Longer-Term Educational Consequences of Contracting Out Public Schools: Evidence from Administrative Records in Colombia*

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Abstract

This paper evaluates longer-run effects on academic achievement of contracting out public schools to private operators drawing from the *Colegios en Concesión* (CEC) program implemented in 2000 in Bogota, Colombia. Previous research on the effects of contracting out public schools focuses mostly on the (short-run) effects of attending privately run public schools on test scores, with most of the existing evidence coming from evaluating US charter schools. Missing from these studies is an assessment of longer-run outcomes of attending such schools, including higher education outcomes which may be more clearly tied to economic success. In this paper, I examine a series of college outcomes for students graduating from public schools in Bogota in 2007 and 2008. In particular, I look at how CEC students compare to Traditional Public School (TPS) students in terms of college enrollment, selective institution attendance, the probability of majoring in 2-year vocational programs, and their propensity for dropping out of college. Given the non-random nature of CEC program participants, I obtain causal estimates of CEC attendance by exploiting variation in distance from a student's residence to the closest CEC school as an instrument for CEC attendance. Two-stage Least Square estimates indicate that, relative to TPS students, CEC students are substantially more likely to enroll in college —especially in two-year vocational programs— and slightly more likely to be admitted at selective, public institutions. Also, CEC students are not more likely to drop out of college relative to TPS students.

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1. Introduction

The question of whether private schools provide better education than public schools has been a long and much debated issue. This question, for example, at the center of the debate over the effects on academic performance of programs such as vouchers, charter schools, or education management organizations. Unlike voucher programs —where the control over the quality of education provided by participating schools is mostly left to private users— other programs have been designed so that the state retains a fair measure of control over service delivery by monitoring performance, imposing penalties or by replacing providers in case of performance failure. To some extent, charter schools in the Unites States and in Alberta (Canada), Academies in England, Free schools in Sweden, and CEC schools in Bogota (Colombia) are salient examples of this second provision type. In general, these initiatives aim at broadening the decision-making autonomy of schools and promoting accountability, while remaining under —admittedly varying levels of— public control.

Previous research on the effects of this second provision type focuses mostly on the short-run effects of attending privately run public schools on test scores, with most of the existing evidence coming from evaluating US charter schools with rather mixed results (Angrist et. al [2010]; Abdulkadiroglu et. al, [2009]; Dobbie and Fryer, [2009]; Hoxby and Murarka, [2009]; Hoxby and Rockoff, [2004]; Saas, [2006]; Bifulco and Ladd, [2004]; Hanushek et. al, [2007]; Booker et. al [2007]). For an experience outside the United States, Bonilla (2011) finds positive effects of attending CEC schools on college entry standardized tests in Colombia. Nevertheless, missing from these studies is an assessment of longer-run outcomes of attending such schools, such as earnings and college enrollment, outcomes that are more clearly tied to economic success.

While generating higher earnings capacity is one of the most important goals of education, using earnings as an outcome to evaluate school quality is empirically difficult for a variety of reasons, including the fact that actual earnings do not show up until many years after individuals have finished their secondary education. As a result, standardized tests have been used as proxies for school quality, even though the existing evidence of the relationship between test scores and earnings is not conclusive. While some have argued in favor of a positive relationship between test scores and individual earnings and productivity (e.g., Hanushek, [2006]; Lazear, [2003]), others have asserted

that standardized tests can only partially measure a student's ability and cannot measure students' deeper problem-solving skills (Card and Krueger, [1992]; Evans and Schwab, [1995]). Consequently, these authors have stressed the importance of looking at alternative measures of educational attainment such as completing high school or going on to college to evaluate school performance. Looking at college entrance is an important outcome because of the high pecuniary gains derived from higher education and its potential effects on reducing income inequality.

This paper examines the longer-run effects of attending contracted-out public schools using data from Bogota's CEC school program, previously discussed in Bonilla (2011). The CEC program contracted out the administration of all the public schools built between 2000-2003 in Bogota to reputed private high schools and universities. This program allows CEC schools to operate outside the collective bargaining provisions that traditional public schools have in return for increased school accountability, including test-based accountability on a college entry national standardized test, informally known as the ICFES test. To the best of my knowledge, this paper is the first attempt to look at the causal relationship between contracted out public schools and higher education outcomes.

The ICFES test is a high-stakes standardized test taken by the vast majority of students in their last year of high school. In 2008, for instance, 93% of TPS and 96% of CEC students, respectively, took the test. Taking the test is a compulsory requirement for students intending to enroll in college in Colombia and serves as the primary college admission criteria (ICFES, 1999). Therefore, it seems natural to evaluate whether CEC students have been able to translate higher ICFES test scores into high school graduation rates and higher college enrollment rates relative to Traditional Public School (TPS) students. The latter outcome is a relevant long term measure of school performance given that the returns to college in Colombia have been estimated to be twice as large as the returns to secondary schooling (World Bank, 2003).

In addition to this outcome, I also consider whether students who attended CEC schools are more likely to be admitted at selective universities, as there is causal evidence for Colombia showing that students who attend selective universities are more likely to have formal employment and have higher earnings than students attending non-selective institutions (Saavedra, [2008]). However, low-fee charging, selective, public universities in Colombia have managed to keep the number of admitted

students low (World Bank, 2003). As a result, low-income students who traditionally graduate from TPS and CEC schools may be having a hard time competing with private school students for admission into selective, public institutions. As a result, some public schools may be aiming at placing their students in two-year vocational programs, specifically designed to increase students' odds of getting formal employment. In fact, some CEC schools have developed terminal vocational courses in order to smooth out their students' entrance to vocational programs at higher education institutions. Thus, as a third outcome, I look at the probability of enrolling in 2-year technical and technological programs relative to TPS students.

Lastly, I look at the college dropout behavior of CEC students. In Colombia, about 50% of the students that enroll in higher education institutions drop out from their programs (MEN, 2010). While part of this may be due to financial considerations, including inadequate student financial aid for low-income students, it is often argued that the low-quality of secondary education is also an important reason for dropping out of college.

To construct these higher education outcomes, I use administrative data from the Ministry of Education on college enrollment which has student-level information on institution and program enrollment as well as dropout information. Given that students who attend CEC schools may differ in unobservable ways from public school students, I obtain causal estimates of CEC attendance by exploiting variation in distance from a student's residence to the closest CEC institution to construct an instrument for CEC attendance. In Bonilla (2011), I carefully argued that this instrument is conditionally exogenous of unobserved determinants of academic achievement.

