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The Impact of Chicago's Small High School Initiative

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This project examines the effects of the introduction of new small high schools on student performance in the Chicago Public School (CPS) district. Specifically, we investigate whether students attending small high schools have better graduation/enrollment rates and achievement than similar students who attend regular CPS high schools. We show that students who choose to attend a small school are more disadvantaged on average, including having prior test scores that are about 0.2 standard deviations lower than their elementary school classmates. To address the selection problem, we use an instrumental variables strategy and compare students who live in the same neighborhoods but differ in their residential proximity to a small school. In this approach, one student is more likely to sign up for a small school than another statistically identical student because the small school is located closer to the student's house and therefore the "cost" of attending the school is lower. The distance-to-small-school variable has strong predictive power to identify who attends a small school. We find that small schools students are substantially more likely to persist in school and eventually graduate. Nonetheless, there is no positive impact on student achievement as measured by test scores.

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I. Introduction

There is a building consensus among policy makers, educators, parents, and future employers that American high schools are in need of significant reform. Nationwide, only about 75 percent of high school freshmen graduate from high school within 4 years (Snyder and Dillow, 2012). Students from poor families and students of color are more likely to drop out than more advantaged youth. Improvements that have recently been seen in lower grades (possibly because of the introduction of accountability reforms like *No Child Left Behind*) have failed to carry over to high school performance. According to the National Assessment of Educational Progress (NAEP), 74 percent of 12^{th} graders have math skills below the proficiency level, and 88 and 93 percent of Hispanic and Black students, respectively, fail to meet the bar.[1] Further, over 60 percent of employers complain that high school graduates do not have good math and writing skills (U.S. Department of Education, 2003).

The organization of schools has a potentially large impact on the performance of students (Barker and Gump, 1964; Chubb and Moe, 1990). In the recent past, high schools have been accused of being rather large, impersonal educational "factories" where teachers know little about the students in their charge, and the learning environment is not very supportive (Sizer, 1984; Sizer 1997). In response, reform efforts known as the "Small Schools Movement" have been mounted to reduce the size of high school learning communities by breaking up existing large schools and creating new schools that are small by design. The Bill & Melinda Gates Foundation was a major supporter of this reform, making over $2 billion in grants to invest in small schools

[1] Cited statistics are 2013 NAEP test score results for 12^{th} grade students reported at the website www.nationsreportcard.gov.

(Gates Foundation, 2009). The Annenberg Foundation, Carnegie Foundation, and Department of Education also contributed substantial resources to small schools (Shear and Smerdon, 2003).

Despite the substantial financial investment in small school reforms, there have been few experimental or quasi-experimental evaluations of their impacts on student outcomes. This project attempts to isolate the causal impact of the 22 new small high schools created in Chicago between 2002 and 2006 under the Chicago High School Redesign Initiative (CHSRI). We use individual-level longitudinal data from the Chicago Public Schools (CPS) and employ an instrumental variables design based on a student's residential proximity to a small high school to measure their impacts on enrollment and graduation up to 5 years after a student began high school.

We document substantial negative selection into small high schools in Chicago. When we control for background characteristics, the correlation between small school attendance and enrollment indicates that small school students are somewhat less likely to drop out and more likely to progress on time and graduate. The instrumental variables estimates are substantially larger than the OLS estimates and suggest that small schools increase the likelihood that a student graduates from high school on time by 20 percentage points on a base of 48 percent. At the same time, however, we find no evidence that small high schools raise student test scores. These findings are consistent with the broader literature that finds strong impacts of high school improvement on educational attainment, but more mixed results on test scores. For example, Evans and Schwab (1995) and Altonji et al. (2005) find that Catholic high schools increase educational attainment but not test scores. On the other hand, as described below the literature on small high schools in New York City has found mixed results on scores (Bloom and Unterman 2014; Schwartz et al. 2013; Abdulkadiroglu et al. 2013).

II. Background on the Small Schools Movement

The small schools movement grew out of the observation that poor, urban students who already have lower levels of academic performance are more likely to drop out of large high schools (Toch, 1993; Bryk and Thum, 1989; Maeroff, 1992). There are several theories about why small schools can be more effective, largely involving improved relationships between teachers and students in small schools (Rossi and Montgomery, 2004). In smaller schools, teachers may be able to get to know their students better and tailor their teaching approaches to students' interests and strengths; students may feel more connected to a small school community which leads to reduction in violence and dropping out; and expectations may be raised for the high achievement of all students. In addition, teachers are thought to be more collaborative, creative and effective in small schools.

Policies to expand the availability of small schools in urban environments were motivated by mostly correlational research from an earlier generation of small school interventions that showed positive outcomes (Cotton, 1996; Haller, 1993; Howley, 1989). Small schools had been shown to have lower dropout rates, smaller achievement gaps, and better access to challenging coursework (Bryk et al. 1990; Darling-Hammond et al., 2002; Holland, 2002; Pittman and Haughwout, 1987). However, the research was not universally positive; one-half of the studies reviewed in Cotton (1996) showed no impact of small schools.

Fueled by this theory and empirical evidence, over 1600 new, mostly urban small schools were founded in the early 2000's (Toch, 2010). While the guideline for enrollment was no more than 600 – and ideally closer to 400 students – it is important to note that the intervention of the small schools movement was intended to be about more than just the number in the student body. The small schools were expected to have an additional set of attributes including common focus, high expectations, a culture of respect and responsibility, performance standards, and effective use of technology.

Despite much previous research on small schools, our knowledge of the potential impact of policies encouraging the formation of new small high schools in urban districts is limited. Early studies on the introduction of small schools in Chicago found positive impacts on measures of student engagement, but no impact on gross measures of achievement (Kahne et al., 2005; Wasley et al., 2000; Hess and Cytrynbaum, 2002). The lack of findings on achievement may be due to evaluating the schools "too early" after their opening while schools were still struggling with basic start-up organizational challenges or because selection into the new schools was not properly addressed. Additionally, the first small high schools to open in Chicago differ from later-opening small schools in potentially important ways. Namely, the first schools were so-called "conversion" schools that divided a large high school into a number of small schools in the same building.[2] The schools chosen for conversion were previously among the lowest-performing schools in the city (Kahne et al., 2006). Later-opening schools were more typically new-start schools, which were potentially better positioned to choose faculty and enroll students who were more committed to the small schools approach. All small schools were given flexibility to structure their curriculum, schedule, and other

[2] Most of the small conversion schools were merged back into large schools between 2008-2011.

school attributes (Sporte et al., 2004).

As we demonstrate in Table 1 below, the student body in small schools was, on average, negatively selected relative to their 8th grade classmates. Qualitative studies indicate a variety reasons that students chose to attend small schools (Sporte et al., 2004). Some students report being drawn to the schools because of the small size and the resulting additional attention from teachers. Others reported reasons such as “my counselor made me” and “because it’s close to home.” Still, others reported being assigned to the schools because they did not express a different preference, or because they were not accepted to other high schools. Note that the guiding principle for the small schools initiative in Chicago was the desire for small schools to serve students from their local neighborhoods. Using longer run data, Sporte and de la Torre (2010) find that small school students in Chicago have better attendance and persistence than a demographically similar control group, but perform no better on test scores. They find similar impacts for both conversion and new-start schools. Our paper is the first to use a quasi-experimental design to address negative student selection into the small schools and to evaluate the performance of small schools in Chicago.

The most credible causal evidence on the impacts of small high schools comes from three recent studies of New York City public schools. Bloom and Unterman (2014) use lotteries for admission to over-subscribed small high schools to compare outcomes for lottery winners who go on to attend one of the new small high schools to lottery losers who attend one of the other types of public high schools available in New York City. Because lottery winners were randomly chosen, on average the two groups should have identical observable and unobservable characteristics. The authors find that winners of the grade nine admission lotteries were 9.5 percentage points more likely to graduate from high school within four years. They also find that lottery winners were more likely to score at or above 75 points on the English Regents exam, the level at which the City University of New York exempts students from taking remedial English classes. They find no impact on Regents exam math scores. Using a somewhat different lottery design and longer-run data, Abdulkadiroglu, Hu, and Pathak (2013) replicate many of these findings and additionally find positive test score impacts in all subjects and increased college enrollment rates.

In work most closely related to our paper, Schwartz, Stiefel, and Wiswall (2013) also study the effect of new small high schools on student outcomes in New York City using distance from student zip codes to the nearest schools by size and age as instrumental variables for attending a new small school, a new large school, an old small school, or an old large school. They find that students who attend one of the new small high schools are 17 percentage points more likely to graduate from high school than students who attend a large high school. Further, new small high school students are more likely to attempt a Regents math or English test by around 16 percentage points. In contrast to the findings from the lottery studies, however, Schwarz et al. (2013) find that new small high school students perform no differently on the mathematics Regents' exam and less well on the English Regents' exam compared with their large high school counterparts, although they are also more likely to have taken the exam.

While the small schools movement in Chicago and New York share many features in common in terms of motivation for the founding of small schools, there are also important differences. New York's small schools movement was substantially larger, with more than 100 new small schools created between 2002 and 2008 (Bloom and Unterman, 2014, Abdulkadiroglu et al., 2013) and over 20 percent of high school students enrolled in small schools (Schwartz et al., 2013). Chicago's small schools initiative included only 22 schools, making up just over 5 percent of ninth grade enrollment in the system. Because of the differences in magnitude of the small schools movement, it is possible that the general equilibrium impacts of small schools are larger in New York. In addition, the extent of negative selection into small high schools in New York was more modest. Small schools students scored 0.1 standard deviations below large school students on 8th grade exams in New York, compared with a 0.2 standard deviation difference in Chicago.

