of the minority and non-immigrant community. These effects are estimated for the voucher program initiated by the New York City School Choice Scholarships Foundation (SCSF) in 1997. SCSF specified that applicants must be entering first through fourth grades and are eligible for participation in the federal free and reduced-price lunch program, a household income threshold set at 185 percent of the poverty line (Author DATE). Information on the offer of a voucher in a lottery is combined with data on postsecondary enrollment and degree attainment information provided by the National Student Clearinghouse as of the fall of 2017.

Our data on college enrollments and completion was gathered four years after the collection of outcome data reported in Author DATE. During the intervening period, many students who had experienced interruptions in their education persisted to graduation, and the bachelor's degree attainment rate for students in the control group increased by six percentage points. Despite that change in overall graduation rates, we confirm the findings reported in the earlier study that vouchers had no overall impact on educational attainment rates but did positively impact graduation rates of students from minority and non-immigrant households. However, we now observe that those positive impacts are concentrated on students from moderately disadvantaged households. Statistically significant intent-to-treat impacts on graduation rates of about 6 to 8 percentage points are observed for minority students from moderately disadvantaged backgrounds. When treatment-on-the-treated effects on minority students are estimated, graduation rates for this group increase by as much as 42 percent to 68 percent of control-group rates. However, we detect no significant voucher effects for students living in very low income households or in families where neither parent had attended college.

Theoretical Framework and Literature Review

College enrollment rates vary substantially for students from moderately low-income and extremely low-income households. Theoretical and qualitative empirical research suggest that the ability of families to exploit opportunities for social mobility differ sharply between those who have modest material and cultural resources and those who are extremely deprived (Bourdieu, 1986; Wilson, 1991). Yet few quantitative studies of the consequences of school choice opportunities for educational attainment report heterogeneous effects by SES within low-income or minority communities.

Moderate vs. Extreme Levels of Disadvantage

The correlation between SES and educational attainment is well documented (Buchmann and DiPrete, 2006; Chetty et al. 2017, Author DATE; Park and Hessler, 2014; Reardon, 2013; Vigdor and Ludwig, 2008;). Bailey and Dynarski (2011) show large disparities arise with even moderate increments in household income. Only 29 percent of high school students born between 1979 and 1982 enrolled in college if they lived in households in the lowest quartile of the distribution. But 42 percent of this cohort enrolled in college if they lived in households in the second lowest quartile. Four-year completion rates were even more sharply differentiated. Only 9 percent of those in the lowest quartile graduated, while 21 percent of those in the second quartile did. Of those who enrolled in college, 32 percent of the lowest quartile persisted through to graduation, while 44 percent of those in the second quartile finished.

Qualitative researchers have explored potential factors that might induce such variation. Wilson (1991), in a classic study, distinguishes between the moderately poor and those he characterizes as "the truly disadvantaged":

> The ghetto features a population, the underclass, whose primary predicament is joblessness reinforced by growing social isolation. Outmigration has decreased the contact between groups of different class and racial backgrounds and thereby concentrated the adverse effects of living in impoverished neighborhoods. These concentration effects, reflected, for example, in the residents' self-limiting social dispositions, are created by inadequate access to jobs and job networks, the lack of involvement in quality schools, the unavailability of suitable marriage partners, and the lack of exposure to informal mainstream social networks and conventional role models (p. 462).

Wilson's study provides a structural context for understanding distinctions drawn in earlier research (Miller, 1958; Lewis, 1961, 1966). Hannerz (1969), for example, drew a sharp contrast between those in an inner-city neighborhood that he labeled "mainstreamers" and "street families." The former, he says, are "stable working-class people" who "conform most closely to mainstream American assumptions about the 'normal' life." The mainstreamers "generally spend much time at home" and, if the parents have school-age children, they "try to see to it that home work gets done." By contrast, the street families "are conspicuous in the open-air life of ghetto street corners and sidewalks". Males "usually hold low-paying, unskilled jobs and are sometimes unemployed." As a consequence, "street families have a lower average income than mainstreamer families, and a great number of them fall below the poverty line" (p. 46-55).

Similarly, Anderson (1991), distinguishes between "two lifestyles" that "tug at young people of underclass neighborhoods." On the one side, there is "the stable 'decent' family with its belief in upward mobility. . . . [On the other side, there is] the street culture, which revolves around violence, drugs, sex, having babies out of wedlock, and other problem behavior…. Those who are not well supervised and raised with optimism toward the future may linger in the street culture and may eventually succumb to its standards." But "young people who are raised with a sense of opportunity and are able to realistically to picture a better life are often successful in avoiding the draw of the street culture" (p. 395).

Private-School Vouchers and the truly disadvantaged

The case for concentrating voucher opportunities on those from low-income families derives from the undeniable fact that students from such households lack equitable access to educational opportunity relative to higher-income families (Wolf, 2010). Yet income eligibility requirements for most private-school voucher interventions are broad enough to allow for

participation by both the truly disadvantaged and those that are less so. For example, families with incomes as much as 75 percent above the official poverty line eligible to participate in the U.S.'s first private-school voucher intervention in Milwaukee (GAO, 2001). Other programs prioritize or offer vouchers to those from households with incomes ranging between 100 and 250 percent of the official poverty line (Author DATE; Mills and Wolf, 2015; Waddington and Berends, 2018; Wolf et al., 2013).

