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The achievement and course-taking effects of magnet schools: Regression-discontinuity evidence from urban China

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ABSTRACT

We examine the effects of attending elite magnet schools on the subsequent academic performance of high-school students in urban China. Using a novel data set of the students who entered high school from 2006 to 2008 in a Chinese city, our fuzzy regression discontinuity estimates exploit the threshold values of the high school entrance exam scores. Passing the thresholds significantly reduces the financial cost and raises the probability of attending a magnet school. However, attending such an elite school does not meaningfully improve the academic performance of the marginal student.

1. Introduction

The notion that school attendance generates meaningful improvements in human capital and subsequent economic success is an uncontroversial one. Similarly, there is compelling evidence that the variation in quality across schools is considerable in most settings, including China (e.g., Lai, Sadoulet, & Janvry, 2011). Parents and students frequently expend considerable effort and resources to secure a seat in what they perceive as selective, high-performing schools. Such elite schools are typically characterized by high-quality peers, rigorous curricula, and ample resources. However, an active and recent empirical literature has provided mixed evidence on whether attending elite secondary schools actually leads to unique improvements in the performance of the marginal entrant. For example, using a fuzzy regression discontinuity (RD) design, Abdulkadiroglu, Angrist, and Pathak (2014) show that attending an elite exam school in Boston or New York does not improve students' academic achievement. An RD study by Dobbie and Fryer (2014) also suggests that elite exam schools in New York City do not generate significant improvements in longer-term student outcomes. Similarly, an RD study based on selective schools in the United Kingdom finds little benefit in terms of improved academic performance (Clark, 2010). In contrast, RD estimates based on data from developing countries such as Romania (Pop-Eleches & Urquiloa, 2013), Mexico (de Janvry, Dustan, & Sadoulet, 2012), and Trinidad and Tobago (Jackson, 2010) suggest that attending elite schools does meaningfully enhance student outcomes.

This study contributes to this growing literature by presenting new evidence based on unique student-level data from a school district in a large city in northern China. Private schools are rare in China and students are instead sorted to conventional public and elite magnet high schools based in large part on their performance on the high school entrance exam (HSEE). Students with higher HSEE scores are significantly more likely to attend a magnet high school.

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On average, students enrolled in magnet schools perform much better than students in regular schools on various high school exams, including the high-stakes college entrance exam (CEE) that determines opportunities for college enrollment.

To separate the effect of school quality on academic performance from the effect of positive selection into magnet schools, we use a fuzzy RD design that leverages the threshold values of the HSEE at which a student with a low HSEE score can attend an elite magnet school by paying a high "selection fee." Despite a "jump" in the probability of attending a magnet school among the students whose HSEE score is just above the threshold, the RD estimates provide no clear evidence that attending such a school influences the test performance of the marginal entrant on low-stakes annual city exams in high school. Our RD estimates, though statistically imprecise, also suggest that magnet schools do not significantly increase the probability of taking the CEE. However, we note that the graphical evidence from this RD design is consistent with the hypothesis of small but positive effects on this important form of test participation. In contrast, conditional on the CEE attendance, there is no positive effect of magnet schools on the CEE scores. Our OLS estimates, conditional on a parsimonious set of controls (e.g., demographic traits and baseline HSEE scores), are consistent with the RD estimates.

The RD analysis specifically targets the marginal students who pay the high selection fee, a long-standing and highly controversial pricing practice in China. Due to limited magnet schools and strong demand for high-quality educational resources, the selection fee has grown very fast and the central government has tried to curb it since 2003.[1] However, rent-seeking activities and corruption are still prevalent. One *New York Times* article (Levin, 2012, November 21) reports that for students whose HSEE scores are lower than the official threshold of an elite high school in Beijing, they can obtain an extra point for each $4800 their parents contribute to the school. In another elite high school in Beijing, students with a low HSEE score can pay a lump-sum fee of $80,000 to $130,000 for admission. Our results show that there is no significant improvement in academic performance in high school among those students who pay the high fee. Even if their participation in the CEE increases somewhat, their CEE scores do not appear to improve.

We organize the paper as follows. Section 2 introduces the institutional background of Chinese high schools. Section 3 describes the data. Section 4 explains the framework of the fuzzy RD specifications. Section 5 reports and interprets the estimation results. Section 6 concludes.

2. Institutional background

After nine years of compulsory education, Chinese students must pass a city-wide unified HSEE to enter high school. Scores in the HSEE largely determine whether a student can attend a magnet high school. In most cities, there are three thresholds of the HSEE: the highest one for magnet high schools without paying extra fees, the middle one for paying fees to attend a magnet school, and the lowest one for regular high schools without paying extra fees.[2] The thresholds vary year by year, according to relative performance on the annual HSEE and the capacities of high schools. Curriculum and textbooks in all high schools are usually identical within a city. The superior performance of students at magnet schools is attributed to the perception that they have better teachers and supportive peer environments. In order to compensate for limited funding from governments and to retain high-quality teachers and maintain facilities, magnet high schools are allowed to lower their official threshold to a certain point to enroll extra students by charging a significant "selection fee."

We use administrative data collected from the local bureaus of education in one large city in Inner Mongolia, a northern province in China.[3] The city had a population of over 1 million, with a GDP per capita of over $10,000 in 2009. This is a relatively rich city in China thanks to its abundant natural resources.[4] There were more than 100,000 enrolled students in middle and high school in 2009 (National Bureau of Statistics, 2009). The city has several school districts, but only one district maintains detailed historical data of all test scores and student information. This district has 12 high schools, including three magnet schools and nine regular schools.

In this city, like in most other Chinese cities, the HSEE covers five main subjects: Chinese, English, math, comprehensive sciences (physics, chemistry, and biology), and social studies (history, geography, and politics). The total possible score is 680. A typical lowest threshold is set at approximately 350, the middle at 460, and the highest at 480. The grading of the HSEE is completely anonymous, and the graders cannot see any personal information about students. During the grading process, graders are isolated in hotels and are not allowed to go home or contact people outside the hotel until the grading is finished. Each grader only grades some questions in one test subject, and the total score of the HSEE represents the sum of grades given by multiple graders. The thresholds are based on the general distribution of grades for all students, which is only known after all the grading is finished. These grading rules essentially preclude the manipulation of the HSEE scores around the threshold.

Fig. 1 illustrates these thresholds for entering different types of high schools. Students who do not pass the lowest threshold usually do not attend high school. Students who only pass the lowest threshold can choose a regular high school within the district and pay tuition of about $120 per year. Students who pass the highest threshold can choose a magnet school to attend for the same modest tuition. For

[1] In 2003, the Ministry of Education announced a so-called "three-limits" policy. Local governments must establish a limit on the amount of selection fee, a limit on the number of students who can be enrolled by paying the fee, and a limit on the minimum HSEE score that students must pass in order to be eligible for paying the fee.

[2] Regular high schools usually do not lower their thresholds for charging selection fees due to limited demand for their services. Students whose HSEE scores are very low usually do not attend any high school.

[3] As a part of the agreement with the local bureau of education, the identity of this city is not revealed.

[4] In 2009, the median GDP per capita among Chinese cities was about $4800, and the median was $7100 among cities in Inner Mongolia (National Bureau of Statistics, 2009).