OLS and 2SLS estimates indicate that, relative to TPS students, CEC students are substantially more likely to enroll in college in general and to enroll in two-year vocational programs in particular. Moreover, while CEC students score significantly higher in the ICFES test than TPS students, these higher scores do not seem to be sufficiently larger to effectively compete for admission at selective, public institutions in Bogota. I also provide some evidence that better academically prepared students are less likely to drop out from college.

The remainder of the paper proceeds as follows: Section 2 provides background information on the CEC program and on the higher education sector in Colombia. Section 3 describes the sample

and the construction of the higher education outcomes. Section 4 presents the empirical strategy. Section 5 provides the OLS and IV results and Section 6 concludes.

2. Background

The demand for secondary education dramatically increase in the last two decades in Colombia. In 2002, there were 1.6 millon 15- and 16-year-olds in the country, of whom 57% were attending a high school institution. By 2010, this gross enrollment rate reached 79%, even though the population in that age bracket also grew by 8 percent during that period (MEN, 2010). As a result, the number of high school graduates increased by 67% between 2002 and 2009. Interestingly, most of the increase in high school enrollment was primarily absorbed by the public education system, with 81% of the high school students attending public schools, up from 70% a decade earlier.

What these figures suggest is that both local and national education authorities in Colombia have implemented policies to meet the increasing demand for public education. However, local governments have also been exploring policies aiming at improving the quality of public education. Colombia has consistently performed below average in international standardized tests relative to countries with similar levels of income. Figure 1 shows that the country average results on the 2006 PISA test for reading, mathematics and science are slightly below the Latin American average and much lower relative to other emerging OECD countries. Alternative international evaluations such as TIMSS 1995, TIMSS 2006, and Pisa 2009 show similar results.

Some of the implemented policies to either increase enrollment or improve quality involved the participation of the private sector in the provision of public education. The PACES program, for instance, during the 1990s in Colombia is known for being one of the largest voucher school programs to have ever been implemented (Angrist, 2002) in an effort to increase secondary enrollment rates among low income families. In addition to this program, the local government of Bogota implemented in 1999 the *Colegios en Concesión* (CEC) Program, a large-scale initiative, which contracted out the administration of all the new public schools constructed in the city in the period 2000-2003.

The CEC program allowed contracted out schools to operate outside teacher collective bargaining provisions in return for increased school accountability, including test-based accountability. More

specifically, the program made CEC schools subject to an annual evaluation on a series of factors related to education quality including, for example, teachers' education and experience and student dropout and transfer rates. Also, CEC schools failing to meet academic standards based on the school's average score on the overall ICFES test may be subject to contract rescission.

Instrumental variable results in Bonilla (2011) show that CEC students' ICFES scores in 2008 are approximately 0.6 and 0.25 standard deviations higher in math and verbal test scores, respectively, relative to TPS students. Moreover, the results on ICFES composite test score[1] indicate that attending a CEC school increases composite test scores by 0.3 standard deviations relative to TPS students. This latter finding is of interest for the present study given that the ICFES composite test score is the single most important criterion used by higher education institutions to determine admission (ICFES, 1999). Then, the idea of the present study is to determine to what extent the higher ICFES test scores exhibited by CEC students have translated into better education outcomes for them relative to TPS students.

2.1. Higher Education in Colombia

In Colombia, the proportion of 18- to 24-year-olds enrolled in college in 2010 reached 37%, which represents a 85% increase relative to the rate in 1999 (MEN, 2011) —although, it is still below the Latin American rate which has an average rate of 44%. Despite these gains in college enrollment in the last decade, it is noticeable the large difference between a gross college enrollment rate of 37% and a the high school gross enrollment rate of 79%. However, as is true almost everywhere, college enrollment in Colombia raises dramatically with income. According to Saavedra (2008), whereas 40% of the 18- to 24-year-olds from the wealthiest income quintile are enrolled in college, only 6% from the lowest quintile do.

There are 289 colleges and universities in Colombia, 72% of which are privately owned. About 44% of college students attend private institutions indicating that private institutions serve fewer students on average relative to public ones. There are four types of tertiary education institutions: Universities (27% of the total number of institutions), university institutions (40%), technological

[1] the ICFES test evaluates students on most of the curriculum subjects determined by the Colombian Ministry of Education, namely, Math, Reading, Biology, Chemistry, Physics, History, Geography, Philosophy, and English.

institutions (18%), and technical training institutions (15%). While the first two categories serve as teaching and some as research institutions, technical and technological institutions provide short, non-academic programs that respond flexibly to labor market demands —similar to two-year colleges in the United States. Whereas in 2000, 86% of higher education students were enrolled in either universities or university institutions (World Bank, 2003), by 2010 65% of them are. This suggests that most of the large increase in college enrollment in Colombia in the last decade has been absorbed by technical and technological institutions (MEN, 2011).

There are 59 selective higher education institutions in Colombia, that is, institutions with more applicants than slots. As expected, the most selective institutions are those with higher expenditures per student, higher fractions of full time and PhD faculty, and admit students with higher ICFES test scores (Saavedra, 2008).

As noted above, students intending to enroll in college in Colombia must be high school graduates and must have taken the ICFES test. Moreover, a high ICFES score almost surely guarantees a place in high-return programs at selective universities. In fact, of the 59 selective universities in Colombia, 25 use the ICFES test exclusively to determine admission; and the remaining schools use it too in combination with other requisites (Saavedra, 2008). The test is conducted twice a year, usually in April and September, given that some high schools in Colombia end their academic year in June while others do so in December. As a result, higher education institutions also have two different entry periods each year.

In Colombia, the private returns to each year of tertiary education reached 22% in 2001. Moreover, workers with tertiary education earn 275% more than high school students and more than 6.5 times the wage of a worker with no education (World Bank, 2003). As reference, college graduates in the US earned 55% more in average than high school graduates in 2009 in the United States (Becker et al, 2010).