Some scholars have argued that "truly disadvantaged" students will find it difficult to benefit from attending a private school of choice. Wells and Scott (2001) report that "students who were not trying hard enough, were frequently tardy or absent, wore the wrong clothes, or misbehaved (as defined by the school's conduct code) could be kicked out" (p.252). In Bryk et al.'s (1993) study of Catholic schools, the authors say students, to remain, must conform to school expectations:

> Implicit here is the idea that participation in a particular school is not an inalienable right. Catholic school faculty go to great length to help students and work with parents, but reciprocity is also expected. Students who seriously or chronically violate the community's norms must leave. Indeed, students are more likely to exit for this reason than for poor academic performance. (p. 313)

The same is true for charter schools that set high expectations for students and families. As Robert Pondiscio (2019) observes:

> the common criticism [of charter schools] is that they 'cream students,' attracting bright children, and shedding the poorly behaved and hardest to teach. This misses the mark. [These schools are] *creaming parents.* Parents who are not put off by uniforms, homework, reading logs, and constant demands on their time…. Parents who are not

> upset by tight discipline and suspensions but grateful for it, viewing it as a safe haven from chaotic streets and schools. (p. 242)

In sum, students from households that lack the cultural capital to exploit opportunities to exercise school choice may not benefit from such programs.

Voucher impacts on attainment

Research on voucher impacts on student test-score performance report mixed (Mills, and Wolf, 2015; Shakeel et al., 2016). Those studies have been recently augmented by research that estimates impacts on educational attainment. For example, Author DATE find that participation in the Florida tax-credit program, which gives scholarships to low-income students to attend private schools, increases enrollment rates at Florida public colleges by six percentage points. However, they identify no significant impacts on two-year degree attainment at Florida colleges and are unable to estimate impacts on four-year degree attainment. Author DATE finds no voucher impact on college enrollment in the Washington, D.C. voucher program, but he is unable to estimate impacts on B.A. degree acquisition. Wolf et al. (2018) report that voucher students in Milwaukee were more likely to enroll in college but no more likely to complete college than a matched comparison group.

These evaluations of impacts on attainment seldom distinguish between impacts on those from moderately and extremely deprived backgrounds. The only study that ventured into this space found positive effects on high school graduation concentrated on those who had higher levels of academic performance prior to participation in the program (Wolf et al., 2013). Otherwise, the topic, to the best of our knowledge, remains virgin territory.

Methodology

We estimate heterogeneity by SES experimentally with data from a 1997 SCSF offer of a voucher to low-income elementary school students in New York City on college enrollment and graduation rates as of the fall of 2017. After estimating overall effects to replicate earlier findings of SCSF, we test for these heterogeneous effects by including an interaction term which differentiates minority and non-immigrant students from moderately disadvantaged backgrounds with those from extremely disadvantaged backgrounds. Indeed, as prior research has theorized and documented, it is the intersection of race and class that places particular segments of the population at a deeper disadvantage (Bourdieu 1986; Lubienski, 2002; Wilson, 1991). Following prior research that has also explored these dynamics (Buchmann and DiPrete, 2006; Author DATE; Park and Hossler, 2014; Perna and Titus, 2005; Rowan-Kenyon, 2007), we test for treatment effects among ethnic minorities or those from non-immigrant households by income and parental education.

New York SCSF Program

In the spring of 1997, SCSF offered three-year half-tuition scholarships worth up to $2,380 (2019 dollars) annually[2] to 1,000 low-income families with children who were entering first through fifth grades.[3] Program eligibility was limited to those who came from "families with incomes such that they qualified for the U.S. government's free [and reduced price] school lunch program" (Author DATE). A student from a household that was at as much as 185 percent of the poverty line was eligible for participation in the program. The SCSF scholarship program was promoted in low-income neighborhoods during the application period, and, as a result, over 25,000 students applied. Preference was given to those of very low income; 51 percent of the

[2] $1,500 in current dollars. Unless otherwise indicated, all dollar amounts are given in 2019 dollars.
[3] Although the initial voucher offer was for three years, scholarships continued through the end of eighth grade to students who remained continuously in the private sector.

sample consisted of students from households with incomes of less than $12,900 a year (see Table 1).

A recipient could use the voucher to attend a private school in New York City. Because the number of applications for a voucher exceeded the available number of vouchers being offered, random lotteries were held to determine whether a student received a voucher. Over two-thirds of those receiving an offer initially chose to attend a Catholic school. Additional details of the program and evaluation procedures associated with the program can be found in Author DATE.

