

Contracting Out Public Schools for Academic Achievement: Evidence from Colombia*

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Abstract

This paper evaluates the causal impact on academic achievement of contracting out public schools to private operators. The Colegios en Concesion (CEC) program is a large-scale initiative implemented in 2000 in Bogotá, Colombia, that contracted out all new public schools to reputed, not-for-profit private schools and universities. This program allowed CEC schools to operate outside the collective bargaining provisions of traditional public schools in return for higher accountability, including test-based accountability. To overcome potential selection bias of CEC school attendance, I exploit variation in distance from a student's residence to the closest CEC institution as an instrument for CEC attendance. While distance may in theory be correlated with unobservable characteristics of students, I demonstrate using a variety of empirical strategies that this instrument is conditionally exogenous of unobserved determinants of academic achievement. The two-stage least squares estimates obtained indicate that CEC students score 0.6 and 0.2 standard deviations higher in math and verbal tests, respectively, relative to public school students. I provide evidence that the estimated results are not driven by unintended strategic responses by CEC schools, such as excluding low-performing students from the pool of test-takers, differential dropout rates, or via test specialization in the curriculum.

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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 in both academic and policy circles. This question is, for example, at the center of the debate over the effects that vouchers and charter school programs have on academic performance.

Proponents of contracting out public education argue that the political institutions that govern public schools inhibit the existence of academically effective organizations as services are provided by well-organized labor unions that tend to sub-optimally weight the welfare of their members (Chubb and Moe, 1990; Shleifer, 1998). Opponents, on the other hand, assert that due to contractual incompleteness, contractors may engage in cost-saving strategies that affect those aspects of quality which are essentially non-contractible and even avoid unprofitable students such as those with special education needs. Opponents also argue that private schools may have curricula that do not fully reflect the social goals of public education such as serving as an agent of socialization into a common set of moral values (Benveniste et al, 2003).

In the literature on public-private partnerships (PPPs) in education, US charter schools, which are choice-attended privately run public schools, have received special attention (for a description of US charter schools see, for example, Wilson, 2008; Hoxby et al, 2009). Nevertheless, the existing evidence on charter school effectiveness is rather inconclusive—with positive effects on test scores being found for some schools and some grades only (Angrist et al, 2010; Abdulkadiroglu et al, 2009; Dobbie and Fryer, 2009; Hoxby and Murarka, 2009; Hoxby and Rockoff, 2004; Saas, 2004; Bifulco and Ladd, 2004; Hanushek et al, 2007; Booker et al 2007)—, which has lead some authors to question the effectiveness of the different forms of PPPs in education (Benveniste et al, 2003; Levin, 2003; Ravitch, 2010). Perhaps what the existing evidence suggests, however, is that the debate should not be so much about privately versus publicly run schools, but about the institutional practices that need to be implemented in order to improve student achievement in public schools. For example, recent evidence on public schools that subscribe to a pedagogical model known as the "No Excuse" approach demonstrates that schools that emphasize on comportment, have longer shifts and school years, invest on better human capital, develop programs for students with learning disabilities, and

create a culture of high expectations among students and their families can significantly increase achievement, especially for low income students (Abdulkadiroglu et al. 2011; Angrist et al. 2011; Dobbie and Fryer, 2011; Fryer, 2011).

This paper studies the causal impact on academic achievement of the *Colegios en Concesión* (CEC) Program, a medium-scale initiative implemented in Bogotá, Colombia, which contracted out the administration of all the public schools that were constructed in the city between 2000 and 2003 to well regarded, not-for-profit private schools. The CEC program allowed contracted out schools to operate outside teacher collective bargaining provisions in return for increased school accountability, including test-based accountability. In addition to this, the selected organizations were not only chosen for exercising pedagogical practices at their parent establishment which were along the lines of the "No Excuse" approach, but also are contractually required to adopt these practices at their contracted schools. Indeed, provision contracts establish that CEC schools are subject to an annual evaluation based on a series of factors related to education quality such as teachers' education and experience, student dropout rates, and the length of the academic year. More importantly, CEC schools failing to meet well defined academic standards based on the results of a national standardized test can end up in contract rescission. This program is of particular interest given it was the first education policy in the country aiming at holding public schools academically accountable for their students' performance.

To estimate the effect of CEC attendance on academic achievement, I examine its impact on math and verbal test scores from the *SABER-11* test (hereafter ICFES test), a national standardized test taken by the vast majority of high school students in their last year of high school, using data for all public and CEC students in Bogotá who took the ICFES test in the second semester of 2008.

The major empirical challenge in studies of alternative school models is selection bias. Students who attend CEC schools may differ in a number of ways from public school students. Some of this bias is eliminated by controlling for observable student and family characteristics, but the possibility of bias remains from unobserved variables that determine school choice such as student ability, motivation or some other features of family background. For example, higher unobserved motivation among parents of CEC schools can erroneously lead to the conclusion that CEC students improve

academic achievement relative to traditional public schools even if there is no difference in the quality of these schools. Alternatively, estimates of the effects of CEC schools on achievement could be downward biased if CEC families have unobserved lower socioeconomic conditions relative to families of students attending traditional public schools.

Therefore, establishing the causal effect of CEC school attendance on academic achievement requires an exogenous source of variation in school choice. Basic economic models of education choice suggest that schooling decisions are based on the costs and benefits of alternative choices. In this paper I exploit geographic differences in accessibility to CEC schools as a source of exogenous variation. Using administrative data of student and school addresses, I conduct an instrumental variables approach that uses a function of residential distance to the closest CEC school, as an instrument for CEC attendance. As I explain in detail below, the proposed instrument solves the unobserved selection problem as long as the distance of a student’s residence to the closest CEC school has a strong effect on the probability of attending a CEC school, without affecting student outcomes directly conditional on other exogenous covariates. Intuitively, differential distances to CEC schools induce quasi-experimental differences in transportation and time costs of attending a given CEC school, differences that are especially important for students with low socioeconomic background for whom the decrease in costs due to CEC proximity may induce CEC school attendance.

While residential distance to the closest CEC school may in theory be correlated with unobservable characteristics of students, I demonstrate using a variety of empirical strategies that the proposed instrument is likely to be conditionally exogenous to unobserved determinants of academic performance, at least in this context. The most important factor driving this conditional exogeneity is that all CEC schools were constructed in neighborhoods with excess demand for public education in the poorest areas of the city.¹ Thus, conditional on residing in these areas, I first show that the distance from a student’s residence to the closest CEC school is not correlated with family or student determinants of academic performance and, therefore, it is likely to be uncorrelated with unobserved determinants too. To further check for instrument exogeneity, I also perform a reduced-form placebo test using students’ test scores for the year 2000, one year before the first program participants took

¹The city’s Department of Education (SED) was responsible for locating and constructing all CEC schools in Bogotá. As a result, selected providers did not have any influence on the location of the schools.

the ICFES test, and show that CEC schools were not systematically placed in areas with higher probabilities of being successful.

I find that, relative to public school students, CEC students scores are around 0.6 and 0.25 standard deviations higher in math and verbal test scores, respectively. Taken at face value, these effects reduce by a half the public-private school achievement gap in math and verbal test scores, a significant effect considering the large differences in socio-economic characteristics between these two population groups. The estimated results are actually significantly higher than OLS estimates for CEC attendance, suggesting that the observed association between CEC attendance and test scores is not driven by omitted variables such as higher ability or highly motivated families among CEC students. Instead, the evidence points to the possibility that the unobserved variables that determine selection into CEC schools are negatively associated with academic performance. That is, if anything, my results are lower bound estimates of the test score gains from CEC attendance.

As is generally the case with most multi-factor education interventions, it is rather unfeasible to identify the actual mechanisms driving the estimated results. Thus, the closest available option to interpret the results is to rule out some of the potential explanations and use auxiliary evidence to argue in favor of some other ones. Thus, I start by showing that, unlike some programs that have implemented test-based accountability practices in public schools in the US (Koretz and Barron [1998]; Figlio and Getzler [2002]; Cullen and Reback [2002]; Jacob [2003, 2004]), the higher performance exhibited by CEC students are not driven by strategic responses by CEC schools such as forcing low-performing students to either transfer or dropout from CEC schools, or by preventing students in some other way from taking the test. I also provide evidence that the estimated effects are not driven by specializing in high-stakes academic subjects at the expense of ignoring other critical areas of learning. First, different from most standardized tests, the test used in this study evaluates students on most subjects included in the national curriculum,² which reduces the effectiveness of test specialization. Second, neither schools nor students have incentives to exert more effort on specific subjects. From the point of view of the schools, the academic requirements defined in the provision contracts are based on their students' ICFES composite test scores, calculated for each student as

²ICFES test evaluates students on Math, Verbal, Biology, Chemistry, Physics, History, Geography, Philosophy, and English.

a weighted average of all test sections. For the students, ICFES composite test score serves as the main admission criterion to colleges in Colombia (ICFES, 1999). My instrumental variables results indicate that attending a CEC school increases composite test scores by 0.3 standard deviations relative to public school students, suggesting that CEC schools are not specializing in just math and reading.

On the other hand, I argue that the higher academic results of CEC schools can be primarily attributed to the effect of contracting public schools out to private institutions and holding them accountable for the academic achievement of their students. Also, by allowing CEC schools to operate outside teacher collective bargaining provisions, contracts also allow CEC schools in turn to hold teachers accountable. Lastly, the evidence suggests that the contractual arrangement reduces CEC providers' incentives to incur in inefficient quality-reducing cost reductions or promoting unintended strategic responses. First, both student school choice and school competition as well as reputational considerations of the selected institutions significantly moderate CEC schools to undertake detrimental cost reductions. Second, as predicted by Glaeser and Shleifer (1998), the incentives for inefficient cost reductions are further attenuated since not-for-profit is the prevalent organizational structure in the CEC program, given that non-profit organizations are barred from distributing profits to those exercising control over them.

The rest of the paper is organized as follows. Section 2 describes the institutional framework of Bogotá's public education system and briefly summarizes the literature on related school programs. Section 3 introduces the data sources and presents some descriptive statistics of the population of interest. Sections 4 and 5 describe the empirical strategy and the estimation results. Section 6 checks for the robustness of the results. Section 7 discusses the evidence on strategic responses to test-based accountability and the plausible mechanisms through which CEC schools are able to achieve higher academic results than traditional public schools. Section 8 concludes.

2. Background

2.1. Public Education Sector in Bogotá

There were 1.6 million children enrolled in primary or secondary school in Bogotá in 2008. Of these, 1.1 million children were part of the public education system: 80% of them attended more than 340 TPS, 5% attended 25 CEC schools and the remaining 15% attended 332 private schools paid by the City's Department of Education (SED, hereafter) for taking public school students unable to obtain a seat in existing public schools.³

Public schools in Bogotá largely educate the children of low income families. As expected, families demanding education self-select into schools according to their economic means, which leaves the public schools with students from the bottom of the income distribution. For example, data on student socioeconomic characteristics collected at registration for ICFES test shows that 67% of students attending a public school come from families with a monthly household income less than two times the monthly minimum wage; this figure is just 30% for students attending private schools.

Families applying for a public or CEC school for the first time must provide a preference-ranked list of up to four schools.⁴ Before allocating children to schools, the SED sorts students according to the socioeconomic means of their families. That is, students from the most economically disadvantaged households are allocated first to their most preferred options. If no seats are available for the preferred choices, students are placed in the closest available school to their residence with available seats. It is worth noting that this process is the same for students attending either public or CEC schools. That is, neither TPS or CEC schools can select their students using admission tests or similar criteria.

As a result of the admission process, public schools exhibit important differences in the observed characteristics of their students and, very likely, in their unobserved characteristics too. On the one hand, the allocation algorithm gives priority to families with the lowest socioeconomic status (SES). That is, for two students applying to a given school, the one with the lowest SES is more likely to

³This initiative is different from a voucher program since students are not free to choose the private school they attend, but must attend the one to which they are assigned by the SED. Students enrolled in participating private schools usually reside in areas with excess demand for public education.

⁴Students currently enrolled in a given school are guaranteed a place in their current academic institution.

attend it. Then, over subscribed schools could systematically get students with lower than average SES. On the other hand, the SED allows students to apply to their most preferred institutions which may lead to selection of most informed or motivated parents into better public schools. Consequently, it is unclear which selection mechanism dominates in this context and, in particular, what exactly leads students to attend a CEC school. Because of this, in order to estimate a causal effect of CEC attendance on academic achievement, an identification strategy must account for the potential selection of CEC program participants into CEC schools.

2.2. The *Colegios en Concesión* (CEC) Program

The effectiveness of the SED to implement policies that improve academic performance depends, to a great extent, on its ability to direct and coordinate the actions of the complex public education sector in Bogotá, which consists of more than 26,000 teachers operating within a national collective bargaining agreement. The existing institutional arrangement leaves the SED with little room to introduce major changes aiming at improving quality of education. First, wages are the result of a bargaining process between the teachers union and the national government—not the local government—and are determined by education and tenure as opposed to performance. Second, the SED has little ability to coordinate the actions of TPS through school principals, and principals themselves do not have social or legal instruments to exert authority and demand the fulfillment of assigned tasks to teachers. Indeed, although the SED has the power to appoint and transfer school principals and teachers, dismissals or other disciplinary sanctions are the responsibility of the Ranking Board, a committee where teachers' interests had been traditionally over-represented (Gandour et. al, [2000]).

These institutional limitations prompted the creation of the CEC school program. The argument was that this program would allow the SED to be able to monitor and demand academic quality in some schools given the lack of high power incentives to encourage teacher cooperation in TPS. Thus, all the new public schools constructed by the SED between 1999 and 2003 were contracted out to private academic institutions. The SED established 15-year contracts with private schools and universities through a bidding process based on the superior academic results of their own institutions

in the ICFES test, the proposed profile of potential teachers and yearly cost per-student. A total of 16 schools opened primary school grades (grades 1 to 5) in April 2000 and then added secondary education (grades 6 to 11) the year after. Six more schools began operating in March 2001, providing up to 10th grade that year and graduating their first class in 2002. The last 3 schools opened in 2003 for all academic grades. By 2008, approximately 40,000 students were enrolled in CEC schools in Bogotá.