The joint existence of high returns to higher education and low enrollment rates suggests there may be some systematic barriers which are preventing students from investing in higher education. Although a comprehensive characterization of this phenomenon is out of the scope of the present study, some studies have argued that the low and unequal access to higher education in Colombia is

partly originated in the basic education system (Bloom and Hansen, 2003). That is, the low quality primary and secondary education may be preventing students from being admitted at selective, high returns college and majors, leaving low-quality, low-return institutions as their only choice. Indeed, whereas low-fee, selective, public institutions have been in strong demand in the last two decades, private, non-selective institutions have faced oversupply (World Bank, 2003).

In addition to this, there is also evidence suggesting that the probability of dropping out from college in Colombia is highly correlated with poor academic background. First, only 14% of college dropouts passed all attempted credits in the period 1998-2005. Second, the largest college dropout rates occur in the first two semesters of college. Indeed, out of 100 students enrolled in higher education, 25 dropped out at the end of the first semester —by far the largest dropout rate for a given semester. This may be a sign that students enrolling in college may have not been sufficiently prepared for it. Third, the highest dropout rates occur among those with the lowest composite ICFES scores as well as those enrolled in majors with higher requirements for high-school background such as engineering (MEN, 2006).

Consequently, improvements in the quality of education received by low-income households at public schools should not only increase their odds of attending more selective institutions, but also the likelihood of staying enrolled while in college.

3. Data and Descriptive Statistics

The data used for this study are derived from three sources. First, I use administrative data from ICFES, which contains student level information on TPS and CEC students that took the test in the second semesters of 2007 and 2008. For both of these years, I have individual scores for each one of the nine sections of the test, the student's high school, age, gender, and residential address. For the year 2008, I also have information on students' parental education, residence stratum,[2] household income, number of household members, and asset ownership (e.g., car, computer, cell phone, TV, etc.).

[2]The stratum is a six-level classification used by the local government to characterize the socio-economic characteristics of a given dwelling. The higher the stratum is, the better the socioeconomic status of the dwelling. In general, residents of dwellings in the first 2 strata are considered the urban poor and pay, for example, subsidized prices for public utilities such as water and electricity.

The second source of data uses Bogota's cadastral database, a comprehensive register of all the real properties in the city. This dataset —which includes details of ownership, tenure, location (GPS coordinates), area, value, and UPZ location of all properties— allows me to assign geographic coordinates (e.g., latitude and longitude) to 81% and 85% of the students' residences for the years 2007 and 2008, respectively. By geo-referencing students residences, I am able to calculate the distance from a student's home to both actual and potential TPS and CEC schools in Bogota. As shown in Table 2.12 in Bonilla (2011), there are no economically significant differences in the SES characteristics of the matched and unmatched samples for the year 2008, suggesting, for example, that students with lower SES are not more likely to misreport their home address. Unfortunately, this analysis can only be conducted for a subset of the SES variables in 2007 since most of the SES variables were not collected in this year. Nevertheless, the results for 2007 also show that there are no significant differences in students' age and gender between matched and unmatched samples.

The last data source uses information from SPADIES 2010, an administrative dataset from the Ministry of Education of Colombia that contains individual level information on college enrollment such as institution attended, major, date of first entry into higher education, and date of last semester the student is observed enrolled.

Table 1 presents descriptive statistics for CEC and TPS students by year of high school graduation and college enrollment status. Some of these statistics are worth discussing. The first important remark is that students enrolled in college have higher ICFES test scores than students who did not enroll. For instance, for both 2007 and 2008 and both school types (i.e., TPS and CEC), students attending a college institution score 0.3 standard deviations higher in Math relative to students not in college. Second, as shown in columns 7 to 10, relative to non-college students, college students are younger, come from smaller families, have more educated parents, have a higher family income, and live in better neighborhoods as indicated by the stratum of the dwelling. In general, these figures provide evidence that college enrollment in Bogota is positively correlated with higher levels of family income.

Third, 34% of TPS students and 35% of CEC students are enrolled in higher education in 2007. It is rather surprising, however, that only 18% of TPS and CEC students were found pursuing a

college degree in 2008. It is not clear what the reason is for this lower college enrollment rate on 2008. Although the 2007 cohort has had three years to have enrolled in college by 2011 —relative to two years for the 2008 cohort—, data on students' college entry dates shows this extra year explains little of the difference in college enrollment rates. That is, the 2007-cohort college enrollment rate is as high as 31% whenever the students who enrolled in college in their third year after high school graduation are considered as not enrolled. A more plausible explanation is that some higher education institutions have not reported their most recent information on enrollment to SPADIES. In any case, the striking difference in enrollment for these two cohorts cast some doubts on the use of the 2008 data on higher education. Consequently, in Section 5, I will be presenting separate results for 2007 cohort as well as joint results the 2007 and 2008 cohorts.

Finally, I compare test scores and SES characteristics for TPS and CEC students who enrolled in college and whose residences are located in UPZs with nearby CEC schools (henceforth, the UPZ sample). UPZs are subdivisions of the city used by the local government for urban planning purposes and are defined such that the urban and economic characteristics of the real properties within them are similar. The descriptive statistics in column 12 show that CEC and TPS students have very similar SES characteristics, although CEC students are slightly more likely to live in low-strata neighborhoods. Nevertheless, CEC students exhibit higher ICFES scores than TPS students of about 0.15 to 0.2 standard deviations.

In Table 2, I also present descriptive statistics on college outcomes by high school graduation cohort and school type. Using observations in the *full sample*, one can see that higher education outcomes between TPS and CEC students in the full sample are rather similar. First, TPS and CEC students have very similar college enrollment rates. Second, around 30% of both CEC and TPS students are enrolled at a selective institution.[3]. Third, they also have very similar major distributions with 2-year vocational programs (i.e., technical and technological) being the program most commonly chosen by students. Fourth, their ICFES composite test scores make them equally eligible for government sponsored ICETEX loans for higher education studies.[4]

[3]An institution is considered selective if the ratio of slots over applicants is less than one. I construct this ratio based on information from ICFES (2002)

[4]The ICFES score is just one of the criteria used to grant these loans. Students are also required to have guarantors with collateral, which in practice may have resulted in low-income students receiving a relatively low proportion of the granted loans.

