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The Role of Selective High Schools in Equalizing Educational Outcomes: Using Place-Based Affirmative Action to Estimate Heterogeneous Effects by Neighborhood Socioeconomic Status

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We investigate whether elite Chicago public high schools differentially benefit high-achieving students from more and less affluent neighborhoods. Seats are allocated based on prior achievement and neighborhood socioeconomic status (SES). Using regression discontinuity design, we find no effects on traditional academic outcomes and generally positive effects on student experiences for all students. For students from low-SES neighborhoods, we estimate significant negative effects on relative rank in high school, grades, and the probability of attending a selective college. Further evidence suggests these effects may be a consequence of being lower-achieving on average relative to classmates admitted from higher SES neighborhoods.

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I. Introduction

In this paper, we investigate whether offering low-income students with strong prior academic records an education at elite public high schools can improve these students' educational outcomes and high school experiences. The difference in test scores between low-income students and their more affluent counterparts has widened in the last 50 years (Reardon, 2011). While much attention has been paid to racial achievement gaps, the differences between students from low-income and high-income families are actually much larger. The fact that low-income students often attend low-quality public schools (Rouse & Barrow, 2006; Barrow & Schanzenbach, 2012) may contribute to the differences in achievement levels of low- and high-income students. Further, a child's family economic conditions also have implications for her future success, and poor children in the United States often grow up to struggle economically because intergenerational income mobility is quite low compared with other developed countries (Solon, 2002; Corak, 2013). Limited access to high-performing schools coupled with persistent economic hardships outside of school suggest that without interventions low-income students are likely to face poverty as adults. High-quality public schools may be a lever for closing the achievement gap between high- and low-income students by providing equitable educational opportunities for students who have fewer economic resources at home.

Affirmative action admissions policies acknowledge that access to high-quality schooling opportunities may not be equitable. The goal of these policies is to increase the probability that historically disadvantaged groups gain admission to elite schools, particularly at the university level. A mechanical result of affirmative action is that those students who are admitted as a result of the policy have lower qualifications, on average, than other students. In Chicago, admissions to selective public high schools are determined by a combination of prior academic performance and family income as proxied by socioeconomic status (SES) of the student's residential neighborhood (i.e., place-based affirmative action). This policy explicitly reserves seats for students from low-SES neighborhoods who may not otherwise have access to these selective schools. In this paper, we use this variation in admissions criteria to determine if selective public schools benefit students from high-poverty neighborhoods relative to students living in low-poverty neighborhoods.

If selective public schools improve student outcomes for low-income students by a greater amount than they improve outcomes for high-income students, then selective public schools could

help close achievement gaps by family income. However, this is not the case in Chicago. We find that selective high school admission has no effect on test scores, regardless of neighborhood SES, though students admitted to selective high schools are more positive about their high school experiences, including reports of relationships with peers and perceptions of personal safety. There is a negative effect of selective high school admission on GPAs, which is significantly larger for students from low-SES neighborhoods than for students from high-SES neighborhoods. Further, we find that students from low-SES neighborhoods who are admitted to a selective high school are 16 percentage points less likely to attend a selective college than students from low-SES neighborhoods who just miss the admissions cutoff, which is troubling if college selectivity translates into different rates of college completion and/or different labor market trajectories. Because admissions cutoffs are higher in high-SES neighborhoods, our findings may be attributable to students' relative ranking in the achievement distribution of the school rather than to neighborhood SES. To address this correlation between achievement and neighborhood SES, we restrict the estimation to low-income students living in any neighborhood and find that poor students in high-SES neighborhoods who are relatively higher achieving are not negatively affected by selective high schools. This finding suggests that the negative impact estimates for students from low-SES neighborhoods may be driven by the effect on a student's relative ranking rather than reflecting that the schools themselves either benefit or harm student learning.

II. Background and Prior Research

A. The Goal of Selective Public Schools

Selective public schools (known as "exam" schools in Boston and New York and "selective enrollment" schools in Chicago) provide an option for academically high-performing students who might benefit from a challenging curriculum beyond what is offered in traditional public high schools. The CPS policy additionally states that the purpose of the selective high schools is "to develop students' critical and analytic thinking skills and promote diverse academic inquiry by bringing students together from a wide range of backgrounds." Nationally, some of these selective public high schools have been around for more than 100 years, while others were established quite recently. In some districts these high schools started by a push from policymakers, parents, or

philanthropic foundations. In other cases, these schools were the product of court-ordered desegregation efforts.

Selective schools are characterized by having admissions requirements, but the exact selection process varies across schools and districts. In some districts, each school sets its own admissions requirements; some districts base admissions on a single entrance exam, making this exam extremely high stakes for students; and yet other districts rely on a combination of grades and test scores to determine which students are admitted. The selectivity of these public schools results in media attention and even controversy. Because of the correlation between achievement and demographic characteristics, the student body of these schools often looks very different from the composition of students in the district overall. As a result, there are concerns about the lack of diversity in terms of race, gender, and/or income among students attending these schools. Some are concerned that students from high-income families have an unfair advantage in admission because low-income students are more likely to attend lower-performing elementary and middle schools and may therefore be less well-prepared for the entrance exams or cannot afford to pay for test preparation courses. Still others are opposed to any public schools that are accessible only to a subset of high-performing students because these schools draw students and resources away from neighborhood high schools and serve only a small share of the total students in a district.

In the presence of these objections, questions remain about whether these schools offer a distinct advantage over other public high school options. Because of the selection criteria used for determining admissions to these schools, it is not surprising that students who attend them do well academically. What is less clear is if these students would have done well regardless of the high school attended or if selective schools are doing something special—providing exceptional peers, higher quality instruction, and/or higher expectations—to improve the outcomes of the students who attend them. We also know little about the potential heterogeneous effects of selective schools on students from various backgrounds, and that is the focus of this paper. We review the existing research in the following section.

B. Existing Research on Selective Schools

Studies on the effectiveness of schools with achievement-based selection criteria provide mixed evidence. Research using data from countries outside the U.S. where secondary school assignment system-wide is based on prior achievement test scores find positive impacts on later test score

outcomes. Pop-Eleches & Urquiola (2013) use a regression discontinuity design (RDD) with data from Romania to show that attending a higher-performing high school raises student test scores on a high-stakes test by 0.05 standard deviations. Jackson (2010) uses an instrumental variables strategy based on school assignment rules and student preferences to study the effects of attending high schools with higher achieving peers in Trinidad and Tobago. He finds that attending schools with higher achieving peers based on incoming test scores raises the number of high stakes secondary school exams passed. He also finds that it raises the probability of passing at least five such exams, which is a typical prerequisite for continuing post-secondary education. These papers look at the effect of attending high-achieving high schools and point to the potential for selective schools to improve test score outcomes.

Unlike the Romanian and Trinidad and Tobago systems, other education systems allocate seats to only a subset of secondary schools based on prior achievement. This practice is most similar to what we study in Chicago, and the evidence from these studies is less positive. Research in the United Kingdom using a RDD finds no impact of attending a selective high school on student test scores but finds suggestive evidence that attending a selective high school for four years may increase the probability of enrolling in a university (Clark, 2010). RDD studies using data from Boston and New York find no effect of attending elite exam schools on either student test scores or college going (Abdulkadiroğlu, Angrist, & Pathak, 2014; Dobbie & Fryer, 2014). In earlier work on the subsample of students enrolling in NYC public high schools, Dobbie & Fryer (2011) find that students take more rigorous coursework and have a higher probability of graduating with a more advanced high school diploma. These benefits, however, do not translate into positive effects on college outcomes.

The research on selective public high schools in Boston and New York City suggests that the apparent benefits to attending these schools is due to selecting high achieving students at admission rather than that these schools improve student learning. This finding is at odds with public perception. A number of the selective high schools are among the top-ranked schools in their state and even in the country according to US News and World Report, many students have high hopes to attend one of these schools, parents purchase test-prep services to improve admissions odds for their children, families have been known to misrepresent their addresses in order to be eligible for attendance, and school districts like CPS have invested in creating additional selective high schools in order to increase the number of students who have access to selective high schools. These

investments and efforts are undergirded by the assumption that schools matter and that selective schools in particular will improve outcomes for the students who attend them.

One reason that past research has found no evidence that selective high schools improve student outcomes may be because the admissions systems in the cities previously studied take only the very highest achieving students who are often more advantaged than the typical student in the district. In other words, these programs select the students who would thrive academically no matter what school they attended. Admissions systems that take into account other student characteristics such as SES likely change the set of students admitted, and some of the students admitted under such a system may stand to benefit more from attending a selective high school than the typical high-achieving student. While we might not be surprised that students selected purely on academic achievement would do well regardless of the high school they attend, one would hope that selective schools might actually generate benefits for students who face more economic disadvantages and may have lower-quality outside options. We test this directly because CPS admits students from different economic backgrounds separately by reserving seats based on neighborhood SES. Estimating separate effects for students from different ends of the neighborhood SES distribution also allows us to contribute to the conversation about affirmative action admissions policies. Opponents to affirmative action programs have suggested that students admitted to programs based on affirmative action may be harmed because they are not prepared to handle a rigorous academic program. With the CPS admissions policy we can evaluate whether, indeed, the students whose chances of admission are enhanced by the affirmative action policy benefit from admission to a selective high school.

Prior research provides average treatment effects for the marginal students - those, by definition, who are the closest to the cut score for admission and are, therefore, the lowest relative achievers in their schools. This strategy raises questions about the generalizability of the results to students at other points in the distribution of achievement. The admissions policy in CPS generates different margins on which to estimate the impacts of attending a selective school. One potential problem is that achievement and family income are positively correlated so that students from higher-SES neighborhoods generally face higher cutoffs. For example, a school for which the cut-off score for admission would be at the 84th percentile of the application score distribution without the quota system has cutoff scores ranging from the 73rd percentile to the 90th percentile under the quota

system.[1] Because of this relationship, it is difficult to know if there are heterogeneous effects by neighborhood SES or by a student's relative position in the achievement distribution in his/her school. To address this, we can limit the analysis to students who qualify for free/reduced-price lunch[2] and test for different impacts for low-income students facing high admissions cutoff scores (those living in top neighborhood SES category) and low-income students facing lower cutoff scores (those living in the bottom neighborhood SES category). Estimating on this subsample allows us to better isolate the effects of relative achievement ranking from the effects of poverty and to test whether selective schools benefit relatively high- versus low-achieving low-income students.

Finally, previous work includes a limited set of outcomes, focusing on test scores and college admission. Test scores are very highly correlated over time within student so it is not completely surprising that high-achieving students would continue to be high achieving regardless of the school they attend. However, many parents and members of society expect schools to do more than just increase test scores. They expect children to be in settings where they are happy, feel safe, have peers who are a good influence on them, and learn about a variety of subjects that don't often turn up on exam questions. It may be the case that families so highly value these experiential outcomes (e.g., safety is a real concern for many families in Chicago) that they prefer these schools even if the schools do not increase (or may even decrease) academic outcomes. In this paper, we are able to go further than previous work by using survey data on students' perceptions of their high school experiences.

C. The Case for Admissions Quotas

The admissions policy in Chicago uses neighborhood SES quotas (described in greater detail later in the paper). This aspect of the policy allows us to test whether students from low-SES neighborhoods benefit more from selective high schools than students from high-SES neighborhoods. But why might we expect selective schools to affect high-achieving disadvantaged youth differentially?

One argument for giving high-performing low-SES students access to these selective schools comes from concerns that students from high-poverty neighborhoods are stuck in extremely low-

[1] Estimates based on simulations by Michelman & de la Torre (2016).

[2] Students whose family income is between 130% and 185% of the federal poverty line qualify for reduced-price lunch, and those whose families make less than 130% of the poverty line qualify for free lunch.

performing schools with very low graduation rates. Approximately 2,000 high schools in the country have been identified as "dropout factories," producing 51 percent of the nation's dropouts (Balfanz & Legters, 2004). These schools generally serve large numbers of low-income students; they face substantial educational challenges; and staff members often are overwhelmed by trying to serve so many high-needs students (Neild, 2004). Empirically, we show that in Chicago high-achieving students living in low-SES neighborhoods generally attend lower-performing schools than students from high-SES neighborhoods.

Figure 1 contrasts the quality of the high schools attended by high-achieving students from low-SES neighborhoods (left panel) and high-achieving students from high-SES neighborhoods (right panel). [3] We use data made publicly available by CPS on the school-level growth rate on exams administered in ninth and tenth grades. The percentiles represent the school's place in the national distribution of growth, so, for example, a school at the 20th percentile represents a school where 80 percent of other schools nationwide outperformed them in terms of growth between test administrations. High-achieving students living in low-SES neighborhoods are more likely to attend high schools with national growth percentiles below 20. Almost half of high-achieving low-SES students attend a high school at or below the 20th percentile in growth (44 percent) compared to 21 percent of high-achieving high-SES students. This discrepancy perhaps points to inequitable access to high-quality high schools even for students who do well academically prior to high school. Thus, students from low-SES neighborhoods may benefit more from attending a selective high school than students from high-SES neighborhoods.

On the other hand, students coming from more disadvantaged backgrounds could be made worse off if selective high schools offer a more rigorous educational experience, but low-SES students arrive underprepared, and the schools cannot provide enough supports to bridge the gap. Under Chicago's accountability system, all schools are given a performance level based on student test scores, attendance, and value-added in reading and mathematics. In Figure 2, we graph the shares of high-achieving students from low- and high-SES neighborhoods who attend each accountability level of elementary school using data from the cohorts of students in our study. High-achieving

[3] High-achieving students score one standard deviation above average on their combined reading and math score in 8th grade. Low neighborhood SES refers to the bottom quartile of student-weighted census block groups on the UChicago Consortium measure of social status based on Census measures of education and employment in managerial and professional positions. High neighborhood SES refers to the top quartile of student-weighted census block groups using this measure of social status. We use data on students enrolled in 9th grade in fall 2010, 2011, and 2012 and publicly available data on national growth percentiles from 2014 for high schools for students taking the EPAS EXPLORE in grade 9 and the PLAN in grade 10. These students were admitted to high school after the district adopted neighborhood SES as part of the admissions policy. The share of students from low-income neighborhoods attending a selective high school increased from 12 percent in 2002 (under the race-based admissions policy) to 19 percent in 2016 (under the SES-based admissions policy). See Barrow & Sartain (2017).

students from low-SES neighborhoods are roughly equally likely to attend elementary schools of each level. In contrast, high-achieving students from high-SES neighborhoods are much more likely to attend an elementary school with the highest rating (66 percent) than an elementary school with the lowest rating (7 percent).