Data

We link individual-level lottery data from SCSF to college enrollment and completion data provided by the National Student Clearinghouse (NSC). The enrollment status for every academic term and postsecondary institution that a student attended as well as whether the student earned a degree is reported in the NSC. Among the 2,666 students in the study population, 2,634 students had the information (name and date of birth) needed to attempt a match to the NSC data.[4] In the analytic sample, 1,356 students were assigned to the treatment group and 1,278 students were assigned to the control group. Minority students constitute 85 percent of the sample, and students with U.S.-born mothers constitute 61 percent of all those for whom immigrant status is known. Those attending low-performing public schools were given a better chance of winning the lottery, increasing the number of observations of those from extremely disadvantaged backgrounds. However, we employ weights to adjust for imbalances in the sampling frame, so the sample is representative of the applicant pool.

[4] The 99 percent match rate makes differential attrition bias highly unlikely.

Table 1 shows summary statistics for the analytic sample by treatment status. The students who applied for a voucher were socioeconomically disadvantaged, which is unsurprising given the income eligibility requirements of SCSF. Eighty-five percent of survey participants were born to mothers who were of African American or Hispanic backgrounds. Fifty-one percent of the students came from households with an income of less than $12,900. Forty-two percent of students came from families in which neither parent attended college; 53 percent of students were said to have at least one parent who had enrolled in college. This information is missing for the remaining students.

≪Table 1 Here≫

As is shown in Table 1, the characteristics of the treatment and control groups are similar, as is expected given the random assignment of students to receive a voucher. Treatment students are less likely to be of Hispanic descent and less likely to have parents who only complete high school or earn a GED. With nearly 20 different statistical tests, these two differences may have occurred at random, and a joint significant test of the variables listed in Table 1 in a regression of treatment status on these variables and randomization group dummies yields a p-value of 0.20. These results provide evidence of the fidelity of the random assignment. As discussed in the next section where we detail our empirical strategy, we also control for the full set of observed covariates.

Estimation procedure

We estimate both the overall effects of voucher offers and the differential effect of voucher offers on those from moderately disadvantaged and severely disadvantaged SES backgrounds.

Full sample and selected subgroups. We estimate the following linear probability model of the effect of the offer of a voucher or the intent-to-treat (ITT) effect. That is, we estimate the impact on college enrollment and degree attainment of being offered a scholarship:

$$Attain_i = \beta_0 + \beta_1 Treat_i + \beta_2 X_i + \delta_i + \epsilon_i. \quad (1)$$

In equation (1) $Attain_i$ is an indicator for either whether student *i* enrolled in postsecondary education or completed a postsecondary degree. $Treat_i$ is a dummy variable identifying students assigned to the treatment group (i.e., offered a scholarship), and X_i is the vector of student demographic characteristics shown in Table 1. Students were randomized in blocks that were formed based upon family size, the verification and testing session, and whether their baseline school had an average test score above or below the city median. To capture the experimental design in our model, we include δ_g, a vector of randomization block indicators. Finally, ϵ_i is the error term. We use weights in the regressions to make the sample representative of those who originally applied for a scholarship and cluster standard errors by randomization block. This model replicates the models in Author DATE, except that our data spans through the fall of 2017 instead of ending in the fall of 2013.

Also following Author DATE, we present estimates of this regression model for the full sample as well as for samples restricted to particular segments of the population — by ethnicity, immigrant status, household income, and parent's educational attainment. As a robustness check, we additionally estimate ITT impacts using probit models instead of linear probability models and find similar results. Probit estimates are shown in Appendix A. We further estimate treatment-on-the treated (TOT) models. That analysis can be found in Appendix B.

Moderately versus extremely disadvantaged. To estimate heterogeneous effects that distinguish students from moderately disadvantaged and extremely disadvantaged households,

we estimate models that only include students from ethnic minority and non-immigrant backgrounds. We then include a term that interacts receipt of a voucher with indicators for either parental education or household income. More specifically, for the education interaction term, we dichotomize education between those who do or do not have a parent with some college, as reported by the adult accompanying the child to the initial testing session. We dichotomize income between those from households who reported income of more or less than $12,877 in 2019 dollars, which is approximately the median income level of voucher applicants in the analytic sample. In practice, the interaction term estimates the differential impact of the receipt of a voucher for students from ethnic minority or non-immigrant households that are additionally low income or have no college-educated parents, that is, the truly disadvantaged population.

Results

Our results report enrollment and degree attainment information as of the fall of 2017, which allow estimates of four-year degree attainment for students who receive that degree as much as three to seven years after expected college graduation. Students in the SCSF control group had, as expected, higher enrollment and graduation rates by the fall of 2017 than they had attained by the fall of 2013. Author DATE report rates of 26 percent for two- and four-year enrollment in 2013. In 2017, enrollments in two-year institutions for the full sample increased to 29 percent, while four-year enrollment rate climbed to 39 percent, as shown in the first row of Table 2. Bachelor's degree attainment rates also increased from 10 percent to 16 percent over this time period (see Table 3). Interestingly, that graduation rate is similar to the 15 percent graduation rate reported for students from the bottom two quintiles by Bailey and Dynarski (2011).

Postsecondary Enrollment and Degree Attainment for Full Sample and Selected Subgroups

Although enrollment and degree attainment rates rose between 2013 and 2017, the voucher impact on this outcome did not change materially from the result reported in Author DATE. In Columns 1 and 3 of Table 2, we display the ITT impact estimates on two-year and four-year post-secondary enrollment (see Appendix B for TOT results). Among the full sample of students, those who received a voucher are 1.2 percentage points more likely to enroll in a two-year college and are 1.5 percentage points less likely to enroll in a four-year college. Neither effect is statistically distinguishable from zero.