Fifth, based on students' ICFES scores and cut-offs used to determine admission into engineering programs at the *Universidad Distrital*, I find that at most 6% of TPS and CEC students are eligible for admission into selective, 5-year engineering programs at this institution. The *Universidad Distrital* is a low-fee, selective, public university in Bogota, although it is not the most selective, public university in the city.[5] This shows that low-income students intending to enroll in selective, public institutions in Bogota are facing strong competition from private school students. Lastly, CEC and TPS students have similar college dropout rates with a quarter or more of them dropping out at the end of their first semester of enrollment and 40% or higher dropping during their first college year.

While the higher education statistics for the *UPZ sample* mostly reflect the patterns of the *full sample*, two differences are worth mentioning. First, CEC students are 9 percentage points more likely to enroll at a college institution in 2007. Second, CEC students are slightly more likely to be enrolled at a selective, public university than TPS students.

4. Empirical Strategy

For this study, I reproduce the identification strategy used in Bonilla (2011), which relies on an instrumental variables approach using distance to closest CEC school to construct an instrument for CEC attendance. As previously discussed, the algorithm used in Bogota to allocate students into public schools gives priority to families with the lowest socioeconomic status (SES) and, as a result, over subscribed schools could systematically get students with lower than average SES. On the other hand, students are allowed to apply to any school in the city, something that can lead to selection of most informed or motivated parents into better public schools. Whatever the case, an identification strategy must account for the potential selection of CEC program participants into CEC schools in order to estimate the causal effect of CEC attendance on higher education outcomes.

A consistent estimate for the effect of CEC attendance on academic performance can be recovered if there is at least one variable Z that, in addition to being uncorrelated with unobserved determinants of college outcomes, it is also a strong predictor of the probability of attending a CEC school. I exploit variation in distance from a student's residence to the closest CEC institution to construct

[5] I use the Universidad Distrital as an example here since —unlike other selective, public institutions in Bogota— its admission process is only determined by ICFES test scores.

an instrument for CEC attendance. More specifically, I first calculate the distance to the closest CEC school relative to the closest TPS, mostly to account for the fact that students who live distant from a CEC school may still live even further away from a TPS and consequently are more likely to attend a CEC school. Thus, I define the instrument as a categorical variable taking the value of 1 if a student lives closer to a CEC school than to a traditional public school (i.e., for negative relative distances) and 0 otherwise. That is,

$$Z_i = \mathbf{1}\{RD_i < 0\}, \text{ where } RD_i = \underset{c \in CEC}{MIN}(d_{ic}) - \underset{p \in TPS}{MIN}(d_{ip}) \tag{1}$$

where d_{ij} is the distance from student's i residence to school $j \in [c, p]$

The rationale behind the proposed instrument is that differential distances to CEC schools may induce quasi-experimental differences in transportation and opportunity costs of attending a given CEC school to students and their parents. These differences may be especially important for low-income students for whom the decrease in costs due to CEC proximity is what may induce attendance into CEC school. Nevertheless, for the proposed instrument to be valid, it can only affect student outcomes through its effect on CEC attendance. Since CEC schools were located in low-income neighborhoods in Bogota, students who live closer to CEC schools are also more likely to have a lower SES relative to TPS students and, as a result, distance to CEC schools would also be capturing their lower socio-economic background, violating the exclusion restriction.

Indeed, in Table 1, columns 8 and 10, the SES characteristics of CEC students who enrolled in college are slightly lower than those of TPS students. That is, CEC students have lower educated parents, come from lower income families, and live in low-strata neighborhoods. Note also that CEC students also have a lower SES than TPS students among those that did not enroll in college —columns 7 versus 9. However, the SES characteristics of the 2008 CEC and TPS students who are enrolled in college and belong to the UPZ sample (columns 11 and 12) are remarkably similar. Moreover, correlations between each of the SES variables and the categorical instrument for the 2008 cohort presented in Table 3 suggests that the instrument is not correlated with SES variables in those specifications that control for either student UPZ fixed effects or include observations only from the UPZ sample. I interpret these results as evidence that the proposed relative distance instrument

is exogenous conditional on UPZ fixed effects or conditional on residing in UPZs with nearby CEC schools (i.e., the UPZ sample).

5. Results

This section estimates 2SLS specifications of CEC attendance on higher education outcomes. To account for the possibility of correlation of student outcomes within a given neighborhood, all regression estimates are clustered at the UPZ level for the 2007 cohort and at the UPZ-year level for specifications with data from both 2007 and 2008 cohorts .

5.1. First Stage Estimates

Table 4 shows the estimates of linear probability models for CEC school attendance on the categorical relative distance instrument and different sets of exogenous regressors. For the 2007 cohort and using all observations in sample, the probability of attending a CEC school is 16 percentage points higher whenever the closest school available to the student is a CEC school. In turn, using observations from the UPZ sample increases this probability by 26 percentage points.

Notice that whereas the inclusion of UPZ fixed effects slightly reduces the reported point estimates, controlling for SES student characteristics such as age, gender, and student's residential stratum yield practically the same point estimates. That is, that the coefficient estimates and standard errors show little to no change across columns indicates there is little correlation between the instrument and the observable characteristics what supports the argument that the proposed instrument may be uncorrelated with unobserved characteristics as well.

First stage estimates obtained from the joint 2007-2008 sample largely replicates the results of the the 2007 cohort. Notice that, whenever this sample is used, I also include a year fixed effect to account for differences in CEC attendance in time. Lastly, note also that the F-statistic on the excluded instrument in all specifications are well above the conventional levels used to assess finite sample bias from weak instruments and provide evidence on the strong association between the relative-distance based instrument and the probability of CEC attendance.

5.2. 2SLS Estimates

I now proceed to present ordinary least squares (OLS), reduced form (RF), and two-stage least square (2SLS) estimates of CEC attendance on higher education outcomes. In particular, I estimate the effects on ICFES test scores as well as the effects on the probability of college enrollment, the probability of being enrolled at a selective public institution, the probability of enrolling in a 2-year vocational program, and the probability of dropping out during the first year in college. Notice that in Table 5, I restrict the analysis to observations from the UPZ sample to better control for unobserved neighborhood characteristics. In addition to this, all specifications include UPZ fixed effects, age, gender, and student residential stratum as controls. For the joint 2007-2008 cohort specifications, I also include a 2008 year fixed effect.