Like TPS, CEC schools are supported by public funds, receive practically the same amount per student from the SED that TPS receive, cannot select their own students, follow a standardized academic curriculum, have the same academic year length, and obey most TPS regulations.

On the other hand, CEC schools are different from TPS in some important ways. First, CEC schools are able to hire teachers at regulated salaries on ten-month renewable contracts from a non-unionized pool of applicants. That is, unlike TPS, CEC schools have the flexibility to adjust the teachers' body as needed on a yearly basis. In addition to this, the contracts establish that teachers should have at least a college degree in Education and have some years of relevant experience. Moreover, teacher wages are regulated by law so that CEC teachers earn at least what TPS teachers earn according to education level and experience. Interestingly, given the differences in job stability for public and CEC teachers, CEC school teachers often find it optimal to move to TPS, with some CEC schools having turnover rates of as much as 40% per year. Second, while many TPS provide either primary or secondary grades, CEC schools provide all academic grades, a strategy that not only aims at reducing dropouts, but perhaps more importantly a strategy that incentivizes long run student investments by the school. Third, the average CEC school has better school facilities than the average TPS as a result of being more recently built by the SED. Nevertheless, as many as 50 new TPS constructed after 2004 and located in similar low-income neighborhoods (see Figure 1) have facilities comparable to CEC schools.

CEC School Evaluations

Perhaps the most important difference between CEC and TPS schools is that the former are

subject to performance evaluations by organizations contracted by SED for this purpose. Importantly, only after 2007 a standardized and more comprehensive annual evaluation has been implemented — including additional indicators in terms of ICFES test results. Before 2007, the evaluations conducted did not aim at becoming a regular instrument for tracking CEC performance partly since these were conducted by different organizations with different methodological approaches.

The current evaluation, which started in 2007, uses quantitative and qualitative indicators on multiple outcomes related to academic quality such as teachers' education and experience, participation of students, parents and teachers in school bodies, quantity and quality of food provision, and transfer and dropout rates. As shown in Table 1, the current methodology is divided in components and each component is in turn divided in indicators. Both indicators and components are weighted in order to generate an overall grade for each CEC school. An important feature of the current evaluation is that it allows for individual school comparisons in time.

Regarding academic achievement, which receives 20% of the overall weight, the current evaluation looks at each CEC school average performance on the ICFES test using a weighted average of their overall and relative performance. The overall measure —receiving 40% of the weight within the Academic Performance component— ranks all private and public schools in the country according to their average performance in the ICFES test in 7 achievement levels. Whereas the overall average score received by CEC schools in the period 2004-2007 is 4.44, this average is 4.59 for the period 2008-2010. As a reference, the 2008 difference in average CEC ICFES score between any two adjacent levels is of 0.2 standard deviations. This may be an indication of how difficult it may be to move to a higher achievement level. This may be partly explained by the fact that this indicator does not control for SES differences between schools. Thus, in order to move to a higher achievement level, schools need to improve their performance relative to all schools including the private schools.

Provision contracts with CEC providers recognize that overall performance is an imperfect measure of school quality as academic achievement is highly correlated with students' background. Indeed, contracts state that the SED can unilaterally break the contract whenever a school's average results in the ICFES test are worse than the performance of the average TPS in their locality for two consecutive years.⁵ Consequently, the current evaluation takes this indicator into account. In

⁵Bogota is administratively divided in 20 localities and there are CEC schools in 10 of them.

Figure 2, I show differences in means between each CEC school and the average TPS in their locality for both 2007 and 2008. For both years, the horizontal axis is sorted in ascending order of the 2008 CEC-TPS ICFES difference to facilitate visualization. Note, first, that for 2008, seven CEC schools have scores statistically higher than the average TPS in their locality. Also, for the remaining schools, the difference in means is not statistically different from zero at a 95% confidence level. Moreover, although four CEC schools in 2007 did perform below the average TPS in their locality, they managed to improve their performance in 2008. What these results suggest is that defining academic achievement relative to TPS in the same locality as stated in the provision contracts is a condition that not all CEC schools find it easy to achieve.

In Figures 3 to 5, I present the evolution of the current evaluation for the period 2007 to 2009. Figures 3 shows the results in percentage terms on the academic achievement component for all CEC schools for these years, where the horizontal axis represents each one of the CEC schools. As shown, the vast majority of schools have consistently maintained or improved their academic performance in these 3 years. However, that many schools are scoring just 60% in this component suggests there may be some room for improvement in this area —especially in the relative-to-TPS-in-locality indicator. Moreover, note that the positive trend in time is not only occurring in the academic component. The results are indeed similar in all components including, as shown in Figure 4, the one related to having low drop-out rates or the quality and quantity of the food provided to students. The overall grade for each CEC school in Figure 5 just confirms the pattern. Overall, I interpret these results as evidence that CEC schools are taking the current evaluation seriously partly to comply with contractual demands, but also because they may be interested in showing merits in case they apply for contract renewal in the years to come.⁶

2.3. Related Literature

Charter Schools

The CEC program has common features in common with some charter school experiences in the US and therefore serves as a framework to compare the estimated effects of CEC attendance with those of charter school programs. Both CEC and US charter programs are supported by public

⁶The first contracts will expire in 2014.

funds, receive students interested in public education, cannot select their own students, and are not subject to teacher collective bargaining agreements. However, unlike CEC schools, charter schools are responsible for finding their own students, may target students interested in non-standard education programs (e.g., arts, music, language, special education, etc.), and must be partially funded by private donors.⁷ CEC schools, on the other hand, are required to take the students allocated by the SED, have the same academic curriculum TPS have, and are fully funded by public resources.

Most of the recent studies on charter schools use admission lotteries to circumvent the concerns about non-random selection. There is mixed evidence in the lottery-based literature of charter school attendance on academic achievement, usually with positive effects being found for some grades only. The overall evidence indicates that charter school students score from 0.3 to 0.4 standard deviations higher than lottery losers in math tests per year of treatment and around 0.1 to 0.2 standard deviations higher in reading tests per year (Angrist et. al [2010]; Abdulkadiroglu et. al, [2009]; Dobbie and Fryer, [2009]; Hoxby and Murarka, [2009]; Hoxby and Rockoff, [2004]).

Interestingly, studies that have used panel data to account for unobserved time invariant student characteristics in the US find that charters students experience poor test score growth in the first years after enrollment but later recover from this initial disruption, with no significant gain in test scores from charter school attendance after some time (Saas, [2004]; Bifulco and Ladd, [2004]; Hanushek et. al, [2007]; Booker et. al [2007]). There is some evidence, however, of positive charter effects on school attendance and lower disciplinary sanctions (Imberman, [2009b]).

Test-Based Accountability

A second group of educational programs that have similarities to the CEC school program are those that impose sanctions on low-performing public schools.⁸ The existing literature has traditionally focused on school responses to increased accountability, in particular, to what extent higher academic results are driven by unintended strategic responses by affected schools. An example of a positive response to increased accountability is Chiang (2009). Using a regression discontinuity design and

⁷For example, the Harlem Children Zone Charter in New York City spends 25% more than the median per-pupil expenditure in New York State public schools (Dobbie and Fryer [2009]).

⁸In the US, for example, the No Child Left Behind Act of 2001 (NCLB) established penalties for failing to meet performance standards in all states. In particular, the NCLB requires states to test students in grades 3 to 8 each year and to judge school performance on the basis of these test scores.

data from public schools in Florida, this study finds that threatened elementary schools raised math and reading test scores in 0.12 and 0.1 standard deviations, respectively, by raising spending on technology, curricular improvements, and teacher training.

Although schools face a powerful incentive to raise their academic performance ratings by reforming the inputs and processes of the educational production, most of the existing evidence suggests that schools opt to strategically respond to the accountability system in ways not intended by policy makers. That is, by raising test scores without contributing to students' knowledge and skills. Examples of these responses are to reclassify low-performing students into special education, or to impose longer disciplinary sanctions near testing dates so that these students do not affect school average test results (Deere and Strayer, [2001]; Figlio and Getzler, [2002]; Cullen and Reback, [2002]; Jacob, [2005]; Figlio, [2006]). Moreover, there is also evidence that higher test score results have been driven by increasing test-preparation at the expense of low-stakes subjects such as the natural sciences (Koretz and Barron, [1998]; Jacob, [2005]), or through teacher cheating (Jacob and Levitt, [2003]). This literature stresses the importance of assessing potential strategic responses by CEC schools when interpreting the estimated effects of CEC attendance on test scores.

CEC School Program

There have been two previous evaluations of the CEC school program in Bogotá. First, Sarmiento et al. (2005) applied detailed questionnaires to 22 CEC schools as well as to 10 TPS with similar characteristics. This study concludes that CEC schools have a better academic environment, have more autonomy to manage both teachers and resources, and are more exposed to supervision by the SED. Barrera (2005), using a propensity score matching strategy, finds that CEC schools have lower dropout rates compared to similar TPS. He also finds evidence that students from CEC school students score 1 to 2 more points in the ICFES test relative to TPS students. Both of these studies are early evaluations of the effects of the program, which may be problematic given that students graduating from CEC schools in the first years of the program spent most of their elementary and middle school years at TPS.

3. Data

Administrative data for this chapter comes from 3 main sources. The first source is ICFES, a public organization in charge of designing and administering standardized tests for all schools and universities in Colombia. For the purposes of this study, we use the test known as Exámen de Estado (commonly known as ICFES test), taken by most high school students in their last year of school, which evaluates them on the multiple subjects mentioned above. A rich set of demographic data on students and their families is collected at the time of test registration, 3 months before the test is taken. Self-reported demographic information includes, for example, gender, age, parents' education, number of household members, asset ownership (e.g., car, computer, cell phone, TV, etc), household income, and residential address. In this chapter, I use the 2008 ICFES results from students attending either TPS or CEC schools and set to graduate in the second semester of 2008. Using data from 2008, 6 years after the last CEC school started operating, allows me to estimate the cumulative effect of CEC school attendance for students who presumably attended all their middle and high school years at these schools.⁹

The initial sample of public and CEC students graduating in the second semester of 2008 has 50,199 observations. After excluding students who attend night, technical, rural or military public institutions (because of concerns with the unobservable characteristics of these students) as well as observations with missing data for at least one of the variables (different from home address), I am left with 39,282 observations. The percentage of missing observations over total observations is around 6% for both CEC and TPS indicating that public students are not more likely to fail reporting their personal information than CEC students (Table 2).

The second administrative data source comes from UAECD (*Unidad Administrativa de Catastro Distrital*), a local government organization responsible for maintaining a database of all legal buildings in Bogotá for urban planning and tax purposes. UAECD uses a geographic information system (GIS) that assigns coordinates (e.g., latitude and longitude) for all buildings in the city. Thus, using the residential address reported by students at the time of ICFES registration, I am able to calculate the

⁹Dropout and transfer rates from these schools are very low as shown in Figure 3 (Section 7). Thus, even though individual years of exposure to treatment for each student is not available, data at the school level indicates this should not be a concern.

distance from a student’s home to both actual and potential TPS and CEC schools in the city.¹⁰ As shown in Table 2, I am able to match 85% of students’ addresses as reported at ICFES registration to addresses in the UAECD database.¹¹ In general, the absence of meaningful demographic differences between the matched and unmatched samples suggests that we are not left with a non-random sample of students, something that could biased the estimated effects if, for example, students with lower SES are more likely to misreport their home address. The final regression sample has 33,413 observations, formed by 31,783 public and 1,630 CEC students.

Table 3 presents descriptive statistics for the year 2008 for public and CEC students. Panel A includes all the students used later for estimation (which I hereafter refer as *the full sample*). The results indicate that, relative to students from TPS, CEC students have slightly larger families, have less educated parents, and come from lower income households. Moreover, CEC students are more likely to live in low-strata neighborhoods. The stratum scheme 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. Whereas 94% of CEC students live in the lowest 2 strata of the city, 66% of public students do, indicating that the average CEC student lives in neighborhoods with very low socioeconomic conditions. Thus, even though the average TPS student comes from a low SES household, the average CEC school student has an even lower socio-economic background. These figures are not surprising given that CEC schools were systematically located in strata 1 and 2 neighborhoods in peripheral areas of the city, as shown in Figure 1.

To compare the socioeconomic characteristics of CEC and TPS students living close to CEC schools, I select all students living in UPZs with nearby CEC schools (henceforth, the UPZ sample —see Figure 6). UPZs are subdivisions of the city which are used by the local administration for

¹⁰Matching student addresses with the UAECD database requires addresses to be written in the same way UAECD addresses are written. Given that less than 15% of the addresses were exactly matched, a Stata program was created to standardize students addresses

¹¹It is comforting that there are no economically significant differences in the demographic characteristics of the matched and unmatched samples as shown in Appendix C. The same patterns persist when looking at public and CEC students respectively.