Similarly, as of the fall of 2017, a voucher offer shifted upward the percentage of students who obtained a four-year degree by only 1.4 percentage points, a statistically insignificant amount, and it had an even smaller impact on two-year degree attainment. These ITT results are presented in Table 3. Heterogeneities by ethnicity and immigrant status also resemble those reported in Author DATE, where impacts are concentrated among African American students and students from non-immigrant families.

≪Table 3 Here≫

Results for the Moderately and Extremely Disadvantaged

We now turn to results from our models that examine effects for moderately and extremely disadvantaged students. Panel A of Table 4 displays results for postsecondary enrollment. Among ethnic minority students, those from relatively higher income backgrounds and those with a college-educated parent are 4.7 and 4.2 percentage points, respectively, more likely to enroll in a two-year institution if they received a voucher (columns 1 and 2). Yet the difference is not statistically significant. Nevertheless, the impact of receiving a voucher is 7.0 and 7.6 percentage points lower for ethnic minority students from lower income households or

without college educated parents, respectively. The latter estimate of the interaction term is statistically significant at the 10 percent level.

<<Table 4 Here>>

In columns 3, we see a similar pattern for enrollment in a four-year degree program. Ethnic minority students from higher-income households who receive a voucher are 7 percentage points more likely to enroll, a result that is statistically significant at the 0.05 level. The treatment impact for those from low-income is nearly 12 percentage points lower, a difference that is statistically significant at the 0.05 level.

In columns 5 through 8, we observe analogous patterns among students who come from non-immigrant households. Treatment effects among the moderately disadvantaged — namely, higher income and college-educated households — are positive and sometimes statistically significant. In contrast, treatment effects among the extremely disadvantaged are less by a statistically significant magnitude, zeroing out any voucher impact. None of the overall treatment effects among the extremely disadvantaged subgroups are statistically significant.

In Panel B of Table 4, we report the results for degree attainment. Patterns are similar to those observed for postsecondary enrollment in Panel A. Consider the results in column 3: among ethnic minority students with moderately higher incomes within the eligibility criteria, the impact of a voucher offer on four-year degree attainment is 5.8 percentage points. Yet the treatment effect for their lower-income counterparts is 4.7 percentage points lower for an overall effect of essentially zero. Proceeding to column 4, ethnic minority students who were offered a voucher and also had parents who attended college were 6.8 percentage points more likely to earn a bachelor's degree, an effect size that is nearly 9 percentage points higher than for ethnic minority students who do not have college-educated parents. As shown in columns 5 through 8

of Panel B, the offer of a voucher increased degree attainment rates for students from non-immigrant households but only if they also come from higher-income or college-educated backgrounds.

Discussion

Overall, SCSF program impacts on enrollment and degree attainment as of the fall of 2017 do not differ substantially from those observed in 2013 (Author DATE). The offer of a voucher has a statistically insignificant average impact on college enrollment and degree attainment.[5]

These overall results, however, mask important distinctions between moderately and extremely disadvantaged student populations. If the family lacks financial, social, and cultural resources, the opportunity created by the voucher yields no detectable benefit. Impacts of the voucher opportunity are not significantly different from zero for minority students who would be first-generation college students as well as for those from very low-income households. Similar results are obtained for students with mothers born in the United States. In other words, we are unable to detect voucher benefits for extremely disadvantaged minority and non-immigrant students who suffer extreme deprivations.

But among minority and non-immigrant students with some educational and financial resources, voucher usage can yield important long-term educational benefits. If these students also come from households with higher incomes or a college-educated parent, impacts of being offered a voucher on four-year degree completion are 6 to 8 percentage points. Considering that the four-year degree completion rate among the entire control group is approximately 16 percent, these gains are substantial — an increase of nearly 50 percent. Effects for the usage of a voucher,

[5] However, some scholars have argued that a zero effect may imply higher productivity in the private sector than in the public sector, given the higher costs in the public sector (Author DATE; Wolf and McShane, 2013).

as estimated by the TOT models shown in Appendix B stretch even larger to 12 percentage points. Gains from being offered a voucher are roughly 8 percentage points for students with native-born mothers who had relatively higher-income backgrounds, nearly doubling the four-year completion rate of their control group counterparts. All of these gains are substantial, especially considering the fact that the SCSF program initially promised only half-tuition, three-year scholarships.

The results raise policy questions about the size of a school voucher that is necessary for a program targeted to the most disadvantaged families to be effective. The SCSF scholarship covered only half the costs of tuition up to $2,340. Minority families with minimal resources may not have been able to have paid the balance. Indeed, our first-stage estimates for our TOT analysis (see Appendix Table B1) show the average number of years in attendance at a private school was greater among students from higher income families among those eligible to participate. Those of low income seldom attended private school at all, while those of higher income went to a private school for well over two years.