In Bonilla (2011), I provide causal evidence that CEC students graduating from high school in 2008 exhibited large and significant gains in test scores relative to TPS students. In the top panel of Table 5, I estimate the effects of CEC attendance for those graduating in 2007 as well as for the joint 2007-2008 cohorts. The point estimates for 2007 indicate that CEC students score 0.13 standard deviations more in the ICFES test than TPS students. Similar point estimates are found for the math and verbal sections of the test. Note that these results are smaller than the ones found in Bonilla (2011) for the 2008 cohort and similar in magnitude to OLS estimates. In fact, the results using both 2007 and 2008 cohorts show stronger results of ICFES scores in favor of CEC students mostly because of the large effects of the 2008 cohort. The lower estimates of the 2007 cohort could be a result of a series of factors including CEC schools learning curve. In addition to this, as discussed in detail in Bonilla (2011), it was only after 2007 that a standardized and more comprehensive annual evaluation process to CEC schools' performance was implemented, including more demanding conditions in terms of ICFES test results. These evaluations have been conducted yearly since then to all CEC schools and allow for individual school comparisons over time.[6]

Regarding higher education outcomes, I first report the estimates of CEC attendance on college enrollment. In 2007, CEC students are 12 percentage points more likely to enroll in college. This represents more than a 50% increase over the average college enrollment of 22% for this sample. For

[6] In future work, it will be of interest to determine how more recent cohorts of CEC students have performed in the ICFES test to further assess the evidence among these two plausible explanations.

the joint 2007-2008 cohorts, the increase in the probability on college enrollment of CEC students relative to TPS students is less pronounced, 4.6 percentage points, and less precisely estimated —although similar in magnitude to the more precise OLS estimate. In any case, as stated before, it remains to see to what extent this lower estimated effect has been affected by the suspiciously low proportion of 2008 students found enrolled in higher education as discussed in Section 3.

There is a rather low proportion of students in the sample who are enrolled at the selective public universities in Bogota, namely, the *Universidad Nacional* and the *Universidad Distrital*. This is not surprising given that these two universities are the most highly selective, low-fee institutions in the city and, as a result, public high school students face strong competition from private school students. In any case, OLS and 2SLS estimates for the 2007 cohort indicate that CEC students are about 1 percentage point more likely to attend one of these institutions than TPS students —a relatively large effect compare to an unconditional mean of 3%.

The low proportion of public high school students enrolled at selective, public institutions provides suggestive evidence that there is high demand for public, selective institutions in the city and, unless public school students have outstanding high ICFES scores relative to *all* college applicants, the probability of being admitted to programs at these institutions is quite low. Figure 2 presents some evidence on this point. In particular, it shows kernel distributions of all ICFES test takers in the second semester of 2008 in Bogota by school type. First, notice that —despite large heterogeneity in test scores among private school students— the test score distribution for private school students is to the right of CEC and TPS distributions. As a result, private school students are more likely to be admitted at selective institutions thanks to having higher ICFES test scores. More importantly, note how similar the unconditional test score distributions for CEC and TPS are. However, in chapter 2 I provided evidence that —after accounting for negative selection into the CEC program— the average CEC student significantly outperforms the average TPS student in the ICFES test, especially for the 2008 cohort. What these two results indicate is that, although CEC schools attendance improve average performance in the ICFES test, these higher results are not sufficiently large so to compensate for the negative selection nature of CEC participants and to effectively compete with private school students for admission at selective institutions.

Nevertheless, what the results on college enrollment indicate is that CEC students are significantly more likely to enroll than TPS students, just not at selective institutions. I therefore consider, as a third outcome for higher education, the probability of attending a two-year vocational program by CEC students. The results indicate that CEC students are almost 8.8 and 6.5 percentage points more likely to attend a vocational program than TPS students in the 2007 and the 2007-2008 samples, respectively. These results represent more than an 85% increase when compared to the unconditional means of 2-year programs. The estimated results for this outcome are of interest because, according to the Ministry of Education, 74% of the graduates from technological programs in Colombia have formal employment —just 3 percentage points less than graduates from 5-year colleges and universities in the 2001-2009 period (MEN, 2011). Also, graduates from technology programs have earnings equal to 75% the earnings of university graduates. Thus, these suggests that attending a CEC school has important longer-run effects related to higher education, even though these effects are not so much obtained via higher ICFES test scores. Lastly, the evidence on the probability of dropping out in the first two semesters after enrolling in higher education suggests there is not a statistically significant difference in this probability between CEC and TPS students.

6. conclusion

This paper estimates the causal effects of attending contracted out public schools on higher education outcomes. The issue of contracting out public schools has gained attention in the education literature as a potential alternative for the provision of public education with schools experiencing higher levels of autonomy while being contractually accountable for their students' performance. Given that the literature has mostly focused on the effects on standardized tests, this paper is, to the best of my knowledge, the first attempt to look at the effects of these programs on longer-run outcomes and, in particular, on tertiary education outcomes.

Given that in Bogota CEC students were not randomly allocated into schools and CEC schools were not randomly allocated in the city, I use an instrumental variables strategy that exploits exogenous variation in distance from a student's residence to the nearest CEC school. In Bonilla (2011) and here, I provide evidence that the location of CEC schools was unrelated to the academic performance

of potential students and that the proposed instrument is likely to be uncorrelated to unobserved determinants of academic performance.

OLS and 2SLS estimates indicate that CEC students are substantially more likely to enroll in college in general and to enroll in two-year vocational programs in particular. Moreover, while CEC students score significantly higher in the ICFES test —the main criterion used to determine admission into higher education in Colombia— than TPS students, these higher scores do not seem to be sufficiently higher to effectively compete for slots at selective, public institutions in Bogota. I also provide some evidence that better academically prepared students are less likely to drop out from college.

This study provides compelling evidence that students attending CEC schools exhibit both short- and longer-term gains in academic performance. Future research is needed to understand the full welfare impacts of this program, in particular, on its effects on complete higher education histories as well as labor market outcomes such as wages and employment.