III. Data

The data used in this project come from the Consortium on Chicago School Research's longitudinal dataset on student enrollment patterns and test scores. These data have been a fruitful source for many recent research projects on a variety of topics (e.g., Roderick et al., 2002; Cullen et al., 2005; Jacob, 2005; Jacob and Levitt, 2003; Neal and Schanzenbach, 2010). These data allow us to address some of the problems that have plagued earlier studies of high school reform. Because of the availability of prior test scores and other demographic characteristics, we can account for selection on observables into new high schools. We include controls for a student's age, race, gender, neighborhood characteristics, whether she is old for her cohort (a proxy for grade retention), and whether the student is eligible for free or reduced price lunch or participates in a special education program. We have pre-test scores from the 8th grade math and reading components of the state standardized test, the Illinois Standards

Achievement Test (ISAT). Because the Consortium has access to student address data, they were able to construct our instrumental variable—the distance from the student's home to the closest small school.

The Chicago Public School District (CPS) is the third-largest district in the United States, with large numbers of students from several racial/ethnic groups. CPS students overall are 40 percent Black, 45 percent Hispanic, 3 percent Asian, and 9 percent White. Most students in the district are disadvantaged – 85 percent are from low-income families who qualify for free or reduced-price lunch – and dropout rates are high (35-43 percent in recent cohorts).[3] Chicago's introduction of new small high schools occurred against a backdrop of considerable existing school choice (over half of the 100,000 Chicago high school students attend a high school outside of their attendance area), several charter high schools, and improving test scores as a result of its 1997 NCLB-style accountability reforms (Jacob, 2005).

Our primary outcome measures use fall administrative enrollment records to construct indicators of whether a student is still enrolled, is progressing from grade to grade on time, and whether they graduated from high school. We use five cohorts of students who enter 9th grade between fall 2002 and fall 2006 at one of 22 new small high schools. We have data to follow all students through 5 years after entering high school—long enough to capture most high school completion information even for students who are delayed. We also have standardized test scores from ACT's Educational Planning and Assessment System (EPAS) given to students in the fall of 9th and 10th grades, and spring of 11th grade. The 11th grade test includes a full-length ACT test that can be sent to colleges for admissions purposes.

[3] These are five-year cohort dropout rates reported by CPS (2012).

The primary challenge of evaluating the effectiveness of new small schools is to isolate causality – that is, what would the student's outcome have been if she had attended a "regular" school, and how does that compare to her outcome at the small school she actually attended? In order to begin to describe the difficulties of isolating causality, we first document the extent of the selection problem by presenting 8th grade characteristics of students who do and do not choose to attend a small school in 9th grade.[4] These are presented in Table 1. The first column shows mean characteristics of students who enroll in a small school. Because the schools are located in particular neighborhoods, we do not compare these students to the overall CPS population. Instead, we form the comparison group for 9th grade small school students using their former 8th grade classmates. Small school students were drawn from about 400 different 8th grade "sending" schools (out of almost 500 8th grade schools in the CPS system). Mean characteristics of the 8th grade classmates of small school students are in column (2). Because sending schools have varying rates of treatment (that is, one school might only send one or two students to a small high school, while another might send half of their enrollment or more to a small school), we test whether these characteristics are different conditional on sending school fixed effects. In other words, we examine how students who go to small schools compare to their own 8th grade classmates. P-values associated with tests for differences in means between columns (1) and (2) after conditioning on sending school fixed effects in an OLS regression are shown in column (3). Most characteristics are measured as binary variables, with a value of one indicating that the student has the characteristic described (e.g. female, receive free or reduced price lunch).

[4] Our sample is limited to students who are in 8th grade in the spring of year t-1 and in 9th grade in the fall of year t. We omit approximately 5 percent of the control group who enrolled in a selective high school in 9th grade; this has no significant impact on the results.

About 80 percent of the small school students are Black or African American, 20 percent are Hispanic, and nearly 90 percent are eligible for free or reduced price lunch. Roughly one-third of the small school students are old for their grade, and almost one-quarter has some type of disability identified by having an Individualized Education Program (IEP) plan. Small school students live 1.2 miles away from the closest small school (whether or not they attend that particular small school). While their 8th grade classmates are equally likely to be low-income as measured by school-lunch eligibility, they are less likely to be African American, somewhat more likely to be Hispanic, less likely to be old for their grade, and less likely to have any disability. Small school students are also more likely to have unstable enrollment in 8th grade, which is measured as whether a student ends the school year attending a different school than he or she began the year.

We also observe ISAT test scores from when the students were enrolled in grade 8. The ISAT was re-normed in 2005 (when our final cohort was in 8th grade), so we standardize math and reading scores by the mean and standard deviation across all CPS test takers in the same grade level and year in order to produce comparable statistics over time. The average 8th grade math score among small school enrollees is -0.45, that is 0.45 standard deviations below the district average, and the average reading score is -0.34. While the 8th grade classmates of small high school students also score below the district average on the 8th grade ISAT tests, their average test scores are significantly higher than the small school enrollees by roughly 0.2 standard deviations.

Finally, we also include mean characteristics for the Census block groups in which the students reside based on data from the 2000 Census. Specifically we look at poverty concentration, socioeconomic status (SES), and the average number of years household heads have lived in their residence.[5] Students enrolling in small high schools have very similar neighborhood characteristics to their 8th grade classmates.

Overall, we conclude that small school students are negatively selected in terms of expected educational outcomes compared to their prior classmates: they are more likely to have an IEP and be old for their grade (a proxy for whether they have been held back in a prior year), more likely to have changed schools during the 8th grade school year, and their test scores are markedly worse in both math and reading and in 8th grade. Based on these differences we would expect small school students to have worse high school outcomes than their peers, all else equal.

The raw outcome means are presented at the bottom of Table 1. About 10 percent of students drop out or leave the Chicago Public Schools after each year of high school. That is, in the control group 10.8 percent of students are no longer enrolled in CPS in the fall of what would be their 10th grade year if they had progressed on time, denoted here as T+1 for one year after starting 9th grade. Twenty percent are no longer enrolled in the fall 2 years after starting 9th grade (i.e. what would be their 11th grade year), and thirty percent are no longer enrolled in the third fall after starting high school. Forty percent have dropped out or left CPS as of the fall 4 years after starting high school. A related measure of high school attainment is whether a student is still enrolled and is accumulating course credits progressing up the grade levels on time. Approximately

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[5] All three measures are constructed by CCSR. Poverty concentration is constructed using percent of adult males employed and percent of families with incomes above the poverty line. The measure is standardized such that the mean value for all census block groups in Chicago equals zero and one-half of the Census blocks will have above average poverty concentration (a positive value) and one-half will have below average poverty concentration. The SES measure is constructed using data on mean level of adult education and the percentage of employed persons who work as managers or professionals. The measure is similarly standardized so that mean Census block in Chicago equals zero, high SES block groups have positive values, and low SES block groups have negative values.

three-quarters of the 9th graders in our sample are enrolled as 10th graders in CPS the subsequent year, and just under half of them graduate from high school on time. Note that despite the fact that small school 9th graders are negatively selected along observable characteristics, their average high school outcomes are the same as their prior classmates.

Cohort-by-cohort summary statistics are presented in Appendix Table 1. Over time, the cohorts attending small schools become slightly less negatively selected on test scores: each year the pooled mean test scores among the small schools treatment group improve by approximately 0.04 standard deviation in math (from -0.54 for 2002 9th graders to -0.39 for 2006 9th graders) and 0.025 standard deviation in reading (from -0.38 to -0.32). In the empirical work that follows, we always condition on cohort fixed effects.

To get a sense of school differences between the treatment and control groups, Table 2 presents school-level characteristics (based on 9th grade students) for small high schools as well as for the high schools attended by the former classmates of small high school students. School-level mean characteristics are calculated by 9th grade cohort, and in Table 2 we present averages of the school-level means weighted by 9th grade enrollment for all 9th grade students enrolling in small high schools and their former classmates. We also present average school characteristics separately for Black and Hispanic students. As expected, the 9th grade cohort size is substantially smaller for small school students compared with their former classmates who attend regular high schools. Small schools' average cohort enrolled 154 students, compared with 519 for the large high schools attended by their former classmates. There are some differences across demographic characteristics, with small schools enrolling a higher share of learning disabled students (16.0 percent vs. 13.6 percent), a higher share of Black students

(79 percent vs. 64 percent), and a lower share of Hispanic students (19 percent vs. 29 percent). The 8th grade achievement level of students in small schools is also markedly lower. Small schools students scored an average 0.25 standard deviations lower in math, and 0.18 standard deviations lower in reading, and substantially fewer students had test scores above the district average (i.e. z-score greater than zero). Panels B and C break out the school characteristics separately by student race. The patterns between small schools and regular schools are relatively similar across these panels, with small-school students attending schools with higher percentages of Black students, fewer percentages of Hispanic students, and lower baseline test scores. Notably, Black students attend small schools with higher enrollment levels, but the control group attends regular schools with lower enrollment levels, so the difference in enrollment between small and regular schools is smaller for Black students than for Hispanic students.

IV. Empirical Approach

As shown above, small school students differ from their prior classmates along observable characteristics. One approach to measure the relationship between small school attendance and student outcomes would be to condition on these observable characteristics such as special education status, race and gender. We model this approach as follows:

(1) $$Y_{itys} = \alpha_0 + X_i\beta + \alpha_1 SM_{i9} + \gamma_y + \varepsilon_{itys}$$

where Y is an outcome measure, such as standardized test score or dropout status, for student i at time t in cohort y in school s. X is a vector of student characteristics such as race, gender and free-lunch status, SM is an indicator variable for whether a student is enrolled in a small school in grade 9, γ is a cohort fixed effect (that is, a dummy variable for the year in which the cohort enters 9th grade), and ε is an individual error term that includes a component that allows for correlations across students in the same school. We augment the equation to include fixed effects η for 8th grade school units, or fixed effects φ for a student's home ZIP code, or both. This approach adjusts for selection into small schools as reflected by demographic characteristics.