In addition, the benefits of attending school with many high-achieving peers may differ for students from high- and low-SES neighborhoods. Selective schools attract high-achieving students creating a student body of academically-oriented peers. Access to such a peer group may be more beneficial to high-performing students from low-SES neighborhoods who might otherwise attend schools with comparatively disadvantaged and lower-performing peers. The evidence is mixed on whether access to higher-performing peers improves test scores by student race or income. Card and Giuliano (2016) find that tracking of elementary school students into gifted programming had large effects on student achievement particularly for black and Latino students. In contrast, Bui, Craig, and Imberman (2014) find no positive effect of gifted programming on student achievement overall or for race or income subgroups.

However, research that looks at outcomes other than test scores provides evidence that students' grades and pass rates tend to be lower in classrooms with higher-achieving peers, compared to students with similar test scores in classrooms with lower-achieving peers (Farkas, Sheehan, & Grobe, 1990; Kelly, 2008; Nomi & Allensworth, 2009). If grades largely reflect relative performance, students in academic settings with higher-achieving peers will appear weaker academically which then could translate into lower grades. One might be concerned that lower grades in high school could have direct effects on students' future access to more selective colleges and universities. Because on average, students from low-SES neighborhoods will be lower in the achievement distribution under the current admissions system, grades for students from low-SES neighborhoods may be more likely to suffer from attending a selective school than grades for students from high-SES neighborhoods.

Finally, the benefits of attending a selective high school may be larger for students from lower-SES neighborhoods if higher-SES parents offset any differences in school quality with private investments in ways that lower-SES parents cannot (Rouse & Barrow, 2006; Barrow & Schanzenbach, 2012). It may also be the case that high-achieving students from low-SES neighborhoods benefit from the social capital generated by gaining access via enrollment in selective schools to parents and communities that have more economic and social resources to

support schools (Bryk, Sebring, Allensworth, Luppescu, & Easton, 2010; Coleman & Hoffer, 1987).

III. Selective High Schools in Chicago

Chicago has a longstanding history of offering many school choices to families, including most recently an expansion of charter schools and selective enrollment schools.[4] The first selective enrollment high school (SEHS) in Chicago was created in 1997. As of the 2013-14 school year, there were 10 selective enrollment high schools. These SEHSs are quite different on a number of dimensions than those typically attended by CPS ninth graders. Table 1 shows characteristics of SEHSs and non-SEHSs, weighted by the number of students who attend them. Test scores are stronger – the average ACT score at the typical non-SEHS is 17 compared to 24 at the typical SEHS. Educational attainment is higher as well – the graduation rate at the typical non-SEHS is 62 percent compared to 90 percent at the typical SEHS; 56 percent of graduates enroll in college at the typical non-SEHS contrasted with 84 percent of graduates at the typical SEHS. Student and teacher reports suggest vastly different schooling environments, as well. For example, student reports of community support for the typical non-SEHS is 0.1 standard deviations above the mean compared to 1.0 at the typical SEHS.[5] (See Appendix Table 1 for a description of the survey measures.) Whether SEHSs look better on these indicators because they are higher quality schools or because they admit students who are already high-performing is explored further in this paper; regardless, SEHSs can safely be characterized as different from other schools in the district.

Admission to these schools is based on student achievement, although to uphold a 1980 court-ordered desegregation consent decree, race was also a formal component of the application until 2009. In order to achieve the consent decree goal of desegregation, selective enrollment (and magnet) schools used race-based admissions policies. In 2009, a United States federal court lifted the consent decree, which resulted in CPS removing race as an admissions factor. Concerns were

[4] Cullen, Jacob, & Levitt (2006) explore high school choice in Chicago. Specifically they look at the effects of winning a lottery at an oversubscribed Chicago public high school in the early 2000s. They disaggregate effects by the performance level of the high school and find no effects of attending high-performing high schools on traditional academic outcomes like test scores, course performance, or high school graduation, although they do find that students who win lotteries are lower ranked in their high schools than those who do not. Students who win lotteries to attend high-performing schools also report being less likely to get in trouble at school or be arrested. However, in this paper, we examine the effects of selective schools on student outcomes. These schools serve the highest-performing students in the district and are much higher-performing than those studied previously in Chicago.

[5] School survey measures are standardized at the school-year level. In schools where students respond negatively about their schools, there tends to be low enrollment. Because the values reported in the table are weighted by enrollment, the averages reported for non-SEHSs and SEHSs are generally both above (or below) the mean.

raised that if seats were awarded based solely on student achievement, the selective schools would primarily serve students from affluent families and neighborhoods and undo the racial diversity of the schools that was achieved under the consent decree. In response, CPS immediately established a new admissions policy to ensure that the selective high schools would continue to be relatively diverse. Beginning with applications for enrollment in fall 2010, neighborhood characteristics were used in the application process for the first time.

CPS assigns each Chicago census tract to one of four SES 'tiers" based on six factors. Five come from Census data—median family income, adult educational attainment, percent of homes that are owner occupied, percent of single-parent households, and percent of the population speaking a language other than English. The sixth factor reflects neighborhood school performance. Tier 1 neighborhoods, the lowest SES neighborhoods, are clustered on the west and south sides of the city, while the north side neighborhoods are primarily tier 4, the highest SES neighborhoods. The SEHSs are located throughout the city. See Appendix Figure 1 for a map of census tract tiers and the SEHS locations.

Each applicant receives an application score of up to 900 points based on test scores and grades. Final grades in seventh-grade core courses (math, English, science, and social studies), seventh-grade standardized test scores, and the test score from a selective enrollment entrance exam each account for a maximum of 300 points. In order to be eligible for admission, students must have an application score of 650 or above. Figure 3 shows the distribution of application scores for all SEHS applicants entering 9th grade in fall 2010 through fall 2013, with a vertical line denoting the 650-point eligibility requirement.[6] The majority of applicants (59 percent) do not meet that threshold. It is also worth noting that there is some bunching at the top of the distribution with 0.7 percent of all applicants receiving the maximum score.

Students are able to rank up to six selective schools through a centralized application process. The first 30 percent of available seats in each school are assigned based on academic performance (open seats), and the remaining 70 percent of seats in each selective high school are divided equally among students in the four SES tiers (tier seats). The assignment mechanism is a serial dictatorship with students ranked according to their application score and assigned seats in the order they are ranked. Each applicant is awarded an offer from the highest-ranked school on their application for which an open or tier seat is still available. Open seats at each school are filled before tier seats. If

[6] There is a separate admissions process for students with identified disabilities, so we do not include these students.

all tier seats are filled for a student's neighborhood tier at all of the schools to which she applied, no offer is given. The district then moves on to the next highest ranked student on the list. This process continues until all available seats have been filled or no qualifying applicants remain.

Each year, CPS makes admissions offers to each SEHS using the rules described above and publicly posts a table of cutoff scores by school for open seats and tier seats. We define a student as having received an offer to attend a SEHS if she scores above the published admissions cutoff score for her neighborhood tier for any school to which she applied in the year of her application.

IV. Data Description and Analytic Sample

A. Data Description

We use CPS SEHS application data which include a record for each student, his/her ranking of up to 6 selective high schools, overall application score, the scores for the three component parts, neighborhood tier, and ultimate admission status. We also use publicly available tier cutoff scores for each SEHS in each year in order to identify which students are offered a SEHS seat. (See Appendix Table 2 for the cutoff scores for tier seats by tier, school, and application cohort.) We link the application data to longitudinal CPS administrative data, as well as UChicago Consortium annual survey data on student experiences. The administrative data contain complete enrollment and demographic records for each student, high school course transcripts, and achievement test scores. For CPS graduates, the administrative data also include National Student Clearinghouse data on college enrollment. Using these linked data, we are able to study the impact of attending a SEHS on students' test scores, course grades, college enrollment, and experiences in high school.

Specifically, to measure the impact of admissions to an SEHS on traditional academic student outcomes, we use the following data sources.

Enrollment Data.—CPS enrollment records, called master files, link individual students to the school they attend in a given semester and year. We use these data to construct an indicator for whether or not a student graduates from a CPS high school in four years after initial enrollment in ninth grade. Note that if a student transfers out of CPS during high school, that student receives a zero for this indicator. Students who drop out of high school are also coded as a zero.

Test Score Data.—CPS students take standardized tests in the spring of grades 3 – 8. From these data we make use of a UChicago Consortium predicted grade 8 test score in order to calculate an

incoming class percentile rank for each student in the high school they attend.[7] During the period we study, all CPS high school students took the ACT Educational Planning and Assessment System (EPAS) series of tests: EXPLORE, PLAN, and ACT. Grade 11 ACT test scores are missing for the most recent cohort of students. We standardize the EXPLORE and PLAN scores to have a mean zero and standard deviation of one within cohort and test. For the ACT, we make use of the published means and standard deviations by test component for high school graduates from 2014, 2015, and 2016 (See ACT 2016).

Grades and Transcript Data.—These data provide detailed course-taking information for each student, providing a list of courses in which the student enrolls, the grades they receive, and an indicator for whether the course is an honors or Advanced Placement level course. From these data, we construct grade point averages (GPA) for grades 9 and 11 and an indicator for whether a student takes any honors or AP classes in 9th grade.

National Student Clearinghouse Data.—For CPS graduates, CPS obtains matched data reflecting where a graduate is enrolled in college in the fall following high school graduation. We use these data for the oldest cohorts of students to identify whether and where a student enrolls in college, and we use Barron's college selectivity rating categories to define whether the college attended is among the most competitive to get into. We define "selective" as any college defined by Barron's as "Very Competitive Plus" (selectivity rank of 1, 2, 3, or 4). See Leonhardt (2013).

Survey Data.— Studying SEHSs in Chicago also allows us to explore the impact of SEHSs on students' experiences in high school in ways that have not been previously explored. To do this, we use a variety of survey data outcomes. UChicago Consortium conducts district-wide surveys of all high school students and teachers every spring. We link these data to administrative data about the student, so we can compare the responses of students admitted to selective enrollment high schools to the counterfactual students. Survey items are used to construct measures of school climate, including personal safety, course quality, and relationships with teachers and peers. Appendix Tables 1 and 3 list the survey measures and their component items for those measures that we use in this paper. When used to characterize overall school climate (Tables 1 and 3), we aggregate the student-level responses to the school level and then standardize across schools by

[7] The predicted test score comes from a three-level hierarchical linear model, with a measurement model at level 1 taking into account the standard error associated with any single test score, and test scores nested within year (level 2) and students (level 3). The model additionally controls for the student's age (and square term) at the time of the test, cumulative number of times the student was retained, cumulative number of times the student skipped a grade, the school, and the student's cohort.

year. When used as outcomes (Tables 4 and 5), we standardize survey responses within cohort at the student level for all first-time ninth graders in CPS. Eighty-one percent of our analytical sample has data for at least one survey measure with most measures having response rates between 75 and 80 percent. We find no differences in response rates by admission to a SEHS overall or by neighborhood tier.

Address Data.—CPS enrollment records include student residence data at the Census block group level. We calculate distance from the centroid of a student's residential Census block group to the centroid of the Census block group of the high school they attend. Distance is presented in miles.

B. Overall and Analytic Sample Characteristics

For the 2010-11 through 2013-14 school years, there were 84,905 first-time grade 9 students who were also enrolled in CPS in grade 8 during the prior school year.[8] Of these 41,111 students completed SEHS applications. We restrict the sample to students enrolled in CPS in grades 8 and 9 in order to have pre-treatment data, as well as outcome data, for these students.[9] Restricting the sample in this way means that we are excluding three types of students from the estimation sample: 1) grade 8 CPS students who applied to a SEHS but left the district for grade 9 (8.8 percent of applicants), 2) non-CPS grade 8 students who applied to a SEHS and enrolled in CPS for grade 9 (5.3 percent of applicants), and 3) non-CPS grade 8 students who applied to a SEHS but did not enroll in CPS in grade 9 (3.7 percent of applicants).[10]

Table 2 shows pre-treatment characteristics for all CPS students enrolled for the first time in grade 9 who were also enrolled in CPS in grade 8 (column 1), the subset of those students who completed applications for a SEHS (column 2), and our analysis sample which further limits the sample to students whose application score is within 0.5 standard deviations of the lowest admissions cutoff among the SEHSs to which they applied (column 3). As one might expect,

[8] These numbers, and the numbers shown in all tables except Table 1, exclude students with Individualized Education Plans (i.e., special education students). The SEHS admission process functions differently for special education students, so we do not include them in the analysis.

[9] Results are unchanged if we also include students who enter CPS in grade 9.

[10] Attrition can be a threat to valid estimation in our RD approach. Overall, we find that within the estimation application score bandwidth 8 percent of admitted students leave CPS before grade 9 compared to 12 percent of non-admitted students. The likelihood of leaving the district increases monotonically with neighborhood tier (10 percent leave in tier 1 compared with 19 percent in tier 4). Using a regression framework, we predict whether or not an applicant leaves CPS with a variety of observable characteristics, as well as interactions between being admitted to a SEHS and those same characteristics. Most of the predictors are not statistically significant – exceptions include free/reduced-price lunch status and race is white. Controlling for these characteristics in the RD models does not affect the results. Given our investigations, we believe that attrition is unlikely to bias our results.

applicant students are positively selected on academic achievement when compared with non-applicant students, both in terms of test scores and GPA in seventh grade. Applicants are also more likely to have engaged in school choice prior to high school with 56 percent attending their assigned neighborhood elementary school compared with 63 percent of students overall. Applicant students are more likely to be white or Asian, somewhat less likely to be African American or Latino, less likely to qualify for free/reduced-price lunch, and less likely to be male than non-application students. It is worth noting that only 43 percent of applicants met the eligibility threshold of 650 application points while 28 percent scored above the cutoff for admission at one of the schools to which they applied, and many of those eligible enrolled in a SEHS. In other words, for many students the hurdle for admission is attaining an application score of 650.