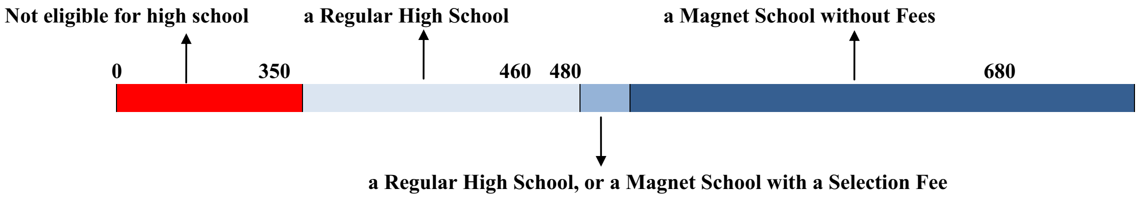

Fig. 1. The typical thresholds of HSEE scores for high school. This figure illustrates the typical thresholds for entering different types of high schools, based on the HSEE scores. The total HSEE score is 680. These thresholds change every year with the distribution of the HSEE scores and capacities of high schools.

those whose scores are between the middle and the highest threshold, [460,480] in Fig. 1, they can either pay a regular tuition and attend a regular high school, or pay a "selection fee" of about $3000 to attend a magnet school. The fee is a lump sum for the three years of study, and students still have to pay the regular tuition. Not surprisingly, most parents opt to pay the fee for a better school. The threshold for the selection fee is jointly determined by the city government and magnet schools, and the collected fee is also shared by the government and the schools. In practice, magnet schools also enroll students whose HSEE scores are below the official threshold for the selection fee but do so by privately charging a much higher fee. In this school district, the private fee ranges from $6000 to $10,000, depending on the bargaining power of a student's parents (determined by their connection with a certain magnet school or with the local government). The magnet schools keep all those private fees and usually use it to subsidize their teachers, whose salaries are fixed and determined by the government.

All high school students study the same curriculum in the first year. At the beginning of the second year, students must choose one study track: either science or social studies. In principle, the curriculum is still the same for all students in the second year and only differs in the third year. In reality, after the division, the students in the science track focus much more on subjects such as physics and chemistry, while the students in the social studies focus much more on subjects such as history. At the end of the third year, students who want to attend a college must pass the National College Entrance Exam (CEE).[5] The CEE includes four subjects, and all students regardless of study track must take three common tests: Chinese, English, and math.[6] Those students in the science track take the Comprehensive Sciences test, and those students in the social studies track take the Comprehensive Social Studies test. Generally, students in the science track are only allowed to choose college majors related to science, and students in the social studies track are only allowed to choose majors related to the social sciences and humanities. Thus, the choice of study track in high school roughly determines the choice of major in college.

Throughout the three years of high school, the city also conducts an annual test (CT). Unlike the optional CEE, the annual CT is required for earning a high school diploma. Another goal of the test is to improve students' comprehensive skills, in order to avoid an education that is biased towards training exclusively for the CEE. Thus, a typical CT includes nine subjects: Chinese, English, math, politics, history, geography, biology, chemistry, and physics. All students must take the same exam in the first two years, and only the third year exam differs by study track. Compared to the CEE, which determines college enrollment and is generally perceived as the most important exam in China, the CTs are low-stakes and much less stressful (at least for students near the selection fee threshold who are highly likely to complete high school).

3. Data

The administrative data from the local bureau of education consist of students who graduated from middle school between 2006 and 2008 and attended one of 12 high schools in the school district. We match the HSEE scores with academic and demographic records in high schools, by year, gender, and name. The academic records include test scores in three annual CTs for each subject, and the demographic information includes gender, birth year, and minority status. We further match the data with the total scores on the CEE after three years in high school, from 2009 to 2011.[7]

The data record the HSEE scores for 14,245 students, and we were able to match 6673 of them with their records in high school. There are four sources of data attrition. First, the year-gender-name matching algorithm generates multiple matches for 2048 students, and we treat all these multiple matches as attrition. Since the algorithm has used all available information in both the HSEE data and the data in high school, we are not able to further refine these multiple matches. Given the huge population in China and the limited number of Chinese characters, it is very common that many Chinese people have the same name, of which usually consists only two or three characters, including the surname. The census reports that the top 10 most popular surnames cover 529 million people, and anecdotal evidence suggests that the top 10 most popular names are shared by over 2.5 million people.[8] Second, 2316 students do not pass the lowest threshold for attending a high school. They usually do not

[5] Some provinces in China are allowed to use the province-level CEE. The CEE in the province in our data is jointly conducted with several neighboring provinces in northern China.

[6] The math exam for students in the track of sciences is more difficult than in the track of social studies. The other two exams are exactly the same for all students.

[7] We do not have subject-specific data of the CEE scores.

[8] For the census report, see http://www.sootoo.com/content/524698.shtml (in Chinese, last accessed on May 21, 2015). For the two statistics of the most popular Chinese names, see the two online reports from Sina: http://news.sina.com.cn/s/2014-11-12/172031133494.shtml (in Chinese, last accessed on May 21, 2015); http://news.sina.com.cn/s/2007-07-25/144113525318.shtml (in Chinese, last accessed on May 21, 2015). All these popular names share one of the top 4 most popular surnames. In principle, a single match generated by our algorithm could also be a wrong

attend any high school. Third, 3190 students pass the lowest threshold for attending high school but do not attend one of the 12 high schools in the school district. They could move to other districts or even other cities for high school, or they may not attend high school at all. Finally, for 18 matched students, the ID of their high school is missing and we are not able to determine what type of high school they attended.

For student i who graduates from middle school in year t, we standardized their scores s_{it} in the HSEE around the threshold for the selection fee in each year, $selection_t$:

$$s_{it} = \frac{hsee_{it} - selection_t}{(standard\ deviation\ of\ hsee_{it})_t} \tag{1}$$

A student is eligible to attend a magnet school conditional on paying an official selection fee if $s_{it} \geq 0$. Appendix A shows that the probability of attrition varies with the standardized HSEE scores, s_{it}. Particularly, when students reach the threshold for attending a local magnet school without paying extra fees, they are more likely to stay in the district and there is a sharp decrease in the probability of attrition. This decrease in the probability of attrition could be related to unobserved family income: students from low-income family are more likely to attend a local magnet school when it is free. To avoid the sample selection bias caused by potential relationship between unobserved family income and academic performances, we drop all students whose HSEE scores are higher than these thresholds: 0.329 in the year of 2006, 0.372 in 2007, and 0.227 in 2008. Furthermore, we only use students whose scores are in the symmetric interval of $[-0.329, 0.329]$ in the year of 2006, $[-0.372, 0.372]$ in 2007, and $[-0.227, 0.227]$ in 2008. These intervals are close to the discontinuity point $s_{it} = 0$ and are the key of identification in a discontinuity design framework. Students whose HSEE scores are within these intervals all face similar options: they could attend a local regular high school for free, or they could pay extra fees to attend a local magnet school. These intervals include 3381 records on the HSEE scores, and 1690 of them are matched with academic records in local high schools. Appendix A shows that the probability of attrition does not change at the selection fee threshold $s_{it} = 0$.

There are three magnet schools in this district, and we bundle them together and treat them as one. These three schools are known to have similar educational quality. In order to compete for students, they use the same selection fee threshold $s_{it} = 0$. Consistent with the perception of their quality, Appendix B shows that there is no significant difference in academic performance between the three magnet schools.