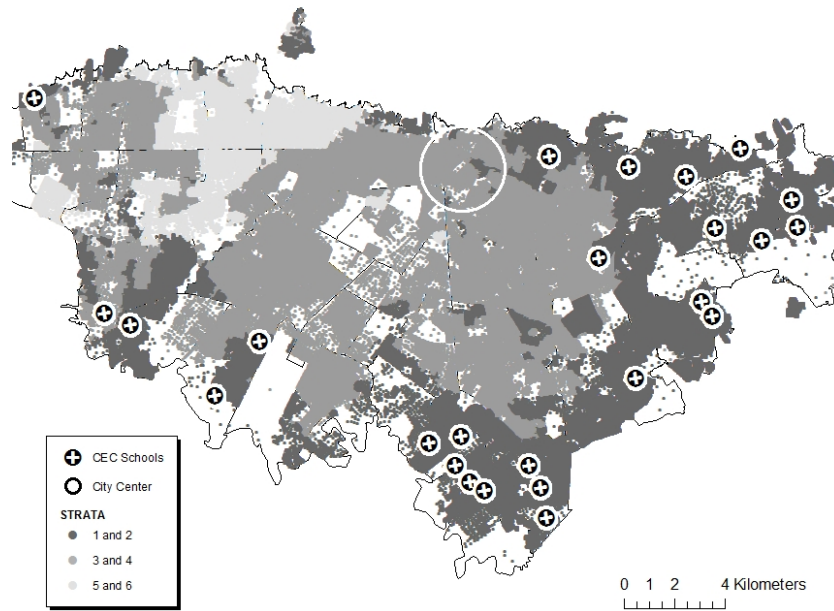


Figure 1. Location of CEC Schools

Notes: This figure shows the location of all the residential units and the 25 CEC schools in Bogotá. Residential units are characterized by their stratum index. Stratum is a categorical index running from 1 to 6 and summarizes the socio-economic status of the dwelling and its neighborhood, 1 being the lowest. Dark gray areas correspond to strata 1 and 2 neighborhoods, medium gray to strata 3 and 4, and light gray to strata 5 and 6.

urban planning purposes. The 120 UPZs in the city are defined such that the urban and economic characteristics of the housing units within them are very similar. Panel B of Table 3 presents descriptive statistics for public and CEC students in the UPZ sample. As shown, public and CEC students from the UPZ sample are very similar along most observable dimensions. This happens because the socioeconomic characteristics of TPS in Panel B worsen relative to Panel A. For example, the average *public* student in the UPZ sample has more family members and lower educated parents, lives in a lower stratum dwelling, and has a lower income relative to the average public student in the full sample. These figures provide evidence that CEC schools were located in economically deprived areas of the city.

The last data source used in this chapter is the school surveys C600 for the year 2008 conducted by DANE (the Colombian national department of statistics). These surveys have detailed information for each school in the country on the number and education level of teachers by academic grade, number of students per grade, and the number of students who dropout or transfer at each grade.

This information is used later in Section 7 when I consider potential explanations for CEC school higher academic performance.

4. Empirical Strategy

4.1. Structural Equation

I begin by estimating the average differences in ICFES test scores as a function of CEC school attendance, controlling for other student, family, and neighborhood characteristics. The structural equation for the outcome of interest Y for student i in UPZ u is given by:

$$Y_{iu} = \rho D_{iu} + \gamma_u + X_i \Gamma + \epsilon_{iu} \quad (1)$$

where γ_u is a UPZ fixed effect and X_i is a vector of potential observable determinants of academic performance, which includes all the socio-economic variables described in Table 3. The regressor of interest, D_{iu} , is an indicator variable that equals 1 if a student attends a CEC school and is 0 otherwise.

To estimate the causal effect of CEC school attendance on academic performance, the decision to attend a CEC school must be uncorrelated with unobserved determinants of academic performance captured in the error term, ϵ_{iu} , conditional on UPZ fixed effects and observable characteristics, X_i . If unobservable variables that determine the selection mechanism are omitted, estimates of CEC attendance (ρ) derived from OLS regressions in Equation 1 would be inconsistent.

4.2. Estimating the Causal Effect of CEC School Attendance

As stated above, the set of rules used by the SED to allocate students into schools may facilitate self-selection of highly motivated students into CEC schools since students are first assigned according to their stated school preferences. Were this the case, OLS estimates of CEC attendance would be upward biased. On the other hand, the student allocation algorithm gives placement priority to students with the lowest socioeconomic characteristics. In fact, the evidence presented in Table 3 leans toward the possibility of negative selection into CEC schools. That is, compared to the average

TPS student, CEC school students come from families with observably lower SES and live in low-income neighborhoods. It is entirely possible, then, that there are other unobservable characteristics which are both positively correlated with CEC school attendance and negatively correlated with academic performance. In this case, OLS estimates would be biased towards zero.

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 the error term in Equation 1, is also a strong predictor of the probability of attending a CEC school in the following first stage regression

$$D_{iu} = \alpha Z_i + \lambda_u + X_i\beta + \mu_{iu} \quad (2)$$

where D_{iu} is the indicator variable for CEC attendance of individual i in UPZ u , λ_u is a UPZ fixed effect, X_i is a vector of the student's socioeconomic characteristics and μ_{iu} is an error term. The causal effect of CEC attendance on academic achievement then can be estimated using Two-Stage Least Squares (hereafter, 2SLS).

4.3. Using Distance to the Closest CEC School as an Instrument

To estimate the causal effect of attending a CEC school on academic achievement, I exploit variation in distance from a student's residence to the closest CEC institution to construct an instrument for CEC attendance. For a function of distance to the closest CEC school to be a good instrument for CEC attendance, two conditions are required. First, the distance of a student's residence to the closest CEC school should have a strong effect on the probability of attending a CEC school. Second, for instrument validity, 2SLS should retain only the variation in the probability of CEC attendance that is generated by the quasi-experimental variation generated by the instrument. Intuitively, 2SLS allows us to compare the academic performance of students who differ in their propensity to attend a CEC school just because they reside various distances from these institutions. That is, distance to the closest CEC school should not be correlated with other unobserved determinants of academic performance. In this section, I show that the proposed distance instrument is both a valid and relevant instrument for CEC attendance.

An Instrument for CEC Attendance

The idea of using distance as an instrument has been exploited before. In the economics of education literature, Card (1993) estimated the returns to schooling using variation in college proximity. Distance-based instruments have also been exploited in the health economics literature (McClellan, [1994]; Kessler and McClellan, [2000]; Freedman, [2010]), and in studies of the effects of child subsidies on children wellbeing (Herbst and Tekin, [2010]) and the impact of community nurseries on low-income children nutrition in Colombia (Attanasio, [2010]).

There are different ways to implement distance to the closest CEC as an instrument for CEC school attendance. For the empirical strategy, I define the instrument in terms of distance to the closest CEC school relative to the closest TPS. Two main reasons justify this decision. First, a relative distance instrument should have more power for those students who, in spite of living somehow far from a CEC school, live even further away from a TPS.

Second, it allows me to define a categorical instrument that takes the value of 1 if a student lives closer to a CEC school than to a TPS (i.e., for negative relative distances) and 0 otherwise. That is,

$$Z_i = \mathbf{1}\{RD_i < 0\}, \text{ where } RD_i = \underset{c \in CEC}{MIN}(d_{ic}) - \underset{p \in TPS}{MIN}(d_{ip}) \quad (3)$$

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

Using a categorical instrument is partly driven by the non-linear relationship between relative distance to CEC school and CEC attendance probability. That is, relative distance in meters should be a strong predictor for CEC attendance only for students living within a certain distance from a CEC school, and be rather ineffective for students who live relatively far from it. Figure 7 presents evidence on this point. It shows the fraction of total students attending a CEC school who live within a given interval of relative distance. This figure shows that whenever a student lives closer to a CEC than to a TPS (i.e., relative distance is negative), there is a higher probability of attending a CEC school. More importantly, for almost all the distance intervals for which a student lives closer to a TPS than to a CEC school (i.e. positive relative distance), the fraction of CEC students is not only small, but also non-decreasing in relative distance.

To account for these non-linearities in the CEC attendance probability, I could partition the

continuous instrument into several categorical variables for different intervals of relative distance. As it turns out, however, using a single categorical instrument that takes the value of 1 for students who live relatively closer to CEC schools, exhibits the strongest effect on the probability of attending a CEC school as indicated by the F-test statistic in the first-stage specifications compared to a wide range of alternatives, including specifications with high order polynomials or multiple categorical instruments.

Instrument Relevance

Basic Economic models of education suggests that the school choice decision by a household is made by maximizing the difference between the expected returns and costs of attending a given school. The expected returns to attending a school are a function of the quality of the education provided. In turn, the costs of attending a public school are mainly determined by transportation and opportunity costs for both the students and their parents who usually need to walk their young children to school. Note that both of these costs are increasing in the distance from a student's residence to a given school.

The expected returns to attending a given school depend on the information set available to households. However, there is only partial public information on the quality of public schools in Bogotá. In fact, the only existing source of public information on school quality is average ICFES test scores at the school level, available online for each of the test subjects. Even if parents of public school students use this information to guide their school choice decision, Table 3 shows that unconditional test score means for CEC schools are less than 0.1 standard deviations higher relative to TPS. Moreover, given that few cohorts have graduated from CEC schools, there is also limited information from this source that might significantly affect the expectation of the returns to CEC school attendance. Thus, given the information set available to public school users, the expected returns to attending a CEC school may not be very different from attending a TPS.

On the other hand, transportation and opportunity costs of sending a child to a school far from home can be prohibitive for most of these households. Monthly public transportation expenditures for a single person represent 15% of a monthly minimum wage. Also, due to traffic congestion,

the average speed of public transportation in the city is around 14MPH,¹² meaning that having to commute to a school far from home may significantly reduce the time that both children and their parents could otherwise use for work or housework. It can be argued that some households could find it optimal to assume one-time residence reallocation costs in order to reduce the costs of attending a preferred school. There is no evidence, however, that housing and school locations in Bogotá are jointly determined by public student households. The 2007 Encuesta de Calidad de Vida, a locality-representative household survey in Bogotá, shows that, even though 21% of the households change their residence every 2 years, just 4% of them move due to education or health considerations.

This simple framework suggests that parents' maximization problem in the current environment boils down to sending their children to schools where is less costly to do so, that is, to schools close to their residence. Figure 8 shows the proportion of students in the sample who live within a given distance interval from the school they actually attend. Approximately 15% of all students in the sample live within 300 meters (0.18 miles) from their school. Moreover, the cumulative distribution for both CEC and TPS students shows that 73% of them live less than 2000 meters (1.24 miles) from the school they attend. I interpret this as evidence that residential distance to schools determine the set of potential schools available to low income students in Bogotá.

More importantly, this framework suggests that functions of distance to the closest CEC school could be used as an instrument for CEC school attendance as differential distances to CEC schools generates quasi-experimental differences in the costs of attending a given CEC school. The empirical evidence supports the idea that living close to a CEC school is a strong predictor of the probability of attending a CEC school. First, Figure 9 shows that CEC students' residences (dark gray dots) cluster around CEC school locations (crossed black dots). Moreover, data collected by 5 of the 25 CEC schools on students transportation habits indicates that around 90% of CEC students walk to school and for 95% of them it takes less than 25 minutes to get to school as shown in Figure 10. A third piece of evidence is presented in Figure 2, which shows the distribution of students living at various relative distances from the closest CEC school. The figure shows that the empirical distribution for CEC students stochastically dominates the TPS distribution for negative values of

¹²Source: Instituto de Estudios Urbanos, Universidad Nacional. www.redBogotá.com last visited on October 10, 2010.

relative distance (i.e., the closest CEC school is closer than the closest TPS). In contrast, those living closer to a TPS relative to a CEC school are more likely to attend the former. This figure motivates the use of the categorical instrument previously defined.

More formally, first stage results presented in Section 5 show there is, in fact, a strong statistical relationship between distance to the closest CEC and CEC attendance probability.

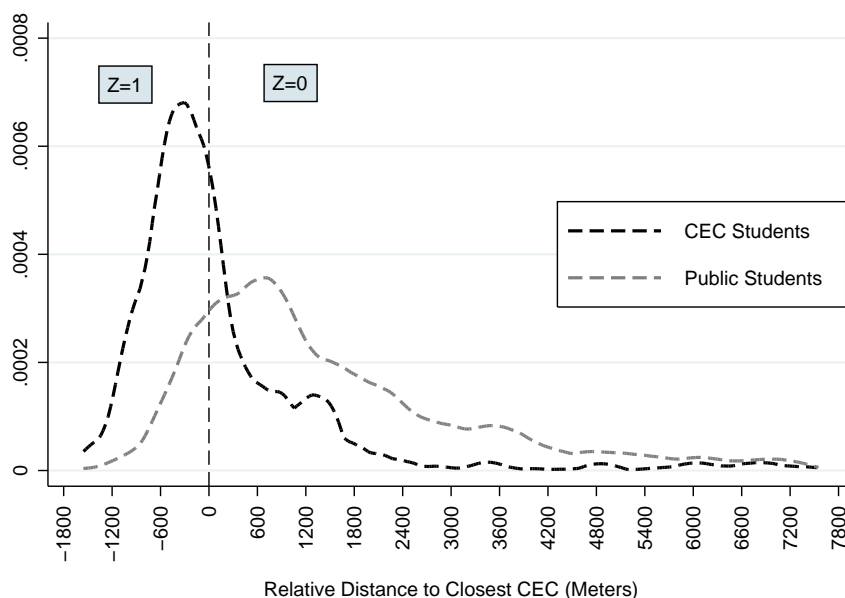


Figure 2. Distribution of Relative Distance to Closest CEC

Notes: This figure shows the empirical distributions of relative distance in meters for both CEC and TPS students. Relative distance is defined as the distance to the closest CEC school minus the distance to the closest TPS. The figure graphically depicts the categorical instrument defined in Equation 3.

Instrument Validity

The second condition for distance to be a good instrument for CEC attendance is that the only relationship between the outcomes of interest and the instrument is through the first stage. This condition, known as the exclusion restriction, implies that the instrument should be uncorrelated with unobserved determinants of academic achievement. One concern is that families jointly determine their school choice and residence. Card's (1995) college proximity instrument, for example, has been questioned on grounds of the joint decision between schooling and residence in the US since families with a higher taste for education may also choose to live near a college institution (Kling, 2001). Although the validity of an instrument is a non-testable condition, Altonji et al (2005) argue that if an instrument is uncorrelated with a rich set of observable characteristics, it is likely to be uncorrelated with unobserved outcome determinants.