In Table 2, we also compare the characteristics of applicant students (column 2) to our analytic sample (column 3), which further limits students to those scoring relatively close to the admissions cutoff score as described in more detail below. This limitation drops many students whose application scores lie well below the eligibility cutoff for admission. Not surprisingly, the analytic sample is higher-achieving than the application sample. Seventh-grade math test score percentiles for the analytic sample are about 20 percentile points higher than all students and 8 percentile points higher than all applicants. Grade 7 GPA is also considerably higher for the analytic sample – about one GPA point higher than all students and about 0.5 GPA points higher than all applicants. Again, this sample is less likely to be African American, more likely to be white or Asian, less likely to qualify for free or reduced-price school lunch, and less likely to be male.

Throughout this paper, we focus on comparisons of impacts for tier 1 applicants (from the lowest-SES neighborhoods) with impacts for tier 4 applicants (from the highest-SES neighborhoods). Average pre-treatment characteristics for students in the analytic sample from each tier are shown in columns 4 through 7. While race is not used to determine neighborhood tier, the percent black or Latino declines monotonically with neighborhood tier, reflecting the racial and economic segregation of Chicago. Nearly all of tier 1 students are African American or Latino and 4 percent are white or Asian, while 49 percent of tier 4 students are African American or Latino and 48 percent are white or Asian. Tier 4 students are also more likely to have attended their neighborhood elementary school than tier 1 students (56 percent compared with 48 percent), suggesting that CPS elementary schools in high SES neighborhoods are perceived as being more desirable. Students from tier 4 neighborhoods tend to be relatively higher performing – their

seventh-grade math test scores are about 6 percentile points higher, their seventh-grade GPAs are about one-quarter of letter grade higher (0.28 GPA points), and their average application scores are 100 points higher. Some of these differences are relatively small, and it is worth noting that students in the tier 1 analytic sample are much higher performing than the typical CPS student. Ninety percent of tier 4 students met the eligibility threshold of 650 application points and 56 percent met the admission cutoff for at least one SEHS to which they applied, compared with 67 percent being eligible and 47 percent scoring above an admission cutoff for tier 1 applicants.

C. Characterizing the Counterfactual High School Experience

Like selective high schools in Boston and New York City, SEHSs in Chicago differ from the other public high schools on many observable characteristics (as described earlier in Table 1). In Table 3, we present how the characteristics of high schools attended differ by admission status for students from low- and high-SES neighborhoods. The characteristics listed in this table are the same as in Table 1, although here we restrict contrasts to the analytic sample. The purpose of Table 3 is to compare high school experiences for admitted and non-admitted students from tier 1 neighborhoods, and also for their counterparts from higher-SES neighborhoods (tier 4), in order to better contextualize the findings.

Overall, the differences in mean high school characteristics by admission status are similar for tier 1 and tier 4 students. For example, the percent of ninth-grade students on track to graduate from high school was 78 percent at the typical high school attended by a tier 1 student who was not admitted compared to 88 percent at the typical high school attended by an admitted tier 1 student. The comparable numbers of tier 4 students not admitted and admitted are 79 percent and 89 percent. The difference in the averages for both tier 1 and tier 4 students is around 10 percentage points. A few exceptions are measures related to college going. For example, tier 1 students who are admitted to a SEHS attend high schools where graduates are more likely to persist in college than tier 1 students who are not admitted (a difference of 12 percentage points). The difference in college persistence rates for tier 4 students who do and do not get admitted to a SEHS is only 7 percentage points.

We further characterize differences in student high school experience using student and teacher survey reports (at the school level) of things like peer resources outside of school (i.e., parental support, community support) and teacher satisfaction with the school and district. Generally, for

students admitted to a SEHS, reports on these survey measures look similar for tier 1 and tier 4 students, not surprisingly, as many of them attend the same high schools. For students not admitted to a SEHS, however, the school-level survey measures tend to be higher in schools attended by tier 4 students than by tier 1 students. In other words, non-admitted tier 4 students attend high schools with higher levels of reported parental and community support for students than at the high schools attended by non-admitted tier 1 students. The teacher perspective differs in that teacher reports of program continuity and satisfaction are actually higher in the schools attended by non-admitted tier 1 students than in those attended by non-admitted tier 4 students. The overall pattern of these survey measures suggests that being admitted to a SEHS may generate some differences in high school experiences by neighborhood SES.

V. Regression Discontinuity Approach

We estimate the effect of attending a SEHS for students coming from different SES backgrounds. Because admissions are conducted separately for each SES tier and each school, multiple cutoff points determine admissions based on student preferences, the number of seats at a particular school, and the student application scores for a given year. As long as a student lists at least one school on their application for which their score exceeds the cutoff for their neighborhood tier, the student should be offered a seat at a SEHS. If a student's application score exceeds the relevant tier cutoff for more than one school on her application, her own preference ranking will determine at which school she is offered a seat. In order to estimate the effect of being admitted to any SEHS, we center students' application scores around the school on their application with the lowest cutoff score, whether or not the school is the lowest ranked school on their application. For students who are not admitted to any SEHS, this school will be the school to which they came closest to receiving an offer.[11] We implement a regression discontinuity design, using the various cutoffs based on neighborhood tiers as the exogenous source of variation to identify the "intent-to-treat" (ITT) estimate of the effect of attending a SEHS for students from each SES neighborhood tier. The running variable in this case is the centered application score, and the main identifying assumption is that within neighborhood tier students with application scores just below the cutoff provide a good comparison group for those with application scores just above the cutoff. Further, because

[11] Overall this centers about 40 percent of the analytic sample around the cutoff for a school that was the student's first or second choice. Tier 1 students are somewhat less likely to be centered around a school ranked first or second (37 percent) and tier 4 students are somewhat more likely to be centered around one of their top two ranked schools (48 percent).

students cannot precisely manipulate their application score around the threshold, we assume acceptance to a SEHS for students near the cutoff is as good as random.

Because of the allocation of seats by neighborhood tier, we have four cutoff points for each of Chicago's ten selective high schools. Using the RDD approach, we estimate both an overall ITT effect of being admitted to a selective high school as well as separate ITT effects for students from each neighborhood tier. In both cases, we estimate the ITT effects using ordinary least squares (OLS). We also implement a nonparametric approach described in the online appendix.[12]

More formally, define the centered application score (X_{icjt}) for student *i*, in cohort *c*, applying to school *j*, and living in a tier *t* neighborhood as the individual student's application score minus the relevant cutoff score (based on school, cohort, and neighborhood tier). The estimating equation for the overall effect of admission to a selective high school can be expressed as follows:

$$(1) \qquad Y_{icjt} = \beta_0 + \delta SE_{icjt} + \beta_1 f(X_{icjt}) + \beta_2 f(X_{icjt}) * SE_{icjt} + \phi_{cjt} + \varepsilon_{icjt},$$

where Y_{icjt} is the outcome of interest, $f(X_{icjt})$ is a quadratic function in the centered application score; SE_{icjt} is an indicator for whether student *i* was offered a seat at school *j*; ϕ_{cjt} is a cohort-school-neighborhood tier fixed effect; and ε_{icjt} is the individual error term. We control for interactions of the centered score quadratic terms with the SE_{icjt} indicator to allow for differences in functional form on either side of the cutoff. δ is our parameter of interest to be estimated and represents the impact of being offered a seat at a SEHS on the outcome of interest.

In order to investigate heterogeneity by neighborhood tier, we interact everything with neighborhood tier, and our estimation equation is the following:

$$(2) \qquad Y_{icjt} = \sum_{t=1}^{4} [\beta_{0t} tier_t + \delta_t tier_t SE_{icjt} + \beta_{1t} tier_t f(X_{icjt}) + \beta_{2t} tier_t f(X_{icjt}) * SE_{icjt}] + \phi_{cjt} + \varepsilon_{icjt},$$

where $tier_t$ are neighborhood tier fixed effects which have been fully interacted with the quadratic terms in the running variable, the indicators for being offered a selective enrollment seat, and the

[12] Our nonparametric estimates are qualitatively similar to those which limit the estimation sample to those with centered application scores within one-half standard deviation of the cutoff.

interactions of the quadratic terms with the SE_{icjt} indicator. Our parameters of interest are the δ_t, and we test whether the estimates differ for students from tier 1 and tier 4 neighborhoods.

In order to produce unbiased estimates of the effect of being offered a seat at a selective high school, RDD relies on the assumption that assignment of students to selective high schools at the cutoff score is as good as random (Lee & Lemieux, 2010). The extent to which students are able to manipulate their application score, thus changing their admissions status, poses a threat to this key assumption. It may be the case that individual components of the admissions score—particularly grades—are vulnerable to manipulation. For example, a teacher may assign a higher grade to a student than the student earned if the teacher knows the student is likely to apply to a selective school. Ultimately, however, the application score consists of pieces that are less subject to manipulation, namely standardized test scores. In addition, students do not know the cutoff scores prior to applying, as students with the highest scores are admitted up until the point that there are no more seats available. The cutoff for any given year depends on all students' rankings of selective high schools and their individual application scores. We demonstrate the smoothness of select pre-treatment covariates through the application score cutoff in Appendix Figure 2. We generally do not see discrete discontinuities in these variables at the application score cutoff. Other pre-treatment variables look similar, and figures are available upon request. We also find that our estimates are unaffected by controlling for student demographics directly. We formally test for discontinuities in the baseline characteristics—race, sex, free lunch status, and an indicator for attending one's assigned elementary school—using seemingly unrelated regression and our analytic sample. These results overall and separately by tier are presented in Appendix Table 4. We find some evidence of a discontinuity in sex at the cutoff in the overall estimates (p-value = 0.08), but the p-value on the joint test that the discontinuities equal 0 is 0.36. We find no statistically significant discontinuities in our baseline characteristics for either tier 1 or tier 4 students.[13]

Figure 4 presents the probability of enrolling in a SEHS in grade 9 as a function of the centered application score for each tier. Twenty to 30 percent of students with application scores just below zero are enrolled at a SEHS in grade 9 based on the administrative records. At zero, roughly 60 percent of students are enrolled in a SEHS in grade 9. Across tiers, the first-stage estimate of the

[13] We find evidence of discontinuities in sex, free lunch status, and attending one's assigned elementary school for students in tier 3 neighborhoods and a discontinuity in sex for tier 2.

effect of being offered a seat on the probability of actually enrolling in a SEHS is 0.27. The tier-by-tier first-stage estimates vary slightly with tier 1 at 0.35 and tier 4 at 0.29. Enrollment below the cutoff could occur for a few reasons. Students below the cutoff may enroll in SEHSs as part of the No Child Left Behind (NCLB) choice program or under "principal discretion." It is also the case that some of these students may be enrolled in a program at the SEHS building that is not part of the selective enrollment program.[14]

VI. Results

A. Academic Performance

Table 4 presents ITT estimates of the effect of attending a SEHS on outcomes reflecting measures of academic performance.[15] (See Appendix Figure 3 for graphical evidence of the effects for select outcomes.) Each column represents a different outcome measure, and for each outcome, the first row (counterfactual mean) contains the outcome variable mean and standard deviation for the analysis sample students who score below the admissions cutoffs for all schools to which they apply.[16] Subsequent rows present overall estimates based on equation (1) (the all tiers row), as well as estimates based on equation (2) allowing for the impact of attending a SEHS to vary by neighborhood SES (rows tier 1 through tier 4) followed by the p-value for the test that the impact estimate for tier 1 (lowest neighborhood SES) equals the impact estimate for tier 4 (highest neighborhood SES). Finally, we include the number of student observations in the last row of each column. Nonparametric estimates for these outcomes are shown in Appendix Table 6.

We find no effect of SEHSs on grade 9 test scores overall or by neighborhood tier; the same is true for grade 11 ACT scores, which is administered to all CPS 11th-grade students. In a recent paper on RD in a serial dictatorship setting, Abdulkadiroglu, et al. (2017), also find that SEHSs in

[14] During our sample period both South Shore and Westinghouse offered Career and Technical Education (CTE) programs, and South Shore also housed an International Baccalaureate (IB) program. These additional programs also have achievement-based admission requirements but do not use the selective admissions exam.

[15] In addition to our preferred specification, we have estimated numerous alternative specifications for robustness. Specifically, we 1) include observable pre-treatment student characteristics in the model, 2) include third- and fourth-order polynomial terms of the running variable in the model, 3) allow entrants into CPS in grade 9 to contribute to the estimation, 4) center students admitted to a SEHS around the school to which they were admitted and allow students not admitted to serve as controls for multiple schools as long as they are with the one-half standard deviation distance from the cutoff, and 5) include fixed effects for the applicant's ranking of the school. Our estimates are qualitatively similar across these specifications. One exception is that when we change the schools around which students are centered and allow students who are not admitted to appear in the "control" sample multiple times, we additionally estimate positive effects on student reports of science course quality, teacher-student trust, and distance between home and high school attended. Results from robustness checks are available upon request.

[16] Outcome means by SES tier are in Appendix Table 5.

Chicago have no overall impact on exam scores. Ultimately, when it comes to outcomes like test scores, these students do well regardless of admission to a SEHS.

We estimate negative impacts on grades. Overall, students who are admitted to SEHSs have 9th-grade GPAs that are on average 0.122 grade points lower than their counterparts' who were not admitted to a SEHS. The magnitude of the negative GPA effect is larger for students from the lowest SES neighborhoods (tier 1) than for students from the most affluent neighborhoods (tier 4). Students from tier 1 neighborhoods who are just admitted to a SEHS have a GPA that is 0.342 grade points lower than their counterparts who are not admitted to a SEHS while students from tier 4 neighborhoods who are admitted to a SEHS have a GPA that is only 0.072 grade points lower (p-value of the difference = 0.004). This is perhaps not surprising to the extent that students just admitted to a SEHS may be at the bottom of the SEHS achievement distribution (as two-thirds of the application score is based on test score percentiles) while those falling just below the cutoff may end up at the top of the distribution of the non-SEHS in which they enroll. The negative effect on GPA persists through grade 11 although the effect is somewhat smaller. Overall, being admitted to a SEHS has a -0.097 effect on grade 11 cumulative GPA that is not statistically different from zero. For tier 1 students the estimate is -0.287, and the estimate for tier 4 students is -0.053 (p-value of the difference = 0.04).