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Table 1. Selected Descriptive Statistics by College Attendance

	2007						2008					
	TPS		CEC		In College (UPZ Sample)		TPS		CEC		In College (UPZ Sample)	
	Not (1)	In College (2)	Not (3)	In College (4)	TPS (5)	CEC (6)	Not (7)	In College (8)	Not (9)	In College (10)	TPS (11)	CEC (12)
ICFES Math Score in sd	-0.11 (0.95)	0.24 (1.06)	-0.080 (0.88)	0.22 (1.12)	0.13 (1.02)	0.20 (1.13)	-0.085 (1.00)	0.34 (0.95)	0.028 (0.89)	0.41 (1.07)	0.31 (0.92)	0.45 (1.05)
ICFES Verbal Score in sd	-0.14 (0.97)	0.32 (0.98)	-0.11 (0.96)	0.28 (1.01)	0.17 (0.98)	0.26 (1.00)	-0.087 (1.02)	0.35 (0.88)	0.011 (0.87)	0.41 (0.90)	0.29 (0.88)	0.48 (0.79)
ICFES Composite Score in sd	-0.51 (0.59)	-0.095 (0.69)	-0.47 (0.56)	-0.14 (0.71)	-0.23 (0.65)	-0.16 (0.70)	-0.41 (0.76)	0.013 (0.62)	-0.33 (0.60)	0.047 (0.69)	-0.035 (0.61)	0.092 (0.61)
I(Relative Distance to CEC < 0)	0.094	0.075	0.47	0.44	0.13	0.47	0.090	0.070	0.43	0.41	0.16	0.53
Male $= 1$	0.46	0.49	0.48	0.49	0.46	0.48	0.46	0.48	0.46	0.49	0.47	0.48
Age	16.4 (1.61)	16.0 (1.38)	16.4 (1.39)	15.8 (1.22)	15.9 (1.81)	15.8 (1.22)	17.2 (1.33)	16.6 (1.02)	17.1 (1.60)	16.6 (2.26)	16.5 (1.09)	16.5 (2.51)
No. Household Members	.	.	.	.	.	.	5.21	4.94	5.35	5.18	5.07	5.29
No. Rooms in House	.	.	.	.	.	.	4.19	4.46	4.28	4.48	4.47	4.52
Father Education Primary $= 1$	.	.	.	.	.	.	0.42	0.26	0.45	0.31	0.35	0.31
Father Education Secondary $= 1$	.	.	.	.	.	.	0.47	0.48	0.45	0.52	0.49	0.55
Mother Education Primary $= 1$	.	.	.	.	.	.	0.36	0.21	0.41	0.24	0.27	0.27
Mother Education Secondary $= 1$	.	.	.	.	.	.	0.51	0.53	0.47	0.56	0.56	0.56
Stratum $1 = 1$	0.13	0.060	0.20	0.16	0.15	0.17	0.16	0.080	0.25	0.18	0.17	0.22
Stratum $2 = 1$	0.46	0.39	0.67	0.68	0.65	0.69	0.53	0.47	0.69	0.76	0.69	0.74
Stratum $3 = 1$	0.36	0.49	0.11	0.15	0.19	0.13	0.30	0.43	0.052	0.054	0.14	0.035
House Income: 1 MW or less	.	.	.	.	.	.	0.16	0.078	0.15	0.088	0.11	0.092
House Income: $1 <$ MW < 2	.	.	.	.	.	.	0.55	0.46	0.60	0.53	0.52	0.53
House Income: $2 <$ MW < 3	.	.	.	.	.	.	0.22	0.30	0.21	0.30	0.28	0.32
Computer at Home $= 1$	.	.	.	.	.	.	0.45	0.68	0.43	0.65	0.61	0.63
Car Ownership $= 1$	.	.	.	.	.	.	0.14	0.23	0.15	0.20	0.16	0.20
Internet at Home $= 1$	.	.	.	.	.	.	0.20	0.38	0.17	0.28	0.28	0.27
Observations	21988	11759	971	518	2196	465	25780	6006	1334	296	1614	229
Proportion	0.66	0.34	0.65	0.35			0.81	0.19	0.82	0.18		

Table 2. Descriptive Statistics for Higher Education Outcomes

	2007				2008			
	Full Sample		UPZ Sample		Full Sample		UPZ Sample	
	TPS	CEC	TPS	CEC	TPS	CEC	TPS	CEC
Enrollment and Majors								
Enrolled at Selective	0.28	0.28	0.27	0.28	0.31	0.35	0.31	0.36
Enrolled at Selective and Public	0.18	0.22	0.19	0.21	0.22	0.26	0.25	0.27
Two-year Technology Program	0.15	0.18	0.18	0.19	0.13	0.13	0.15	0.14
Two-year Vocational Program	0.19	0.24	0.25	0.24	0.20	0.22	0.24	0.23
Health	0.07	0.07	0.06	0.07	0.07	0.07	0.06	0.07
Social Sciences	0.08	0.06	0.07	0.07	0.09	0.09	0.08	0.09
Economics / Business	0.18	0.10	0.15	0.10	0.15	0.15	0.14	0.16
Engineering / Architecture	0.17	0.13	0.13	0.13	0.18	0.16	0.15	0.16
Education	0.12	0.16	0.13	0.16	0.14	0.15	0.15	0.14
Student Loan and Selective Program Eligibility								
ICETEX Eligible for 5-year Program	0.80	0.77	0.74	0.76	0.83	0.83	0.81	0.83
ICETEX Eligible for 2-year Program	0.96	0.95	0.94	0.95	0.97	0.97	0.97	0.97
UD Eligible for Cadastral Engineering	0.15	0.16	0.10	0.16	0.15	0.17	0.14	0.18
UD Eligible for Mechanical Engineering	0.05	0.05	0.03	0.05	0.05	0.06	0.04	0.06
UD Eligible for Industrial Engineering	0.06	0.05	0.03	0.05	0.05	0.06	0.04	0.06
UD Eligible for Industrial Technology	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Dropout Behavior								
Drop out in 1st Semester	0.24	0.25	0.26	0.26	0.29	0.27	0.30	0.26
Drop out in 1st or 2nd Semester	0.36	0.40	0.37	0.40	0.45	0.41	0.46	0.40
Observations	11759	518	2196	465	6006	296	1614	229
Proportion enrolled in College	0.35	0.35	0.25	0.34	0.19	0.18	0.15	0.18