To check for instrument exogeneity, Table 4 reports coefficients from OLS regressions of the socio-economic characteristics indicated in each row on the instrument, for specifications with and without UPZ fixed effects. The results in Column (2), which corresponds to a specification without UPZ fixed effects and uses all the observations in the full sample, shows that living relatively closer to a CEC school is correlated with some of the students' observable characteristics such as low parent education levels, living in stratum 2, not living in stratum 3, coming from a low monthly income household, and less likely to have a computer, home internet service or a car. These results are not surprising as they just confirm that CEC schools were located in low-income areas of the city. In fact, after conditioning on UPZ fixed effects in Column (3), the results indicate that relative distance is not systematically correlated with student socioeconomic characteristics. Moreover, using observations only from the UPZ sample, which is an alternative way of controlling for neighborhood characteristics near CEC schools, confirms the absence of correlation between the instrument and the rest of the exogenous covariates. I interpret this as evidence that the proposed relative distance instrument is exogenous conditional on UPZ fixed effects.

5. Results

This section estimates 2SLS specifications of CEC attendance on academic achievement. To account for the possibility of correlation of student outcomes within a given neighborhood, all regression estimates are clustered at the UPZ level using a paired bootstrap strategy that samples at the UPZ level.

5.1. First Stage Estimates

In this section I present the first stage estimates of the effect of living relatively closer to a CEC school than to a TPS on the probability of CEC attendance. I provide evidence that the instrument is strongly correlated with attending a CEC school and additional evidence that the proposed instrument satisfies the exclusion restriction.

Table 5 shows the estimates of linear probability models for CEC school attendance on the categorical relative distance instrument and different sets of exogenous regressors.¹³ Columns (1) to (3) show the results for the full regression sample. Column (1), which only includes the instrument as a regressor, indicates that living closer to a CEC than to a TPS increases the probability of attending a CEC by 17 percentage points. Once UPZ fixed effects are added in Column (2), the estimated effect is reduced to 10 percentage points. Furthermore, adding the rich set of exogenous covariates in Column (3) do not change the point estimates of the instruments. I interpret the stability of these estimates as evidence in favor of the exclusion restriction conditional on UPZ fixed effects.

At the bottom of the table, I also report the correct prediction rate for these linear probability models as well as F-statistics on the excluded instrument to assess the relevance of the instrument. The F-statistics for the specifications with UPZ fixed effects using the full sample are 27.64 and 27.83, well above the conventional critical values to assess finite sample bias due to weak instruments. Moreover, the correct prediction rates of these two specifications are above 71%. That is, both measures suggest that the proposed instrument is a strong predictor of CEC attendance. The results for Panel B, which includes only students living in UPZs with nearby CEC schools largely replicate the results of the full sample, although the instrument is even stronger for this sample, as indicated

¹³The full set of first stage estimates are presented in Table 1 of Appendix B.

by the large F-statistics in all three specifications in Columns (4) to (6).

5.2. 2SLS Estimates

Table 6 presents both OLS and 2SLS results of CEC school attendance on math, verbal, and the composite ICFES test scores measured in number of standard deviations for both the full and UPZ samples and for different sets of exogenous covariates and UPZ fixed effects.¹⁴

I report OLS and 2SLS estimates of CEC attendance on test scores in Table 6. OLS estimates for all specifications (no covariates, UPZ fixed effects only, and covariates along with UPZ fixed effects) in both samples indicate that CEC students score 0.16, 0.18, and 0.13 standard deviations higher than TPS students in math, verbal, and the composite ICFES tests, respectively.

Drawing from evidence I have provided that relative distance to a CEC school is exogenous conditional on UPZ fixed effects, I first focus on the results from Column (2), using observations from the full sample. 2SLS estimates show that attending a CEC school increases math, verbal, and the composite test scores by 0.52sd, 0.15sd, and 0.3sd, respectively, relative to TPS students, although the effect on the verbal test is imprecise. The 2SLS results in Column (3) shows that CEC attendance estimates are practically insensitive to the inclusion of the remaining exogenous covariates. As before, the stability of the estimates in Column (3) provides evidence on instrument exogeneity conditional on UPZ fixed effects. Moreover, the 2SLS estimates using observations from the UPZ sample exhibit very similar magnitudes and significance levels.

The lower gains in verbal test scores suggests that CEC schools have a stronger impact on some academic fields than others. Interestingly, this fact is consistent with the results found in both the charter school and test-based accountability literature in the US, where the gains in math are always larger than the gains in verbal test scores. Note also that 2SLS estimates for the math and the composite tests are more than 4 and 3 times larger than the OLS estimates, respectively. This supports the claim that students attending CEC schools are different from public students in some unobservable dimensions that negatively affect test scores, which causes the OLS estimates to be downward biased. More formally, a Hausman exogeneity test of the equality of the OLS and

¹⁴To assess whether the estimated effects are driven by few outstanding CEC schools, I run all specifications excluding one CEC school at a time and show that 2SLS results are not sensitive to this. See Appendix D for details.

2SLS estimates is conducted through a paired-bootstrap procedure that samples at the UPZ level to account for correlation of student outcomes within UPZs.¹⁵ The results indicate that OLS and 2SLS estimates of CEC attendance for the math and composite tests are statistically different at the 5% and 10% significance levels, respectively. While the 2SLS estimated effect for the verbal test is 58% higher than the OLS estimate (0.208 vs 0.131) in Column (3), I cannot reject that they are statistically equal.

To assess the magnitude of the estimates, I compare the effect of attending a CEC school with some of the estimates of the socio-economic determinants of test scores, presented in Table 2 in Appendix B. For example, the estimates for the math test in Column (1) show that having parents with at most primary education reduce math test results by 0.12 standard deviations relative to college educated parents and living in a stratum 1 neighborhood decreases math test scores by 0.1 standard deviations relative to living in stratum 4. Similarly, coming from a household with a monthly income less than one monthly minimum wage reduces math test scores by 0.2 standard deviations relative to those earning 4 or more times the minimum wage. These effects are significantly lower than the estimated 0.6 standard deviations effect of CEC attendance on the math test.

Alternatively, I also compare these results with respect to the average performance of private school students in Bogotá taking the test in the second semester of 2008.¹⁶ As mentioned earlier, the choice between private and public schools in Bogotá is highly determined by income. On average, private schools score one standard deviation higher than TPS in math and 0.5 standard deviations higher in verbal and the composite test. Altogether, the estimated effects for CEC attendance suggest that attending a CEC school reduce by a half the public-private school achievement gap, a significant effect considering the large differences in socio-economic characteristics between these two population groups.

¹⁵Given that the standard errors allow for correlation at the UPZ level, the variance covariance matrices under the Hausman null hypothesis are not asymptotically efficient as required. Thus, a 5000-repetition, paired bootstrap strategy that samples at the UPZ level with replacement is conducted in order to construct a consistent difference between the 2SLS and OLS variance-covariance matrices.

¹⁶The ICFES test is conducted two times a year as there are 2 different school calendars, one for the period February-December and the other for August-June. While all public and CEC schools operate in the first calendar, private schools operate in both.

6. Robustness Checks

In this section I explore the robustness of the results in two ways. First, I conduct a placebo test to further check for instrument exogeneity. Second, I also check whether the estimated effects of CEC attendance are driven by some specific population groups.

6.1. A Placebo Test

The fundamental claim that justifies using an IV strategy to identify the causal effect of interest is that the only reason why test scores change as the instruments change is through the variation that the instruments have on CEC attendance. That is, there should be no relation between the instrument and test scores in samples where there is no relationship between CEC school attendance and the instruments.

In order to further assess the validity of the instrument, I construct a placebo test using ICFES data from the year 2000, one year before CEC schools graduated their first class. The idea is to construct the same categorical relative distance instrument used earlier for estimation on a sample for which the instrument should not be relevant. To do this, I first georeference the residential address of public students who took the ICFES test in the second semester of 2000. Then, I construct a variation of residential relative distance to the closest CEC school as introduced earlier in Equation 3. Recall that relative distance is defined as the distance to the closest CEC school minus the distance to the closest TPS. Note, however, that it is not possible to calculate the actual distance to the closest CEC school for high school students taking the ICFES test in 2000 because CEC schools were not available for these students in that year. Instead, I calculate the distance for all TPS students in the sample to the closest *potential* CEC school to construct a measure of relative distance. Then, I define the instrument as an indicator variable that takes the value of 1 if potential relative distance is negative and 0 otherwise.

The placebo test consists in estimating reduced form specifications, that is, estimating the effect of the dummy instrument on the math, verbal, and overall test scores. More specifically, the reduced form specification is given by:

$$\begin{aligned}
Y_{iu} &= \delta Z_i + \phi_u + X_i\Pi + \xi_{iu}, \quad \text{where} \\
Z_i &= \mathbf{1}\{PRD_i < 0\} \\
PRD_i &= \underset{c \in CEC}{MIN}(pd_{ic}) - \underset{p \in TPS}{MIN}(d_{ip})
\end{aligned} \tag{4}$$

That is, PRD_i is the potential relative distance for student i , pd_{ic} is the potential distance of student i to CEC school c , and d_{ip} is the actual distance from student's i residence to TPS p . Note that a positive reduced form effect of the instrument on test scores would question the exogeneity of the instrument for it would imply, for example, that CEC schools were strategically located in areas of the city with a higher probability of academic success.

Reduced form estimates of the instrument on ICFES test scores, δ , are presented in Table 7 for both 2000 and 2008 academic years. As before, I focus on the results from Column (3) and (6), which are the specifications with the full set of UPZ fixed effects and exogenous covariates. The reduced form estimates of the effect of living relatively closer to a CEC school on the math and verbal tests in the year 2000 are slightly negative and not statistically different from zero. The estimated effect on the composite test score in both samples is also negative and not different from zero in the UPZ sample. In contrast, all the reduced form effects using 2008 data show a significant positive effect of living relatively closer to a CEC school. These results provide strong evidence that the estimated effects of CEC attendance are not the result of a systematic unobserved component that positively covariates with the areas where CEC schools were located. If anything, the negative reduced form estimates for the year 2000 indicate that CEC schools may have been constructed in neighborhoods with lower than average SES even within UPZs. In that case, the presented 2SLS estimates for CEC attendance would be lower bounds of the true causal estimate. However, most of the 2000 reduced form estimates either in the specification in Column (3) in the full sample or in all the specifications using the UPZ sample show the year 2000 reduced form estimates are insignificant. Thus, I interpret the results from this test as additional evidence on the statistical validity of the instrument.¹⁷

¹⁷One concern with this placebo test, however, is whether students graduating in 2000 actually lived close to where potential CEC schools were later located, that is, whether student are similarly distributed in the city in both years. To evaluate this point, Figure 11 shows the empirical distributions of relative distance in meters for both 2000 and 2008

6.2. Characterizing Treatment Effect Heterogeneity

Up to this point, the estimated effects of CEC attendance have been assumed to be the same for all students in the data. However, IV estimates can be interpreted as a weighted average of causal effects for particular subgroups of the population for whom the treatment status is changed by the instrument (Imbens and Angrist, [1994]). For example, Card (1993) argues that the effect of college proximity on college attendance should be more important for children of less wealthy households. That is, what pushes some low-income students into college is the reduction in the costs due to college proximity. As a result, Card’s 2SLS estimates of the return of college attendance can be interpreted as being the return to college only for students from less wealthy households.

In order to assess possible treatment exogeneity, I first construct a socio-economic index on the sample of students who live closer to a TPS than to a CEC school using all the observable characteristics used earlier in estimation. This index is constructed as the predicted probability of being a very-low income household.¹⁸

Panel A of Table 8 shows descriptive statistics of selected student socio-economic characteristics by quartiles of the constructed index. By construction, students from the lowest quartile have larger families, lower parental education and income, and a higher probability of living in low strata neighborhoods. Following Kling (2001), the overall weight received for each group q when using 2SLS is given by

$$\omega_{q|x} = W_q \lambda_{q|x} \Delta D_{q|x} / \sum_q W_q \lambda_{q|x} \Delta D_{q|x} \quad (5)$$

That is, conditional on the exogenous covariates X , the weight given by 2SLS to a specific quartile q is formed by three components. The first one is the proportion of observations that belong to quartile q , W_q . Second, 2SLS weights the observations by the average conditional variance of the instrument estimated over the empirical distribution of X for each q , that is, $\lambda_{q|x} = E[P[Z|X, q](1 - P[Z|X, q])|q]$. The last term reflects the average impact of the instrument on CEC attendance for

academic years. The large similarities of these distributions suggest that results for year 2000 are not driven because of a disproportionately low amount of public students in future CEC school areas.

¹⁸In practice, this is equivalent to being a SISBEN 1 household. SISBEN is a poverty-targeting index used by the Colombian government to determine eligibility for social programs. The index takes on 6 values, where only levels 1 and 2 are eligible for most government subsidies and is constructed from a rich set of variables such as housing materials, access to public utilities, ownership of durable assets, demographic composition, educational attainment, and labor force participation.

quartile q , $\Delta D_{q|x} = E[E[D|Z = 1, X, q] - E[D|Z = 0, X, q]|q]$.

Estimates of $\omega_{q|x}$ in Equation 5 and its components are presented in Panel B of Table 8. The results in this table show that the two lowest quartiles receive marginally higher weights than the last two quartiles. That is, they receive just 58% of the total weight. These results are evidence of a rather homogeneous treatment effect of the CEC program. This does not contradict the idea that the way the instrument operates is by lowering the costs of attending a CEC school. In fact, given that all students attending TPS belong to households with low socio-economic characteristics, it is not surprising that they respond similarly to cost reductions in school attendance.

7. Mechanisms for Higher Academic Achievement

Understanding the mechanisms that make some schools have better academic outcomes is a relevant policy question. This section discusses some possible mechanisms through which CEC schools achieve a higher academic performance. First, I evaluate whether CEC schools responded strategically to the imposed accountability system in ways similar to the ones referenced in the test-based accountability literature. Second, I explore other dimensions in which CEC schools are different from TPS (besides higher flexibility and accountability) to assess whether these differences are the driving force behind the higher academic achievement of CEC students.