The negative impacts on GPA do not appear to translate into negative impacts on high school graduation or college enrollment on average (see columns (5) and (6) of Table 4). Students from SEHSs are no less likely to graduate from high school or enroll in college than their counterparts in other high schools. However, we estimate a statistically significant negative effect on the probability of enrolling in a selective college overall and for students from low-SES neighborhoods.[17] Tier 1 students admitted to a SEHS are 16 percentage points less likely to enroll in a selective college, conditional on graduating from a CPS high school, than tier 1 applicants who are not admitted to a SEHS. The point estimate for tier 4 students is also negative but a much smaller 2.6 percentage points and not precisely estimated; as such, we cannot reject that the estimated effects for tier 1 and tier 4 students are equal (p-value = 0.111).

[17] We use Barron's college selectivity list accompanying Leonhardt (2013) and define "selective" as any college defined by Barron's as "Very Competitive Plus" (selectivity rank of 1, 2, 3, or 4).

B. High School Experience

If there are no positive academic effects of being admitted to a SEHS, and possibly negative effects especially for students from lower-SES neighborhoods, why are these schools so highly sought after? One possibility is that parents want to enroll their children in these schools for the different high school environment and experience they offer in terms of peers, teachers, and course quality. We turn to estimates of the effect of SEHS admission on these outcomes in Table 5, which is structured in the same way as Table 4.[18] We characterize differences in academic experience as measured by a student's place in the incoming distribution of achievement compared to his or her high school peers, whether or not a student takes honors courses, the amount of time spent on homework, and the quality of science courses (columns 1-4 of Table 5).[19] We then present results for survey measures of personal safety, peer support, teacher-student trust, and sense of belonging in the school (columns 5-8 of Table 5). Finally, results on distance to high school are presented in column 9. Nonparametric estimates for these outcomes are shown in Appendix Table 7.

First, there is a large negative effect on incoming class rank. On average at the beginning of ninth grade, students admitted to SEHSs were ranked 11 percentile points lower than the counterfactual students not admitted to a SEHS. This is, perhaps, of little surprise. Students admitted at the margin will have relatively higher performing peers than the students who just miss the cutoff. When we allow the effect of SEHS admission to differ by neighborhood tier, we estimate that the negative effect on incoming rank is larger in absolute value for tier 1 students than for tier 4 students. Tier 1 students admitted to a SEHS rank 18 percentile points lower in their high school than tier 1 students who are not admitted to a SEHS. For students from tier 4 neighborhoods, being admitted to a SEHS lowers their incoming rank by 8 percentile points.[20]

How a student ranks in the distribution of her peers may be important for several reasons. First, if schools track students into different courses based on prior achievement, lower ranked students may not have access to the same courses, peers, or teachers as higher ranked students. Additionally, lower rank may also translate into lower grades to the extent that grades are a relative performance

[18] Survey responses were collected during grade 9. We also replicated these findings using survey responses to the same items in grade 11. The estimates are very similar regardless of the grade at which the survey is administered. We prefer the results from grade 9 because response rates are higher in the earlier high school grades.

[19] Although we also have measures for English and math courses, the science measure was the most statistically reliable of the three. The results for English and math are similar to science and available on request.

[20] These differences are not driven by differences in average rank for the counterfactual students. Average incoming rank for students not admitted to a SEHS ranges from 73 for tier 4 students to 77 tier 3 students. The average rank for a tier 1 student who is not admitted to a SEHS is 75.

measure rather than an absolute measure. Because academic achievement is correlated with SES and the admissions system in Chicago reserves seats for students from different SES tiers, this issue may be most relevant for students from low-SES neighborhoods who are on average lower-ranked in their SEHSs than students from higher-SES neighborhoods. Finally, rank may also affect how students perceive their own academic skills or ability, how teachers perceive students, or both.

We next look at enrollment in honors courses, reports of time spent on homework, and student reports on the quality of their science courses. Admission to a SEHS has no overall effect on the probability of taking an honors class, the probability of spending 10 or more hours per week on homework, or the perceived quality of science courses. When we look at the effects by neighborhood tier, we find a statistically significant difference between tier 1 and tier 4 for the likelihood of spending 10 more hours on homework per week. Tier 1 students admitted to a SEHS are no more likely to report spending 10 or more hours on homework than tier 1 students not admitted to a SEHS. In contrast, tier 4 students admitted to a SEHS are 11 percentage points less likely to report spending 10 or more hours per week on homework than their peers who were not admitted to a SEHS. This point estimate is statistically different from zero at the 5 percent level, and we can reject that the tier 1 and tier 4 estimates are equal (p-value = 0.062).

Being admitted to a SEHS appears to make the most difference in the day-to-day relationships that students experience in the school building. The most consistent evidence we find is that students admitted to a SEHS report better relationships with peers. On average, students report a greater sense of personal safety in their school (a 0.23 standard deviation difference) and more supportive peers (a 0.14 standard deviation difference). However, students admitted to a SEHS are no more likely to report better, more trusting relationships with teachers or a better sense of belonging at their school. Looking at results by neighborhood tier, the estimates are not statistically different between tier 1 and tier 4 although the point estimates for tier 4 students suggest that tier 4 students are experiencing a larger improvement in their school environment.

In the final column of Table 5 we look for differential effects on the distance students are traveling to school. On average, admission to a SEHS has no effect on the distance traveled to high school, and we cannot reject that the effects are the same for tier 1 and tier 4 students.

C. SES versus Relative Ranking

Assuming that the SEHSs are not lower quality than the counterfactual high schools, one explanation for the results shown in tables 4 and 5 is that the SEHSs are more challenging than the counterfactual high schools and that high-SES parents are able to provide more outside support for their children than either the school or low-SES parents can provide. Alternatively, since low-SES students attend lower quality elementary schools on average, low-SES students may get lower grades because they are less well prepared for high school. The table 4 and 5 results could also be explained by differences in relative ranking of tier 1 and tier 4 students, as tier 1 students are likely to be at the bottom of their class academically.

Because student achievement and neighborhood SES are correlated, the total points needed for admission to a particular school is almost always higher for students from high-SES neighborhoods than for students from low-SES neighborhoods (see Appendix Table 2). For example, in 2014 the total points needed to receive an offer at Jones is roughly 100 points higher for tier 4 students than for tier 1 students. This feature makes it difficult to discern whether differences in treatment effect estimates between tier 1 and tier 4 students are driven by differences in neighborhood SES or differences in incoming ability as measured by prior achievement. In Figure 5, we show the distribution of total application score by SES tier for each high school. We limit the sample of students to those who are in our estimation sample and who are admitted to a SEHS based on the published cutoff scores. For a school like Lane Tech (the largest SEHS in terms of enrollment), one can see that the distribution shifts up with neighborhood SES tier, with considerable differences in the application scores for students from low- and high-SES neighborhoods. For other schools, like South Shore, the relationship is pretty constant across tiers.

To understand more about the potential effects of relative ranking, as well as to identify effects at different points in the achievement distribution, we limit the sample to students who qualify for free/reduced-price lunch (FRPL). [21] Because neighborhood SES is a proxy for individual circumstances, even in tier 4 neighborhoods 47 percent of students qualify for FRPL. All of these students are living in low-income households. We believe that limiting the sample in this way improves our ability to isolate the effects of relative ranking from the effects of family resources.

[21] The distributions of application scores by tier for students eligible for free or reduced-price school lunch looks very similar to Figure 5.

Tier 1 FRPL students are low-income students who face lower admission cutoffs and are, therefore, relatively lower achieving compared to tier 4 FRPL students with higher achievement. In tables 6 and 7 we present estimates limiting the sample to FRPL students. These estimates correspond to those in tables 4 and 5 based on all students. Across the tiers, the estimates are quite similar. Low-income students facing higher admissions thresholds do no better when admitted to a SEHS than their counterparts who just miss the admissions cutoff, and low-income students facing lower admissions thresholds are made worse off in terms of GPA and the probability of enrolling in a selective college. Like the overall sample, the negative effects on relative ranking of being admitted to a SEHS are larger for students facing the lower admissions thresholds than students facing the higher thresholds. These results provide suggestive evidence that the differences in estimated effects are being driven by the impacts on relative rank rather than a story about parental resources.

VII. Discussion and Conclusion

Selective enrollment high schools command a lot of attention – they generally serve the most academically successful students, the seats are highly coveted as there are many more applicants than available slots, and they are often hailed as the best schools in the system. These schools also receive criticism for serving student bodies that are much less racially diverse than the districts in which they are situated. The affirmative action admissions policy in Chicago, reserving seats for students from low-SES neighborhoods, makes selective schools the most racially diverse public high schools in the city. This policy also allows us to look at separate effects for students from different SES backgrounds. We find that when it comes to test scores, attending a SEHS has no statistically significant impact – not even for students from the most disadvantaged neighborhoods or for the highest achieving low-income students who would be admitted even without place-based affirmative action. Given these findings, SEHSs are not helping to close the achievement gap between low- and high-income students.

But test scores are only one outcome. SEHSs have a positive effect on students' perceptions of the high school experience. When it comes to relationships with students, SEHS students are more positive than their counterparts in non-SEHSs. SEHS students are more likely to say that students get along well and treat each other with respect. Students in SEHSs also report a greater sense of personal safety – they are less likely to worry about crime, violence, and bullying at the school.

Perhaps it is factors like these that make SEHSs highly desirable to students and families – more so than the potential to improve test scores and college outcomes. Regardless, these results combined with no effect on academic achievement suggest that districts may want to focus on ways to improve the school environment at all schools rather than investing in additional selective high schools.

High school GPA is an important academic outcome that affects both college admissions and college scholarship eligibility. We find negative effects of being admitted to a SEHS on GPA, and this effect is primarily driven by the large negative impact on GPA for students from more disadvantaged neighborhoods. Why do SEHSs lower GPAs for students from low-SES neighborhoods while having no effect on test scores? We think it is likely because grades are a relative measure and students admitted from the lowest-SES neighborhoods are, on average, the lowest-achieving students in selective schools. It could also reflect something about school practices like biases in grading or lack of academic supports for students who need them. Ultimately, the negative impacts on GPA may explain the result that admission to a SEHS reduces the probability that a student from a low-SES neighborhood attends a selective college, a finding that is particularly troubling.

Our data on college selectivity is based on where students enroll in college. We do not have information about where students apply or where they get in. As a result, we cannot determine whether the difference in the effect of SEHSs on the probability of enrolling in a selective college is driven by differences in where students are admitted, where they apply, or where they ultimately decide to enroll. For students admitted to SEHSs from the lowest-SES neighborhoods, their average grade 11 GPA – the GPA used on college applications – is around 2.50, which may be close to a cutoff for admissions or scholarship eligibility. If that is the case, these students may not be admitted to selective colleges or they may become ineligible for merit-based scholarships, which are likely especially important for these students. Further, there is a push for colleges to rely less on test scores and weigh other measures, such as grades, more heavily. This "test-optional" movement may have the unintended consequence of penalizing students like those admitted to SEHSs from low-SES neighborhoods: otherwise qualified students with relatively lower grades. In addition, we do not know how counseling resources at high schools are allocated, or if counselors are encouraging relatively lower-performing students to apply to a different set of

colleges than relatively higher-performing students. At the same time, students from lower-SES neighborhoods may rely more heavily on college counselors at high schools for advising.

Whether or not historically disadvantaged students can benefit from high-performing school environments has received national attention. In the U.S. Supreme Court case *Fisher v. University of Texas* challenging the University's use of race in admissions decisions for students outside of the top 10 percent of their high school class, Justice Scalia speculated that affirmative action admission policies might result in less-qualified minority students gaining access to colleges that are too rigorous for their level of preparation or previous academic successes. The tier system in Chicago Public Schools puts into place admissions quotas based on students' neighborhood SES, which result in affirmative action in high school admissions by neighborhood context. We do not believe that it is the case that students from low-SES neighborhoods cannot do well in elite public school programs. In fact, there is no evidence of reduced learning, as test scores for less affluent students are unaffected; and further, we find no relative test score gains for any students, even those coming from the top end of the ability distribution as measured by prior achievement. On a less objective measure of academic performance – grades – students from low-SES neighborhoods do not perform as well and access to selective colleges suffers. Understanding the mechanism driving this result is important for determining policy implications.

One could conclude from these results that CPS should do away with SEHSs because they have no impacts on student achievement outcomes and yet they increase uncertainty and stress for parents and children, attract high-achieving students away from other high school programs, and require the district to administer entrance exams and operate an admissions system. At the same time, these schools serve the additional goal of creating more diverse schools than generally arise in a neighborhood school system. Another potential benefit of offering selective schools as part of a portfolio of high school options is that SEHSs may attract or retain families who would otherwise leave the district for private schools or suburban districts. Retaining families could ultimately benefit districts in terms of financial and nonfinancial resources by increasing the tax base and the social capital of families with children in the public schools. How families respond to the various schooling options they face is an important area for further study and one that should certainly be investigated as it relates to selective schools.

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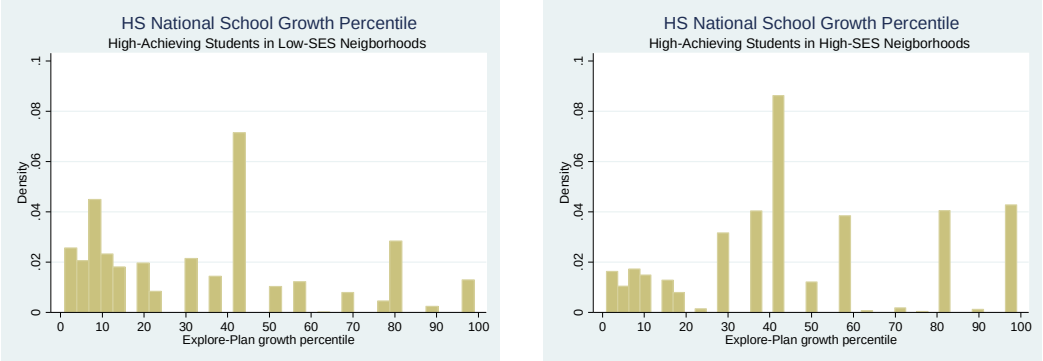


FIGURE 1. DISTRIBUTION OF NATIONAL SCHOOL GROWTH PERCENTILE FOR EXPLORE TO PLAN AT HIGH SCHOOLS ATTENDED BY HIGH-ACHIEVING STUDENTS FROM LOW-SES NEIGHBORHOODS (LEFT) AND HIGH-SES NEIGHBORHOODS (RIGHT).