Table 3. Exogeneity of Relative Distance to Closest CEC

	Full Sample			UPZ Sample		
		Balance Regressions			Balance Regressions	
	RD>0 Means	No Controls	UPZ Fixed Effects	RD>0 Means	No Controls	UPZ Fixed Effects
	(1)	(2)	(3)	(4)	(5)	(6)
Student and Family Characteristics						
Male	0.46	-0.003	0.006	0.47	-0.009	0.004
Age	17.07	0.038	0.023	17.09	0.014	0.014
Number Household Members	5.17	0.012	-0.032	5.31	-0.114	-0.075
Father Education: Primary = 1	0.38	0.107***	0.016	0.47	0.034	0.006
Father Education: Secondary = 1	0.48	-0.048**	-0.009	0.45	-0.019	0.000
Mother Education: Primary = 1	0.32	0.077***	-0.002	0.40	0.020	-0.007
Mother Education: Secondary = 1	0.52	-0.026	0.014	0.48	-0.004	0.019
Dad is Literate	0.98	-0.003	0.004	0.98	0.000	0.004
Mom is Literate	0.99	-0.005	0.002	0.98	-0.002	0.003
No Younger Siblings	0.34	-0.038***	-0.023*	0.32	-0.022	-0.026*
Household Income						
Stratum 1 = 1	0.15	0.050	-0.010	0.24	-0.001	-0.018
Stratum 2 = 1	0.50	0.214**	0.025	0.65	0.061	0.040*
Stratum 3 = 1	0.34	-0.253***	-0.014	0.11	-0.060	-0.021
House Floors - Low Quality	0.09	-0.031**	-0.000	0.08	-0.018	0.006
House Floors - Med Quality	0.34	0.111***	0.005	0.44	0.021	-0.011
Number of Rooms in Household	4.24	0.016	-0.008	4.24	0.011	-0.017
House Income: 1 MW or less	0.14	0.014	0.004	0.16	-0.000	0.006
House Income: 1 < MW < 2	0.53	0.034**	-0.006	0.58	-0.005	-0.015
House Income: 2 < MW < 3	0.23	-0.008	0.003	0.20	0.011	0.008
Household Assets						
Computer at Home	0.50	-0.065**	-0.007	0.43	-0.014	-0.005
DVD at Home	0.75	-0.014	-0.004	0.75	-0.008	0.001
Car Ownership	0.16	-0.031**	-0.003	0.12	-0.000	-0.002
Motorbike Ownership	0.07	0.002	0.001	0.08	-0.003	-0.002
No Cellphone in Household	0.06	-0.001	0.005	0.06	-0.007	0.008
One Cellphone in Household	0.22	0.005	0.007	0.22	0.001	0.002
Internet at Home	0.24	-0.053**	0.011	0.17	0.003	0.020
Cable TV at Home	0.61	-0.058*	-0.018	0.58	-0.043	-0.030
N	29971	33413	33413	9373	11968	11968

Notes: Columns (1) and (4) report means of the variable indicated in each row for students living closer to a TPS than to a CEC school for the full and UPZ samples, respectively. Columns (2), (3), (5), and (6) report coefficients from regressions of the variable indicated in each row on an indicator variable equal to one if the student leaves closer to a CEC school than to a TPS (i.e., the relative distance instrument). Columns (2) and (5) only include the instrument as a regressor. Columns (3) and (6) include also UPZ fixed effects. Significance Levels *** 1%, **5%, *10%. All standard errors account for clustering at the UPZ level.

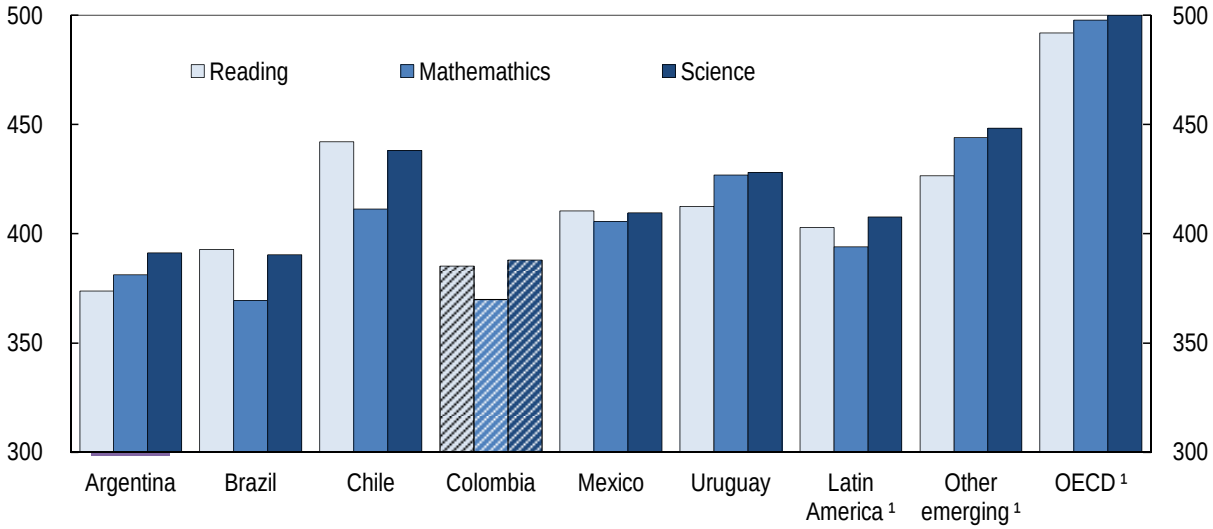
Table 4. First Stage Results

	2007						2007-2008					
	Full Sample			UPZ Sample			Full Sample			UPZ Sample		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
I(Relative Distance to CEC < 0)	0.16***	0.13***	0.13***	0.26***	0.24***	0.23***	0.17***	0.12***	0.12***	0.23***	0.19***	0.19***
	(0.03)	(0.03)	(0.03)	(0.05)	(0.05)	(0.04)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.02)
I(Male $= 1$)			0.00			0.01			0.00			0.00
			(0.00)			(0.01)			(0.00)			(0.00)
I(Stratum $1 = 1$)			0.01			-0.01			0.01			0.03
			(0.02)			(0.09)			(0.01)			(0.05)
I(Stratum $2 = 1$)			0.00			-0.02			0.01			0.03
			(0.02)			(0.10)			(0.01)			(0.05)
I(Stratum $3 = 1$)			-0.01			-0.06**			-0.01			-0.03
			(0.01)			(0.02)			(0.01)			(0.03)
I(Year=2008)							0.01	-0.00	-0.00	-0.03*	-0.06***	-0.06***
							(0.01)	(0.00)	(0.00)	(0.02)	(0.02)	(0.02)
UPZ Fixed Effects	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Exogenous Covariates	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes
Correct Prediction Rate	0.89	0.71	0.71	0.81	0.74	0.75	0.89	0.72	0.70	0.79	0.71	0.72
F-Statistic of Excluded Instruments	39.72	24.59	24.73	25.33	22.86	31.46	80.55	49.76	49.13	69.99	49.47	57.37
N	34710	34710	34710	9817	9817	9817	67347	67347	67347	21008	21008	21008