However, a larger voucher amount may not be sufficient. The significant effects of parental education on voucher impacts suggest that cultural as well as pecuniary factors may be at work. Social and cultural capital are crucial elements for improving educational attainment and other outcomes (Bourdieu, 1986; Author DATE; Perna and Titus, 2005; Rowan-Kenyon, 2007). Nurturing social networks and institutions that enable parents to more fully participate in voucher programs may be necessary (Wolf and Stewart, 2014). Otherwise, in the presence of these gaps in social and cultural capital, school choice may sustain inequalities as the most disadvantaged families are left behind in lower-resourced schools (Wells and Scott, 2001). This has evoked criticism from those who caution that school of choice "will leave regular public

schools with the most difficult students to educate, thus creating a two-tier system of widening inequality" (Ravitch, 2010, p. 145). But other researchers say there is little reason "why low-income families of color should not have the ability to send their children to school with the children of other parents who are equally engaged, committed or ambitious for their children, [as that] is what affluent parents do" (Pondiscio, 2019, p.301).

Whatever the merits of these alternative judgments, the results reported suggest that opportunities for low-income minority families to attend private schools are largely beneficial for those who have some economic and cultural resources. Private schools, like public schools, seem to have found it difficult to address the educational needs of the truly disadvantaged. The SCSF voucher program may have enhanced the educational opportunities of the moderately disadvantaged segment of the low-income community, but the tools, policies, and institutions needed to assist the "truly disadvantaged" remain elusive.

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Table 1: Summary Statistics

	Treatment (N= 1,356)	Control (N = 1,278)	p-value
Baseline Math Test Score	17.1	17.1	0.914
Baseline Reading Test Score	24.6	22.9	0.247
Parents' Highest Education			
No College Education			
Some High School	0.16	0.16	0.943
High School Diploma/GED	0.28	0.24	0.063
Some College Education			
No BA degree	0.40	0.41	0.732
BA degree or more	0.13	0.15	0.220
Family Income (2019 dollars)			
Extremely Low Income			
Less than $8,048	0.29	0.27	0.359
$8,049-12,876	0.22	0.24	0.382
Moderately Low Income			
$12,877-17,705	0.15	0.13	0.242
$17,706-24,144	0.14	0.14	0.791
$24,145-32,760	0.11	0.11	0.901
$32,760 or more	0.10	0.11	0.396
Mother born in U.S.	0.61	0.58	0.157
Racial/Ethnic Background			
African American	0.42	0.41	0.659
Hispanic	0.42	0.47	0.017
Other Race	0.16	0.12	0.011
Mother Works	0.34	0.35	0.825
Father Absent	0.35	0.36	0.680
English main language	0.71	0.72	0.903
Female	0.50	0.49	0.422

Notes: Weighted averages shown. P-values for a test that there are no differences in demographic characteristics between control and treatment groups are shown. A joint significance test also fails to reject the null hypothesis that variables are not jointly different across treatment and control conditions (p=0.200).

Table 2: Intent-to-Treat Estimates for Postsecondary Enrollment

	Two Year College		Four Year College		
	(1) Treatment Group Difference	(2) Control Group Mean	(3) Treatment Group Difference	(4) Control Group Mean	(5) Sample Size
Full Sample	0.012	0.288	-0.015	0.388	2,634
	(0.020)		(0.021)		
Results by Subgroup					
Minority	0.007	0.290	0.000	0.375	2,313
	(0.022)		(0.022)		
African American	0.018	0.258	-0.008	0.358	1,097
	(0.030)		(0.031)		
Hispanic	-0.009	0.317	-0.002	0.390	1,216
	(0.030)		(0.030)		
Non-Minority	-0.013	0.276	-0.095	0.489	321
	(0.059)		(0.075)		
Immigrant Family	-0.012	0.352	-0.069+	0.518	997
	(0.036)		(0.036)		
Non-Immigrant Family	0.023	0.255	0.029	0.317	1,576
	(0.025)		(0.025)		
Lower Income	-0.032	0.304	-0.046	0.383	1,255
	(0.031)		(0.031)		
Higher Income	0.051+	0.283	0.037	0.399	1,158
	(0.030)		(0.033)		
First Generation College Student	-0.003	0.268	-0.046	0.360	1,237
	(0.028)		(0.029)		
Parents Attended College	0.026	0.306	0.013	0.413	1,397
	(0.030)		(0.030)		

Notes: Sample weights included. Estimates based on linear probability models. Standard errors clustered by randomization block.
** p<0.01, * p<0.05, + p<0.1