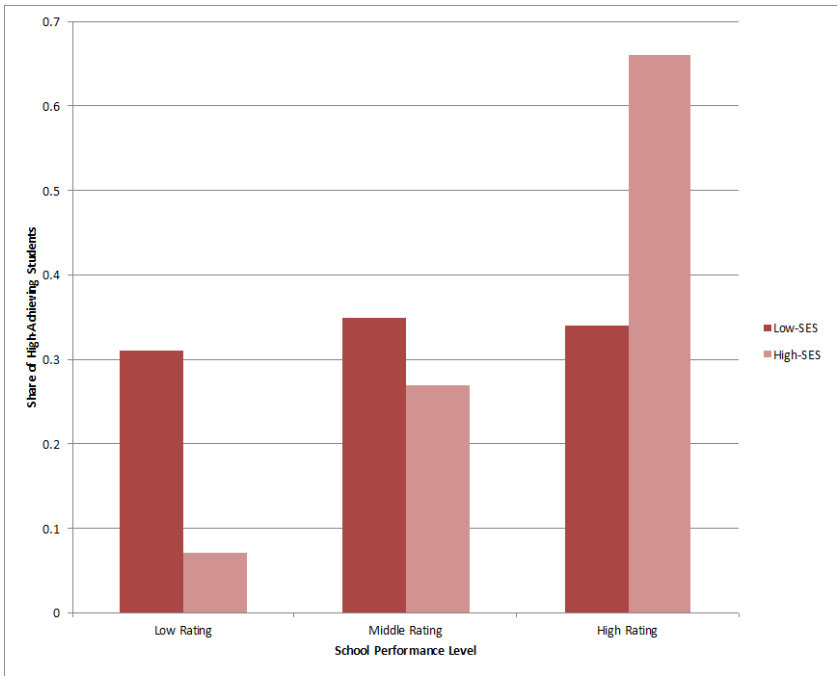


FIGURE 2. SHARE OF HIGH-ACHIEVING STUDENTS ATTENDING EACH PERFORMANCE LEVEL OF ELEMENTARY SCHOOL BY NEIGHBORHOOD SES

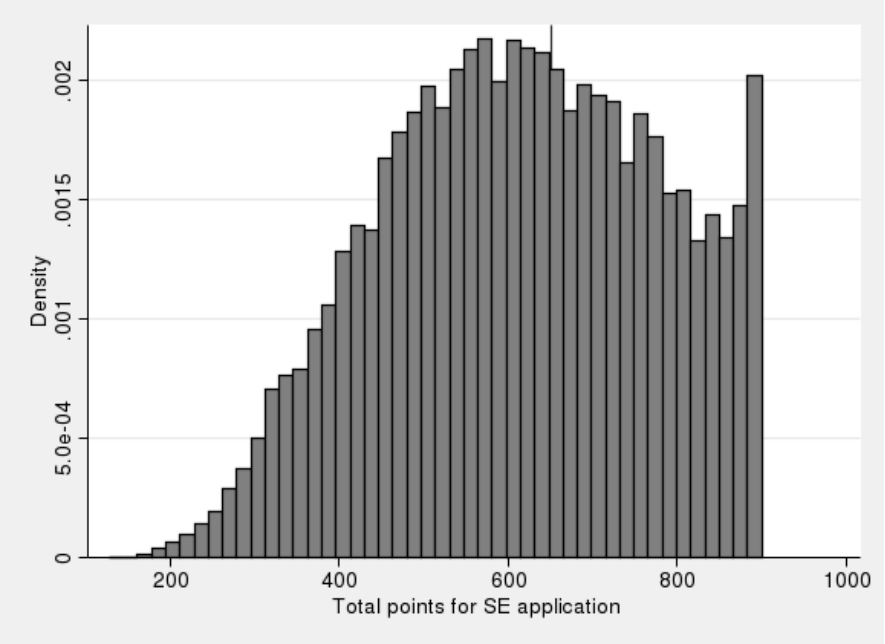


FIGURE 3. DISTRIBUTION OF SEHS APPLICATION SCORES

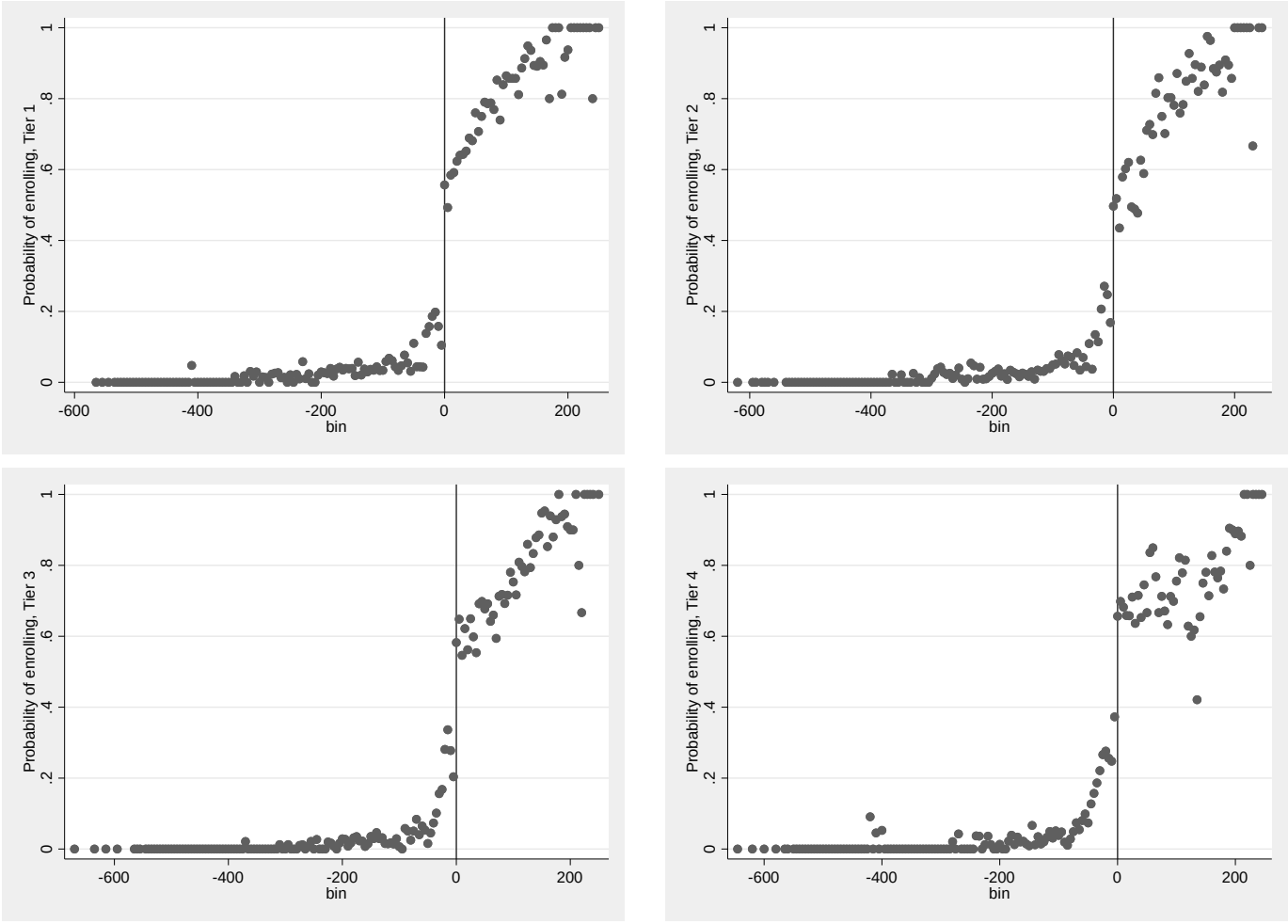


FIGURE 4. PROBABILITY OF ENROLLING IN A SEHS GIVEN CENTERED APPLICATION SCORE

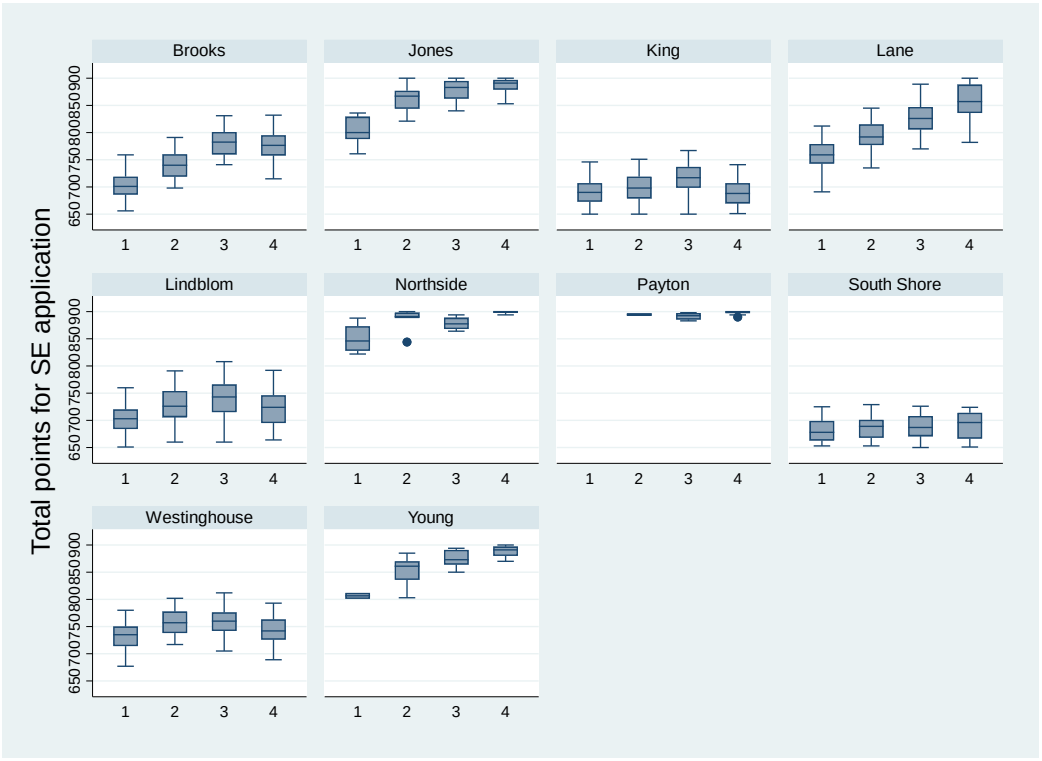


FIGURE 5. DISTRIBUTIONS OF INCOMING ACHIEVEMENT AND SELECTIVE EXAM BY SCHOOL AND NEIGHBORHOOD TIER

TABLE 1. MEANS OF AVERAGE SCHOOL CHARACTERISTICS FOR NON-SELECTIVE ENROLLMENT HIGH SCHOOLS AND SELECTIVE ENROLLMENT HIGH SCHOOLS (S.D. IN PARENTHESES)

School level characteristic	Does not attend a SEHS	Attends a SEHS
Percent of grade 9 students on track for graduation	67.4 (12.3)	91.4 (6.2)
Percent of students enrolled in AP classes	12.8 (7.7)	36.2 (11.1)
Average ACT composite score	16.7 (1.9)	24.1 (2.7)
5-year Cohort Graduation Rates	62.2 (14.0)	90.1 (6.6)
Percent of grads enrolling in college	56.3 (14.2)	83.7 (3.3)
Percent of college enrollees enrolled for a second year	68.5 (10.6)	90.5 (3.9)
Year-end attendance rate	84.7 (8.9)	94.2 (2.6)
Percent of students receiving an out-of-school suspension	23.0 (15.5)	4.9 (6.8)
Herfindahl-Hirschman index of racial concentration	0.685 (0.234)	0.403 (0.200)
Percent male	50.6 (9.6)	42.7 (3.1)
Percent of students with an IEP	14.4 (6.7)	6.5 (2.4)
Percent of students eligible for free/reduced-price lunch	87.6 (12.6)	59.1 (16.8)
Total enrollment	1211.0 (821.2)	2124.1 (1508.3)
Average student report of parental support	-0.044 (0.957)	0.960 (0.494)
Average student report of community support	0.100 (0.985)	1.042 (1.538)
Average student report of classmates' views on importance of school	0.363 (0.478)	1.283 (0.575)
Teacher report on crime/disruption/violence	0.005 (0.908)	-1.492 (0.485)
Teacher report on program continuity	-0.084 (1.037)	0.276 (0.813)
Teacher satisfaction with CPS	-0.054 (1.131)	0.511 (0.727)

Notes: Means are weighted by student such that schools enrolling more students receive more weight. Attendance at a SEHS is determined based on CPS master file records of where the student is enrolled in 9th grade. A student is considered "on-track" to graduate if she earns at least five full-year course credits (10 semester credits) and has no more than one semester F in a core course (English, math, science, or social science) in her first year of high school. The 5-year cohort graduation rate reflects the percent of first-time 9th grade students graduating high school as of 5-years after first-time 9th grade enrollment. Verified transfers out of the district are excluded from this calculation. Survey measures are standardized at the school level. See Appendix Table 1 for descriptions of the survey measures. “Teacher report on crime/disruption/violence”

has a negative valence such that lower values mean less crime, etc. School-level discipline data are unavailable in 2010 and 2011. 5-year cohort dropout and graduation rates as well as average ACT test scores are missing for recently opened schools. Additionally, charter schools do not report school-level transcript and discipline measures.