However, equation (1) ignores potentially important unobserved characteristics that may be correlated with both the outcome and the decision to enroll in a small school. Failure to control for these characteristics would bias the measured impact of small schools. Thus, one can additionally control for a baseline test score *T*, such that:

(2) $$Y_{itys} = \alpha_0 + X_i\beta + \alpha_1 SM_{i9} + T_i\delta + \gamma_y + \varepsilon_{itys}.$$

This strategy works under the (likely untenable) assumption that the baseline test score adequately captures all of the other unobserved characteristics that affect both the student outcome and whether a student enrolls in a small school. In effect, equation (2) compares two children who have the same prior test score and share the same demographic characteristics, but one is enrolled in a small school and the other is enrolled in a regular school. A positive coefficient on α_1 (for an outcome such as a test score) would indicate that the test score gain (or value-added) is larger for a student who attends a small school.

While the approach described in equation (2) is an improvement over the approach in equation (1), there are still potentially serious shortcomings. For example, there is considerable year-to-year fluctuation in test score performance. If due to chance a student has an unusually bad test performance in 8th grade, her parents may react to this low score by enrolling her in a new school. The next year, we would expect her score to rebound to its previous higher level no matter whether she enrolls in a small or a regular high school. But failure to account for her previous test score trend will result in this "rebound" effect being attributed to the new school (Ashenfelter, 1978). If on the other hand an 8^{th} grader has an unusually high score – again, just due to chance – his parents will likely judge that the current school regime is serving him well and may be less likely to enroll him in a different school. One can imagine situations in which this type of bias cuts in favor of small schools and other situations in which it cuts against them. In any case, the estimated effect will be biased.

Ideally, we would be able to evaluate the effectiveness of small schools by utilizing some sort of random assignment mechanism. Some recent studies of school reforms – including the Bloom and Unterman (2014) and Abdulkadiroglu et al. (2013) papers on small schools in New York – have used variation induced by randomized lotteries that are often used to allocate school admissions when there are more students who want to participate in a program than can be accommodated. In a classic lottery-style setup, students would be randomly assigned by a lottery to attend the new school or not from a school's application pool, and then the students who were assigned to attend the new school would be compared to those who lost the lottery. The students who signed up for the lottery likely share some similar characteristics – they may have highly motivated parents who are looking for the best available educational opportunity, or they may be students who feel they were not served well by the old school, or they may be students who faced academic or disciplinary problems at their prior school. The key feature for evaluation is that once the students identified themselves as being interested in changing schools, no characteristics predict whether they were selected from the list of applicants to attend the new school. As a result, the lottery "winners" and "losers" share the same distribution of prior achievement, family characteristics, etc. Since the groups are on average the same at the beginning of the year, any average difference at the end of the year would be due to the impact of the new school. Unfortunately, in this case there are no such lotteries available to use to help isolate the treatment effect of attending a small school.

In the absence of a truly randomized experiment, we turn to an instrumental variables strategy to isolate the causal impact, similar to the approach in recent papers in the economics literature that use proximity to college (Card, 1995; Kling, 2001; Currie and Moretti, 2003) or selective high schools and career academies (Cullen et al., 2005) as an instrument for attendance. In our implementation of this approach, the distance between a student's home and the nearest small school is used as a proxy variable for the time cost of attending a small school. The maintained assumption is that residential location is given, and proximity to a small school is not correlated with other determinants of attending a small school. If living closer to a small school increases the likelihood of enrolling in a small school but does not directly impact or proxy for other characteristics that directly impact student outcomes, then distance to the nearest small school can be used as an instrument for small school enrollment. In other words, there is some (partially unobserved) selection process into small schools. Conditional on observable characteristics, those who choose small schools could have the most highly motivated parents, or they could be the most likely to drop out of a regular high school, or something else. The instrument is based on the intuition that students who live 1.0 vs. 1.4 miles away from a small school have the same underlying propensity to have motivated parents, a high likelihood of dropping out, etc. However, the difference in proximity to a small school generates a difference between students in the costs of enrolling in and attending a small school.

To be a credible instrument, distance from small schools must be a strong predictor of small school attendance but must not belong in the outcome equation directly nor proxy for other unmeasured characteristics that are omitted from the outcome equation. On the other hand, if students with unobservable characteristics that make them more likely to persist in high school (e.g., more motivated parents) also live closer to a small high school, then the instrument would be invalid. For example, we might be concerned that more motivated parents actually move to be close to a small high school rather than that students live close to a small school simply because CPS located the school close to their residence. Note that for selection on unobservable characteristics to invalidate the instrument, these characteristics would have to be different from those captured by 8th grade test scores, which are observed and included in the regressions. Further, because we condition on rather fine geographic fixed effects, the selection would have to occur within a relatively small area.[6] The instrumental variables approach allows us to estimate the local average treatment effect, or in other words, we estimate the causal impact of small schools on those students who decide to enroll in one due to its proximity. Using this approach, we cannot infer the treatment effect on students who would always choose to attend a small school no matter how far away they lived from one, or those who would not attend a small school even if they lived next door to it.

Some evidence on the validity of the instrument is presented in Table 3. As

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[6] Furthermore, the unobservable characteristics would have to be correlated only with distance to existing high schools that were selected for conversion to small schools or to the location of new start high schools, and not to regular high schools or elementary schools.

discussed in the results section, we can also attempt to help ensure against proximity to a small school reflecting something like motivated parents moving to be closer to small high schools by limiting the estimation sample to students who do not move residences. When we condition on relatively small geographic units such as ZIP code, 8th grade neighborhood school, or both, the difference in proximity to a small school is relatively small with standard deviation ranging from 0.55 to 0.76 miles.[7] Nonetheless, proximity to the nearest small school is a strong predictor of small school attendance as shown in the Table 3 row marked "First stage regressions." Conditional on background characteristics and ZIP code fixed effects (column 2), living one mile closer to a small school increases the probability that a student attends a small school by 5 percentage points, with an F statistic of 64. Results are similar if we condition on 8th grade neighborhood school fixed effects (column 3) or saturate the model with both types of fixed effects (column 4).[8] To further assess the validity of the instrument, we investigate whether distance from a new school is correlated with pre-existing characteristics such as a student's prior test scores that might proxy for other, unobservable characteristics. When we control for 8th grade neighborhood school fixed effects, the instrument does not predict 8th grade math scores, student gender, whether they had unstable enrollment in 8th grade, or disability status. It is, however, correlated with 8th grade reading scores, free lunch status and student race. The estimated coefficients are not large, and we control for these characteristics directly in all subsequent regressions.

[7] The average (standard deviation) of students per cohort in a ZIP code is 292 (326), and in an 8th grade neighborhood school zone is 43 (53).
[8] Results are very similar if only geographic fixed effects are included and individual and neighborhood characteristics are omitted.

Specifically, the first stage equation is:

(3) $$SM_{iyn} = \alpha_0 + X_i\beta_1 + N_n\beta_2 + \alpha_1 MinDist_i + \gamma_y + \delta_n + \varepsilon_{iyn}$$

where an individual i in cohort year y living in neighborhood n decides to enroll in a small school based on distance to the nearest small school, a vector *X* of other student-level characteristics including race, gender, disability status and prior achievement, a vector *N* of neighborhood characteristics measured at the Census block level such as SES and poverty concentration, cohort-specific dummy variables, neighborhood-specific dummy variables (measured as fixed effects for 8th grade neighborhood school, ZIP code, or both) and an error term. The instrumental variable is the minimum distance between a student's home address and the closest small school location. In the data, a student who attends a small school attends the unit that is closest to her home about three quarters of the time.

V. Results

To construct the analysis sample, we identify all students in each school year T (spanning fall 2002-fall 2006) who are enrolled in 9th grade in either the fall or spring semester at a small school and who were enrolled in 8th grade in a CPS school in the spring of the previous school year, T-1. We construct a control group consisting of the small school enrollees' 8th grade classmates who also went on to enroll in 9th grade in a non-selective enrollment, CPS high school in school year T.

We construct several outcome measures for students in school years T through T+5. If the students progress at an expected rate, they will be in grade 10 in year T+1, grade 11 in year T+2, grade 12 in year T+3, and will have graduated by year T+4. Our primary outcomes of interest are measures of persistence in school. We calculate these measures using the district's fall master enrollment file, which includes information on a student's school attended, grade level, and whether they are currently an active student. If the student is not currently active, a code is included indicating the reason that the student exited the system, such as, whether they graduated, dropped out, transferred to a private school or a school out of the area, and so on. Using these data, we construct an indicator for whether in the current year a student is enrolled, graduated, or has dropped out or otherwise left the Chicago Public School system. In theory, this allows us to separate those who drop out from those who otherwise exit the system for parochial or suburban schools. In practice, we are both concerned about the quality of the drop out reason variable in general (because schools may have an incentive to erroneously code a student as a transfer instead of a dropout), and that the quality of this variable may be systematically different in small schools. For example, small schools might systematically do a better job keeping records on the whereabouts of their exiting students because there are fewer of them and would be more likely to know whether a student enrolled in a non-CPS school. As a result, we aggregate leavers and dropouts in our main specifications. We also construct indicator variables for whether a student is in the grade level that would be expected if they were progressing at a normal rate of one grade level per year.