Table 1 shows the summary statistics of the analytical sample of 1690 students (the matched sample within the three intervals defined above) and of the whole matched sample of 6673 students. In terms of student characteristics and the probability of attending a magnet school, the two samples are almost identical. Both samples include about 50% of girls and 9% of minorities. The two samples are also very close in the probability of studying in science track in high school and in the probability of attending the CEE at the end of high school.

One comprehensive measure of academic performance in high school is the average score of the three annual CTs in high school. The CT is designed to test basic knowledge learned in high school, and it is easier and less stressful than the CEE. By covering comprehensive subjects, another goal of the CT is to prevent teachers from training students only for the CEE. The outcome of the CT is not used for evaluating teachers. Compared to the one-time, stressful CEE, the average score of the three CTs could be a more accurate measure of the general human capital acquired in high school. The CT is mandatory, and thus the probability of missing data is very low, ranging from 4% to 5% for different subjects in the analytical sample. As a comparison, Table 1 shows that only 75% of students attend the CEE. In terms of the CT and the CEE scores, the whole matched sample is more variable than the analytical sample, since the latter only includes a very narrow interval in the middle of the distribution of baseline HSEE scores.

4. Fuzzy regression discontinuity design

To separate the effect of school quality on academic performance from the effect of student ability, we exploit the enrollment rule of magnet schools. Around the selection-fee threshold of the HSEE scores, the price of attending a magnet school changes dramatically and the probability of being enrolled in a magnet school jumps. Students whose scores are just below or above the threshold are assumed to have similar academic ability, and the fuzzy regression discontinuity design uses the variation in the probability of attending a magnet school to identify the causal effect of school quality. Among those students who attend a high school, the enrollment rule could in principle create two jumps in the probability of attending a magnet school. One is at the higher threshold for the enrollment without paying extra fees, and the other is at the lower threshold for enrollment by paying a selection fee of about \$3000. We considered also using the discontinuity for higher-scoring students, which makes magnet schools virtually free. However, we found that the internal validity of an RD design based on this threshold might be suspect because students with scores just below this value were more likely to attrit from the district high schools. In addition, Appendix D shows that for students whose HSEE score was just below this value, their parents almost all paid the selection fee and sent them into a magnet school. Thus, there was no difference in the probability of attending a magnet school around this threshold value. In the following RD estimation, we focus on the single threshold for the selection fee and do so in specifications that exclude distal observations that may be shaped by attrition.

A student is eligible to attend a magnet school conditional on paying an official selection fee if $s_{it} \geq 0$, which is denoted by an indicator d_{it}. If $d_{it} = 1$, the student will certainly get an offer conditional on paying the selection fee. If $d_{it} = 0$, the student's parents have to negotiate with a magnet school and pay much more in private. Thus, the threshold for the selection fee significantly changes the cost of attending a magnet school, which generates a "jump" in the probability of

match. For example, our method could match a high school student new to the school district with a student who has the same name and a HSEE score record but does not attend an in-district high school, *if* no other students in the two data sets share the same name. Appendix C shows that our results are not sensitive to this type of potential mismatches.

Table 1
Summary statistics of the analytical sample and the matched sample.

	Analytical sample ($n = 1690$)		Matched sample ($n = 6673$)	
	Mean	Std. dev.	Mean	Std. dev.
Probability of attending a magnet school	0.676	0.468	0.609	0.488
Age at graduation from middle school	15.9	0.78	15.9	0.77
Female	0.52	0.50	0.51	0.50
Minority	0.094	0.292	0.090	0.286
HSEE score	0.002	0.191	−0.177	0.825
City-exam scores	−0.014	0.430	0.026	0.745
Probability of studying in science track	0.605	0.489	0.582	0.493
Probability of taking the CEE	0.749	0.434	0.752	0.432
CEE scores	−0.109	0.649	−0.001	1.000

The analytical sample includes students who are a correct match of a HSEE score and a high school record, and whose HSEE scores lie in the interval of [−0.329, 0.329] in the year of 2006, [−0.372, 0.372] in 2007, and [−0.227, 0.227] in 2008. The matched sample includes all students who are a correct match of a HSEE score and a high school record, regardless of their HSEE scores.

attending such a school. The attendance outcome can be modeled as:

$$magnet_{it} = (1 - d_{it}) f(s_{it}) + d_{it} f(s_{it}) + \beta_1 d_{it} + Year_t + X_{it} + e_{it} \quad (2)$$

$magnet_{it}$ is 1 for attending a magnet school and 0 for attending a regular school, for student i who graduates from middle school in year t. $f(s_{it})$ is a continuous function of the HSEE scores, s_{it}. We interact $f(s_{it})$ with the eligibility indicators d_{it} and $1 - d_{it}$. This flexible specification captures the different distribution of s_{it} on the different side of d_{it} The key requirement of identification in a fuzzy RD design is that we can separate the effects of the threshold from the continuous function $f(s_{it})$, so that β_1 is significantly positive. Gelman and Imbens (2014) suggest that using high-order polynomials of $f(s_{it})$ could lead to misleading results. Thus, we use a linear function of $f(s_{it})$ throughout this paper. Table A7 shows that our results are robust if we use the second- and the third-order polynomials of $f(s_{it})$. $Year_t$ are year dummies that capture general yearly differences in exams and cohort quality. Demographic variables, X_{it}, include age, gender, and minority status. All the results are also robust without including these demographic variables.

The causal effect of receiving a conditional offer from a magnet school can be estimated by β_2 in the following reduced-form specification:

$$outcome_{it} = (1 - d_{it}) f(s_{it}) + d_{it} f(s_{it}) + \beta_2 d_{it} + Year_t + X_{it} + e_{it} \quad (3)$$

The outcome could be scores on the mandatory CT, the choice of the study track in the beginning of the second year in high school, or the attendance and scores on the CEE at the end of high school. In these reduced-form specifications, the key independent variable d_{it} is the eligibility of attending a magnet school by paying a fee, not the actual attendance. For students whose HSEE scores are around d_{it}, some other unobserved factors could affect the final attendance of magnet school, such as family wealth and parents' social networks or willingness to pay. The fuzzy RD design exploits a random factor behind the attendance decision: the randomness in the HSEE scores below or above the d_{it}. These reduced-form estimates of β_2 capture the causal part of the effects of attending a magnet school on outcome variables, without being biased by other unobserved factors.

We estimate Eqs. (2) and (3) within various intervals around the threshold $s_{it} = 0$, as small as to [-0.05, 0.05]. We also report the local linear regression results within the data-driven optimal bandwidth around the threshold, proposed by Imbens and Kalyanaraman (2012) (hereafter, IK). The optimal bandwidth is larger than the smallest intervals that we use in estimating above equations, but smaller than the full sample. The triangle kernel used in the IK estimation puts more weights on observations closer to the threshold point, which is different from unweighted regressions.