7.1. Strategic Responses

One potential concern with evaluating schools according to the performance of their students in standardized tests is the possibility that schools would respond by devoting more instruction time to high-stakes subjects at the expense of other critical areas such as the natural sciences. That is, given that most standardized tests only evaluates students' math and reading skills, there are strong incentives to increase test-specific skills in these areas (Johnson, [1984]; Koretz and Barron, [1998]; Jacob, [2005]).

This concern is largely addressed in the present context by virtue of the design of the ICFES exam, which evaluates students on most subjects included in the standard academic curriculum defined by the Colombian Ministry of Education. Moreover, the composite ICFES test score is

calculated as a weighted average of ICFES test sections that also penalizes students for specializing in some subjects by using a linear function of the student's standard deviation.¹⁹ As shown in Section 5, CEC students score around 0.3 standard deviations higher than TPS students in the composite test. These results suggest that CEC schools are not responding to increased test-based accountability by specializing in some academic subjects. Part of this explained by students' incentives to perform well in all test sections since ICFES composite test score serves as the main (and sometimes only) criterion for admission to 2-year and 4-year college institutions in Colombia. But also, academic accountability for CEC schools is contractually defined in terms of this composite score.

This is an important finding for policy reasons because it suggests that evaluating students on multiple subjects should make test-based accountability programs less likely to be explained by test specialization as long as incentives are defined in terms of composite scores.

A second potential response to test-based accountability is to prevent low-performing students from taking the test by making them transfer or drop out from a given school. Unfortunately, information on dropout or transfer students is not available at the student level. To account for these possibilities, I use data from the C-600 national school survey in 2008, which collects data on teacher and student characteristics at the school level. In particular, this survey collects information on the number of students per academic grade as well as the number of students per grade either transferring or dropping-out. For a given school and grade, the transfer (dropout) rate is calculated as the number of students who transfer (drop out) over the total number of students in that grade. Then, for each academic grade, I calculate the *average* transfer (dropout) rate among all schools which offer that academic grade²⁰ weighted by the total number of students in that school-grade combination. If CEC schools exhibit higher average transfer or dropout rates, this could indicate that higher academic performance in CEC schools is achieved by dismissing low-performing students.

Results on average rates are presented in Figure 3 for three different school samples: all TPS, TPS in the UPZ sample, and CEC schools. Results for TPS in the UPZ sample are included to assess whether TPS in this sample UPZs are more similar to CEC schools than the average TPS in the

¹⁹the overall test score for student i is given by $Score_i = \sum_c \{W_c * Score_{c,i}\} - \frac{\sigma_i}{2}$, where c =[Biology, Chemistry, Physics, Math, Verbal, Social Sciences, Philosophy, English], weights given by $W_c = (1, 1, 1, 3, 3, 2, 1, 1)$ and σ_i equal to student's i standard deviation from all c test components.

²⁰Unlike CEC schools, most TPS do not offer all academic levels from primary to high school but are primary, middle, or high school only.

city. The figure shows that the average dropout rate for primary (1st to 5th), middle (6th to 9th), and high school (10th to 11th) grades in TPS are 3%, 5%, and 4%, respectively. In contrast, CEC schools have average dropout rates slightly above 1% for all academic grades. Interestingly, there are not meaningful differences between the rates for TPS in the full and UPZ samples. Moreover, the results on average transfer rates also indicate that whereas TPS transfer 2.5% of their students in each grade, CEC schools transfer just 1% of their students. Rather than being a concern, these results indicate that CEC schools are actually more successful than TPS at keeping students enrolled in school.

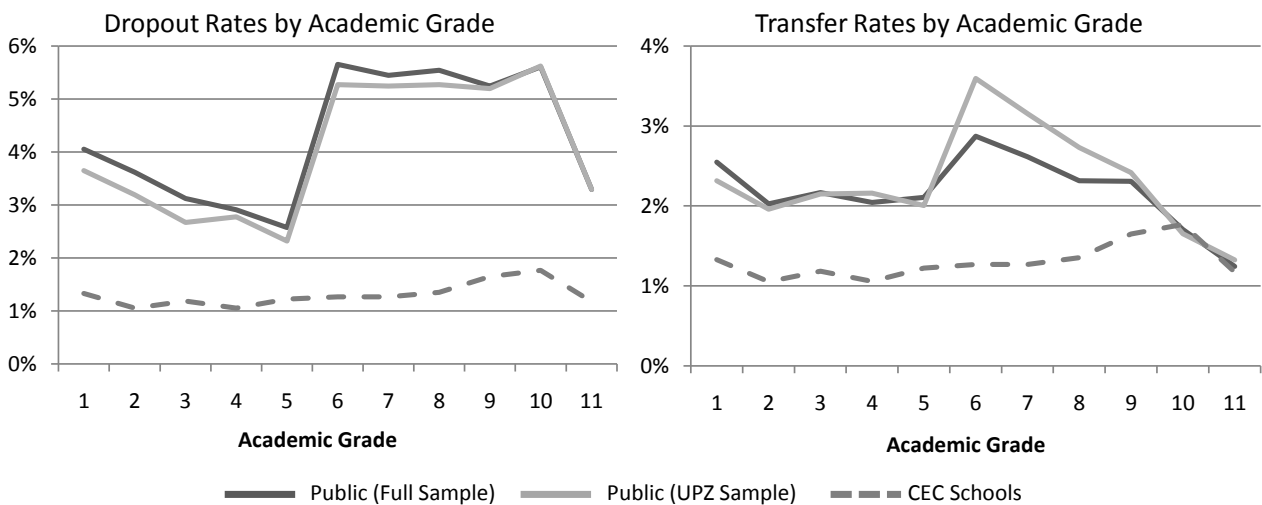


Figure 3. Dropout and Transfer Rates by School Type

Notes: Author's Calculations from 2008 School Survey C-600. This figure shows the average dropout (transfer) rate by grade and school type for both the full regression sample and the UPZ sample. Averages are weighted by the total number of students at each school. Dropout (Transfer) rate is defined as the number of students who dropped out (transfer) from a given school and grade over the total number of students in that grade-school combination.

A third potential unintended response is to prevent low-performing students from taking the ICFES test or, equivalently, to have students self-select into taking the test. A low test taking rate by CEC students would suggest that the higher academic achievement of CEC schools is due to differences in the composition of test takers. To evaluate this possibility, I construct a test taking rate for each school in the sample. For a given school, the test taking rate is defined as the total number of students taking the test in the second semester of 2008 over the total number of students in grade 11th as reported in the 2008 C-600 survey. Test taking-rates for TPS is approximately 93%

to 96% of CEC schools. Moreover, the high test taking rates exhibited by both school types provides evidence on how serious schools and students are about ICFES test.

The existing evidence does not indicate that CEC schools are strategically responding to increased accountability by preventing low-performing students from affecting school results —or at least no more than the average TPS. It is possible that students who drop out, transfer, or do not take the test are more likely to come from the bottom part of the potential score distribution. However, given CEC schools outperform TPS in all these counts, then 2SLS estimates of CEC attendance on test scores would be lower bounds of the true causal effect of interest.

7.2. Alternative Mechanisms

Determining the mechanisms that drive the higher academic achievement of CEC schools is relevant for policy reasons. In this section I discuss some potential mechanisms that may explain the higher academic results of CEC students. First, I look at input differences between public and CEC schools that have been associated with education quality in the education literature. In particular, I look at teachers' education, student-teacher ratios and annual expenditure per student. Table 9 summarizes the results. Regarding teachers' education, TPS have more highly educated teachers relative to CEC schools at all academic levels. For example, whereas 47% of public middle school teachers have a graduate degree, only 11% of primary CEC school teachers do. This result is not surprising since teachers' salaries in TPS are partly determined by educational attainment. Thus, TPS teachers find it optimal to invest in their own education, regardless of graduate program quality. In contrast, at least 75% of CEC school teachers have at most a college degree in Education.

Second, the data indicates that both TPS and CEC schools have almost identical student-teacher ratios in primary and middle school grades of 40 and 30 students per teacher, respectively. For high school grades, CEC schools have a ratio of 21 students per teacher compared to 30 students in TPS. Third, the annual cost of a CEC student to the city is lower than the cost of a TPS student. The higher operational costs of TPS are primarily driven by the higher educational attainment of their teachers relative to CEC schools (Contraloría Distrital, 2003).

In principle, none of these three factors can explain the higher academic achievement by CEC

schools. If anything, having more educated teachers and higher spending per student should increase academic performance of TPS. Also, given that the difference in student teacher ratios between CEC and TPS only exists in the last two years of high school, it is unlikely that the estimated results are driven by this factor. In any case, the literature of the effects of school resources on achievement such as teacher's education, student-teacher ratios and student expenditures are far from conclusive, even in studies that exploit exogenous sources of variation [Hanushek, 1986, 1996, 2006].²¹

7.3. A Contract for Academic Achievement

The CEC program implemented in Bogotá provides strong empirical support for the case of private provision of public education through service-provision contracts. In particular, the existing institutional design exhibits gains in education quality, while limiting the opportunities for inefficient cost reductions.

The factors that explain the gains in quality are primarily due to private operators being contractually subject to annual performance evaluations, which includes rules for the academic performance of their students in standardized tests. Moreover, in addition to holding CEC schools academically accountable, schools themselves are able to hold teachers accountable for the academic performance of their students. It is unlikely that academic performance would improve were the schools not allowed to demand results from teachers.

Nevertheless, the arguments against private provision of public services are related to the part of quality that is not contractible in nature. The CEC program addresses potentially harmful cost reductions in a variety of ways. First, students are allowed to choose the schools they want to attend and private operators are paid according to the number of students enrolled up to school capacity. This creates a potential competition effect that softens quality-reducing decisions. Moreover, schools are not able to select their students in any way and were not able to select the school locations either in order to prevent CEC schools to systematically select profitable students at the expense of unprofitable ones (e.g., problematic, low-performing students).

Second, to further attenuate incentives for cost reductions, contracts were assigned to not-for-

²¹For example, in a review of 376 studies on resources and student performance using US data, Hanushek (2006) finds that in 86% of the studies teachers' education does not improve student performance; 72% do not find evidence of a positive effect of lower student-teacher ratios; and, 66% do not find an effect of higher expenditure per student.

profit, well reputed institutions. The critical characteristic of a non-profit firm is that it is barred from distributing any profits it earns to those who exercise control over it. As a result, profits are usually used to improve the quality of the service (Glaeser and Shleifer, [1998]). This is in fact the case for the CEC program. Although public and CEC schools in Bogotá have similar costs per student, TPS used 30 percentage points more of their annual budget to pay for teachers compensation in 2002 (Cotraloria Distrital, 2003). Additional resources were invested by CEC schools in food provision and school supplies for students. Moreover, by assigning contracts to respected schools and universities, these should face large costs from choosing lower non-contractible quality in the form of lower reputation of their own private institutions. Also, given that service provision contracts in Colombia are subject to renewal for at most 50% of length of the original contract, lower reputation due to reduced quality inflicts large costs to CEC providers interested in contract renewal.

It is also possible that not-for-profit, well reputed organizations have a genuine preference from providing goods of higher quality derived from altruistic behavior (Rose-Ackerman, [1996]; Lakdawalla and Philipson, [1998]). In fact, inspection of CEC school budgets show that they are investing in potential quality-improving activities that are not part of their annual evaluation process such as psychological attention to children, remedial education programs, or by sending school social workers to visit the household of students who have recently stopped attending school.

Third, to avoid *ex-post* opportunistic behavior by CEC providers, ownership of school facilities and supplies —the most specific assets of this contractual arrangement— was retained by the state. By doing so, the SED aimed at retaining residual contract rights in uncontracted circumstances (Joskow, 1988).

One final reason that prevents significant reductions in non-contractible quality lies in the nature of education provision along with the wage structure in the education sector in Colombia. Providing education is a labor intensive service with labor costs accounting for an important fraction of total expenditures. This is even more pronounced for CEC schools given that the state is the formal owner of the school facilities and is therefore responsible for major infrastructure investments. More importantly, wages in Colombia for both private and public teachers are regulated by law. As a result, although CEC schools could find cost reduction opportunities by hiring lower quality workers at lower

wages, the legal constraints on teacher wages incentivize these schools to hire the best teachers willing to work for them.

8. Conclusion

This chapter presents causal estimates of the effects on academic achievement of attending a contracted out public school in Bogotá, Colombia. Instrumental variables estimates constructed by using a distance-based instrument controlling for neighborhood fixed effects and a rich set of exogenous covariates consistently show a positive and large association between program participation and academic achievement. These effects are largest and significant for the math test as well as for the composite test, which evaluates students in most middle- and high-school academic subjects included in the Colombian standard curriculum. The results for the verbal test, while positive, are imprecise. I also provide a variety of empirical strategies to argue that, conditional on taking the test, the proposed instrument is indeed exogenous.

Although standardized tests have been used as proxies for school quality, higher academic results in standardized tests do not necessarily translate into longer-run gains in potentially more meaningful outcomes. Evans and Schwab (1995), for example, argue that standardized tests are limited measures of a student's ability, creativity or deeper problem-solving skills. In Chapter 3, I examine the longer-run effects of CEC school attendance using administrative data on college level enrollment (2- and 4-year programs), major choice, and college academic performance.

This chapter also explores some plausible factors that may have driven the higher academic results of contracted out public schools. Using school-level data, I argue that the higher academic achievement of these schools is unlikely to be explained by unintended strategic responses to increased test accountability. If anything, the lower socio-economic characteristics of student participants and the lower dropout and transfer rates as well as the higher test taking rates of these schools indicate the estimated effects are lower bounds of the true causal effect. Moreover, using school level data on education inputs show that contracted-out schools exhibit higher levels of academic achievement, despite having lower educated teachers and similar student-teacher ratios and expenditures per student.