In addition, we have access to test score outcomes. CPS requires all high schools to administer the EXPLORE and PLAN tests from ACT's Educational Planning and Assessment System (EPAS). These test score outcomes affect high schools' probation status in the CPS Performance, Remediation and Probation Policy. In addition, Illinois requires all students to take the Prairie State Achievement Examination (PSAE) in order to receive a regular high school diploma. One component of the PSAE is a full-length ACT that can be used for college admission. As a result, we generally observe EXPLORE math and reading scores from the fall of 9^{th} grade, PLAN math and reading test scores from the fall of 10^{th} grade, and ACT math, reading, English, and science test scores from the spring of 11^{th} grade.

Of course, test scores are not available for all students in part due to the fact that some students drop out of school before reaching the grade in which the exam is administered and in part because test scores are missing for some enrolled students. Not surprisingly we observe test scores for the largest share of students on the 9^{th} grade exam. Here we observe math scores for 87 percent of the sample of students for whom we also have baseline 8^{th} grade test scores. In contrast, we only observe 10^{th} grade test scores for 69 percent of the sample and ACT scores for roughly 42 percent of the sample. If attrition due to dropout, for example, differs between small high schools and all other CPS high schools then examining test score differences between these school types will likely produce biased results. In particular, if we think that students who are most likely to dropout also have the lowest test scores and that small high schools reduce the dropout rate, then small high schools are likely to have lower average ACT test scores.

One simple way to try to correct for the potentially differential selection across the two groups of students is to impute test scores for all students with missing test scores. This can be done in several ways: impute ACT test scores assuming percentile rankings on the ACT are unchanged from percentile rankings on 8^{th} grade test scores, impute ACT test scores assuming percentile rankings on the ACT are unchanged from the most recent standardized test score available, use conditional score averages from ACT to predict ACT and ACT Plan scores from ACT Plan and Explore scores, or predict test scores using a regression framework. In the paper we report results using percentile rankings available from the most recent standardized test score available and assume that the percentile ranking on the next standardized test would have been the same.[9] For the ACT science test we assume a student's ranking is equal to her most recent math percentile ranking, and for the ACT English test we assume a student's ranking is equal to her most recent reading percentile ranking.[10]

A. Descriptive Results

In the first columns of Table 4 we present OLS estimates of the relationship between small school enrollment in 9th grade and persistence and graduation as described in equation (2). Standard errors are clustered by cohort-by-9th grade school groupings.[11] Each row represents a separate outcome variable. Column (1) presents control group means for the outcome variables, and columns (2) through (4) present estimates from particular specifications in terms of included geographic dummy variables. All specifications include controls for individual demographic characteristics measured in 8th grade including indicators for female, Black, Hispanic, eligibility for free or reduced

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[9] The estimates are roughly the same regardless of what imputation method we choose. If schools have no impact on test scores, then using either 8th grade rankings or the most recent available test score rankings or ACT conditional averages should be roughly equivalent. If schools do impact test scores, then using the most recent test score information available should better reflect the impacts that a school has had on a student up until the point at which she drops out or otherwise fails to take the exam.

[10] Because the EXPLORE, PLAN, and ACT tests are based on scales of only 25 to 36 points, we average test scores within percentile ranks and interpolate scores across gaps in percentile rankings. For example, an ACT math score of 18 equals the 77th percentile in the CPS while a score of 19 is at the 82nd percentile. In order to assign scores to the intervening percentile ranks, we set the 78th percentile equal to 18.2, the 79th percentile equal to 18.4, and so on.

[11] Standard errors are only slightly larger if we cluster by school instead, and statistical significance is not impacted by this choice.

price lunch, whether the student was over age-for-grade, had unstable school enrollment, was disabled or had a learning disability, residential neighborhood characteristics measured at the Census block level, and cohort dummy variables. Since small school students are observably more disadvantaged on many of these characteristics, the inclusion of the controls in the regression pushes the coefficients toward more positive estimates (i.e. less likely to drop out and more likely to progress or graduate on time). Each cell in columns (2) through (4) reports the estimate and standard error on the small school indicator from a separate regression. By the time we would expect students to be enrolled in 10th grade (year T+1), approximately 10 percent of students have dropped out of school or otherwise left CPS (see column 1). After conditioning on background characteristics and ZIP code fixed effects, students who attend small schools are 0.5 percentage points less likely to drop out or leave, but this relationship is not statistically different from zero. The coefficient estimates on dropout rates hover around zero in the first 3 years of high school, and emerge negative and statistically significant by the beginning of what would be a student's senior year if he or she progressed on time. Small school students are slightly more likely to be progressing on time in grade level in grades 10 through 12. They are 3 percentage points more likely to graduate from high school on time, and 2 percentage points more likely to graduate within 5 years. In column (3) we replace ZIP code fixed effects with a fixed effect for residential neighborhood measured as the student's assigned neighborhood school in 8th grade (whether or not the student attended this school). In column (4) we saturate the model with both ZIP code and neighborhood school fixed effects. The estimates are very similar across different specifications.

Although small high school students represent a relatively small share of the total high school student population in Chicago, one might be concerned that some of the difference in student outcomes between small and regular high schools might arise because the schools attended by the control students are negatively affected by the competition from small high schools. In other words, students attending small high schools have better relative outcomes in part because the control group schools are deteriorating. We do not have many characteristics with which to evaluate this possibility, however, when we examine high schools that likely face the most "competition" from small high schools we find that most trends are pretty similar before and after they face competition from a small high school.[12] Weighted by the number of 9th grade students, we see that the average 9th grade cohort is declining from around 665 students to 514 students, four years after schools begin to face small school competition. Most other trends look fairly stable before and after initial small high school competition, although the decline in percent White slows after increased competition, and the percent of students with IEPs for learning disabilities declines somewhat with competition. Thus, it would seem that the small high schools did not have major impacts on trends in characteristics of students at the competing high schools.

B. Instrumental variables approach

In order to isolate the causal impact of small school attendance on student outcomes, we turn to using distance to the closest small school as an instrumental variable for small school attendance as described in equation (3). We present results

[12] We identify schools facing small school competition by identifying the high schools attended by 8th graders at elementary schools sending at least 15 students of one cohort to a small high school. We then identify regular high schools that also receive at least 15 students from these elementary schools, and call these the group of schools impacted by increased competition. There are 21 high schools in this group that we observe for 4 years before and after they first face competition from small high schools.

using this approach in columns (5) through (7) of Table 4. As with the OLS results, the treatment effect is relatively stable across specifications that control for different geographic units.

The results show consistent, strong and positive impacts of attending a small high school that are uniformly larger in absolute value than the corresponding OLS results. This suggests that small school students are negatively selected on unobservable characteristics just as they are negatively selected on observable characteristics. In the fall two years after starting 9th grade, small schools improve the likelihood that a student is still enrolled in CPS by a statistically significant 11 percentage points in the fully saturated model (column 7). Three years after enrolling in 9th grade they are 18 percentage points less likely to have dropped out or left CPS.

Small school attendance also increases the likelihood that a student is still enrolled and progressing through the grade levels on time. While small school students are not significantly more likely to be on time at 10th grade, they are a statistically significant 18-19 percentage points more likely to progress on time to 11th and 12th grade. As a result, small high school students are 20 percentage points more likely to have graduated on time from a base on-time graduation rate of 48 percent.

Lingering concerns about the instrument include whether distance to school attended belongs in the equation directly and whether more motivated (or otherwise positively selected) parents might relocate close to small high schools. If the cost of attending school is lower because a student lives closer to the school, it might directly impact their likelihood of dropping out regardless of whether the high school is small or large. To address this concern, we can additionally control for distance from a student's residence to his or her assigned high school for a subset of years when CPS provided information on a student's assigned local high school. Distance to high school is generally a significant predictor of dropout in the expected direction, that is, living farther away from high school slightly increases the likelihood of dropping out. Nonetheless, results are quite similar when we directly control for distance to the assigned high school.[13]

To address the second concern, we can re-estimate the results limiting the analysis sample to those students who do not move between 8th and 9th grade. While we do not have access to specific student addresses, we can observe whether students change Census blocks between 8th and 9th grade. Using this to identify movers, we find that 21 percent of our sample moves between 8th and 9th grade with small high school students somewhat more likely to move than their 8th grade classmates. If we drop students who move between 8th and 9th grade, our results are quite similar and if anything, suggest even larger impacts on reducing dropout and increasing persistence and graduation.[14]

C. Heterogeneous Impacts across Students

In Table 5 we present OLS and instrumental variables estimates by subgroups of individuals for the fully saturated model with neighborhood school and ZIP code fixed effects (i.e. columns 4 and 7 from Table 3). In each case we present the control group mean in the first column, the OLS relationship between small school attendance and the outcome in the second column, and the IV coefficient and standard error estimates in the third column. We also show that the first stage relationship between distance to school

[13] Results available upon request.
[14] 23 percent of small high school students move between 8th and 9th grade and 21 percent of their former classmates move between 8th and 9th grade. These results are available from the authors on request.

and small school attendance is strong for each subgroup.

Comparing the first two sets of columns, the impact of small schools on Black and Hispanic students are quite different. According to the IV results, the small school impact on Black students is strongest in years T+1 to T+3, but declines sharply thereafter. Note that among Black students the OLS results are consistently zero, suggesting that failing to account for unobservable determinants of small school enrollment paints a particularly misleading picture for this subgroup. Among Hispanics, the pattern is reversed with the estimated impact on the dropout rate and persistence approximately zero in the first two years, but a stronger impact in years T+3, T+4, and T+5. This finding is especially interesting because the year-to-year dropout rates appear quite similar between Black and Hispanic students as indicated by the mean dropout rates in the first column of each set of results. In Table 6, below, we investigate whether this difference can be explained by differences in the schools typically attended by different groups.