5. Academic performance and magnet schools

5.1. Discontinuity in attending a magnet school

The enrollment rule generates a large discontinuity in the probability of attending a magnet school around $s_{it} = 0$, the threshold for the selection fee. Plotted points in Fig. 2 are conditional mean probabilities of attending a magnet school in a binwidth of 0.05. Each graph also includes a local mean-smoothing function estimated on each side of $s_{it} = 0$. We use a triangle kernel in the smoothing function, which is shown to have good properties at boundary points (Hahn, Todd, & van der Klauww, 2001). In each year, there is a "jump" in the probability of attending a magnet school at the point $s_{it} = 0$. When $s_{it} \geq 0$, most parents pay the selection fee and send their child to a magnet school. When $s_{it} < 0$, the negotiation cost with a magnet school sharply rises and the probability of attending a magnet school drops. On both sides, the probability increases with the HSEE scores, which may reflect that parents' willingness to pay increases with their child's academic ability. As a validation check, Fig. 3 shows that the eligibility condition, d_{it}, is not related to predetermined student characteristics, including age, gender, and minority status. Plotted points are conditional mean scores in a HSEE binwidth of 0.02. We choose a smaller binwidth than in Fig. 2 since we combine all three years here and hence have much more observations.

As explained in Section 2, the anonymous and tightly-supervised grading process essentially precludes the manipulation of the HSEE scores. McCrary (2008) develops a formal approach for testing whether the running variable is manipulated. Had students manipulated scores according to the enrollment rule, we would have observed

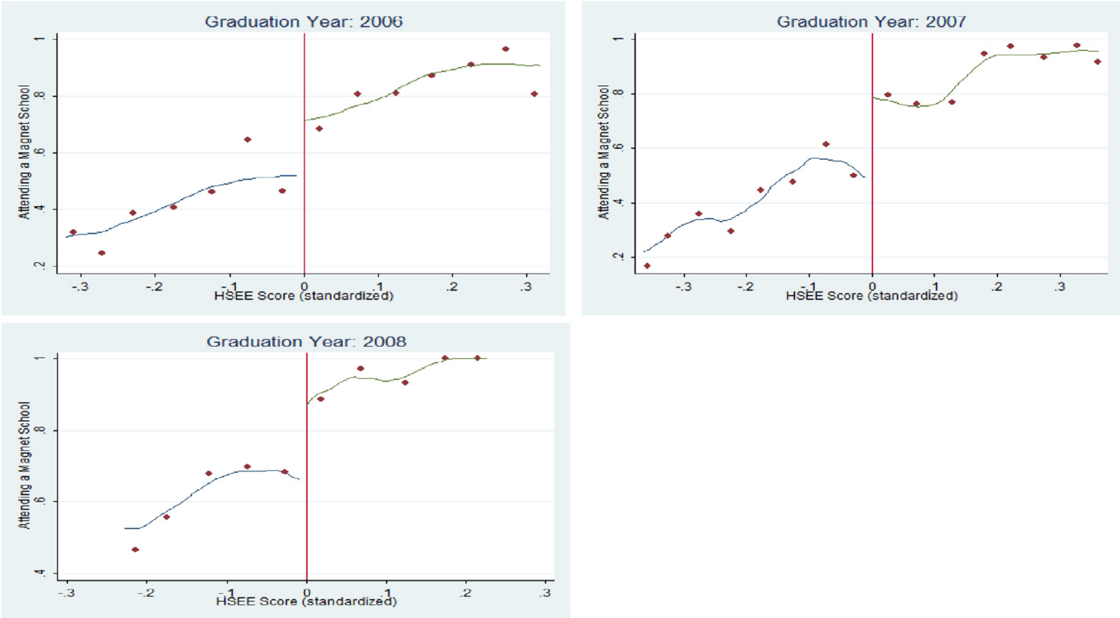

Fig. 2. Probability of attending a magnet school and HSEE scores.

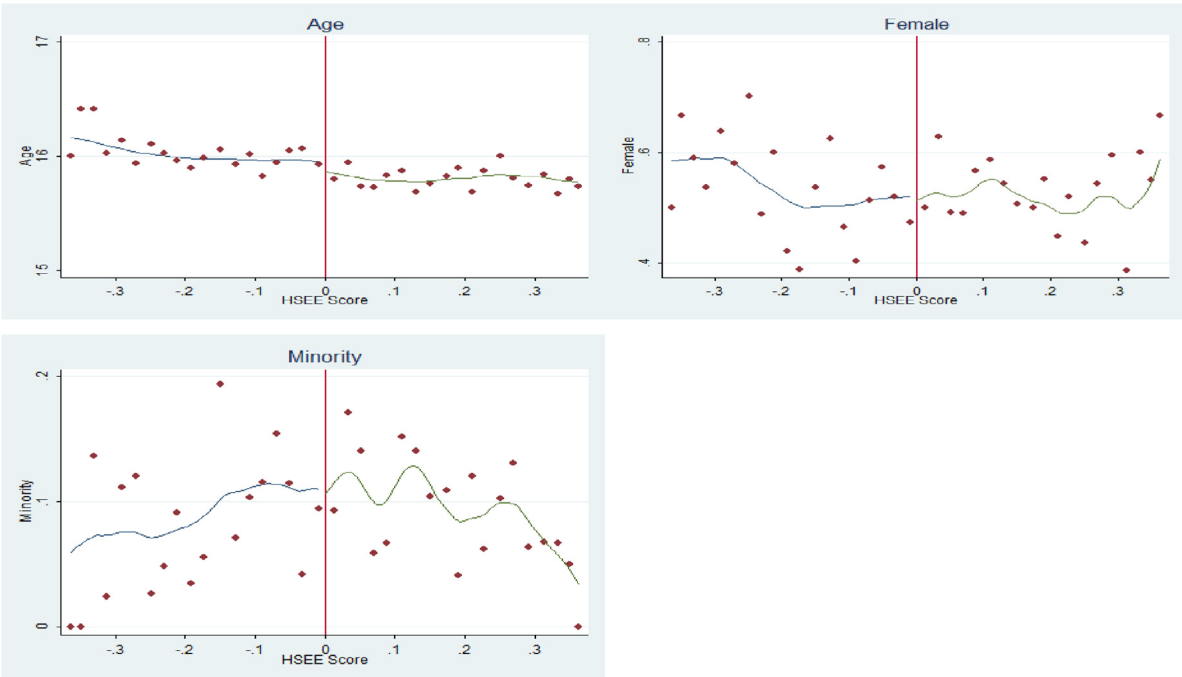

Fig. 3. Students' characteristics and HSEE scores.

the number of students suddenly increases above the threshold. Table A5 shows that, for each year, the number of observations does not change significantly around the threshold. Another related problem is data heaping in the running variable in the regression discontinuity design. Heaping data around the threshold could bias the RD estimation, and the McCrary test may not be able to detect this problem (Barreca, Waddell, & Lindo 2011). Fig. A3 shows that the histograms of the HSEE scores do not display a pattern of data heaping.

The first row in Table 2 estimates the discontinuous change in the probability of attending a magnet school, using both the IK estimation (column 1) and the parametric specification of Eq. (2) (columns 2–6). The parametric specification uses a linear function of $f(s_{it})$ interacted with d_{it}, in different intervals around the threshold. All estimates suggest

Table 2
RD estimates of the effect of eligibility on magnet attendance and main outcomes.