Table 5. OLS, Reduced Form, and 2SLS Estimates of CEC attendance

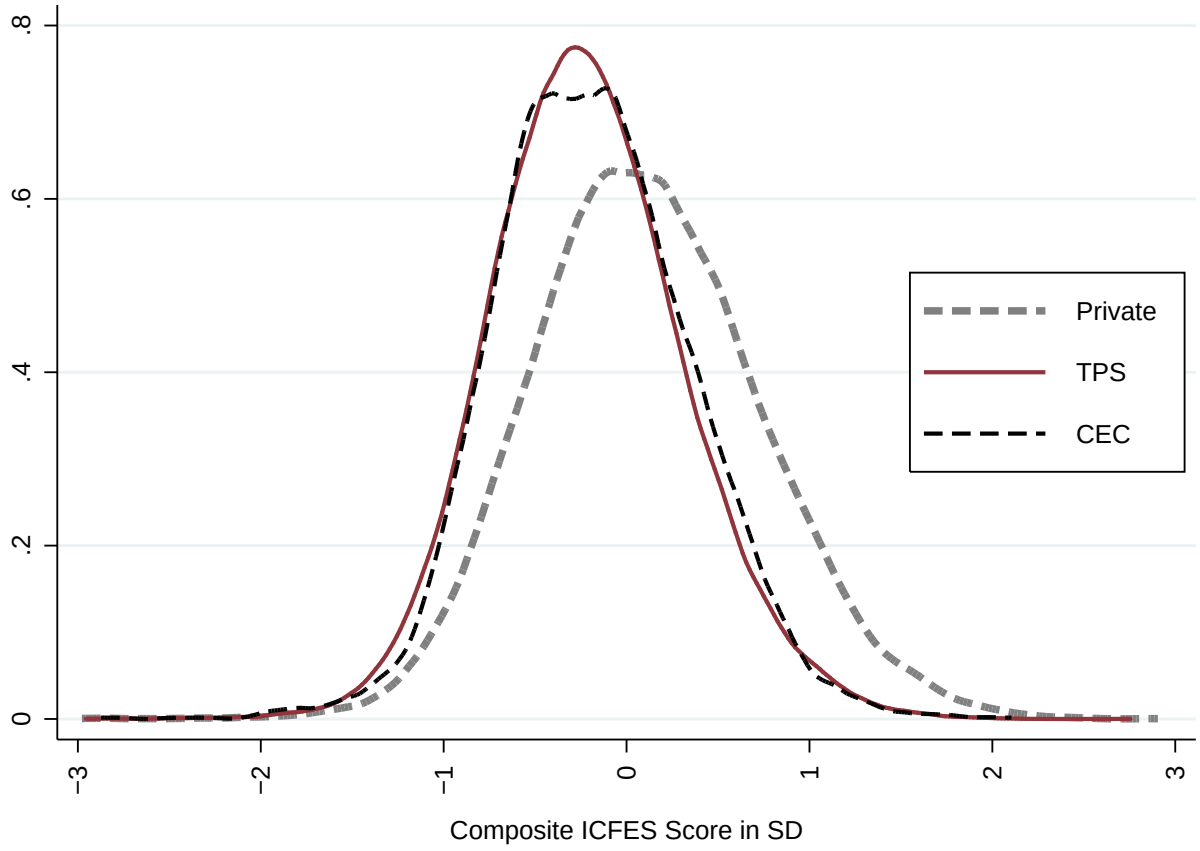
	2007				2007-2008			
Dependent Variable	Mean	OLS	RF	2SLS	Mean	OLS	RF	2SLS
ICFES Test Scores								
Math Score in sd	-0.071	0.114***	0.021	0.092	-0.051	0.125***	0.054***	0.257***
		(0.040)	(0.021)	(0.090)		(0.026)	(0.015)	(0.084)
Verbal Score in sd	-0.106	0.137***	0.037	0.159	-0.078	0.145***	0.036*	0.158
		(0.035)	(0.027)	(0.105)		(0.026)	(0.019)	(0.102)
Composite Score in sd	-0.472	0.125***	0.031*	0.133**	-0.422	0.120***	0.041***	0.172***
		(0.026)	(0.016)	(0.059)		(0.019)	(0.012)	(0.063)
Higher Education Outcomes								
Enrolled in College	0.228	0.092***	0.028*	0.120**	0.187	0.057***	0.006	0.046
		(0.017)	(0.015)	(0.057)		(0.012)	(0.010)	(0.048)
Enrolled at Selective and Public	0.034	0.013***	0.003	0.011	0.031	0.011***	0.001	0.004
		(0.004)	(0.004)	(0.016)		(0.004)	(0.003)	(0.017)
Two-year Vocational Program	0.097	0.044***	0.020*	0.088**	0.076	0.022***	0.011*	0.065**
		(0.012)	(0.011)	(0.041)		(0.007)	(0.006)	(0.030)
Drop out in 1st or 2nd Semester	0.088	0.047***	0.010	0.044	0.078	0.024***	-0.000	0.000
		(0.013)	(0.012)	(0.046)		(0.009)	(0.006)	(0.033)
UPZ Fixed Effects		Yes	Yes	Yes		Yes	Yes	Yes
Exogenous Covariates		Yes	Yes	Yes		Yes	Yes	Yes
N		9815	9815	9815		21006	21006	21006

Figure 1. Country Average 2006 PISA Scores



Notes: Regional averages are simple averages of countries in PISA sample. Mexico is included in OECD and Latin America average. The Latin American countries studied in PISA 2006 are Argentina, Brazil, Chile, Colombia, Mexico and Uruguay. Source: OECD (2007).

Figure 2. ICFES Composite Score Distribution by School Types



Notes: This figure presents kernel distributions of all ICFES test takers in the second semester of 2008 in Bogota.