Comparing across gender, the small school impacts are relatively similar for the first year after high school entry, but by year T+2 the impacts on boys become larger. Note that boys' dropout rates accelerate at the same time relative to girls', as shown in the means. Small school attendance reduces boys' dropout rate in T+3 by 19 percentage points compared to a (statistically insignificant) 7 percentage point reduction for girls. Small schools improve the likelihood of graduating on time by 15 percentage points for boys compared to a statistically insignificant impact of 1 percentage point for girls. While all of the corresponding impact estimates for girls are positive, all are smaller than the estimates for boys, and they are generally not statistically different from zero.

Next we look at the impact by the level of the student's 8^{th} grade test scores. We define a student (somewhat arbitrarily) as having “high” prior test scores if his math and reading z-scores were greater than 0.5, and as having “low” prior scores if both math and reading z-scores were less than -0.5 in 8^{th} grade. Even among students with high 8^{th} grade test scores, almost 30 percent of students fail to graduate from a CPS school. Although the standard errors are large, the point estimates suggest that small school attendance seems somewhat more important for improving outcomes among the higher performing students, especially on measures of staying on track to graduate and graduating on time. In particular, the point estimates suggest that small schools reduce dropout rates for both high and low-performing students and that the magnitudes are larger for high performing students than low-performing students. However, none of the estimates are statistically different from zero at conventional levels. Similarly, the estimated impacts of small school attendance on grade progression and graduation are all positive and generally larger (relative to the control group means) for high-performing students, but once again, very few are statistically significant. Finally, we see that the point estimates of small school impacts are generally largest in magnitude for students who were categorized as learning disabled in grade 8. Three years after 9^{th} grade enrollment, small schools reduce dropout/leave rates for students with disabilities by 32 percentage points (from a base of 34 percent), and five years after high school enrollment small schools reduce their dropout/leave rates by 16 percentage points from a base of 50 percent (although this latter estimate is no longer statistically different from zero). This translates into increases in four- and five-year graduation rates of over 50 percent. In summary, we find that small school attendance improves outcomes for all types of students with larger impacts for boys and students with an identified disability.

In Table 6, we investigate differences in treatment effects across different types of schools. In particular, we are interested in understanding whether the differences between Black and Hispanic students in Table 5 are driven by differences in the types of schools they attend. To test this, we present results separately for Black students who attend predominantly Black schools (defined as share of enrollment 90 percent or greater), and those who attend mixed-race schools (which, in the case of Chicago, generally enroll Hispanic and Black students). Approximately 30 percent of Black small school students attend mixed-race schools. As shown in the control group means, the dropout rate tends to be similar for those who attend primarily Black and racially mixed schools. While both types of small schools reduce dropout and increase persistence, the impacts are generally stronger – especially in the first three years of high school – for Black students who attend mixed-race schools. Combining these results with those in Table 5 suggests that there are strong differences within school and across race in the timing of small school impacts.

We also investigate whether results vary by whether the small school is a conversion school (i.e. a large high school broken up into smaller schools), or a new-start school. Here we find that the difference between the OLS and IV results reveal different patterns between the types of schools. In particular, the OLS results for conversion schools suggest that small schools are associated with higher rates of dropout. This is consistent with the public perception that the conversion schools were not very effective.[15] When we instrument for small school attendance using distance, however, we find that the small conversion high schools reduced dropout and increased persistence in the first few years of high school, which fade substantially by 12th grade. On the other

[15] As a result, all but one of the conversion schools have been either closed or merged back together.

hand, both the OLS and IV results show positive impacts on dropout and persistence rates at the new start small high schools. This suggests that selection into the schools is somewhat different, although the distance instrument is a strong predictor of small school attendance in both cases.

D. Test scores

Test score outcomes are even more problematic than other outcomes because, at a minimum, they are only available for students who are still enrolled in school. Even among students who are still enrolled in CPS, we only observe test scores for a sub-sample. The fact that we find impacts of small school attendance on dropout probabilities and the likelihood of progressing on time through the grades suggests that analysis of the small school impact on test score outcomes will yield biased results. With that in mind, however, in Table 8 we present OLS and instrumental variable estimates of the effect of small school attendance on test scores in 9th grade, 10th grade, and ACT test score outcomes. In order to have some sense of the effect of sample selection on test score estimates, we include one set of estimates based on observed test scores and a second set in which we impute missing Explore, Plan, and ACT test scores in 9th, 10th, and 11th grade with a student's most recent test scores available. We present both OLS and IV estimates for each. The top panel of the table presents results for the math and science tests, while the bottom presents results for the reading and English tests. Note that these scores are measured in score points; the average score is approximately 14 and the standard deviation of scores ranges between 3 and 4.

Comparing the OLS estimates in columns (2) and (5) for 9th, 10th, and 11th (ACT) grade math we see, indeed, that the estimates from the imputed sample are larger than the estimates from the select sample, consistent with small schools reducing dropout/increasing persistence among lower performing students. However, we do not see a similar increase in estimated coefficients on the ACT science test, which is puzzling. Once we instrument for small school attendance using distance to the nearest small school, we find positive but not statistically significant impacts on 9th and 10th grade math and science test scores for the imputed test score sample. In contrast, we estimate a negative and statistically significant impact of small school attendance on ACT math scores. Overall, we conclude that the impact of small school attendance on student math and science scores is, at best, mixed.

Results from the reading and English test score outcomes are more puzzling. Comparing OLS estimates from the select and imputed samples suggests that selection is somewhat less related to reading and English test scores. However, once we instrument for small school attendance with distance, differences between the select and imputed samples are more pronounced, especially for ACT reading scores. However, none of the estimated impacts is statistically significant at conventional levels, and once again we conclude that the impact of small school attendance on English and reading test scores is mixed. Further, research is needed to fully understand these test score implications, but we have little evidence of a positive impact of small school attendance on student test scores.

VI. Discussion and Conclusions

This paper has examined the effects of the introduction of small schools in the

Chicago Public School district on student performance. As in any exercise in evaluating a policy intervention, the strength of the results rests on how well one can define the counter-factual – i.e., what would have happened to the small school students if they had not been granted access to these new schools? We definitively show that students who attend small high schools look different from even their own 8^{th} grade classmates along several observable characteristics. They have a higher probability of having been retained in grade, a history of substantially lower test scores, and are more likely to have a disability. If these characteristics are not properly accounted for, the estimated "impact" of attending a small school will be biased.

We use an instrumental variables strategy to address the selection problem and compare students who attended the same schools for 8^{th} grade and live in neighborhoods with similar characteristics. In this approach, we can estimate the impact of small schools on the population for which one student was more likely to sign up for a small school than another similar student because the small school was located closer to the student's house and therefore the "cost" of attending the school as measured by commuting time is lower. Distance to the nearest small school has strong predictive power to identify who attends a small school. Using this strategy, we find that small school students are substantially more likely to persist in school and eventually graduate.

Our empirical strategy provides the means to identify the causal impact of enrollment in a small school on student outcomes. An important remaining question, then, is what is the likely mechanism for the improvements? While limiting the enrollment of the student body was an important cornerstone of the small schools movement, it also encouraged differences in personnel and culture compared to a typical, large, urban high school. Unfortunately, while we can say that the impact of the introduction of small schools in Chicago has been positive – especially for students who were already relatively disadvantaged – we cannot at this point disentangle what exactly it is about these small schools that generated the improvements in student outcomes.

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Table 1: Mean characteristics of small high school students and their 8th grade classmates

Characteristic	Small school 9th graders	Former classmates	p-value of difference
	(1)	(2)	(3)
8th grade year demographics			
Female	0.505	0.505	0.853
Black	0.804	0.695	0.014
Hispanic	0.179	0.263	0.066
Free and reduced price lunch	0.887	0.886	0.763
Over age-for-grade	0.328	0.286	0.000
Unstable enrollment 8th grade	0.062	0.050	0.001
Disability: any	0.224	0.187	0.000
Diability: learning disabled	0.160	0.127	0.000
Minimum distance to a small high school	1.21	2.48	0.000
Prior test scores			
8th grade math z-score	-0.451	-0.235	0.000
8th grade reading z-score	-0.338	-0.177	0.000
5th grade math z-score	-0.438	-0.191	0.000
5th grade reading z-score	-0.365	-0.162	0.000
2000 Census block group characteristics			
Poverty concentration	0.604	0.501	0.088
Socioeconomic status	-0.399	-0.393	0.166
Tenancy	11.8	11.7	0.924
Missing Census block group characteristics	0.001	0.001	0.529
High school outcomes			
Dropout/left year t+1	0.106	0.107	0.217
Dropout/left year t+2	0.212	0.203	0.081
Dropout/left year t+3	0.304	0.296	0.233
Dropout/left year t+4	0.407	0.409	0.793
Dropout/left year t+5	0.435	0.432	0.749
On time 10th grade	0.767	0.739	0.692
On time 11th grade	0.637	0.611	0.433
On time 12th grade	0.558	0.549	0.862
Graduated on time	0.494	0.483	0.475
Graduated within 5 years	0.532	0.530	0.742
Number of students	7252	56731	

Notes: This table presents summary statistics for the analysis sample. Column (1) presents average characteristics among students who attended a small high school in 9th grade. Column (2) presents average characteristics of the 8th grade schoolmates of the students in column (1). Students who attended a selective enrollment high school are omitted from column (2). Column (3) presents the p-value of a test for equality across columns (1) and (2) after conditioning on 8th grade school fixed effects. 5th and 8th grade test scores are normalized by the district-wide mean and standard deviation in the year of the test. 5th grade test scores are missing for 40 percent of small school 9th graders and 37 percent of their former classmates. High school outcomes are measured in the fall.