TABLE 2. STUDENT CHARACTERISTICS BY APPLICATION STATUS AND TIER

Student Characteristics	All Students	All Applicants	Analytic Sample	Tier 1 (Lowest SES) Analytic Sample	Tier 2 Analytic Sample	Tier 3 Analytic Sample	Tier 4 (Highest SES) Analytic Sample
African American	0.42	0.39	0.32	0.46	0.36	0.32	0.20
Hispanic	0.46	0.44	0.43	0.50	0.54	0.44	0.29
White	0.07	0.10	0.15	0.02	0.03	0.11	0.37
Asian	0.04	0.06	0.08	0.02	0.06	0.11	0.11
Male	0.47	0.43	0.40	0.38	0.38	0.41	0.41
Free/Reduced-Price Lunch	0.88	0.82	0.75	0.91	0.88	0.80	0.47
Attends assigned elementary school	0.63	0.56	0.52	0.48	0.50	0.53	0.56
Grade 7 ISAT math percentile	68.16 (22.15)	79.30 (14.85)	87.11 (9.82)	83.94 (10.08)	85.67 (9.88)	87.53 (9.48)	90.20 (8.92)
Grade 7 GPA	2.50 (1.01)	2.99 (0.84)	3.46 (0.51)	3.32 (0.53)	3.41 (0.51)	3.46 (0.50)	3.60 (0.47)
Application score (maximum of 900)	n/a	614.1 (161.3)	727.9 (80.5)	677.9 (54.2)	706.1 (63.7)	732.0 (70.9)	777.9 (87.8)
Eligible for admission to a SEHS based on total points	n/a	0.43	0.82	0.67	0.80	0.87	0.90
Cutoff based admission	n/a	0.28	0.50	0.47	0.48	0.48	0.56
Enrolled in a SEHS in grade 9	0.12	0.23	0.39	0.36	0.34	0.37	0.48
Number of Students	84,905	41,111	13,299	2,732	3,152	3,614	3,801

Notes: "All Students" includes all CPS students enrolled for the first time in grade 9 who were also enrolled in CPS for grade8 in the prior year, excluding all students with an Individualized Education Program. "All Applicants" includes only the subset who also completed a Selective Enrollment High School (SEHS) application. Our analytic sample further limits the students to those within a one-half standard deviation of the cut-score for each SEHS. "Cutoff based admission" is an indicator for the student being offered a seat at a SEHS based on the published cutoff scores. Students are defined as "enrolled in a SEHS in grade 9" if they are enrolled in one of the SEHSs, regardless of whether they are specifically in the SEHS program.

TABLE 3. MEANS OF AVERAGE SCHOOL CHARACTERISTICS BY SELECTION RULE (S.D. IN PARENTHESES)

	Tier 1 (Lowest SES)		Tier 4 (Highest SES)	
School level characteristic	Not admitted to a SEHS	Admitted to a SEHS	Not admitted to a SEHS	Admitted to a SEHS
Percent of grade 9 students on track for graduation	74.9 (11.7)	85.6 (9.4)	76.4 (11.1)	86.7 (10.4)
Percent of students enrolled in AP classes	16.7 (9.1)	27.0 (10.3)	19.2 (10.1)	32.1 (14.1)
Average ACT composite score	17.8 (2.3)	21.1 (2.9)	19.6 (2.6)	22.9 (3.3)
5-year Cohort Graduation Rates	69.4 (13.3)	82.4 (11.9)	73.7 (13.1)	85.3 (11.7)
Percent of grads enrolling in college	60.7 (13.3)	74.6 (12.9)	68.6 (11.3)	79.0 (9.9)
Percent of college enrollees enrolled for a second year	70.7 (9.4)	82.8 (10.1)	78.9 (7.9)	87.2 (7.3)
Year-end attendance rate	87.5 (6.9)	91.9 (4.9)	88.5 (5.12)	92.7 (4.5)
Percent of students receiving an out-of-school suspension	21.0 (13.3)	9.1 (8.8)	13.3 (8.2)	5.6 (6.8)
Herfindahl-Hirschman index of racial concentration	0.670 (0.229)	0.546 (0.231)	0.441 (0.210)	0.373 (0.172)
Percent male	48.0 (9.8)	44.7 (5.6)	49.0 (6.8)	45.3 (4.3)
Percent of students with an IEP	11.7 (4.2)	7.9 (3.7)	10.8 (4.4)	7.6 (3.7)
Percent of students eligible for free/reduced-price lunch	86.1 (13.0)	73.9 (15.4)	71.7 (15.0)	60.5 (15.5)
Total enrollment	1174.8 (853.5)	2060.0 (1557.4)	1881.6 (1110.3)	2357.7 (1440.1)
Average student report of parental support	0.209 (0.973)	0.495 (0.761)	0.242 (0.695)	0.654 (0.632)
Average student report of community support	-0.044 (0.943)	0.310 (1.341)	1.041 (0.916)	1.532 (1.165)
Average student report of classmates' views on importance of school	0.382 (0.406)	1.014 (0.632)	0.647 (0.513)	1.225 (0.583)
Teacher report on crime/disruption/violence	-0.267 (0.860)	-1.049 (0.746)	-0.363 (0.816)	-1.296 (0.783)
Teacher report on program continuity	0.089 (1.044)	0.175 (0.904)	-0.230 (1.106)	0.197 (0.989)
Teacher satisfaction with CPS	0.137 (1.228)	0.302 (1.015)	-0.340 (1.318)	0.323 (1.075)

Notes: Means are weighted by student such that schools enrolling more applicants from the analytic sample receive more weight. Admission to a SEHS is defined by the rule implied by the published cut-off scores. A student is considered "on-track" to graduate if she earns at least five full-year course credits (10 semester credits) and has no more than one semester F in a core course (English, math, science, or social science) in her first year of high school. The 5-year cohort graduation rate reflects the percent of first-time 9th grade students graduating high school as of 5-years after first-time 9th grade enrollment. Verified transfers out of the district are excluded from this calculation. Survey measures are standardized at the school level. See Appendix Table 1 for descriptions of the survey measures. “Teacher report on crime/disruption/violence”

has a negative valence such that lower values mean less crime, etc. School-level discipline data are unavailable in 2010 and 2011. 5-year cohort dropout and graduation rates as well as average ACT test scores are missing for recently opened schools. Additionally, charter schools do not report school-level transcript and discipline measures.

TABLE 4. REDUCED-FORM ESTIMATES OF THE EFFECTS OF ADMISSION TO AN SEHS ON ACADEMIC PERFORMANCE

	Standardized test score (PLAN) (grade 9)	Standardized test score (ACT) (grade 11)	GPA (grade 9)	GPA (grade 11)	High school graduation (4-year rate)	Enroll in any college the fall after graduation	Enroll in a selective college
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Counterfactual mean (std. dev.)	0.768 (0.653)	0.130 (0.602)	2.938 (0.783)	2.763 (0.823)	0.951 (0.216)	0.830 (0.375)	0.185 (0.389)
All tiers	-0.007 (0.017)	-0.021 (0.017)	-0.122 (0.039)	-0.097 (0.056)	-0.015 (0.018)	0.030 (0.026)	-0.062 (0.024)
Tier 1 (Lowest SES)	-0.035 (0.043)	-0.043 (0.056)	-0.342 (0.028)	-0.287 (0.108)	-0.021 (0.039)	0.025 (0.093)	-0.157 (0.042)
Tier 2	0.017 (0.050)	-0.008 (0.070)	-0.090 (0.073)	-0.082 (0.096)	-0.018 (0.013)	0.053 (0.080)	-0.078 (0.080)
Tier 3	0.032 (0.035)	-0.041 (0.047)	-0.055 (0.048)	-0.024 (0.103)	-0.019 (0.025)	0.043 (0.044)	-0.019 (0.071)
Tier 4 (Highest SES)	-0.050 (0.066)	0.001 (0.023)	-0.072 (0.054)	-0.053 (0.029)	-0.006 (0.016)	-0.005 (0.052)	-0.026 (0.062)
P-value: Tier 1 = Tier 4	0.853	0.546	0.004	0.038	0.632	0.806	0.111
Observations	12,332	12,176	11,540	10,925	8,966	5,370	5,370

Notes: We define "selective" as any college defined by Barron's as "Very Competitive Plus" (selectivity rank of 1, 2, 3, or 4). See Leonhardt (2013). A student's application score is centered around the cutoff for the school on their application with the lowest cutoff score. Bandwidth is limited to centered application scores within 0.5 standard deviations of the cutoff. Estimating equations include an indicator for admission to any SEHS, a quadratic in the centered application score, interactions between the admission indicator and the centered application quadratic terms, as well as application school-by-cohort-by-tier fixed effects. Estimates by tier come from a single regression with control variables fully interacted with tier indicators. The analytic sample includes only applicants with complete applications and who were enrolled in CPS in grades 8 and 9 in consecutive years. Students are first-time ninth graders in 2010-11, 2011-12, 2012-13, and 2013-14. Standard errors are clustered at the application school level.

TABLE 5. REDUCED-FORM ESTIMATES OF THE EFFECTS OF ADMISSION TO AN SEHS ON HIGH SCHOOL EXPERIENCE

	Incoming class rank	Takes any honors class	Spends >10 hours on homework per week	Quality of science courses	Personal safety	Peer relationships	Teacher-student trust	Sense of belonging at school	Distance to high school
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Counterfactual mean (std. dev.)	75.370 (22.384)	0.818 (0.386)	0.211 (0.408)	0.061 (0.847)	0.042 (0.951)	0.072 (0.924)	0.077 (0.965)	0.100 (0.981)	4.607 (4.013)
All tiers	-11.222 (2.462)	0.003 (0.023)	-0.033 (0.019)	0.054 (0.052)	0.227 (0.046)	0.141 (0.039)	0.067 (0.065)	0.054 (0.105)	0.051 (0.204)
Tier 1 (Lowest SES)	-17.542 (3.025)	0.019 (0.070)	0.005 (0.029)	0.094 (0.131)	0.184 (0.144)	0.051 (0.067)	-0.015 (0.160)	-0.098 (0.144)	-0.435 (0.355)
Tier 2	-10.472 (4.560)	-0.009 (0.042)	0.070 (0.024)	0.141 (0.083)	0.269 (0.090)	0.124 (0.140)	0.046 (0.145)	0.072 (0.159)	0.361 (0.470)
Tier 3	-10.587 (4.106)	0.000 (0.050)	-0.064 (0.050)	-0.139 (0.058)	0.229 (0.064)	0.191 (0.098)	0.174 (0.124)	0.108 (0.089)	0.387 (0.272)
Tier 4 (Highest SES)	-7.866 (1.006)	-0.004 (0.038)	-0.111 (0.048)	0.136 (0.172)	0.208 (0.049)	0.164 (0.073)	0.031 (0.100)	0.055 (0.193)	-0.231 (0.467)
P-value: Tier 1 = Tier 4	0.008	0.759	0.062	0.841	0.839	0.129	0.858	0.554	0.780
Observations	13,268	11,540	10,706	10,203	10,693	10,663	10,601	10,657	13,048

Notes: See notes for Table 4. Survey measures are standardized at the student level by cohort. Distance is measured in miles as the crow flies from Census block group of student residence to Census block group of high school attended.

TABLE 6. REDUCED-FORM ESTIMATES OF THE EFFECTS OF ADMISSION TO AN SEHS ON ACADEMIC PERFORMANCE: FREE OR REDUCED-PRICE LUNCH SAMPLE

	Standardized test score (PLAN) (grade 9)	Standardized test score (ACT) (grade 11)	GPA (grade 9)	GPA (grade 11)	High school graduation (4-year rate)	Enroll in any college the fall after graduation	Enroll in a selective college
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Counterfactual mean (std. dev.)	0.699 (0.618)	0.056 (0.564)	2.910 (0.796)	2.758 (0.804)	0.947 (0.225)	0.815 (0.389)	0.171 (0.376)
All tiers	-0.006 (0.025)	-0.022 (0.020)	-0.145 (0.039)	-0.141 (0.069)	-0.023 (0.024)	0.037 (0.018)	-0.062 (0.029)
Tier 1 (Lowest SES)	-0.037 (0.049)	-0.029 (0.065)	-0.348 (0.041)	-0.294 (0.097)	-0.029 (0.038)	-0.024 (0.106)	-0.148 (0.032)
Tier 2	-0.024 (0.057)	-0.043 (0.061)	-0.085 (0.065)	-0.108 (0.099)	-0.029 (0.010)	0.083 (0.081)	-0.057 (0.091)
Tier 3	0.029 (0.036)	-0.034 (0.043)	-0.093 (0.058)	-0.077 (0.094)	-0.035 (0.034)	0.058 (0.048)	-0.034 (0.071)
Tier 4 (Highest SES)	-0.012 (0.056)	0.036 (0.066)	-0.061 (0.087)	-0.101 (0.080)	0.015 (0.037)	-0.016 (0.055)	0.001 (0.085)
P-value: Tier 1 = Tier 4	0.757	0.411	0.029	0.062	0.004	0.956	0.159
Observations	9,144	9,058	8,431	7,963	6,732	4,048	4,048

Notes: See notes for Table 4. Sample is limited to students who were eligible for free or reduced-price lunch in 8th grade.