Table 3: Intent-to-Treat Estimates for Postsecondary Degree Attainment

	Two Year Degree		Four Year Degree		
	(1) Treatment Group Difference	(2) Control Group Mean	(3) Treatment Group Difference	(4) Control Group Mean	(5) Sample Size
Full Sample	0.001	0.093	0.014	0.157	2,634
	(0.013)		(0.016)		
Results by Subgroup					
Ethnic Minority	-0.003	0.092	0.029+	0.144	2,313
	(0.014)		(0.017)		
Non-Ethnic Minority	0.036	0.097	-0.066	0.253	321
	(0.039)		(0.060)		
African American	-0.001	0.108	0.048*	0.104	1,097
	(0.019)		(0.023)		
Hispanic	-0.005	0.067	0.014	0.180	1,216
	(0.019)		(0.025)		
Non-Immigrant Family	0.004	0.079	0.045**	0.089	1,576
	(0.015)		(0.017)		
Immigrant Family	0.014	0.117	-0.023	0.274	997
	(0.022)		(0.032)		
Lower Income	-0.013	0.094	0.010	0.130	1,255
	(0.020)		(0.022)		
Higher Income	0.018	0.090	0.036	0.187	1,158
	(0.019)		(0.024)		
No college	-0.004	0.102	-0.021	0.151	1,237
	(0.019)		(0.022)		
Some college	0.005	0.085	0.045+	0.162	1,397
	(0.017)		(0.024)		

Notes: Lower (higher) income parents have household incomes less (greater) than $12,877 in 2019 dollars. Control variables and sampling weights included. Estimates based on linear probability models. Standard errors clustered by randomization block.
** p<0.01, * p<0.05, + p<0.1

Table 4: Intent-to-Treat Subgroup Estimates for the Truly Disadvantaged

	Ethnic Minority Students				Non-Immigrant Students			
	Two-Year Degree		Four-Year Degree		Two-Year Degree		Four-Year Degree	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Postsecondary Enrollment								
Treat	0.047	0.042	0.070*	0.029	0.063	0.032	0.094*	0.079*
	(0.033)	(0.031)	(0.033)	(0.031)	(0.039)	(0.035)	(0.040)	(0.035)
Lower Income*Treat	-0.070		-0.115*		-0.079		-0.111*	
	(0.046)		(0.046)		(0.053)		(0.053)	
First-Generation College*Treat		-0.076+		-0.063		-0.022		-0.112*
		(0.043)		(0.045)		(0.049)		(0.052)
Panel B: Degree Completion								
Treat	0.006	0.009	0.058*	0.069**	0.039+	0.024	0.065*	0.082**
	(0.021)	(0.018)	(0.027)	(0.025)	(0.023)	(0.021)	(0.027)	(0.024)
Lower Income*Treat	-0.005		-0.047		-0.063+		-0.032	
	(0.030)		(0.035)		(0.034)		(0.036)	
First-Generation College*Treat		-0.028		-0.086*		-0.046		-0.082*
		(0.027)		(0.035)		(0.032)		(0.035)
Sample Size	2,157	2,313	2,157	2,313	1,486	1,576	1,486	1,576

Notes: Panel A displays treatment impacts on postsecondary enrollment. Panel B displays treatment impacts on degree completion. Lower income parents have household incomes less than $12,877 in 2019 dollars. Control variables and sampling weights included. Estimates based on linear probability models. Standard errors clustered by randomization block. **p<0.01, *p<0.05, + p<0.1

Appendix A
Probit Estimates for ITT Results

Table A1: Intent-to-Treat Probit Estimates for Postsecondary Degree Attainment

	Two-Year Degree	Four-Year Degree
Full Sample	0.006	0.022
	(0.012)	(0.015)
Subgroup Results		
Minority	0.000	0.033*
	(0.013)	(0.015)
Non-Minority	0.047	-0.083
	(0.030)	(0.055)
Lower Income	-0.016	0.010
	(0.018)	(0.020)
Higher Income	0.030+	0.049*
	(0.017)	(0.022)
First Generation College Student	0.001	-0.008
	(0.020)	(0.022)
Parents Attended College	0.017	0.048*
	(0.016)	(0.020)
Immigrant Family	0.020	-0.013
	(0.021)	(0.032)
Non-Immigrant Family	0.013	0.047**
	(0.014)	(0.014)

Notes: Sample weights included. Marginal effect estimates displayed. Standard errors clustered by randomization block. ** p<0.01, * p<0.05, + p<0.1

Table A2: Intent-to-Treat Probit Estimates for Postsecondary Enrollment

	(1) Enrollment in Two Year College	(2) Enrollment in Four Year College
Full Sample	0.014	-0.014
	(0.020)	(0.021)
Subgroup Results		
Minority	0.010	0.000
	(0.021)	(0.022)
Non-Minority	0.026	-0.089
	(0.050)	(0.062)
Lower Income	-0.017	-0.049+
	(0.027)	(0.027)
Higher Income	0.051+	0.041
	(0.028)	(0.031)
First Generation College Student	0.010	-0.042
	(0.027)	(0.028)
Parents Attended College	0.030	0.014
	(0.028)	(0.029)
Immigrant Family	-0.009	-0.070*
	(0.034)	(0.035)
Non-Immigrant Family	0.028	0.030
	(0.023)	(0.024)

Notes: Sample weights included. Marginal effect estimates displayed after estimating probit models. Standard errors clustered by randomization block. ** p<0.01, * p<0.05, + p<0.1