	IK estimates	OLS estimates in different intervals of the HSEE scores				
		[−0.05, 0.05]	[−0.1, 0.1]	[−0.15, 0.15]	[−0.2, 0.2]	All
	(1)	(2)	(3)	(4)	(5)	(6)
Probability of attending a magnet school	0.282***	0.353**	0.302***	0.210***	0.144***	0.131***
	(0.083)	(0.124)	(0.082)	(0.064)	(0.055)	(0.041)
	605	267	501	779	1058	1690
City-exam scores	−0.040	−0.010	−0.024	−0.026	−0.045	−0.042
	(0.044)	(0.100)	(0.068)	(0.054)	(0.047)	(0.036)
	1327	249	463	718	979	1567
Probability of choosing science track	−0.049	−0.025	−0.093	−0.057	0.006	0.020
	(0.077)	(0.118)	(0.080)	(0.064)	(0.056)	(0.043)
	684	264	491	760	1034	1651
Probability of attending the CEE	0.070	0.093	0.075	0.055	0.070	0.049
	(0.061)	(0.110)	(0.074)	(0.059)	(0.051)	(0.040)
	952	267	501	779	1058	1690
CEE scores	−0.104	−0.179	−0.168	−0.130	−0.126	−0.095
	(0.074)	(0.180)	(0.120)	(0.098)	(0.085)	(0.066)
	1265	205	377	572	789	1,265

Robust standard errors in parentheses.
This table reports the coefficients associated with magnet school eligibility with selection fees, on dependent variables listed by rows. The number of observations is reported below the standard errors. Column (1) reports IK estimates within the optimal bandwidth. Columns (2)–(6) use specifications as in Eqs. (2) and (3), in different intervals of HSEE scores, controlling for HSEE scores interacted with the eligibility indicator, three demographic variables, and two year dummies.
*** $p < 0.01$.
** $p < 0.05$.

that eligibility for paying the selection fee significantly increases the probability of attending a magnet school. For example, the IK estimation suggests that passing the selection-fee threshold increases the probability of attending a magnet school by about 28 percentage points, a very large effect that is also very close to the visible gap in Fig. 2. As a placebo test, Table A6 shows that the probability of attending a magnet school does not jump at other arbitrarily selected s_{it} that serves as a pseudo-threshold for the selection fee.

5.2. High school academic performance

In terms of high school academic performances, the upper-left panel of Fig. 4 shows a strong positive relationship between the CT scores and the HSEE scores. Around the threshold of $s_{it} = 0$, however, there is no significant jump in the CT scores. The upper-right panel also shows that there is no significant change in the probability of choosing the science study track in high school, around $s_{it} = 0$. The lower-left panel suggests a possible jump in the probability of attending the CEE around $s_{it} = 0$, though the evidence seems not very strong. Conditional on the attendance, the lower-right panel suggests that the eligibility does not change the CEE scores.

To formally estimate the causal effect of attending a magnet school on academic performance, we use both the IK estimation and the reduced-form specification of Eq. (3). In general, being eligible for paying the selection fee into a magnet high school does not improve later performance in the CTs, as shown in Table 2, although it significantly increases the probability of attending a magnet school. Being eligible for selection fee does not increase the probability of studying in the science track either, despite the fact that all magnet schools are known for their strong training in science. The eligibility neither affects the probability of attending the CEE, nor the CEE scores conditional on attendance. If anything, the CEE scores associated with the eligibility for attending a magnet school might be *lower*.

Using similar specifications, Table 3 reports the effects of being eligible for selection fee on scores in five specific subjects of the CTs: math, Chinese, English, comprehensive sciences, and comprehensive social studies. For Chinese, English, and math, we use the average score of all the three annual CTs. For the sciences and social studies, we only use the average of the first two CTs because the third CT is different for students in different tracks.[9] Again, there is no significant effect of being eligible for selection fee on scores in any subject.

It is possible that the differences between magnet school students and regular school students change over the three years in high school. If that was the case, averaging scores over the three years might underestimate or overestimate the differences between the two groups of students. Table 4 disentangle the CT scores by the years in high school. The IK estimates again show that the eligibility for attending a magnet school does not improve CT scores in most subjects and in most years. Overall, the eligible students seem to perform *worse* over the three years, particularly in the subjects of math and Chinese in their final year in high school. In the final year, magnet schools usually ignore the CTs and focus on training students for the CEE, in order to help them enter college, which may explain the lower scores in the third-year CTs.

[9] We combine physics and chemistry into a collective subject of "science" and politics and history into "social studies". We drop geography and biology because they are one-year courses, and students are usually not very concerned about them since their weights in both the CT and the CEE are very low.

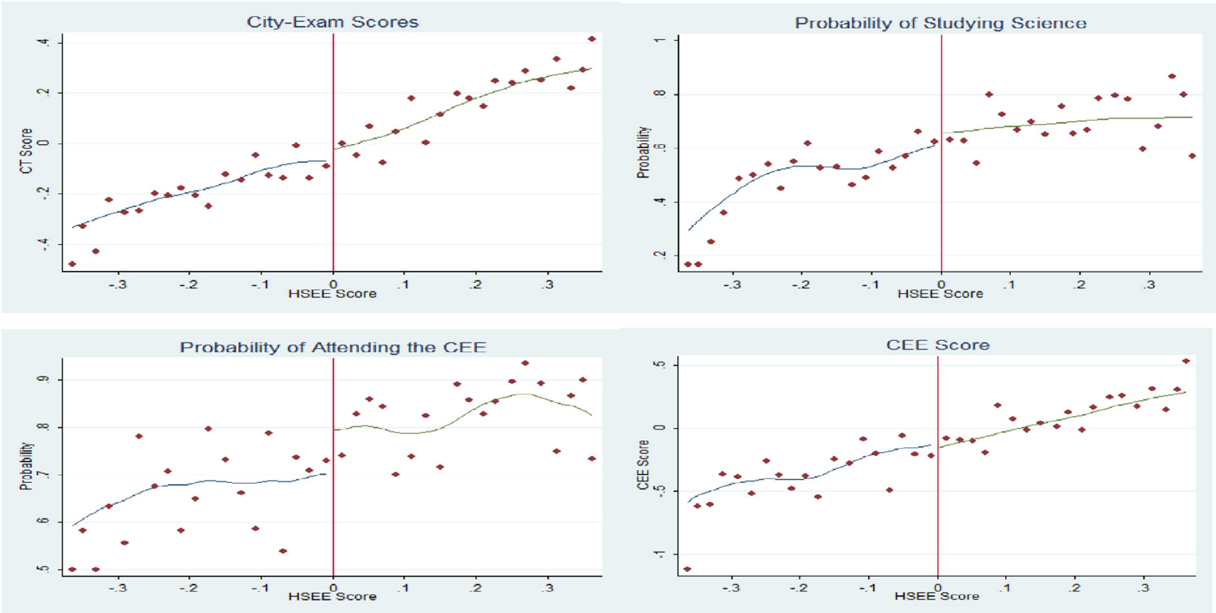

Fig. 4. High school outcomes and HSEE scores.

Table 3
RD estimates of the effects of magnet eligibility on the city-exam scores by subject.