Table 2: School-level characteristics of ninth grade small high school students and their 8th grade classmates

	Small school 9th graders		Former classmates	
	Mean	SD	Mean	SD
	(1)	(2)	(3)	(4)
Panel A: All Students				
Percent female	0.483	0.086	0.483	0.067
Percent LD IEP	0.160	0.055	0.136	0.047
Percent Black	0.792	0.265	0.643	0.375
Percent Hispanic	0.187	0.242	0.291	0.325
Average 8th grade math score	-0.457	0.249	-0.210	0.381
Average 8th grade reading score	-0.346	0.245	-0.165	0.375
Percent w/ math z-score>0	0.244	0.127	0.370	0.184
Percent w/ reading z-score>0	0.347	0.112	0.439	0.179
9th grade cohort size	154	80	519	241
Number of 9th grade students	7920		61727	
Panel B: Black Students				
Percent female	0.482	0.088	0.489	0.073
Percent LD IEP	0.163	0.052	0.133	0.050
Percent Black	0.880	0.184	0.835	0.268
Percent Hispanic	0.108	0.169	0.129	0.222
Average 8th grade math score	-0.514	0.206	-0.286	0.381
Average 8th grade reading score	-0.386	0.225	-0.196	0.390
Percent w/ math z-score>0	0.213	0.103	0.333	0.184
Percent w/ reading z-score>0	0.331	0.103	0.425	0.186
9th grade cohort size	159	78	474	204
Number of 9th grade students	6286		41865	
Panel C: Hispanic Students				
Percent female	0.492	0.078	0.470	0.048
Percent LD IEP	0.146	0.065	0.145	0.039
Percent Black	0.458	0.257	0.229	0.198
Percent Hispanic	0.497	0.245	0.661	0.214
Average 8th grade math score	-0.255	0.272	-0.081	0.304
Average 8th grade reading score	-0.214	0.252	-0.131	0.308
Percent w/ math z-score>0	0.353	0.140	0.436	0.149
Percent w/ reading z-score>0	0.401	0.118	0.455	0.151
9th grade cohort size	134	86	613	287
Number of 9th grade students	1494		17049	

Notes: Average school-level characteristics of 9th graders for all cohorts of 9th grade students by race and school-type. Means are weighted by numbers of 9th grade students in each school and cohort. 8th grade test score averages are observed for somewhat fewer schools and thus represent 7,920 small school students overall (6,286 Black and 1,494 Hispanic students) and 61,695 former classmates (41,835 Black and 17,047 Hispanic students).

Table 3: Relationship between distance to nearest small high school and selected variables

Characteristic	Control group mean	OLS relationship between instrument and dependent variable		
	(1)	(2)	(3)	(4)
Panel A: First stage regressions				
Attends small school		-0.054***	-0.053***	-0.045***
		(0.007)	(0.007)	(0.006)
F statistic		63.5	74.9	51.9
Panel B: Correlation between distance and 8th grade characteristics				
8th grade math z-score	-0.235	0.015**	0.009	0.009
	(0.831)	(0.008)	(0.008)	(0.008)
8th grade reading z-score	-0.177	0.026***	0.021***	0.021***
	(0.899)	(0.007)	(0.008)	(0.008)
Female	0.505	-0.001	-0.002	-0.001
	(0.500)	(0.002)	(0.003)	(0.003)
Black	0.695	0.011*	0.004**	0.005***
	(0.460)	(0.006)	(0.002)	(0.002)
Hispanic	0.263	-0.018***	-0.010***	-0.010***
	(0.440)	(0.006)	(0.002)	(0.002)
Free or reduced price lunch	0.886	-0.009***	-0.005**	-0.005**
	(0.318)	(0.002)	(0.002)	(0.002)
Over age-for-grade	0.286	-0.013***	-0.010***	-0.010***
	(0.452)	(0.003)	(0.003)	(0.003)
Unstable enrollment 8th grade	0.050	0.001	-0.001	-0.000
	(0.218)	(0.001)	(0.002)	(0.002)
Disability: any	0.187	-0.001	-0.001	-0.001
	(0.390)	(0.002)	(0.002)	(0.002)
Diability: learning disabled	0.127	-0.002	-0.001	-0.000
	(0.333)	(0.002)	(0.002)	(0.002)
ZIP code fixed effects		yes		yes
8th grade neighborhood school fixed effects			yes	yes

Note: Sample size is 63,983. The first column presents control group means (standard deviations). In columns (2) through (4) each cell presents the coefficient and (standard error) estimates from a regression on a variable measuring the distance between a student's residence and the closest small high school. The columns differ by what geographic fixed effects are included. Standard errors are clustered by cohort and 9th grade school. Panel A reports the first stage regression and includes the following control variables in addition to the geographic fixed effects: indicators for whether a student is female, black, Hispanic, over age-for-grade, learning disabled, received free or reduced-price lunch or had unstable 8th grade enrollment, and Census tract information on concentration of poverty, socioeconomic status and tenancy. Panel B regresses the dependent variable listed in the row on the distance measure, cohort fixed effects, and geographic fixed effects only.

Table 4: Small high school effects on high school persistence and completion

Outcome	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Control Mean	Ordinary Least Squares			Instrumental Variables		
Dropout							
Dropout/left year T+1	0.107	-0.004	-0.003	-0.002	-0.076**	-0.086*	-0.068
	(0.309)	(0.009)	(0.010)	(0.009)	(0.037)	(0.044)	(0.045)
Dropout/left year T+2	0.203	0.001	0.004	0.005	-0.092**	-0.095	-0.114**
	(0.402)	(0.010)	(0.009)	(0.009)	(0.047)	(0.061)	(0.050)
Dropout/left year T+3	0.296	-0.003	-0.001	-0.002	-0.084*	-0.139**	-0.179***
	(0.457)	(0.010)	(0.010)	(0.010)	(0.050)	(0.066)	(0.062)
Dropout/left year T+4	0.409	-0.018	-0.018	-0.018*	-0.008	-0.035	-0.119*
	(0.492)	(0.011)	(0.011)	(0.011)	(0.051)	(0.067)	(0.062)
Dropout/left year T+5	0.432	-0.015	-0.014	-0.015	-0.033	-0.058	-0.140**
	(0.495)	(0.011)	(0.012)	(0.012)	(0.051)	(0.068)	(0.060)
Persistence							
On time 10th grade	0.739	0.029*	0.026	0.026	0.097	0.125*	0.090
	(0.439)	(0.018)	(0.017)	(0.017)	(0.063)	(0.072)	(0.069)
On time 11th grade	0.611	0.033**	0.028*	0.028*	0.134**	0.170**	0.190***
	(0.488)	(0.015)	(0.015)	(0.015)	(0.062)	(0.075)	(0.065)
On time 12th grade	0.549	0.024*	0.021	0.021	0.060	0.101	0.176***
	(0.498)	(0.013)	(0.013)	(0.013)	(0.056)	(0.070)	(0.065)
Graduated on time	0.483	0.032***	0.027**	0.028**	0.070	0.090	0.202***
	(0.500)	(0.012)	(0.012)	(0.012)	(0.051)	(0.066)	(0.062)
Graduated within 5 years	0.530	0.023*	0.021*	0.022*	0.029	0.050	0.182***
	(0.499)	(0.012)	(0.012)	(0.012)	(0.049)	(0.065)	(0.058)
ZIP code fixed effects		yes		yes	yes		yes
8th grade neighborhood school fixed effects			yes	yes		yes	yes

Note: Sample size is 63,983. The column (1) presents control group means (standard deviations). In columns (2) through (4) each cell presents the coefficient and standard error on an indicator for whether a student attended a small school in 9th grade in a regression where the dependent variable is listed in the row and geographic fixed effects specificied in the column. Standard errors are clustered by cohort and 9th grade school. Baseline controls include In columns (5) through (7) each cell presents the coefficient and standard error of an instrumental variables regression where enrollment in a small high school is predicted by the minimum distance between a student's home address and the closest small high school. All regressions in columns (2) through (7) have standard errors clustered by cohort and 9th grade school, and control for cohort fixed effects and the following characteristics: indicators for whether a student is female, black, Hispanic, over age-for-grade, learning disabled, received free or reduced-price lunch or had unstable 8th grade enrollment, and Census tract information on concentration of poverty, socioeconomic status, and tenancy, and an indicator for missing Census tract information.