In sum, the CEC program provides evidence in favor of the theoretical case of private provision of public education. That is, the overall evidence indicates that the higher academic results of CEC schools are the result of an institutional design that has strong incentives to improve contractible quality, while limiting the incentives for quality-shading cost reductions.

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Table 1. Evaluation Methodology since 2007

Component	Selected Indicators	Weight
<i>Pedagogical Model</i>	Participation of Students, Teachers, Principals, and Concessionnaires in school government, school manual, and pedagogical proposals	40%
	Availability and Accessibility of education materials	
<i>Non-Academic Indicators</i>	Dropout Rate	20%
	Failing Rate	
	Food Provision Quality and Quantity	
<i>Academic Performance</i>	Absolute performance in ICFES test	20%
	Relative Performance in ICFES test	
<i>Other</i>	Programs for community and parental participation in school activities	20%
	Institutional organization	

Source: IDEP (2010).

Table 2. Sample Exclusion Criteria

	Public (1)	CEC (2)	Total (3)
Initial Sample: Students taking 2008 ICFES Test and Graduating in 2008	48,125	2,074	50,199
<i>Exclusion criteria (total cases)</i>			
Night Schools	4,033	0	4,033
Technical Schools (including Teacher Schools)	3,417	0	3,417
Military Schools	239	0	239
Rural Schools	151	0	151
Observations with missing data (different from address)	2,931	146	3,077
Missing observations / Initial Sample (%)	0.061	0.070	0.061
Subtotal (Initial Sample minus excluded observations)	37,354	1,928	39,282
Minus observations with unmatched address	5,571	298	5,869
Unmatched observations / Total non-excluded observations (%)	0.15	0.15	0.15
Matched observations / Total non-excluded observations (%)	0.85	0.85	0.85
Final Regression Sample	31,783	1,630	33,413

Notes: This table presents the sample construction for regression analyzes. The initial sample of public and CEC students graduating in the second semester of 2008 has 50,199 observations. The sample reduces to 31,783 observations after excluding students who attend night, technical, rural or military public institutions, have missing data for at least one of the variables, or were not successfully assigned a valid residential address from the UAEDC database.

Table 3. Descriptive Statistics by School Type

	A. Full Sample		B. UPZ Sample	
	PUBLIC	CEC	PUBLIC	CEC
Male=1	0.46	0.46	0.46	0.46
Age in Years	17.08 (1.30)	16.99 ** (1.75)	17.11 (1.40)	16.97 *** (1.79)
Number Household Members	5.16 (2.05)	5.32 *** (2.06)	5.28 (2.04)	5.40 ** (2.10)
Number of Rooms	4.24 (1.87)	4.32 * (1.77)	4.23 (1.86)	4.36 ** (1.83)
No Younger Siblings=1	0.34	0.27 ***	0.32	0.26 ***
Dad is Literate	0.98	0.98	0.98	0.98
Mom is Literate	0.99	0.99	0.98	0.99
Father Education				
Primary	0.39	0.43 ***	0.48	0.44 ***
Secondary	0.47	0.47	0.44	0.48 ***
Associate	0.08	0.07	0.05	0.06
College or More	0.06	0.04 ***	0.03	0.02
Mother Education				
Primary	0.33	0.38 ***	0.41	0.40
Secondary	0.51	0.49 ***	0.48	0.50
Associate	0.11	0.09 ***	0.08	0.08
College or More	0.05	0.05	0.03	0.03
Household Income				
1 MW or less	0.14	0.13	0.17	0.13 ***
1 < MW < 2	0.53	0.59 ***	0.57	0.60 ***
2 < MW < 3	0.23	0.23	0.20	0.23 **
MW > 4	0.09	0.05 ***	0.05	0.03
Household Stratum				
One	0.15	0.24 ***	0.23	0.26 ***
Two	0.51	0.70 ***	0.66	0.71 ***
Three	0.32	0.05 ***	0.10	0.03 ***
Four+	0.01	0.01	0.00	0.00
Floor Quality of Dwelling				
Low	0.09	0.05 ***	0.08	0.04 ***
Medium	0.34	0.43 ***	0.45	0.43 **
High	0.57	0.53 ***	0.47	0.53 ***
Assets				
Computer at Home	0.49	0.47 ***	0.42	0.45 ***
DVD at Home	0.75	0.75	0.75	0.75
Car Ownership	0.15	0.16	0.12	0.13 *
Motorbike Ownership	0.07	0.10 ***	0.07	0.08
No Cellphone in Household	0.06	0.04 ***	0.06	0.04 ***
One Cellphone in Household	0.22	0.21	0.23	0.19 ***
Internet at Home	0.23	0.19 ***	0.17	0.17
TV Service	0.61	0.56 ***	0.57	0.56
Outcomes				
Math Test Score (SD)	0.00 (1.00)	0.10 *** (0.94)	-0.05 (0.97)	0.10 *** (0.94)
Verbal Test Score (SD)	0.00 (1.01)	0.08 *** (0.89)	-0.07 (0.97)	0.09 *** (0.88)
Overall Test Score (SD)	-0.33 (0.75)	-0.27 *** (0.64)	-0.39 (0.71)	-0.26 *** (0.63)
Distance				
Relative Distance (meters)	1800 (1774)	468 *** (1385)	546 (564)	10 *** (522)
Distance to Actual School (meters)	2856 (3920)	3244 *** (5712)	1803 (2662)	1883 (4901)
Number of Schools	410	25	205	25
N	31783	1630	10664	1304

Notes: Panel A includes all observations with valid non-missing data used later in estimation. Panel B includes all students whose residence is within the same UPZ of a CEC school. The stratum variables is an index running from 1 to 6 which summarizes the socio-economic status of the dwelling and its neighborhood, 1 being the lowest. Household income is measured in number of monthly minimum wages (MW). Relative Distance is defined as distance to closest CEC school minus distance to closest traditional public school. Significance levels for the equality of means tests: *** 1%, **5%.

Table 4. Exogeneity of Relative Distance to Closest CEC

	Full Sample			UPZ Sample		
	RD>0 Means	Balance Regressions		RD>0 Means	Balance Regressions	
		No Controls	UPZ Fixed Effects		No Controls	UPZ Fixed Effects
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Student and Family Characteristics</i>						
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*
<i>Household Income</i>						
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
<i>Household Assets</i>						
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 public school 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 lives closer to a CEC school than to a Public school (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 5. First Stage Results

Dependent: 1{CEC Student =1}	A. Full Sample			B. UPZ Sample		
	(1)	(2)	(3)	(4)	(5)	(6)
{Relative Distance < 0m} = 1	0.17*** (0.03)	0.10*** (0.02)	0.10*** (0.02)	0.20*** (0.03)	0.14*** (0.02)	0.14*** (0.02)
Exogenous Covariates	No	No	Yes	No	No	Yes
UPZ Fixed Effects	No	Yes	Yes	No	Yes	Yes
Correct Prediction Rate	0.890	0.753	0.717	0.789	0.746	0.759
F-Statistic	42.92	27.64	27.83	52.43	46.81	47.77
N	33413	33413	33413	11968	11968	119968

Notes: Panel A includes observations from the full sample. Panel B includes students only from the UPZ sample; that is, those whose residence is located in UPZ nearby CEC schools. Relative distance is defined as distance to closest CEC school minus distance to closest public school. The excluded instrument for CEC attendance is an indicator variable equal to 1 if relative distance is less than or equal to zero. The exogenous covariates are described in Table 3. Significance Levels: *** 1%, **5%, *10%. 5000-repetition, paired bootstrap standard errors sampled at the cluster level in parentheses.

Table 6. OLS and 2SLS Results of CEC Attendance on ICFES Scores

	Panel A. Full Sample			Panel B. UPZ Sample		
	(1)	(2)	(3)	(4)	(5)	(6)
Math Test Score in Standard Deviations						
<i>OLS</i>	0.101*** (0.032)	0.136*** (0.030)	0.120*** (0.030)	0.150*** (0.035)	0.159*** (0.035)	0.134*** (0.035)
<i>2SLS</i>	0.044 (0.119)	0.525*** (0.191)	0.559*** (0.201)	0.309*** (0.096)	0.600*** (0.134)	0.609*** (0.133)
p-value Hausman	0.63	0.05	0.03	0.11	0.00	0.00
Verbal Test Score in Standard Deviations						
<i>OLS</i>	0.088** (0.038)	0.145*** (0.033)	0.131*** (0.036)	0.162*** (0.039)	0.179*** (0.038)	0.159*** (0.038)
<i>2SLS</i>	-0.089 (0.145)	0.156 (0.202)	0.208 (0.213)	0.195 (0.146)	0.239 (0.168)	0.260 (0.169)
p-value Hausman	0.22	0.96	0.71	0.82	0.72	0.54
Overall Test Score in Standard Deviations						
<i>OLS</i>	0.066** (0.029)	0.113*** (0.026)	0.098*** (0.028)	0.126*** (0.031)	0.137*** (0.029)	0.114*** (0.029)
<i>2SLS</i>	-0.060 (0.122)	0.307** (0.151)	0.347** (0.162)	0.206* (0.107)	0.333*** (0.110)	0.343*** (0.109)
p-value Hausman	0.30	0.17	0.10	0.42	0.05	0.03
Covariates	No	No	Yes	No	No	Yes
UPZ FE	No	Yes	Yes	No	Yes	Yes
N	33413			11968		

Notes: See notes to Table 5 for details on samples and exogenous covariates. Relative distance is defined as distance to closest CEC school minus distance to closest public school. The excluded instrument for CEC attendance is an indicator variable equal to 1 if relative distance is less than or equal to zero. 5000-repetition, paired bootstrap standard errors sampled at the cluster level in parentheses. Significance Levels: *** 1%, **5%, *10%.

Table 7. Placebo Test: Reduced Form Effects of Distance

	Panel A. Full Sample			Panel B. UPZ Sample		
	(1)	(2)	(3)	(4)	(5)	(6)
Math Test Score in Standard Deviations						
ICFES 2000	-0.064*** (0.019)	-0.032* (0.016)	-0.026 (0.023)	-0.018 (0.032)	-0.017 (0.031)	-0.040 (0.046)
ICFES 2008	0.007 (0.020)	0.053*** (0.020)	0.057*** (0.020)	0.062*** (0.017)	0.085*** (0.018)	0.086*** (0.018)
Verbal Test Score in Standard Deviations						
ICFES 2000	-0.097*** (0.016)	-0.051*** (0.015)	-0.025* (0.014)	-0.020 (0.032)	-0.034 (0.035)	-0.029 (0.034)
ICFES 2008	-0.015 (0.026)	0.016 (0.020)	0.021 (0.021)	0.039 (0.028)	0.034 (0.023)	0.037 (0.024)
Overall Test Score in Standard Deviations						
ICFES 2000	-0.136*** (0.025)	-0.084*** (0.024)	-0.050** (0.022)	-0.021 (0.050)	-0.047 (0.054)	-0.049 (0.048)
ICFES 2008	-0.010 (0.021)	0.031** (0.015)	0.035** (0.016)	0.041** (0.020)	0.047*** (0.014)	0.049*** (0.014)
Covariates	No	No	Yes	No	No	Yes
UPZ FE	No	Yes	Yes	No	Yes	Yes
N ICFES 2000	20533			3776		
N ICFES 2008	33413			11968		

Notes: This table shows reduced form effects of distance to math, verbal, and composite test scores using 2000 and 2008 ICFES data. The year 2000 is one year before the first CEC schools graduated their first high school class. The instrument for both years is an indicator variable equal to 1 if the student lives relatively closer to a CEC school than to a public school. For the year 2000, the instrument is constructed as the distance to the closest not-yet-available CEC school minus the distance to the closest public school.

Table 8. Treatment Effect Heterogeneity

Panel A. Socio-Economic Characteristics by SES Index				
	SES Index Quartiles			
	Lowest	2nd	3rd	Highest
No. Household Members	5.62	5.25	5.03	4.74
Father Education: Primary = 1	0.75	0.50	0.25	0.04
Mother Education: Primary = 1	0.65	0.42	0.19	0.04
Stratum 1 = 1	0.33	0.15	0.08	0.03
House Income: 1 MW or less	0.30	0.16	0.08	0.02
House Income: 2 < MW < 3	0.08	0.17	0.26	0.44
Quality Floor Materials: Medium=1	0.86	0.37	0.10	0.02
Computer at Home = 1	0.19	0.37	0.55	0.87
Car at Home	0.05	0.09	0.16	0.33
Internet at Home = 1	0.03	0.10	0.21	0.61
Rooms in dwelling	3.91	4.12	4.34	4.64
N	8706	8428	8248	8031
Panel B. Decomposition of IV Weighting by SES Index				
Quartile	W_q	$\lambda_{q x}$	$\Delta D_{q x}$	$\omega_{q x}$
1	0.260	0.077	0.075 (0.020)	0.247
2	0.252	0.065	0.124 (0.026)	0.334
3	0.247	0.055	0.108 (0.025)	0.243
4	0.240	0.042	0.106 (0.022)	0.176

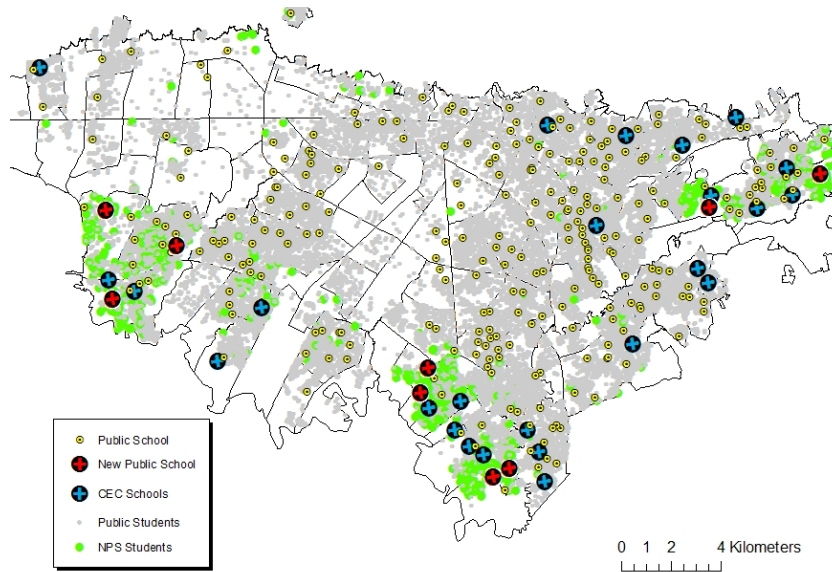
Notes: This table decomposes IV CEC school attendance estimates by quartiles of a constructed socio-economic index. Index reflects the predicted probability of being a SISBEN 1 household using demographic characteristics used in estimation for the sample living closer to a public school than to a CEC school. The SISBEN is a government poverty-targeting index that takes on 6 values, where only levels 1 and 2 are eligible for most government subsidies. $W_q = P(Quartile = q)$ is the proportion of sample observations in quartile $q = \{1, 2, 3, 4\}$. $\lambda_{q|x} = E[P(Z|X, Q)(1 - P(Z|X, Q))|Q]$ is the expected conditional variance of Z for each quartile, where Z is the categorical relative distance instrument. $\Delta D_{q|x} = E[E(D|Z = 1, X, Q) - E(D|Z = 0, X, Q)|Q]$ is the average effect of the instrument on CEC attendance for a given quartile. $\omega_{q|x} = (W_q \lambda_{q|x} \Delta D_{q|x}) / (\sum_q W_q \lambda_{q|x} \Delta D_{q|x})$ is the final weight received by quartile q.