TABLE 7. REDUCED-FORM ESTIMATES OF THE EFFECTS OF ADMISSION TO AN SEHS ON HIGH SCHOOL EXPERIENCE: FREE OR REDUCED-PRICE LUNCH SAMPLE

	Incoming class rank	Takes any honors class	Spends >10 hours on homework per week	Quality of science courses	Personal safety	Peer relationships	Teacher-student trust	Sense of belonging at school	Distance to high school
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Counterfactual mean (std. dev.)	76.450 (21.668)	0.801 (0.399)	0.197 (0.398)	0.058 (0.852)	0.039 (0.955)	0.061 (0.927)	0.085 (0.964)	0.079 (0.982)	4.436 (3.885)
All tiers	-13.027 (3.481)	-0.007 (0.029)	-0.012 (0.027)	0.079 (0.055)	0.255 (0.062)	0.117 (0.060)	0.045 (0.070)	0.047 (0.102)	0.414 (0.244)
Tier 1 (Lowest SES)	-18.721 (3.618)	0.045 (0.069)	-0.006 (0.029)	0.059 (0.112)	0.186 (0.136)	-0.004 (0.072)	-0.078 (0.166)	-0.136 (0.134)	-0.363 (0.312)
Tier 2	-12.847 (5.370)	-0.023 (0.046)	0.095 (0.038)	0.145 (0.080)	0.252 (0.115)	0.124 (0.164)	0.007 (0.167)	0.060 (0.159)	0.558 (0.503)
Tier 3	-11.338 (4.896)	-0.020 (0.054)	-0.053 (0.046)	-0.122 (0.070)	0.273 (0.042)	0.179 (0.133)	0.186 (0.116)	0.142 (0.105)	0.696 (0.243)
Tier 4 (Highest SES)	-8.677 (1.219)	-0.045 (0.067)	-0.110 (0.049)	0.313 (0.154)	0.318 (0.138)	0.169 (0.110)	0.051 (0.093)	0.080 (0.220)	0.780 (0.559)
P-value: Tier 1 = Tier 4	0.008	0.759	0.062	0.841	0.839	0.129	0.858	0.554	0.780
Observations	13,268	11,540	10,706	10,203	10,693	10,663	10,601	10,657	13,048

Notes: See notes for Table 5. Sample is limited to students who were eligible for free or reduced-price lunch in 8th grade.

For Online Publication

Appendix Text, Figures, and Tables

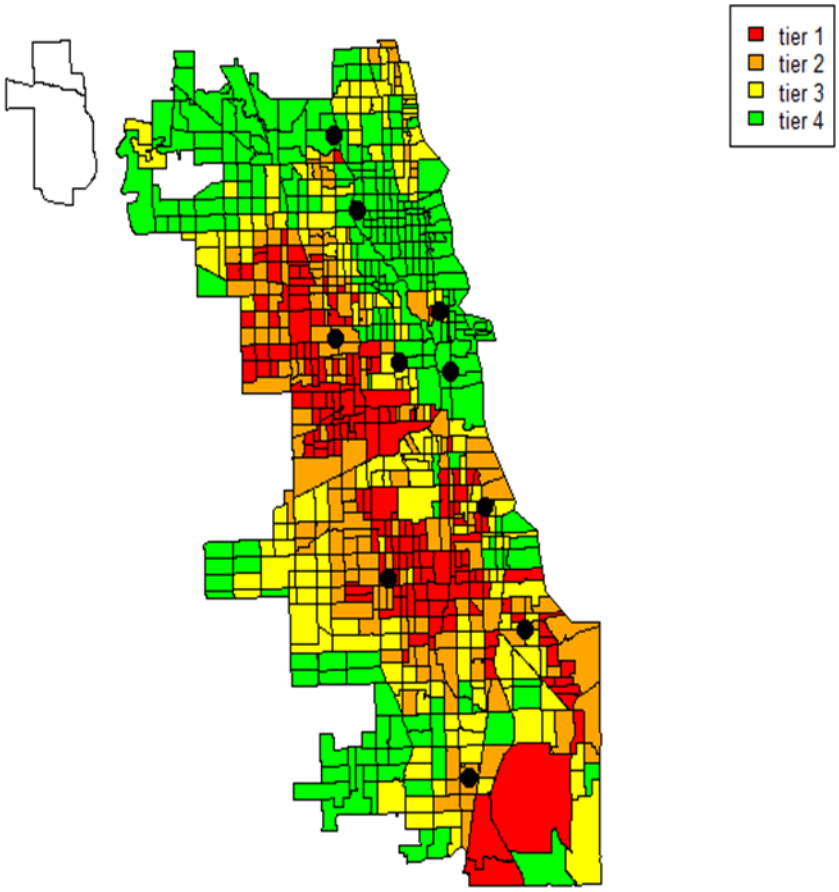
As stated by Lee and Lemieux (2010), the parametric and nonparametric RD estimates should be viewed as a complement to each other and as a way of confirming the specification of the model and the results. Section V in the paper described the estimated model and tables 4 and 5 presented the estimates limiting the sample to observations where the centered application score was within 0.5 standard deviations of the cutoff (approximately 77 points on each side of the cut point).[22] This appendix presents the results from our nonparametric estimation strategy.

We first calculate the optimal data-driven IK bandwidth for each of the cohort-school-neighborhood tier group as suggested in Imbens and Kalyanaraman (2012). We use a uniform kernel and assume a quadratic functional form as described in Section V of the main text. We limit the sample of observations in each cohort-school-neighborhood tier group using the IK bandwidth and estimate the parameters using this sample.

Appendix tables 6 and 7 present the results of the estimation for academic performance and high school experiences, respectively. For each outcome, we show the distribution of the bandwidths applied and how many of the cohort-school-neighborhood tiers are represented. In some instances, it was not possible to find an optimal bandwidth given the functional form and the data. The first thing to notice is that on average the IK bandwidth is somewhat narrower than the 0.5 standard deviation from the cutoff that we allowed in the main results presented in the paper. This leads to having fewer observations in the nonparametric estimation on both sides of the cutoff.

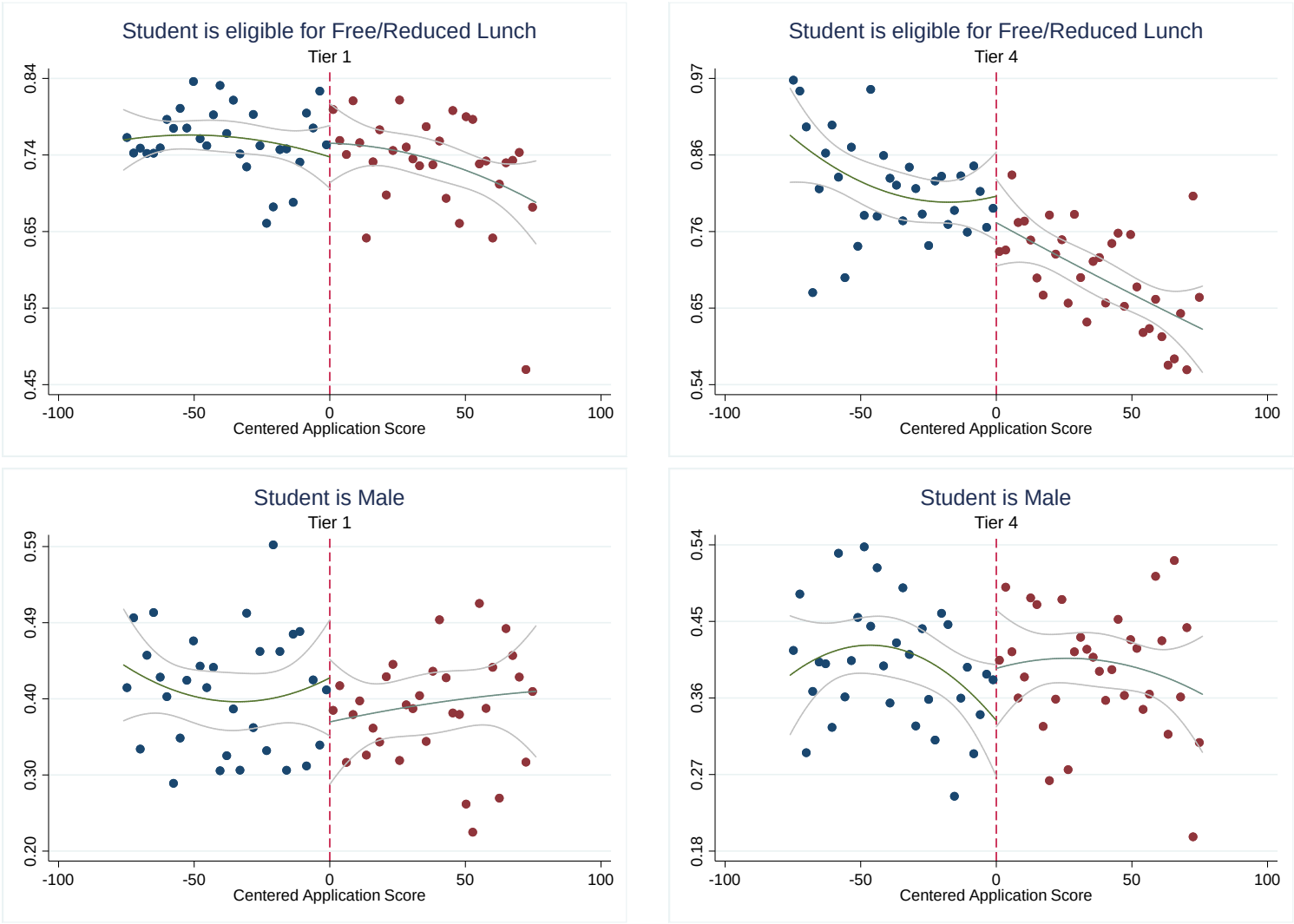
[22] In some sense, this is already a nonparametric approach because not all the observations are used to estimate the model.

The overall academic performance effects are very similar to the ones in Table 4.In terms of high school experiences the overall effects lose statistical significance for self-reports of science course quality and teacher-student trust. Differences among students from low-SES neighborhoods and high-SES neighborhoods emerge in the self-reports of sense of belonging at school. The effect for students from low-SES neighborhoods becomes negative in the nonparametric estimates driving the difference with students from high-SES neighborhoods to be larger and statistically significant (p-value = 0.037). In general, we find the nonparametric estimates are very similar to the main results reported in the report.

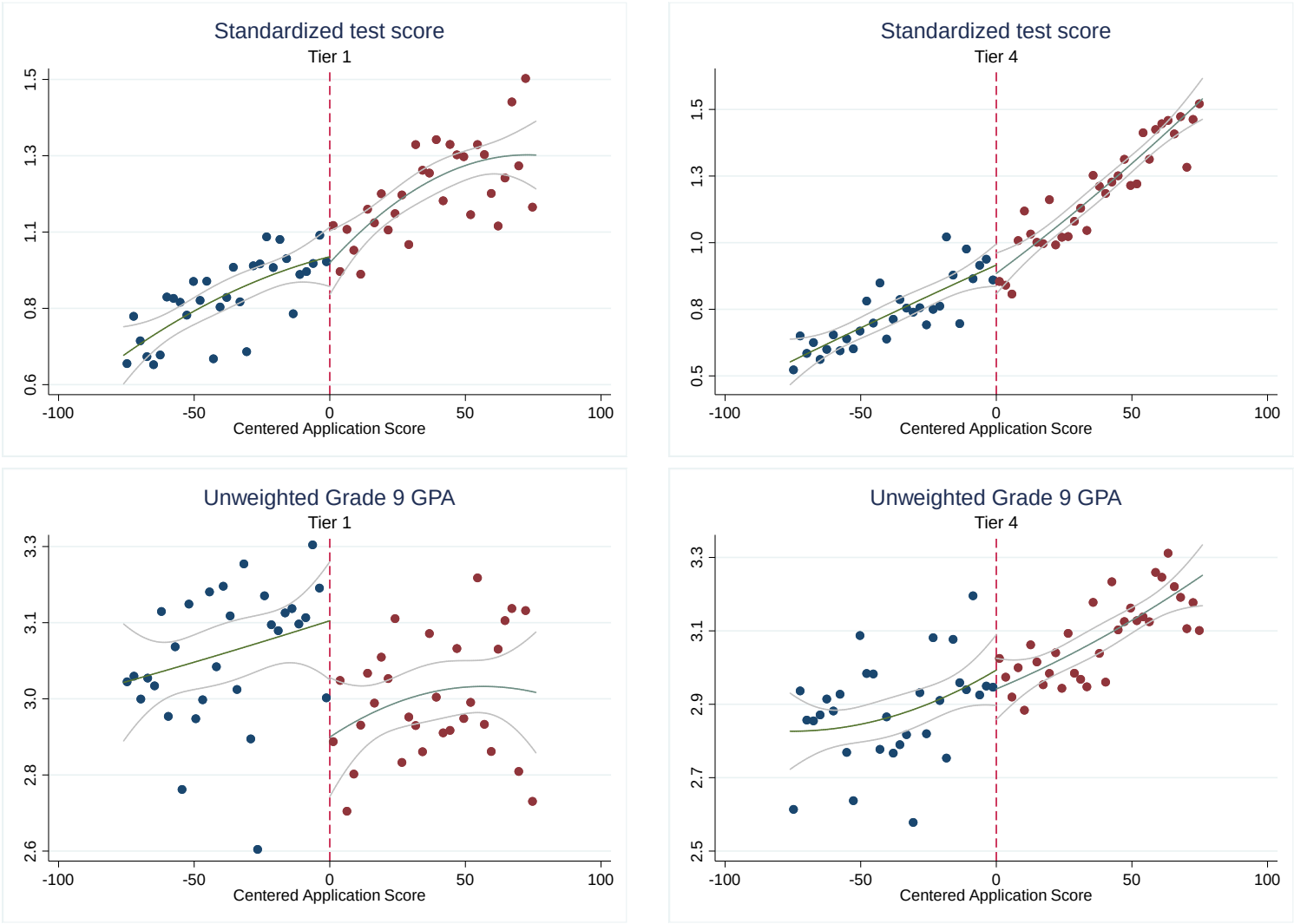


APPENDIX FIGURE 1. MAP OF CHICAGO CENSUS TRACT TIERS AND THE LOCATIONS OF SELECTIVE ENROLLMENT HIGH SCHOOLS

Notes: Each dot represents the location of a Chicago selective high school that was open during the study period,



APPENDIX FIGURE 2. RELATIONSHIP BETWEEN THE CENTERED APPLICATION SCORE AND PRE-TREATMENT CHARACTERISTICS



APPENDIX FIGURE 3. RELATIONSHIP BETWEEN THE CENTERED APPLICATION SCORE AND OUTCOMES

APPENDIX TABLE 1. SCHOOL-LEVEL SURVEY MEASURES

Student report of parental support	*How often do your parents do the following?* • Encourage you to work hard at school • Are supportive of the things you like to do outside of school • Listen to you when you need to talk • Show they are proud of you • Take time to help you make decisions
Student report of community support	*How much do you agree with the following statements about the community in which you live?* • Adults in this neighborhood know who the local children are. • During the day it is safe for children to play in the local park or playground. • People in this neighborhood can be trusted. • There are adults in this neighborhood that children can look up to. • The equipment and buildings in the neighborhood, park, or playground are well kept.
Student report of classmates' views on the importance of school	*How many of the students in your target class?* • Feel it is important to come to school every day • Feel it is important to pay attention in class • Think doing homework is important • Try hard to get good grades
Teacher report on crime and disorder at the school	*To what extent is each of the following a problem at your school?* • Physical conflicts among students • Robbery or theft • Gang activity • Disorder in classrooms • Disorder in hallways • Student disrespect of teachers • Threats of violence toward teachers
Teacher report on program continuity	*To what extent do you disagree or agree with the following?* • Once we start a new program we follow up to make sure that it's working. • We have so many different programs in this school that I can't keep track of them all. • Many special programs come and go at this school. • Curriculum, instruction, and learning materials are well coordinated across the different grade levels at this school. • There is consistency in curriculum, instruction, and learning materials among teachers in the same grade level at this school.
Teacher satisfaction with CPS	*To what extent do you agree or disagree with the following statements?* • I would recommend CPS as a great place to work for my friends. • If I were offered a comparable teaching position with similar pay and benefits at another district, I would stay with CPS. • My school leader encourages me to come up with new and better ways of doing things. • I am satisfied with the recognition I receive for doing my job. • The people I work with at my school cooperate to get the job done. • I have access to the resources (materials, equipment, technology, etc.) I need in order to effectively teach my students.