	IK estimates	OLS estimates in different intervals of the HSEE scores				
		[−0.05, 0.05]	[−0.1, 0.1]	[−0.15, 0.15]	[−0.2, 0.2]	All
	(1)	(2)	(3)	(4)	(5)	(6)
Math	−0.068	−0.085	−0.115	−0.081	−0.060	−0.024
	(0.080)	(0.158)	(0.111)	(0.087)	(0.077)	(0.059)
	886	249	464	721	983	1,573
Chinese	−0.064	0.236	0.021	−0.057	−0.098	−0.105*
	(0.080)	(0.147)	(0.102)	(0.080)	(0.071)	(0.054)
	930	250	464	721	983	1575
English	−0.024	−0.091	0.061	0.035	−0.037	−0.049
	(0.078)	(0.155)	(0.105)	(0.081)	(0.070)	(0.054)
	1085	250	465	722	983	1573
Sciences	−0.036	0.013	−0.098	−0.057	−0.008	0.039
	(0.092)	(0.162)	(0.117)	(0.095)	(0.084)	(0.065)
	838	256	474	733	998	1601
Social studies	−0.030	−0.016	0.091	0.084	0.006	−0.043
	(0.086)	(0.208)	(0.144)	(0.116)	(0.100)	(0.079)
	1598	255	473	732	996	1598

Robust standard errors in parentheses.
This table reports the coefficients associated with magnet school eligibility with selection fees, on dependent variables listed by rows. The number of observations is reported below the standard errors. Column (1) reports IK estimates within the optimal bandwidth. Columns (2)–(6) use specifications as in Eqs. (2) and (3), in different intervals of HSEE scores, controlling for HSEE scores interacted with the eligibility indicator, three demographic variables, and two year dummies.
* $p < 0.1$.

5.3. Robustness check: the OLS estimates

As a robustness check, Table 5 reports the simple OLS estimates of the effects of attending a magnet school on academic outcomes in high school. After controlling for the baseline HSEE scores, columns (1) and (4) show that magnet school attendance is not related to higher scores in the CT or the CEE, consistent with the RD estimates. On average, girls score higher than boys, and older students tend to perform worse. There seems no significant performance difference that is related to the minority status. Column (2) shows a small positive effect on studying science of students in magnet schools, though our RD estimates of this effect is close to zero. As expected, boys are more likely to study science. Column (3) shows a higher probability of attending the CEE. Given parents' large investment in the selection fee to attend a magnet school, attending the CEE is likely to be a superficial response: at least "give it a try". Minority students are also more likely to attend the CEE since the threshold for qualifying for some colleges is lower for minority students.

Table 4
IK estimates of the effects of magnet eligibility on the city-exam scores, by subject and by the year in high school.

	The first year	The second year	The third year
Math	0.033	−0.009	−0.167*
	(0.073)	(0.092)	(0.099)
	1517	1006	675
Chinese	0.088	0.052	−0.137*
	(0.123)	(0.106)	(0.082)
	748	1058	930
English	0.038	−0.015	−0.010
	(0.086)	(0.074)	(0.082)
	1104	1526	1362
Sciences	−0.030	0.001	N/A
	(0.084)	(0.101)	
	1280	811	
Social studies	0.080	−0.110	N/A
	(0.088)	(0.106)	
	1600	1610	
Math + Chinese + English	0.061	−0.012	−0.083
	(0.070)	(0.055)	(0.062)
	803	1458	1292

Robust standard errors in parentheses.
This table reports the IK estimates of the coefficients associated with magnet school eligibility with selection fees, within the optimal bandwidth. The dependent variables are listed by rows, and the specific year in the high school of the exam scores is listed by columns. The number of observations is reported below the standard errors.
* $p < 0.1$.

Table 5
OLS estimates of the effects of attending a magnet school.

Variables	City-exam scores (1)	Probability of choosing science track (2)	Probability of taking the CEE (3)	CEE scores (4)
Magnet school	0.003	0.056**	0.264***	0.043
	(0.023)	(0.029)	(0.026)	(0.044)
HSEE score	0.949***	0.421***	0.041	1.171***
	(0.055)	(0.067)	(0.057)	(0.093)
Age	−0.037***	−0.011	−0.098***	−0.124***
	(0.013)	(0.014)	(0.014)	(0.025)
Female	0.244***	−0.310***	0.035*	0.288***
	(0.019)	(0.022)	(0.020)	(0.034)
Minority	0.012	−0.035	0.063**	0.044
	(0.032)	(0.038)	(0.032)	(0.052)
N	1567	1651	1690	1265

Robust standard errors in parentheses.
This table estimates the effects of magnet school attendance on several academic outcomes in high school. All regressions include two year dummies.
*** $p < 0.01$.
** $p < 0.05$.
* $p < 0.1$.

The OLS estimates are unlikely to capture the causal effects of attending a magnet school, since the attendance is likely to be endogenous. The decision of attending a magnet school could be related with some unobserved characteristics of students that also affect academic performance in high school, such as students' motivation and parents' support. Nevertheless, the overall consistency between the OLS estimates and the RD estimates strengthens our conclusions that attending a magnet school has little causal effect on test scores in high school. In fact, instead of using magnet school attendance as the key independent variable in the OLS estimation, if we use the eligibility of paying the selection fee, as we do in the RD estimation, the estimated coefficients are essentially the same as the coefficients in Table 2.

5.4. Understanding the limited benefits from magnet schools

In general, magnet schools have better peer groups and better teachers, both of which should contribute to academic achievement. Particularly, most Chinese magnet high schools, including the three schools in this paper, are attractive due to their strong academic records in the sciences. In our sample, science students in magnet schools score 0.47 standard deviation higher than students in social studies in the CEE, while science students in regular schools score 0.25 standard deviation *lower* than students in social studies. These results suggest that the science track in magnet schools either attracts higher-quality students, or trains students with higher-quality teachers, or both. For the students who pay the extra high selection fee of $3000 to attend a magnet school, one might expect them to choose the science track in order to maximize the expected returns on their investment. After all, about 70% of students in magnet schools study science, compared to 40% in regular schools. However, as estimated in above sections, being eligible for the selection fee does not increase the probability of studying in the science track. As a result, students who pay the selection fee to attend a magnet school may limit their access to better teachers and classmates in the science track. This may partially explain the null impact of attending a magnet school on their academic performance.

For students who pay the selection fee to attend a magnet school, there are multiple potential reasons for not choosing the high-performance science track. First, they may suffer from some “stigma effect” in magnet schools. In Chinese high schools, the HSEE scores are common knowledge. Both teachers and students can identify the students who are able to attend the school only by paying extra fees. Those students are seen as “inferior students” because their HSEE scores are lower than those regular students who attend the school without paying the fee. In order to avoid this “stigma effect”, students who pay the fee may choose to stay with each other and away from regular students. The social studies track includes more students who pay the fee. In the three magnet schools, 65% of students in the social studies track are students who pay the selection fee, compared to 33% in the science track.

Second, students may compete for teachers’ attention and efforts by choosing a different peer group. Chinese magnet high schools place an extreme emphasis on college enrollment, and rates of college enrollment serve as a major factor in evaluating and rewarding teachers. Thus, teachers have strong incentives to focus on the top students in their classes who are more likely to succeed on the CEE.[10] Since 82% of “strong students” who attend a magnet school without paying the fee choose the science track, staying in the relatively weaker social studies track could improve the class ranking. In terms of the HSEE scores in magnet schools, the average percentile ranking of students who pass the threshold for the selection fee would be only 22nd if they stay in the science track, essentially the bottom of their class. However, the same group of students would be ranked 57th if they choose the social studies track, above the median of their class.[11] In other words, by choosing the social studies track, the students who pay the selection fee can choose a weaker group of classmates and boost their ranking in the class. In addition to more attention from teachers associated with a higher ranking in the class, the increase of relative ranking could also reduce students’ behavioral problems (Cicala, Fryer, & Spenkuch, 2011). Similar phenomena are well-known in the educational psychology literature, and they are sometimes referred to as “big-fish-little-pond effect” (Marsh, Chessor, Craven, & Roche, 1995).