Table 5: Small high school effects on high school persistence and completion: Individual-level subgroup analysis

	Black			Hispanic			Female			Male			Prior Low Score			Prior High Score			Learning Disabled		
	control mean	OLS	IV	control mean	OLS	IV	control mean	OLS	IV	control mean	OLS	IV	control mean	OLS	IV	control mean	OLS	IV	control mean	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(10)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20	(21)
First stage																					
Attend small school			-0.039***			-0.070***			-0.043***			-0.048***			-0.051***			-0.040***			-0.061***
			(0.006)			(0.014)			(0.007)			(0.006)			(0.007)			(0.007)			(0.009)
Dropout																					
Dropout/left year t+1	0.101	0.003	-0.129**	0.121	-0.023	-0.002	0.097	0.002	-0.115**	0.117	-0.004	-0.060	0.121	0.000	-0.079	0.082	0.007	-0.144	0.120	-0.006	-0.223**
	(0.301)	(0.009)	(0.054)	(0.326)	(0.021)	(0.077)	(0.296)	(0.011)	(0.059)	(0.321)	(0.010)	(0.056)	(0.326)	(0.009)	(0.053)	(0.274)	(0.015)	(0.091)	(0.325)	(0.013)	(0.091)
Dropout/left year t+2	0.199	0.014	-0.183**	0.207	-0.035*	0.057	0.178	0.005	-0.042	0.228	0.007	-0.143*	0.244	0.002	-0.064	0.137	0.019	-0.111	0.224	0.008	-0.321**
	(0.399)	(0.010)	(0.077)	(0.405)	(0.019)	(0.108)	(0.382)	(0.011)	(0.075)	(0.419)	(0.011)	(0.086)	(0.429)	(0.010)	(0.071)	(0.344)	(0.018)	(0.118)	(0.417)	(0.017)	(0.137)
Dropout/left year t+3	0.298	0.004	-0.152*	0.289	-0.027	-0.138	0.255	-0.006	-0.074	0.339	0.005	-0.188**	0.364	-0.010	-0.121	0.193	0.030	-0.189	0.341	0.014	-0.316**
	(0.457)	(0.011)	(0.080)	(0.453)	(0.019)	(0.114)	(0.436)	(0.011)	(0.082)	(0.473)	(0.012)	(0.093)	(0.481)	(0.012)	(0.081)	(0.395)	(0.019)	(0.134)	(0.474)	(0.019)	(0.143)
Dropout/left year t+4	0.418	-0.011	0.038	0.384	-0.052**	-0.157	0.351	-0.026**	-0.021	0.468	-0.009	-0.023	0.490	-0.025*	-0.018	0.277	0.008	-0.181	0.461	-0.001	-0.151
	(0.493)	(0.012)	(0.086)	(0.486)	(0.024)	(0.112)	(0.477)	(0.013)	(0.090)	(0.499)	(0.014)	(0.091)	(0.500)	(0.013)	(0.083)	(0.448)	(0.022)	(0.154)	(0.499)	(0.020)	(0.135)
Dropout/left year t+5	0.444	-0.009	-0.000	0.400	-0.040	-0.225**	0.364	-0.026**	-0.041	0.500	-0.003	-0.064	0.521	-0.018	-0.045	0.285	-0.002	-0.237	0.495	0.004	-0.161
	(0.497)	(0.012)	(0.089)	(0.490)	(0.025)	(0.112)	(0.481)	(0.013)	(0.094)	(0.500)	(0.014)	(0.092)	(0.500)	(0.013)	(0.081)	(0.451)	(0.023)	(0.149)	(0.500)	(0.020)	(0.132)
Persistence																					
On time 10th grade	0.746	0.017	0.166*	0.719	0.079***	0.053	0.785	0.022	0.089	0.691	0.026	0.162	0.678	0.022	0.064	0.839	0.016	0.214	0.685	0.009	0.082
	(0.435)	(0.018)	(0.091)	(0.450)	(0.028)	(0.112)	(0.411)	(0.017)	(0.082)	(0.462)	(0.020)	(0.099)	(0.467)	(0.020)	(0.087)	(0.368)	(0.021)	(0.132)	(0.465)	(0.027)	(0.123)
On time 11th grade	0.612	0.018	0.232**	0.605	0.084***	0.084	0.672	0.032*	-0.007	0.548	0.021	0.327***	0.522	0.034*	0.184**	0.755	0.017	0.150	0.548	0.022	0.366**
	(0.487)	(0.016)	(0.096)	(0.489)	(0.026)	(0.120)	(0.470)	(0.017)	(0.092)	(0.498)	(0.017)	(0.103)	(0.500)	(0.017)	(0.084)	(0.430)	(0.022)	(0.152)	(0.498)	(0.024)	(0.146)
On time 12th grade	0.544	0.014	0.045	0.559	0.057**	0.235*	0.616	0.024	-0.006	0.481	0.016	0.185**	0.449	0.028*	0.086	0.713	-0.000	0.200	0.478	0.007	0.221
	(0.498)	(0.014)	(0.086)	(0.497)	(0.027)	(0.129)	(0.486)	(0.015)	(0.094)	(0.500)	(0.015)	(0.092)	(0.497)	(0.015)	(0.082)	(0.452)	(0.023)	(0.157)	(0.500)	(0.023)	(0.138)
Graduated on time	0.471	0.023*	0.016	0.509	0.054**	0.254**	0.559	0.039***	0.012	0.406	0.014	0.149	0.377	0.030**	0.101	0.662	0.008	0.186	0.409	-0.010	0.289**
	(0.499)	(0.013)	(0.086)	(0.500)	(0.025)	(0.109)	(0.497)	(0.014)	(0.095)	(0.491)	(0.014)	(0.091)	(0.485)	(0.013)	(0.075)	(0.473)	(0.024)	(0.162)	(0.492)	(0.021)	(0.132)
Graduated within 5 years	0.513	0.018	0.008	0.569	0.041	0.159	0.601	0.033**	0.005	0.457	0.010	0.080	0.428	0.027**	0.067	0.699	0.008	0.158	0.459	-0.004	0.262**
	(0.500)	(0.013)	(0.087)	(0.495)	(0.025)	(0.100)	(0.490)	(0.014)	(0.094)	(0.498)	(0.014)	(0.088)	(0.495)	(0.013)	(0.076)	(0.459)	(0.022)	(0.150)	(0.498)	(0.021)	(0.130)
Number of students		45,263	45,263		16,188	16,188		32,311	32,311		31,672	31,672		32,462	32,462		11,344	11,344		8,388	8,388

Notes: This table presents heterogeneous impacts across different subgroups. Each set of columns is limited to the subgroup named at the top of the column. The first column in each set presents control group means (standard deviations). The second column reports the OLS relationship between small school attendance and the outcome denoted in the row title, and uses the same specification as column (4) of Table 3. The third column reports the IV estimate of the impact of small school attendance on each outcome, and uses the same specification as column (7) of Table 3. Standard errors are clustered by cohort and 9th grade school. All regressions include fixed effects for cohort, 8th grade neighborhood school, and ZIP code. Where appropriate, additional controls include indicators for whether a student is female, black, Hispanic, over age-for-grade, learning disabled, received free or reduced-price lunch or had unstable 8th grade enrollment, and Census tract information on concentration of poverty, socioeconomic status, and tenancy, and an indicator for missing Census tract information.

Table 6: Small highschool effects on high school persistence and completion: School-level subgroup analysis

	Black Students at All-Black Schools			Black Students at Mixed-Race Schools			Small Schools Converted from Large Schools			New-Start Small Schools		
	control mean	OLS	IV	control mean	OLS	IV	control mean	OLS	IV	control mean	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(10)	(12)
First stage												
Attend small school			-0.039***			-0.028***			-0.033***			-0.057***
			(0.007)			(0.006)			(0.006)			(0.011)
Dropout												
Dropout/left year t+1	0.100	0.003	-0.152**	0.103	-0.004	-0.224*	0.103	0.019**	-0.143**	0.116	-0.054***	-0.057
	(0.300)	(0.010)	(0.062)	(0.304)	(0.017)	(0.120)	(0.304)	(0.009)	(0.061)	(0.321)	(0.016)	(0.062)
Dropout/left year t+2	0.197	0.008	-0.173*	0.202	0.020	-0.296*	0.202	0.036***	-0.121	0.202	-0.071***	-0.086
	(0.398)	(0.012)	(0.091)	(0.401)	(0.014)	(0.161)	(0.401)	(0.009)	(0.091)	(0.401)	(0.017)	(0.110)
Dropout/left year t+3	0.299	-0.007	-0.145	0.298	0.015	-0.343**	0.299	0.032***	-0.138	0.282	-0.101***	-0.211**
	(0.458)	(0.014)	(0.098)	(0.457)	(0.016)	(0.173)	(0.458)	(0.010)	(0.103)	(0.450)	(0.011)	(0.097)
Dropout/left year t+4	0.420	-0.024*	0.054	0.415	0.000	0.059	0.414	0.019*	0.053	0.388	-0.127***	-0.138
	(0.494)	(0.015)	(0.099)	(0.493)	(0.017)	(0.187)	(0.493)	(0.011)	(0.102)	(0.487)	(0.015)	(0.103)
Dropout/left year t+5	0.445	-0.023	0.029	0.438	0.007	-0.082	0.437	0.024**	0.031	0.411	-0.127***	-0.221**
	(0.497)	(0.015)	(0.101)	(0.496)	(0.016)	(0.181)	(0.496)	(0.011)	(0.103)	(0.492)	(0.015)	(0.107)
Persistence												
On time 10th grade	0.747	0.047**	0.260**	0.748	-0.034	0.317	0.742	-0.012	0.236**	0.727	0.135***	0.131
	(0.435)	(0.021)	(0.102)	(0.434)	(0.025)	(0.197)	(0.438)	(0.020)	(0.107)	(0.446)	(0.020)	(0.108)
On time 11th grade	0.613	0.043**	0.249**	0.616	-0.027	0.382*	0.608	-0.011	0.240**	0.614	0.134***	0.130
	(0.487)	(0.020)	(0.110)	(0.486)	(0.018)	(0.221)	(0.488)	(0.016)	(0.118)	(0.487)	(0.025)	(0.116)
On time 12th grade	0.543	0.032*	0.038	0.547	-0.017	0.051	0.545	-0.022*	0.078	0.560	0.143***	0.123
	(0.498)	(0.019)	(0.100)	(0.498)	(0.016)	(0.181)	(0.498)	(0.013)	(0.106)	(0.496)	(0.018)	(0.104)
Graduated on time	0.470	0.038**	0.009	0.473	0.004	0.135	0.477	-0.011	0.066	0.503	0.142***	0.183*
	(0.499)	(0.017)	(0.101)	(0.499)	(0.018)	(0.177)	(0.499)	(0.012)	(0.103)	(0.500)	(0.016)	(0.106)
Graduated within 5 years	0.513	0.029*	0.012	0.519	0.005	0.134	0.523	-0.017	-0.005	0.554	0.139***	0.208**
	(0.500)	(0.017)	(0.097)	(0.500)	(0.017)	(0.178)	(0.499)	(0.012)	(0.100)	(0.497)	(0.016)	(0.104)
Number of students		34724	34724		20873	20873		50260	50260		22671	22671

Notes: This table presents heterogeneous impacts across different subgroups. Each set of columns is limited to the subgroup named at the top of the column. Subgroups are defined based on the type of small school attended by the small school students plus all of their 8th grade classmates. All Black schools are defined as schools for which the student body is at least 90 percent Black; the remainder are categorized as mixed-race. Control group students may appear in multiple subgroup categories. The first column in each set presents control group means (standard deviations). The second column reports the OLS relationship between small school attendance and the outcome denoted in the row title, and uses the same specification as column (4) of Table 3. The third column reports the IV estimate of the impact of small school attendance on each outcome, and uses the same specification as column (7) of Table 3. Standard errors are clustered by cohort and 9th grade school. All regressions include fixed effects for cohort, 8th grade neighborhood school, and ZIP code. Where appropriate, additional controls include indicators for whether a student is female, black, Hispanic, over age-for-grade, learning disabled, received free or reduced-price lunch or had unstable 8th grade enrollment, and Census tract information on concentration of poverty, socioeconomic status, and tenancy, and an indicator for missing Census tract information.