APPENDIX TABLE 2. ADMISSIONS CUTOFFS BY SCHOOL, TIER, AND YEAR

Tier	2010-11 Cohort	2011-12 Cohort	2012-13 Cohort	2013-14 Cohort
		Brooks		
1	688	650	681	675
2	699	697	720	701
3	746	741	758	745
4	758	727	756	715
		Jones		
1	797	780	775	757
2	826	810	816	811
3	847	847	854	840
4	852	865	875	867
		King		
1	672	650	657	650
2	676	671	663	650
3	678	690	691	650
4	665	652	651	650
		Lane Tech		
1	736	688	737	713
2	761	734	768	770
3	771	770	813	804
4	789	782	839	831
		Lindblom		
1	660	651	685	665
2	660	696	706	716
3	660	708	732	708
4	662	686	716	675
		Northside		
1	850	792	792	782
2	850	828	835	837
3	863	872	882	878
4	882	891	895	891
		Payton		
1	855	806	822	801
2	862	833	861	845
3	877	869	885	871
4	889	889	896	892
		Southshore		
1				653
2				653
3				650
4				651

		Westinghouse		
1	701	676	704	691
2	727	717	728	723
3	705	728	738	717
4	702	705	718	689
		Young		
1	818	784	800	803
2	832	802	822	840
3	852	837	864	859
4	864	865	879	876

Notes: Table compiled using publically released admissions cutoff scores in each year by tier available from CPS.

APPENDIX TABLE 3. DESCRIPTION OF STUDENT-LEVEL SURVEY MEASURES ON HIGH SCHOOL EXPERIENCE

Time spent on homework	*How much time do you spend studying or doing homework for ALL your classes?* • Less than 2 hours • 3-5 hours • 6-9 hours • 10-14 hours • 15 or more hours
Quality of science course	*How often do you do the following?* • Use laboratory equipment or specimens • Write lab reports • Generate your own hypotheses • Use evidence/data to support an argument or hypothesis • Find information from graphs and tables
Personal safety (reverse coded)	*How much do you agree with the following statements about your school?* • I worry about crime and violence at this school • Students at this school are often teased or picked on • Students at this school are often threatened or bullied
Peer relationships	*How much do you agree with the following statements about students in your school?* *Most students in my school:* Strongly Disagree, Disagree, Agree, Strongly Agree • Like to put others down • Help each other learn • Don't get along together very well • Treat each other with respect
Teacher-student trust	*How much do you agree with:* Strongly Disagree, Disagree, Agree, Strongly Agree • My teachers really care about me • My teachers always keep his/her promises • My teachers always try to be fair • I feel safe and comfortable with my teachers at this school • When my teachers tell me not to do something, I know he/she has a good reason • My teachers will always listen to students' ideas • My teachers treat me with respect
Sense of belonging	*How much do you agree with the following statements about your school?* • I feel like a real part of my school • People here notice when I'm good at something • Other students in my school take my opinion seriously • People at this school are friendly to me • I'm included in lots of activities at school • I'm excited to go to school every day

APPENDIX TABLE 4. BASELINE CHARACTERISTIC DISCONTINUITIES

	Overall	Tier 1	Tier 2	Tier 3	Tier 4
African American	-0.006	-0.077	-0.003	0.002	0.037
	(0.021)	(0.052)	(0.045)	(0.039)	(0.031)
Latino	0.026	0.073	-0.007	0.049	-0.006
	(0.024)	(0.053)	(0.048)	(0.047)	(0.043)
Male	-0.045	-0.019	-0.132	-0.097	0.064
	(0.025)	(0.056)	(0.050)	(0.049)	(0.049)
Free or reduced-price lunch	0.022	0.008	0.001	0.086	-0.012
	(0.019)	(0.033)	(0.033)	(0.038)	(0.045)
Attended assigned elementary school	0.015	0.004	-0.014	0.086	-0.022
	(0.026)	(0.057)	(0.051)	(0.049)	(0.049)
P-value	0.359	0.770	0.205	0.038	0.644
Number of observations	13,299	2,732	3,152	3,614	3,801

Notes: Sample is limited using distance from the cutoff scores as in tables 4 and 5. Discontinuities are estimated using seemingly unrelated regression. Each covariate equation includes an indicator for admission to any SEHS, a quadratic in the centered application score, and application school-by-cohort-by-tier fixed effects. The p-value reported is for the chi-squared test that the discontinuities are jointly equal to zero.

APPENDIX TABLE 5. OUTCOME MEANS

Outcome variable	All Applicants	Analytic Sample	Tier 1 Analytic Sample admit = 0	Tier 2 Analytic Sample admit = 0	Tier 3 Analytic Sample admit = 0	Tier 4 Analytic Sample admit = 0
Standardized test score (PLAN)	0.587	1.003	0.530	0.660	0.808	1.029
Standardized test score (ACT)	-0.013	0.359	-0.106	0.019	0.163	0.403
GPA (grade 9)	2.767	3.002	2.818	2.884	2.966	3.048
GPA (grade 11)	2.641	2.785	2.695	2.734	2.768	2.833
High school graduation (4-year rate)	0.913	0.953	0.939	0.942	0.958	0.961
Enroll in any college the fall after graduation	0.784	0.847	0.769	0.811	0.839	0.891
Enroll in a selective college	0.171	0.223	0.146	0.174	0.192	0.221
Incoming class rank	63.999	69.345	75.401	75.772	77.057	73.030
Takes any honors or AP class	0.683	0.862	0.764	0.771	0.860	0.856
Spends >10 hours on homework per week	0.193	0.260	0.176	0.170	0.217	0.274
Self-reports of science course quality	0.067	0.096	0.101	0.060	0.078	0.010
Self reports of personal safety	0.147	0.243	0.093	0.021	0.011	0.055
Self reports of peer relationships	0.122	0.247	0.015	0.051	0.092	0.118
Self reports of teacher-student trust	0.078	0.164	0.082	0.083	0.090	0.052
Self reports of sense of belonging at school	0.111	0.198	0.109	0.058	0.116	0.116
Distance in miles from high school	4.740	5.232	4.277	4.273	4.678	5.152

Notes: "All Applicants" includes all CPS students who completed a Selective Enrollment High School application, were first-time 9th grade students, were enrolled in CPS for both 8th and 9th grade, but did not have an Individualized Education Program in 8th grade. . Our analytic sample limits the students to those within a one-half standard deviation of the cut-score for each SEHS. "admit = 0" is indicates that the student was not offered a seat at a SEHS based on the published cutoff scores.

APPENDIX TABLE 6. NONPARAMETRIC REDUCED-FORM ESTIMATES OF THE EFFECTS OF ADMISSION TO AN SEHS ON ACADEMIC PERFORMANCE

	Standardized test score (PLAN) (grade 10)	Standardized test score (ACT) (grade 11)	GPA (grade 9)	GPA (grade 11)	High school graduation (4-year rate)	Enroll in any college the fall after graduation	Enroll in a selective college
	(1)	(2)	(3)	(5)	(6)	(7)	(8)
Control mean	0.690	0.048	2.884	2.745	0.947	0.827	0.179
(std. dev.)	(0.625)	(0.581)	(0.798)	(0.809)	(0.224)	(0.379)	(0.383)
All tiers	-0.025	-0.011	-0.092	-0.056	-0.013	0.021	-0.058
	(0.025)	(0.021)	(0.033)	(0.064)	(0.016)	(0.025)	(0.017)
Tier 1	-0.032	-0.064	-0.314	-0.292	0.000	0.023	-0.117
	(0.044)	(0.039)	(0.054)	(0.112)	(0.038)	(0.085)	(0.033)
Tier 2	-0.037	-0.026	-0.118	-0.119	-0.024	0.069	-0.059
	(0.039)	(0.065)	(0.070)	(0.100)	(0.011)	(0.073)	(0.087)
Tier 3	0.032	-0.031	-0.034	-0.045	-0.022	0.046	-0.038
	(0.045)	(0.041)	(0.062)	(0.116)	(0.023)	(0.050)	(0.071)
Tier 4	-0.078	0.051	-0.018	0.064	0.013	-0.049	-0.046
	(0.076)	(0.026)	(0.042)	(0.059)	(0.024)	(0.046)	(0.064)
P-value: Tier 1 = Tier 4	0.640	0.093	0.013	0.015	0.768	0.560	0.357
MSE optimal bandwidth							
Average	63.5	63.1	66.3	65.7	73.8	63.3	59.4
	(18.2)	(19.1)	(21.6)	(19.6)	(33.5)	(16.8)	(17.4)
Minimum	18.3	21.5	24.4	12.7	22.3	31.0	33.0
Maximum	110.1	105.5	114.3	118.5	235.6	97.3	101.5
# cohort-school-neighborhood tiers	91	92	93	90	63	45	44
Observations	9,241	9,216	9,079	8,263	7,405	4,035	4,058

Notes: Bandwidth is selected using a quadratic uniform kernel for each of the 146 comparisons in the analyses, cohort-school-neighborhood tiers groups. Regressions are limited to students with complete applications. Estimating equations include an indicator for admission to any SEHS, a quadratic in the centered application score, interactions between the admission indicator and the centered application quadratic terms, as well as application school-by-cohort-by-tier fixed effects. Estimates by tier come from a single regression with control variables fully interacted with tier indicators. The analytic sample includes only applicants enrolled in CPS in grade 8 and grade 9 in consecutive years. Students are first-time ninth graders in 2010-11, 2011-12, 2012-13, and 2013-14.

APPENDIX TABLE 7. NONPARAMETRIC REDUCED-FORM ESTIMATES OF THE EFFECTS OF ADMISSION TO AN SEHS ON HIGH SCHOOL EXPERIENCE

	Incoming class rank	Takes any honors class	Spends >10 hours on homework per week	Quality of science course	Personal safety	Peer relationships	Teacher-student trust	Sense of belonging at school	Distance to school
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Control mean	74.5	0.796	0.197	0.065	0.043	0.062	0.065	0.098	4.698
(std. dev.)	(22.8)	(0.403)	(0.397)	(0.860)	(0.959)	(0.947)	(0.969)	(0.980)	(4.040)
All tiers	-10.995	-0.012	-0.029	0.032	0.215	0.127	0.051	0.035	0.235
	(2.004)	(0.035)	(0.017)	(0.043)	(0.058)	(0.036)	(0.059)	(0.104)	(0.222)
Tier 1	-16.102	0.035	0.010	0.113	0.088	0.014	-0.017	-0.135	-0.526
	(3.388)	(0.080)	(0.026)	(0.105)	(0.143)	(0.083)	(0.142)	(0.174)	(0.405)
Tier 2	-10.381	-0.001	0.069	0.107	0.233	0.054	0.048	-0.062	0.638
	(4.142)	(0.042)	(0.023)	(0.058)	(0.107)	(0.136)	(0.098)	(0.163)	(0.516)
Tier 3	-11.757	-0.017	-0.036	-0.148	0.250	0.184	0.129	0.118	0.378
	(4.179)	(0.039)	(0.068)	(0.020)	(0.060)	(0.065)	(0.111)	(0.085)	(0.186)
Tier 4	-9.430	0.005	-0.099	0.039	0.246	0.235	0.070	0.101	0.390
	(1.252)	(0.040)	(0.048)	(0.125)	(0.068)	(0.076)	(0.130)	(0.212)	(0.455)
P-value: Tier 1 = Tier 4	0.133	0.667	0.121	0.648	0.188	0.043	0.719	0.440	0.218
IK bandwidth									
Average	62.9	76.7	64.6	62.5	64.5	563.2	63.1	63.2	72.9
	(17.7)	(36.3)	(17.7)	(17.3)	(18.0)	(18.2)	(16.8)	(17.7)	(41.6)
Minimum	26.4	24.9	23.9	23.2	19.6	21.9	25.7	21.3	17.1
Maximum	105.9	331.8	109.6	114.6	112.7	122.0	106.8	104.2	106.7
# cohort-school-neighborhood tiers	93	90	91	91	91	91	91	90	94
Observations	9,976	10,057	8,334	7,651	8,127	7,984	8,082	8,003	9,584

Notes: Bandwidth is selected using a quadratic uniform kernel for each of the 146 comparisons in the analyses, cohort-school-neighborhood tier groups. Regressions are limited to students with complete applications. Estimating equations include an indicator for admission to any SEHS, a quadratic in the centered application score, interactions between the admission indicator and the centered application quadratic terms, as well as application school-by-cohort-by-tier fixed effects. Estimates by tier come from a single regression with control variables fully interacted with tier indicators. The analytic sample includes only applicants enrolled in CPS in grade 8 and grade 9 in consecutive years. Students are first-time ninth graders in 2010-11, 2011-12, 2012-13, and 2013-14.

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