[10] Duflo, Dupas, and Kremer (2011) develop a model to illustrate a similar relationship between teachers’ incentives and rewarding standards.

[11] As described in Section 2, in order to increase revenues, magnet schools also enroll many students whose HSEE scores are lower than the threshold of the selection fee, by charging a much higher private fee.

6. Conclusion

Like elsewhere in the world, attending a magnet high school is seen as a key step in Chinese secondary education. This emphasis on magnet school attendance has created significant pressure to perform well on the high school entrance exam and has created an economic burden for students who score low and must pay a selection fee. However, a growing body of empirical evidence from other countries suggests that magnet schools may not be more effective at promoting improved student outcomes. This study presented new empirical evidence on this question using novel data from a large urban district in China. Surprisingly, we find consistent evidence that there is no positive effect of magnet school attendance on various outcomes, including scores on the annual city exam, the choice of study tracks, and scores in the college entrance exam.

There are two caveats in the interpretation of our findings. First, by using the regression discontinuity design, we estimate the benefit of attending a magnet school only for *marginal students* admitted to a magnet school. It is possible that the effects are different for top students. In our data, all top students attend a magnet school and it is difficult to find a counter-factual. Second, we only estimate the effects on academic performance, which of course is only a part of the picture. It seems likely that attending a magnet school provides opportunities to build social networks with high-achieving peers, from which students could benefit in the long future. The comprehensive effects of attending a magnet school might only be understood with more data and passage of time.

Acknowledgments

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Appendix A. Data attrition

Fig. A1 shows that the probability of attrition varies with the standardized HSEE scores, s_{it}. The probability first decreases with the HSEE scores, which reflects that students with a very low score may not attend any high school. When students score very high, they become eligible to attend the two best magnet schools in the city that are located in another school district. Thus, after the score reaches a certain point, the probability of attrition starts to increase with the score. When students reach the threshold for attending a local magnet school without paying extra fees, they are more likely to stay in the district and there is a sharp decrease in the probability of attrition. Fig. A1 marks this threshold: 0.329 in the year of 2006, 0.372 in 2007, and 0.227 in 2008.

For reasons explained in Section 3, we only use students whose scores are in the symmetric interval of [-0.329, 0.329] in the year of 2006, [-0.372, 0.372] in 2007, and [-0.227, 0.227] in 2008. In the discontinuity design framework, it is also important that the probability of data attrition does not change below or above the point $s_{it} = 0$. To test this, we use the

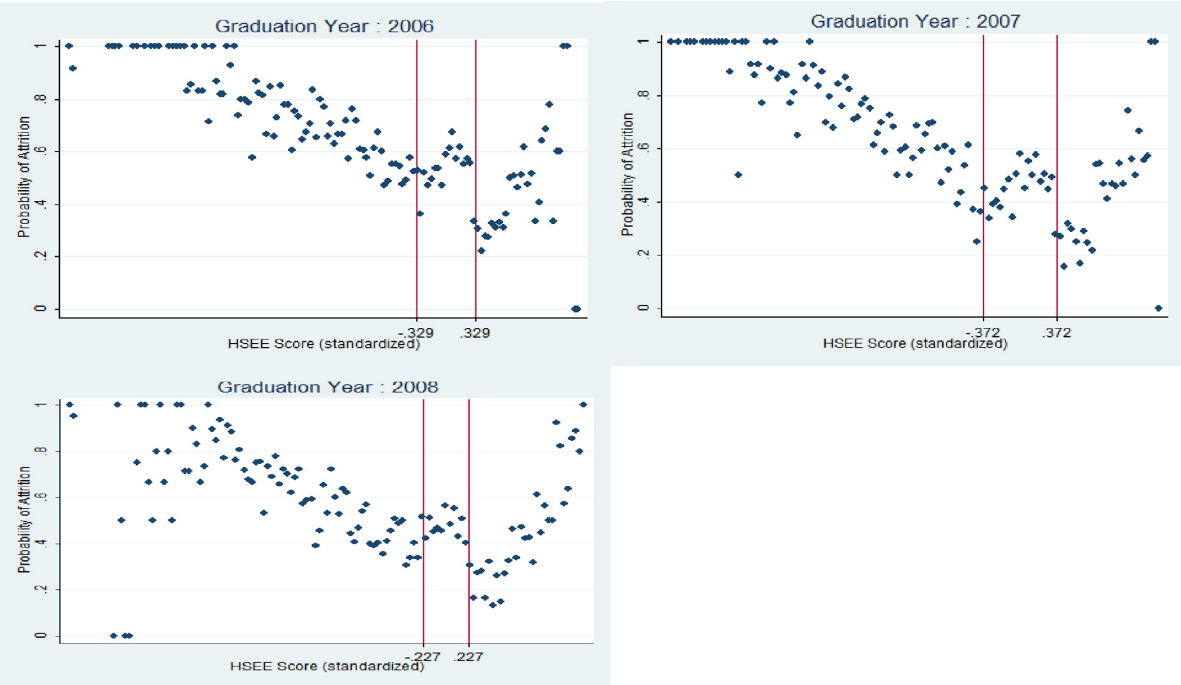

Fig. A1. Probability of data attrition.

Table A1
Determinants of data attrition.

	IK estimate	OLS estimates in different intervals of the HSEE scores				
		[−0.05, 0.05]	[−0.1, 0.1]	[−0.15, 0.15]	[−0.2, 0.2]	All
	(1)	(2)	(3)	(4)	(5)	(6)
Eligibility	0.068	−0.071	0.044	0.078	0.057	0.070**
	(0.047)	(0.093)	(0.063)	(0.051)	(0.043)	(0.033)
HSEE		4.098	−0.097	0.021	0.115	0.196
		(2.550)	(0.845)	(0.438)	(0.276)	(0.136)
(HSEE) × (eligibility)		−1.953	1.013	−0.184	−0.044	−0.369**
		(3.189)	(1.120)	(0.584)	(0.369)	(0.185)
N	2207	544	1039	1593	2173	3381

Robust standard errors in parentheses.
This table reports the estimated effects of HSEE scores and the eligibility for selection fee on the probability of data attrition. Column (1) reports IK estimates within the optimal bandwidth. Columns (2)–(6) use a specification as in Eq. A1, controlling for two year dummies. Column (6) includes the following intervals of the HSEE scores: [−0.329, 0.329] for students who graduated from middle school in 2006, [−0.372, 0.372] in 2007, and [−0.227, 0.227] in 2008.
** $p < 0.05$.

following specification:

$$attrition_{it} = (1 - d_{it})s_{it} + d_{it}s_{it} + \beta_3 d_{it} + Year_t + e_{it} \quad \text{(A1)}$$

$attrition_{it}$ is 1 for attrition from the sample and 0 for being matched, for student i who graduates from middle school in year t. The HSEE score s_{it} is interacted with the eligibility indicator d_{it} that is 1 if $s_{it} \geq 0$. $Year_t$ includes two year dummies that capture general yearly difference in exams and cohort quality. We estimate the specification in various intervals around $s_{it} = 0$, as in our main results in Tables 2 and 3. We also report the IK estimate of the effect of d_{it}. Across samples and specifications, Table A1 shows that the probability of attrition seems not vary around the eligibility indicator $d_{it} = 1$, except for in one sample in column 6.