Table A3: Intent-to-Treat Probit Estimates for the Truly Disadvantaged

	Ethnic Minority Students				Non-Immigrant Students			
	Two-Year Degree		Four-Year Degree		Two-Year Degree		Four-Year Degree	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Postsecondary Enrollment								
Treat	0.052	0.032	0.075*	0.045	0.070+	0.083*	0.100*	0.038
	(0.033)	(0.032)	(0.034)	(0.030)	(0.036)	(0.035)	(0.040)	(0.032)
Lower Income*Treat	-0.072		-0.124*		-0.081		-0.120*	
	(0.046)		(0.049)		(0.051)		(0.055)	
First-Generation College*Treat		-0.071		-0.080+		-0.120*		-0.023
		(0.047)		(0.044)		(0.053)		(0.048)
Panel B: Degree Completion								
Treat	0.010	0.013	0.050**	0.061**	0.041*	0.027+	0.051**	0.058**
	(0.018)	(0.016)	(0.019)	(0.019)	(0.016)	(0.014)	(0.017)	(0.015)
Lower Income*Treat	-0.007		-0.032		-0.054*		-0.019	
	(0.025)		(0.030)		(0.024)		(0.026)	
First-Generation College*Treat		-0.028		-0.074*		-0.039+		-0.050+
		(0.024)		(0.030)		(0.023)		(0.027)
Sample Size	2,157	2,313	2,157	2,313	1,486	1,576	1,486	1,576

Notes: Panel A displays treatment impacts on postsecondary enrollment. Panel B displays treatment impacts on degree completion. Lower income parents have household incomes less than $12,877 in 2019 dollars. Control variables and sampling weights included. Marginal effects displayed after estimating probit models. Standard errors clustered by randomization block.
** p<0.01, * p<0.05, + p<0.1

Appendix B
Treatment-on-the Treated Estimates

We then provide a treatment-on-the treated (TOT) estimate of effects of attendance at a private school. We use a two-stage least squares framework where the offer of a voucher serves as an instrument for whether or not the student attended private school. We estimate

$$Private_i = \alpha_0 + \alpha_1 Treat_i + \alpha_2 X_i + \delta_i + \nu_i \quad (2)$$

$$Attain_i = \gamma_0 + \gamma_1 Private_i + \gamma_2 X_i + \delta_i + \mu_i, \quad (3)$$

where $private_i$ is an indicator equal to 1 if student i ever attended private school throughout the three-year duration of SCSF. The other variables are as they are in equation (1), and ν_i and μ_i are the error terms. Again, we use sampling weights and cluster standard errors by randomization block.[6]

First-stage results are displayed in Appendix Table 3. Receiving a voucher through the lottery clearly influences private-school attendance. Students who win a lottery are about 66 percentage points more likely to attend a private school. As another check for a strong first stage, we use the receipt of a voucher to predict whether or not a student uses the voucher to attend a private school. As shown in column 2 of Appendix Table B1, students who are awarded a lottery spend 1.7 additional years in private school.

TOT estimates are presented in Tables B2 through B5. The coefficients in these tables are properly interpreted as changes in the percentages of degree attainment and postsecondary enrollment that occur if students ever attended a private school during the three years of its existence. No distinction is drawn as the length of time a student was in a private school. It may be for as little as a day or as long as nine years, because the initial promise of three years was

[6] The second stage is estimated using ordinary least squares. Conclusions are unchanged whether one uses probit or linear probability models to estimate equation 3.

extended through eighth grade for all those who continuously used the voucher. The average length of time a private school was attended is 1.74 school years. Since TOT estimates are statistically significant only if ITT estimates presented in the prior tables are significant, the overall pattern results are the same as discussed above, except for the fact that the size of the estimated TOT effects are substantially larger than the ITT effects.

Table B1: First Stage Regression Estimates

	(1) Ever Attended	(2) Years Attended
Lottery Winner	0.655***	1.74***
	(0.018)	(0.048)
Baseline Math Test Score	-0.000	0.000
	(0.001)	(0.001)
Baseline English Test Score	0.000	0.001
	(0.000)	(0.001)
Parent Educational Attainment		
High School Diploma/GED	0.011	0.047
	(0.033)	(0.068)
Some College	0.051	0.101
	(0.033)	(0.069)
BA degree or more	0.065	0.133*
	(0.041)	(0.080)
Family Income (2019 dollars)		
$8,049-12,876	0.027	0.020
	(0.026)	(0.051)
$12,877-17,705	-0.018	0.003
	(0.033)	(0.067)
$17,706-24,144	0.095***	0.260***
	(0.036)	(0.072)
$24,145-32,760	0.103**	0.266***
	(0.046)	(0.094)
$32,760 or more	0.136***	0.347***
	(0.041)	(0.086)
Mother born in U.S.	-0.047*	-0.075
	(0.027)	(0.054)
Racial/Ethnic Background		
African American	-0.021	0.073
	(0.065)	-0.118
Hispanic	-0.001	0.140
	(0.069)	(0.130)
Mother Works	0.007	-0.032
	(0.025)	(0.048)
Father Absent	0.008	0.021
	(0.021)	(0.043)
English main language	-0.011	-0.053
	(0.033)	(0.068)
Female	0.015	0.035
	(0.017)	(0.035)