Table 9. School Inputs

	Primary School		Middle School		High School	
	Public	CEC	Public	CEC	Public	CEC
Teachers' Education						
Less than College	0.07	0.10	0.03	0.11	0.02	0.07
Major in Education	0.48	0.72	0.45	0.76	0.41	0.74
Other Major	0.04	0.01	0.05	0.01	0.06	0.03
Graduate in Education	0.37	0.15	0.43	0.11	0.45	0.15
Other Graduate	0.02	0.00	0.04	0.00	0.04	0.00
Student-Teacher Ratio	40.37	38.09	31.3	31.72	30.26	20.87
	(24.5)	(6.37)	(11.74)	(8.6)	(27.23)	(5.95)
Cost Per Student Ratio	<u>2001</u>		<u>2002</u>		<u>2003</u>	
Public / CEC	1.01		0.99		1.11	

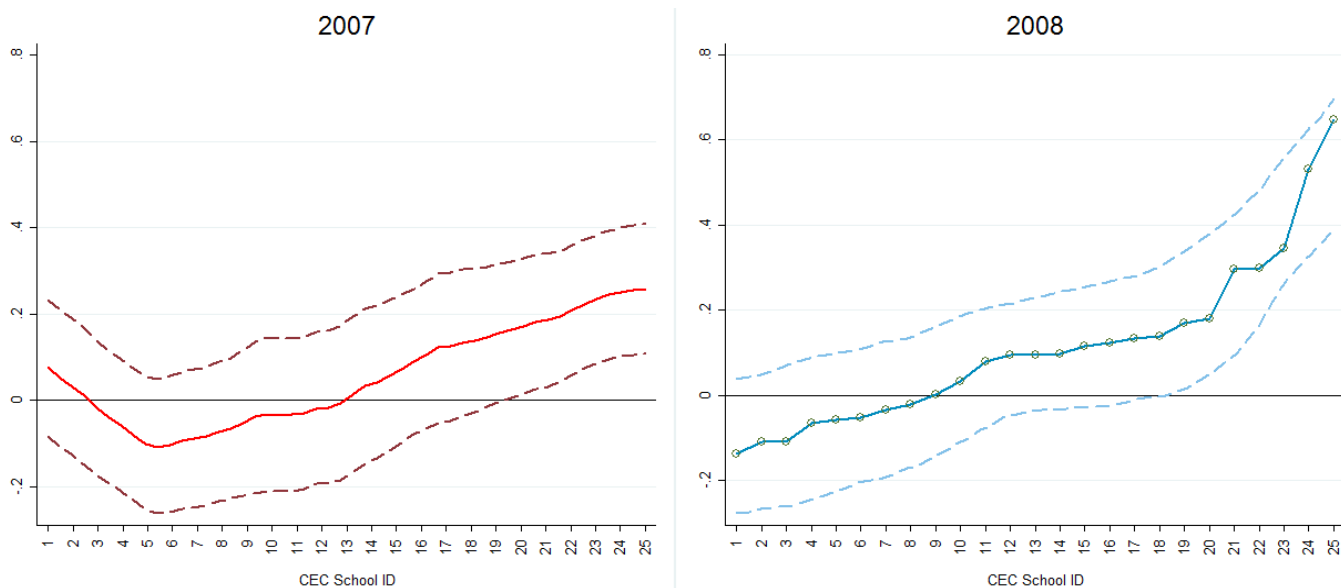
Notes: Author's Calculations from School Survey C-600 for the year 2008 for teachers education and student-teacher ratios. Source for cost per student is Contraloría Distrital, 2003.

Appendix A. Figures



Appendix Figure 1. Location of TPS, New TPS, and CEC Schools

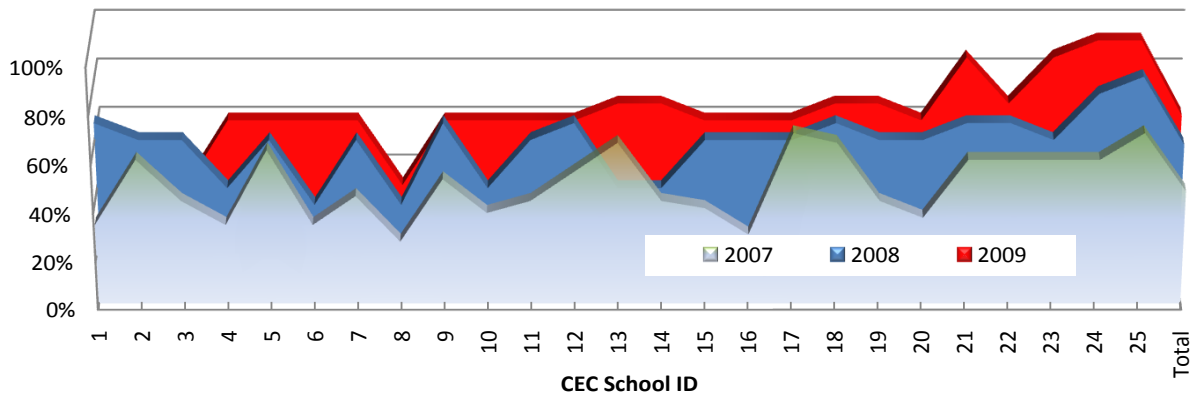
Notes: This figure shows the location of all public and CEC schools in the city as well as the students' residences by type of school attended. CEC and TPS students' residences are depicted with dark and light gray dots, respectively. CEC and TPS locations are represented with crossed black dots and hollow circles, respectively.



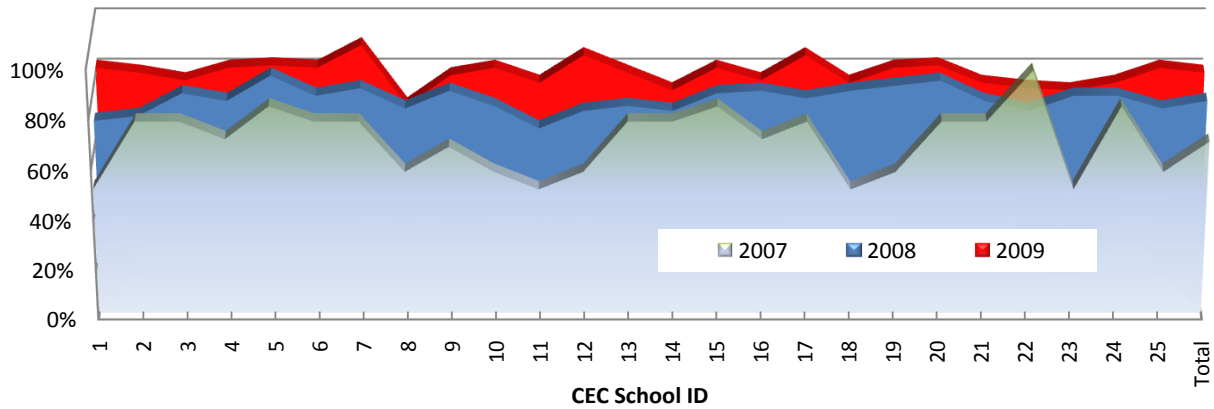
Appendix Figure 2. CEC's ICFES Performance Relative to TPS in same Locality

Notes: This figure shows confidence intervals for the composite ICFES scores difference between each CEC and all TPS located in the same locality. For both years, CEC schools are sorted in ascending order of the 2008 CEC-TPS ICFES difference to facilitate visualization.

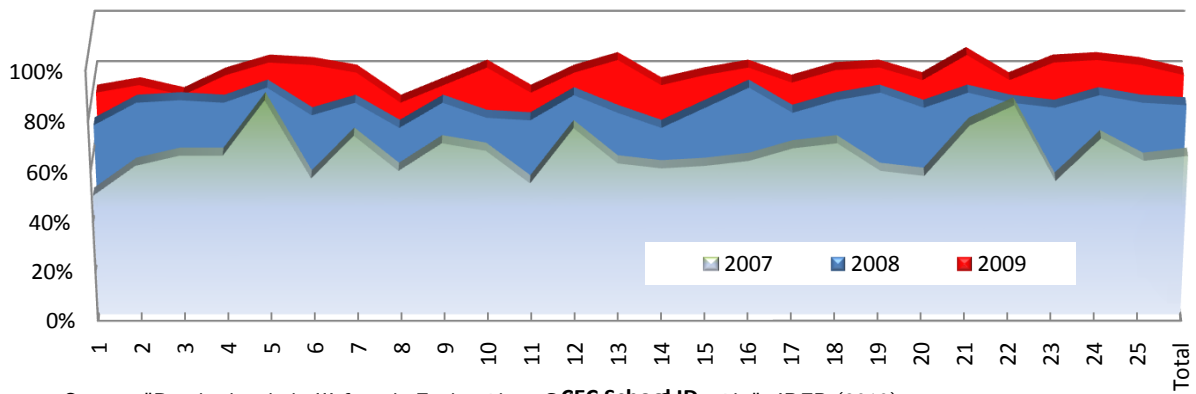
Appendix Figure 3. CEC Academic Performance Component 2007-2009



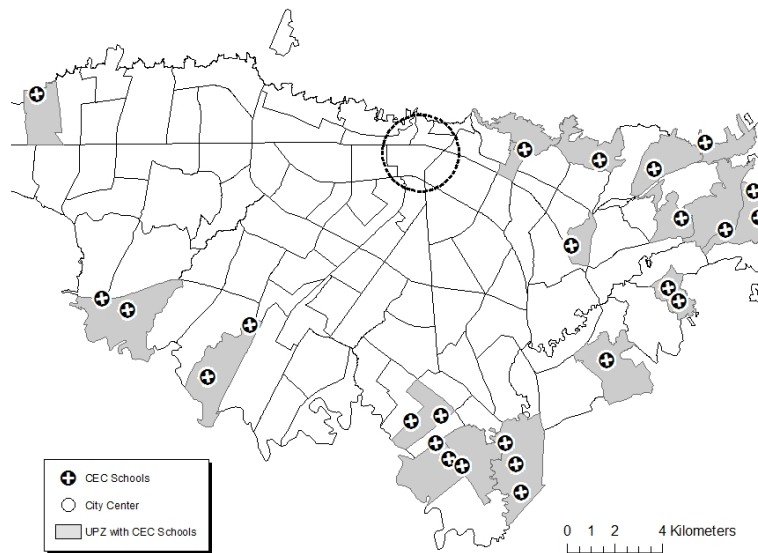
Appendix Figure 4. CEC Non-Academic Indicators 2007-2009



Appendix Figure 5. CEC Overall Evaluation 2007-2009

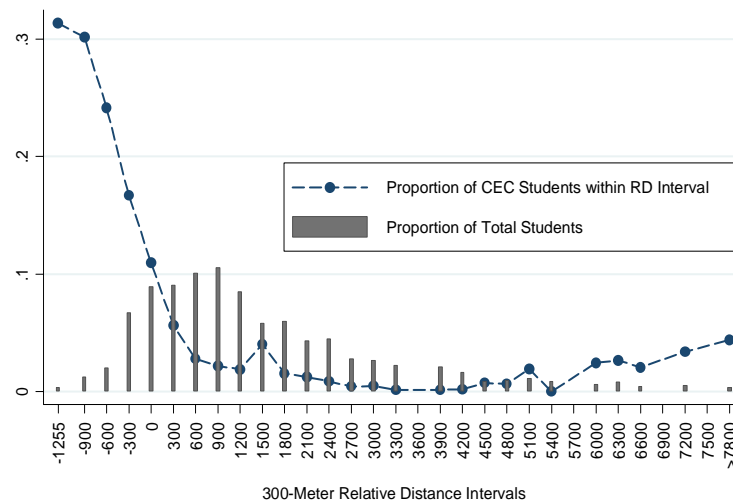


Source: "Resultados de la III fase de Evaluación a Colegios en la Decisión". IDEP (2010).