Table 7: Small high school effects on high school test scores

	Test scores			Test scores with missing scores imputed		
	Mean of control	OLS	IV	Mean of control	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)
Mathematics/science test scores						
Math fall 9th grade	13.041	0.041	0.190	12.928	0.073	0.229
	(3.615)	(0.076)	(0.371)	(3.664)	(0.065)	(0.328)
Math fall 10th grade	14.201	0.070	0.455	13.906	0.101**	0.339
	(3.083)	(0.058)	(0.345)	(3.220)	(0.046)	(0.291)
Math ACT score (spring 11th grade)	16.096	-0.080	-0.626*	15.797	-0.033	-0.454**
	(2.818)	(0.066)	(0.371)	(2.639)	(0.037)	(0.231)
Science ACT score (spring 11th grade)	16.379	0.184**	-0.121	15.869	0.100**	0.266
	(3.616)	(0.083)	(0.526)	(3.560)	(0.050)	(0.340)
Reading/English test scores						
Reading fall 9th grade	12.692	-0.104*	-0.170	12.634	-0.079	-0.220
	(2.809)	(0.056)	(0.306)	(2.807)	(0.049)	(0.269)
Reading fall 10th grade	14.255	0.005	0.370	13.916	0.000	0.211
	(3.451)	(0.072)	(0.419)	(3.489)	(0.059)	(0.341)
Reading ACT score (spring 11th grade)	15.731	-0.071	-1.073	15.22	-0.058	-0.032
	(4.058)	(0.083)	(0.673)	(3.938)	(0.052)	(0.409)
English ACT score (spring 11th grade)	15.145	-0.093	-0.269	14.483	-0.096	-0.116
	(4.543)	(0.102)	(0.654)	(4.533)	(0.067)	(0.379)

Notes: This table presents impacts of small schools on high school test score outcomes. The first set of columns uses all available test scores, and the second set imputes missing values for students who were no longer enrolled or did not take the test for some other reason. The first column in each set presents control group means (standard deviations). The second column reports the OLS relationship between small school attendance and the outcome denoted in the row title, and uses the same specification as column (4) of Table 3. The third column reports the IV estimate of the impact of small school attendance on each outcome, and uses the same specification as column (7) of Table 3. Standard errors are clustered by cohort and 9th grade school. All regressions include fixed effects for cohort, 8th grade neighborhood school, and ZIP code, and indicators for whether a student is female, black, Hispanic, over age-for-grade, learning disabled, received free or reduced-price lunch or had unstable 8th grade enrollment, and Census tract information on concentration of poverty, socioeconomic status and tenancy.

Appendix Table 1: Mean characteristics of small high school students and their 8th grade schoolmates, by 9th grade cohort year

	9th grade in 2002			9th grade in 2003			9th grade in 2004			9th grade in 2005			9th grade in 2006		
Characteristic	**Small school 9th graders**	**Former classmates**	**p-value of difference**	**Small school 9th graders**	**Former classmates**	**p-value of difference**	**Small school 9th graders**	**Former classmates**	**p-value of difference**	**Small school 9th graders**	**Former classmates**	**p-value of difference**	**Small school 9th graders**	**Former classmates**	**p-value of difference**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
8th grade year demographics															
Female	0.534	0.520	0.618	0.474	0.518	0.000	0.496	0.512	0.070	0.516	0.500	0.256	0.508	0.490	0.035
Black	0.817	0.857	0.263	0.858	0.752	0.598	0.862	0.692	0.001	0.782	0.670	0.017	0.761	0.633	0.001
Hispanic	0.178	0.121	0.212	0.132	0.213	0.981	0.117	0.262	0.020	0.203	0.290	0.053	0.217	0.314	0.005
Free and reduced price lunch	0.876	0.895	0.718	0.881	0.879	0.174	0.863	0.876	0.295	0.885	0.890	0.709	0.908	0.893	0.301
Over age-for-grade	0.271	0.237	0.224	0.344	0.290	0.000	0.359	0.283	0.000	0.324	0.305	0.346	0.314	0.285	0.763
Unstable enrollment 8th grade	0.040	0.045	0.242	0.080	0.053	0.042	0.076	0.048	0.001	0.057	0.050	0.473	0.053	0.050	0.312
Disability: any	0.238	0.155	0.000	0.219	0.185	0.000	0.259	0.197	0.000	0.215	0.195	0.003	0.209	0.181	0.008
Diability: learning disabled	0.164	0.113	0.007	0.160	0.127	0.001	0.192	0.133	0.000	0.149	0.129	0.004	0.149	0.126	0.026
Minimum distance to a small high school	1.09	2.88	0.000	1.14	2.58	0.000	1.28	2.48	0.000	1.17	2.35	0.000	1.24	2.39	0.000
Prior test scores															
8th grade math z-score	-0.532	-0.233	0.000	-0.484	-0.255	0.000	-0.519	-0.219	0.000	-0.439	-0.257	0.000	-0.385	-0.217	0.000
8th grade reading z-score	-0.368	-0.114	0.000	-0.376	-0.180	0.000	-0.396	-0.166	0.000	-0.312	-0.197	0.001	-0.303	-0.184	0.007
5th grade math z-score	-0.394	-0.092	0.000	-0.481	-0.202	0.000	-0.425	-0.142	0.000	-0.388	-0.188	0.000	-0.816	-0.782	0.566
5th grade reading z-score	-0.240	-0.027	0.014	-0.379	-0.182	0.000	-0.364	-0.112	0.000	-0.314	-0.154	0.000	-0.894	-0.831	0.409
2000 Census block group characteristics															
Poverty concentration	0.625	0.617	0.946	0.654	0.580	0.048	0.605	0.501	0.759	0.597	0.483	0.504	0.582	0.426	0.013
Socioeconomic status	-0.219	-0.270	0.278	-0.286	-0.399	0.104	-0.338	-0.382	0.863	-0.475	-0.416	0.231	-0.450	-0.413	0.635
Tenancy	12.0	12.4	0.985	11.678	11.841	0.044	11.882	11.586	0.639	11.760	11.497	0.396	11.821	11.547	0.205
Missing Census blog group data	0	0.001	0.136	0.003	0.003	0.708	0.001	0	0.646	0	0.001	0.828	0.001	0.001	0.338
High school outcomes															
Dropout/left year t+1	0.135	0.108	0.640	0.135	0.095	0.002	0.115	0.099	0.050	0.090	0.136	0.038	0.097	0.095	0.182
Dropout/left year t+2	0.252	0.195	0.131	0.261	0.206	0.010	0.221	0.221	0.726	0.204	0.197	0.238	0.187	0.192	0.797
Dropout/left year t+3	0.337	0.294	0.266	0.349	0.328	0.167	0.341	0.284	0.000	0.297	0.308	0.763	0.262	0.276	0.334
Dropout/left year t+4	0.485	0.405	0.037	0.484	0.447	0.117	0.462	0.415	0.015	0.376	0.408	0.429	0.354	0.379	0.027
Dropout/left year t+5	0.515	0.439	0.027	0.507	0.458	0.043	0.476	0.439	0.027	0.412	0.435	0.717	0.385	0.402	0.151
On time 10th grade	0.796	0.760	0.126	0.734	0.757	0.038	0.695	0.740	0.013	0.769	0.683	0.007	0.821	0.767	0.021
On time 11th grade	0.601	0.645	0.039	0.569	0.602	0.085	0.597	0.578	0.381	0.658	0.601	0.160	0.679	0.643	0.167
On time 12th grade	0.480	0.546	0.033	0.502	0.518	0.374	0.531	0.555	0.153	0.576	0.542	0.728	0.596	0.572	0.076
Graduated on time	0.409	0.473	0.023	0.422	0.438	0.262	0.464	0.483	0.283	0.514	0.487	0.521	0.541	0.513	0.033
Graduated within 5 years	0.451	0.503	0.099	0.458	0.492	0.106	0.494	0.523	0.085	0.559	0.534	0.431	0.578	0.564	0.254
N	421	4363		996	10698		1478	13196		2245	13586		2140	15006	

Notes: This table presents summary statistics for the analysis sample, separately by 9th grade cohort year. The first column in each group presents average characteristics among students who attended a small high school in 9th grade. The second column presents average characteristics of the 8th grade schoolmates of the students in column (1). The third column presents the p-value of a test for equality across the first two columns after conditioning on 8th grade school fixed effects. 5th and 8th grade test scores are normalized by the district-wide mean and standard deviation in the year of the test. High school outcomes are measured in the fall.

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