Notes: Model includes controls for randomization blocks. Omitted category for parent education consists of parents who did not complete high school. Omitted category for family income consists of families who make less than $8,049. Sampling weights included. Standard errors clustered by randomization block. ** p<0.01, * p<0.05, + p<0.1

Table B2: Treatment on the Treated Estimates for Postsecondary Enrollment

	Two Year College		Four Year College		
	(1) Treatment Group Difference	(2) Control Group Mean	(3) Treatment Group Difference	(4) Control Group Mean	(5) Sample Size
Full Sample	0.010	0.288	-0.032	0.388	2,634
	(0.031)		(0.033)		
Results by Group					
African American	0.051	0.258	0.027	0.358	1,097
	(0.042)		(0.046)		
Hispanic	-0.005	0.317	-0.008	0.390	1,216
	(0.045)		(0.046)		
Minority	0.012	0.290	0.001	0.375	2,313
	(0.031)		(0.032)		
Non-Minority	0.018	0.276	-0.256+	0.489	321
	(0.132)		(0.145)		
Immigrant Family	-0.013	0.352	-0.128*	0.518	997
	(0.054)		(0.056)		
Non-Immigrant Family	0.024	0.255	0.028	0.317	1,576
	(0.037)		(0.038)		
Lower Income	-0.039	0.304	-0.072	0.383	1,255
	(0.048)		(0.048)		
Higher Income	0.049	0.283	0.043	0.399	1,158
	(0.044)		(0.048)		
First Generation College Student	-0.006	0.268	-0.060	0.360	1,237
	(0.042)		(0.046)		
Parents Attended College	0.031	0.306	0.003	0.413	1,397
	(0.044)		(0.046)		

Notes: Sample weights included. Estimates based on linear probability models. Standard errors clustered by randomization block.
** p<0.01, * p<0.05, + p<0.1

Table B3: Treatment on the Treated Estimates for Postsecondary Degree Attainment

	Two Year Degree		Four Year Degree		
	(1) Treatment Group Difference	(2) Control Group Mean	(3) Treatment Group Difference	(4) Control Group Mean	(5) Sample Size
Full Sample	-0.001	0.093	0.016	0.157	2,634
	(0.019)		(0.026)		
Results by Group					
African American	0.014	0.078	0.091**	0.104	1,097
	(0.026)		(0.034)		
Hispanic	-0.007	0.105	0.010	0.180	1,216
	(0.029)		(0.037)		
Minority	-0.004	0.092	0.042+	0.144	2,313
	(0.019)		(0.025)		
Non-Minority	-0.004	0.097	-0.181	0.253	321
	(0.080)		(0.117)		
Immigrant Family	0.013	0.117	0.027	0.274	997
	(0.034)		(0.034)		
Non-Immigrant Family	0.003	0.079	0.058*	0.089	1,576
	(0.023)		(0.026)		
Lower Income	-0.016	0.094	0.010	0.130	1,255
	(0.030)		(0.035)		
Higher Income	0.020	0.090	0.037	0.187	1,158
	(0.029)		(0.038)		
First Generation College Student	-0.007	0.102	-0.036	0.151	1,237
	(0.030)		(0.035)		
Parents Attended College	0.008	0.085	0.065+	0.162	1,397
	(0.025)		(0.037)		

Notes: Sample weights included. Estimates based on linear probability models. Standard errors clustered by randomization block.
** p<0.01, * p<0.05, + p<0.1

Table B4: Treatment on the Treated Subgroup Estimates for the Truly Disadvantaged

	Ethnic Minority Students				Non-Immigrant Students			
	Two-Year Degree		Four-Year Degree		Two-Year Degree		Four-Year Degree	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Postsecondary Enrollment								
Treat	0.066	0.059	0.097*	0.041	0.088+	0.047	0.130*	0.115*
	(0.045)	(0.043)	(0.045)	(0.043)	(0.053)	(0.050)	(0.054)	(0.050)
Lower Income*Treat	-0.100		-0.165*		-0.113		-0.158*	
	(0.066)		(0.066)		(0.076)		(0.076)	
First-Generation College*Treat		-0.110+		-0.093		-0.031		-0.169*
		(0.063)		(0.064)		(0.073)		(0.077)
Panel B: Degree Completion								
Treat	0.009	0.014	0.080*	0.097**	0.055+	0.035	0.090*	0.118**
	(0.029)	(0.026)	(0.037)	(0.035)	(0.031)	(0.029)	(0.036)	(0.034)
Lower Income*Treat	-0.007		-0.064		-0.093+		-0.037	
	(0.043)		(0.050)		(0.049)		(0.052)	
First-Generation College*Treat		-0.042		-0.124*		-0.070		-0.121*
		(0.040)		(0.050)		(0.048)		(0.052)
Sample Size	2,157	2,313	2,157	2,313	1,486	1,576	1,486	1,576

Notes: Panel A displays treatment impacts on postsecondary enrollment. Panel B displays treatment impacts on degree completion. Lower income parents have household incomes less than $12,877 in 2019 dollars. Control variables and sampling weights included. Estimates based on linear probability models. Standard errors clustered by randomization block.
** p<0.01, * p<0.05, + p<0.1