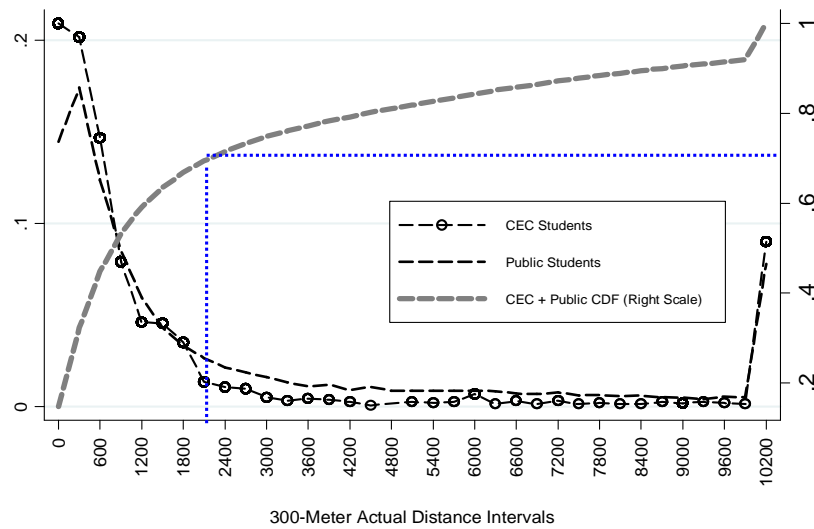
Appendix Figure 6. UPZs with CEC Schools

Notes: This figure shows the 120 UPZs in Bogotá. UPZs are administrative subdivisions of the city used for urban planning purposes. The figure also shows UPZs with nearby CEC schools used to define the UPZ sample used in regression analyzes.



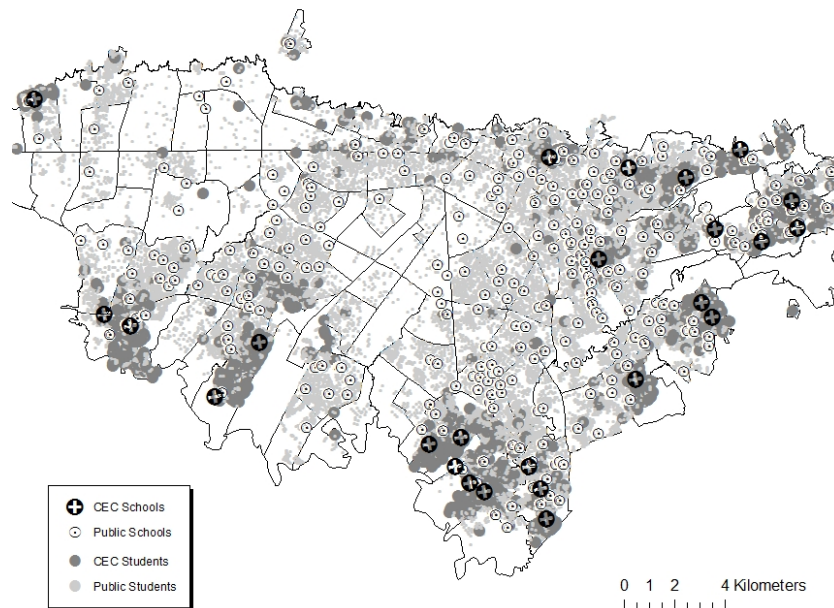
Appendix Figure 7. Non-linearity of RD on CEC Attendance Probability

Notes: This figure shows the fraction of total students attending a CEC school who live within a 300-meter interval of relative distance. Relative distance is defined as the distance to the closest CEC school minus the distance to the closest traditional public school.



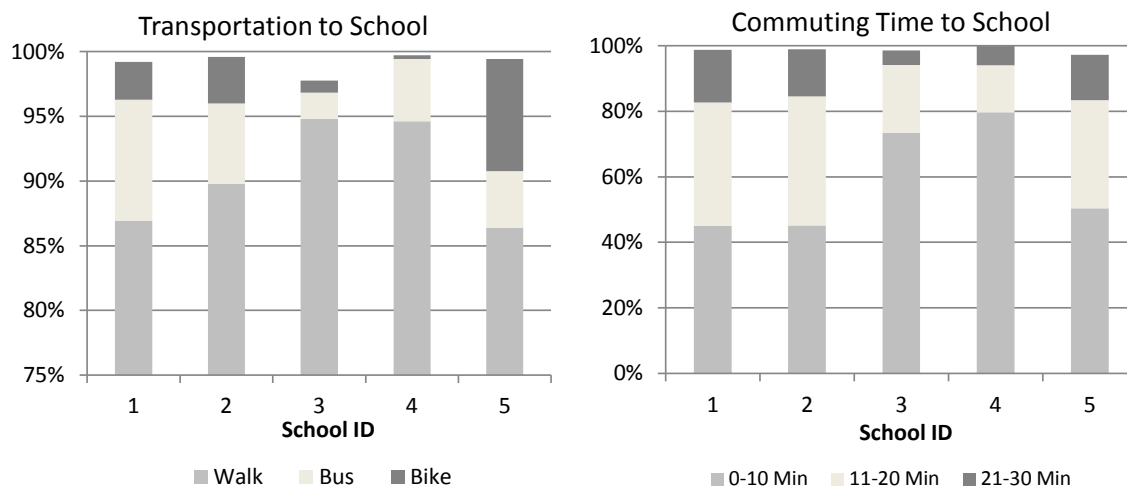
Appendix Figure 8. Proportion of Students by Intervals of Actual Distance

Notes: This figure shows empirical distributions of distance in meters to actual school attended for both CEC and public school students. The gray dashed line depicts the joint empirical cumulative distribution for CEC and public school students, measured in the right scale. Approximately 15% of all students in the sample live within 300 meters (0.18 miles) from the school they attend. 73% of all students in the sample live 2000 meters (1.24 miles) or less (right scale) from the school they actually attend.



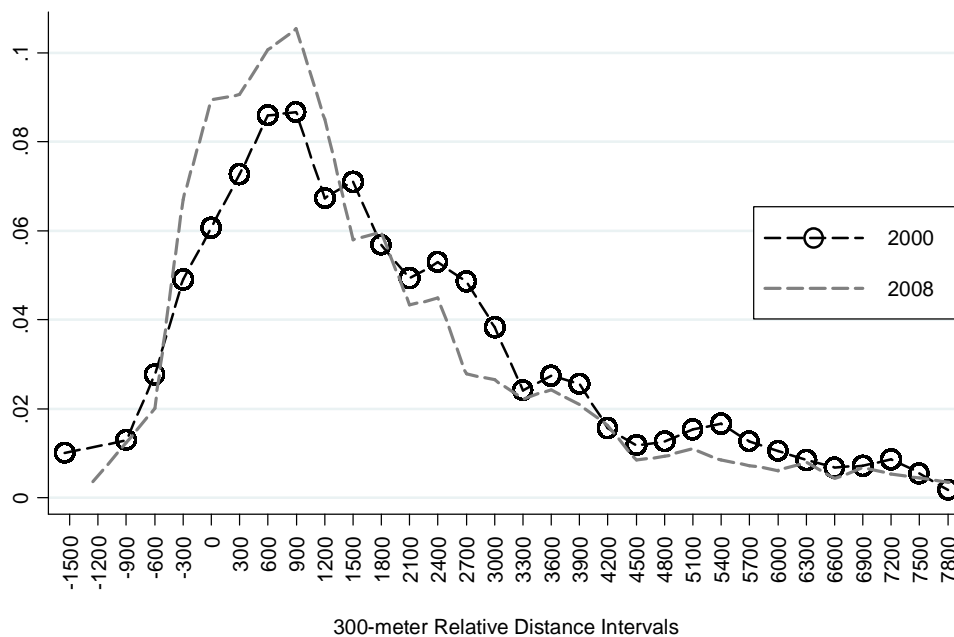
Appendix Figure 9. Location of Public and CEC Students' Residence

Notes: This figure shows the location of all public and CEC schools in the city as well as the students' residences by type of school attended. CEC and traditional public school students' residences are depicted with dark and light gray dots, respectively. CEC and public schools locations are represented with crossed black dots and hollow circles, respectively.



Appendix Figure 10. Commuting Patterns of 5 CEC Schools

Notes: This figure describes commuting habits for students from 5 of the 25 CEC schools. Source: Alianza Educativa.



Appendix Figure 11. Distribution of Relative Distance in 2000 and 2008

Notes: This figure describes the empirical distributions of relative distance for the years 2000 and 2008. The year 2000 is one year before the first CEC schools graduated their first high school class. For the year 2000, relative distance is constructed as the distance to the closest not-yet-available CEC school minus the distance to the closest public school.

Appendix B. Full Set of Estimation Results

Table 1. First Stage Results

Dependent: 1{CEC Student =1}	A. Full Sample			B. UPZ Sample		
	(1)	(2)	(3)	(4)	(5)	(6)
{Relative Distance < 0m} = 1	0.17*** (0.03)	0.10*** (0.02)	0.10*** (0.02)	0.20*** (0.03)	0.14*** (0.02)	0.14*** (0.02)
Male=1			0.00			0.00
Age			-0.00*			-0.01
No. Household Members			0.00			0.00
Father Education: Primary = 1			-0.02**			-0.03*
Father Education: Secondary = 1			-0.00			-0.00
Father Education: Associate = 1			0.00			0.02
Mother Education: Primary = 1			-0.01			-0.01
Mother Education: Secondary = 1			-0.01			-0.01
Mother Education: Associate = 1			-0.01			-0.01
Stratum 1 = 1			0.01			0.09*
Stratum 2 = 1			0.01			0.08*
Stratum 3 = 1			-0.02			0.04
House Income: 1 MW or less			0.01			0.03
House Income: 1 < MW < 2			0.01**			0.05**
House Income: 2 < MW < 3			0.01**			0.04***
Dad is Literate			-0.00			-0.01
Mom is Literate			0.02*			0.03*
House Floors - Low Quality			-0.02***			-0.04***
House Floors - Med Quality			-0.01			-0.02**
Computer at Home			0.00			0.00
DVD at Home			-0.00			-0.01
Car Ownership			0.01			0.01
Motorbike Ownership			0.01			0.01
No Cellphone in Household			-0.01*			-0.02
One Cellphone in Household			-0.00			-0.02
Internet at Home			0.00			0.00
Cable TV at Home			-0.01*			-0.01
Number of Rooms in Household			-0.00			0.00
UPZ Fixed Effects	No	Yes	Yes	No	Yes	Yes
Adj R-Squared	0.06	0.11	0.11	0.07	0.1	0.11
Correct Prediction Rate	0.890	0.753	0.713	0.789	0.746	0.762
F-Statistic	42.92	27.64	27.92	52.43	46.81	47.27
N	33413	33413	33413	11968	11968	119968

Notes: See notes to Table 5 for details on samples and exogenous covariates. Significance Levels: *** 1%, **5%, *10%.

Table 2. Full Set of 2SLS Results

Dependent: Test Score in SD	A. Full Sample			B. UPZ Sample		
	Math (1)	Verbal (2)	Overall (3)	Math (4)	Verbal (5)	Overall (6)
CEC School = 1	0.553***	0.198	0.338**	0.610***	0.256	0.337***
Male=1	0.296***	-0.007	0.135***	0.293***	-0.028**	0.127***
Age	-0.073***	-0.074***	-0.075***	-0.064***	-0.065***	-0.064***
No. Household Members	-0.013***	-0.016***	-0.015***	-0.012**	-0.018***	-0.016***
Father Education: Primary = 1	-0.124***	-0.205***	-0.175***	-0.103**	-0.139***	-0.144***
Father Education: Secondary = 1	-0.109***	-0.164***	-0.145***	-0.068	-0.081*	-0.096**
Father Education: Associate = 1	0.025	-0.024	-0.003	0.085	0.047	0.037
Mother Education: Primary = 1	-0.124***	-0.125***	-0.123***	-0.088	-0.127**	-0.112**
Mother Education: Secondary = 1	-0.075***	-0.094***	-0.084***	-0.054	-0.110**	-0.083**
Mother Education: Associate = 1	0.023	0.019	0.005	0.013	0.024	0.005
Stratum 1 = 1	-0.107*	-0.104*	-0.122**	0.100	0.110	0.119
Stratum 2 = 1	-0.083	-0.042	-0.065	0.133	0.176	0.187
Stratum 3 = 1	-0.014	0.028	0.001	0.174	0.269	0.251
House Income: 1 MW or less	-0.199***	-0.194***	-0.184***	-0.212***	-0.193***	-0.180***
House Income: 1 < MW < 2	-0.099***	-0.121***	-0.103***	-0.112***	-0.135***	-0.096***
House Income: 2 < MW < 3	-0.061***	-0.051**	-0.047***	-0.083**	-0.081**	-0.047*
Dad is Literate	0.054	0.038	0.041	-0.001	-0.020	-0.027
Mom is Literate	0.083*	0.084*	0.106***	0.013	0.051	0.069*
House Floors - Low Quality	-0.007	-0.047**	-0.012	-0.019	-0.097***	-0.039
House Floors - Med Quality	-0.002	-0.013	-0.004	0.037*	0.008	0.021
Computer at Home	0.073***	0.077***	0.078***	0.097***	0.080***	0.088***
DVD at Home	-0.039***	-0.028*	-0.031***	-0.037**	-0.034	-0.029
Car Ownership	-0.020	-0.032**	-0.029**	0.000	-0.054**	-0.040***
Motorbike Ownership	-0.098***	-0.068***	-0.096***	-0.057**	-0.046	-0.068***
No Cellphone in Household	-0.019	-0.040	-0.032	-0.034	-0.050	-0.045
One Cellphone in Household	-0.047***	-0.023*	-0.031***	-0.045*	-0.030	-0.037**
Internet at Home	0.005	0.011	0.010	-0.017	0.007	0.003
Cable TV at Home	-0.044***	-0.060***	-0.056***	-0.044**	-0.053***	-0.056***
Number of Rooms in Household	0.012***	0.009***	0.011***	0.009*	0.012***	0.010***
UPZ Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
N		33413			11968	

Notes: See notes to Table 6 for details on samples and exogenous covariates. Significance Levels: *** 1%, **5%, *10%.