Appendix B. School fixed effects of magnet schools

The three magnet schools in the school district use similar thresholds and charge similar selection fees, and we treat them as one. It is well-known among local residents that the three schools are also similar in educational quality. This section verifies that students' academic performance does not vary with school fixed effects.

We use the following regressions with school fixed effects:

$$outcome_{ist} = \beta \times school_s + Year_t + s_{ist} + X_{ist} + \varepsilon_{ist} \quad \text{(A2)}$$

For student i in school s who graduated from middle school in year t, $outcome_{ist}$ is either her average scores on

Table A2
School fixed effects of magnet schools.

	All students		Analytical sample	
	(1) City-exam scores	(2) CEE scores	(3) City-exam scores	(4) CEE scores
School_A	−0.037	−0.030	−0.062	−0.031
	(0.046)	(0.038)	(0.037)	(0.049)
School_B	−0.051	−0.067	−0.011	−0.003
	(0.059)	(0.034)	(0.051)	(0.035)
Female	0.162***	0.101***	0.236***	0.226***
	(0.021)	(0.017)	(0.038)	(0.054)
Minority	−0.061**	−0.099**	−0.012	−0.000
	(0.020)	(0.035)	(0.047)	(0.058)
Age	−0.049***	−0.117***	−0.055***	−0.130***
	(0.010)	(0.021)	(0.014)	(0.025)
Science track	0.096	−0.056	0.032	−0.170**
	(0.048)	(0.073)	(0.037)	(0.068)
HSEE score	0.742***	1.023***	0.900***	1.159***
	(0.036)	(0.052)	(0.049)	(0.090)
p-value of the *F*-test of the joint significance of school A and B	0.670	0.191	0.243	0.696
N	3848	3385	1065	967

Clustered standard errors in parentheses.
This table reports the effect of attending different magnet schools on the scores in the city-exam and the CEE. All regressions use a specification as in Eq. A2, controlling for two year dummies. Columns (1) and (2) use all students in the three magnet schools; and Columns (3) and (4) use students in the three magnet schools in the analytical sample as in Table 1. Standard errors are clustered at the school and year level.
*** $p < 0.01$.
** $p < 0.05$.

Table A3
IK estimates of the effect of eligibility on magnet attendance and main outcomes, without potential mismatches.

	Without names of two characters (1)	Without names with a popular surname (2)	Without names with a popular surname and two characters (3)
Probability of attending a magnet school	0.255***	0.246**	0.309***
	(0.083)	(0.116)	(0.089)
	511	341	510
City-exam scores	−0.034	−0.051	−0.073
	(0.053)	(0.067)	(0.052)
	896	641	970
Probability of choosing science track	−0.006	0.004	0.018
	(0.083)	(0.079)	(0.063)
	588	714	1,070
Probability of attending the CEE	0.087	0.141*	0.054
	(0.069)	(0.071)	(0.066)
	600	718	729
CEE scores	−0.198*	−0.129	−0.174*
	(0.100)	(0.123)	(0.091)
	704	561	888

Robust standard errors in parentheses.
This table reports the IK estimates of coefficients associated with magnet school eligibility with selection fees, on dependent variables listed by rows, within the optimal bandwidth. The number of observations is reported below the standard errors. All estimates use the analytical sample defined in Table 1, without including students whose name is a possible mismatch, discussed in Appendix C.
*** $p < 0.01$.
** $p < 0.05$.
* $p < 0.1$.

the three annual CTs or her scores on the CEE. A set of cohort dummies, $Year_t$, controls for the general ability of each cohort and the difficulty of their exams. s_{ist} is baseline HSEE scores that control for academic ability of each student. X_{ist} includes demographic variables: gender, minority status, age, and study tracks in high school. If the three magnet schools are similar, estimated coefficients of the two school dummies, $school_s$, should be close to zero.

Table A2 reports the results. Columns (1) and (2) show that the three schools are very similar in scores on the

Table A4
IK estimates of the effect of eligibility on magnet attendance and main outcomes, around the higher threshold.

	IK estimates
Probability of attending a magnet school	0.034
	(0.024)
	1112
City-exam scores	0.016
	(0.050)
	1120
Probability of choosing science track	0.029
	(0.052)
	1397
Probability of attending the CEE	0.018
	(0.051)
	1031
CEE scores	0.039
	(0.076)
	1161

Robust standard errors in parentheses.
This table reports the coefficients associated with magnet school eligibility without paying any fee, using IK estimates within the optimal bandwidth, on dependent variables listed by rows.

Table A5
McCrary test statistics.

Graduation Year of 2006	0.378
(Default bin size = 0.015, IK bandwidth = 0.213)	(0.221)
Graduation year of 2007	−0.130
(Default bin size = 0.017, IK bandwidth = 0.146)	(0.287)
Graduation year of 2008	0.314
(Default bin size = 0.014, IK bandwidth = 0.216)	(0.239)

This table reports the test statistics and standard errors developed by McCrary (2008), which tests the difference of the number of observation around the threshold of HSEE scores. For each year, we use the default bin size and the IK optimal bandwidth.

Table A6
"Placebo" RD estimates for the probability of attending a magnet school at pseudo-thresholds.

HSEE = −0.05	−0.104	HSEE = 0.05	0.035
	(0.070)		(0.053)
HSEE = −0.10	0.036	HSEE = 0.1	−0.137
	(0.064)		(0.078)
HSEE = −0.15	0.097	HSEE = 0.15	0.059
	(0.076)		(0.041)
HSEE = −0.2	0.079	HSEE = 0.2	−0.004
	(0.070)		(0.038)

This table reports the IK estimation of the probability of attending a magnet school, around eight arbitrarily selected HSEE scores that are different from the point where HSEE = 0, the threshold for the selection fee.

CTs and the CEE, among all students who attend the three schools. Columns (3) and (4) further restrict the sample, using the same intervals as in the parametric and nonparametric estimation in Section 5. All estimated βs are very small, neither economically nor statistically significant. The last row of Table A2 shows that the estimated βs for two schools are jointly insignificant either.

Appendix C. Robustness without potential mismatched names

We match the HSEE scores with academic and demographic records in high schools, by year, gender, and name. Since many people have the same name, this algorithm generates multiple matches. We have no further information to refine these multiple matches, and we drop them as attrition. However, there is still another possible resource of mismatch: we match a student in high school who is new to the school district with a different student in the HSEE data, if the two have the same name that no other students in the two data sets share. This appendix shows that our main results are not sensitive to this type of mismatch.

The key is to understand the reason of the name mismatch. Names of most Han-Chinese people, 92% of Chinese population, consist of two or three Chinese characters, and one character is the surname. As reported in Section 3, the top 10 most popular surnames cover 529 million people, about a half of the Han-Chinese. Given the huge population in China and very limited number of Chinese characters, it is common that many Chinese people have the same name. In our sample of 1690 observations within the intervals defined in Section 3, 515 (30.5%) names have two characters and 1172 (69.3%) have three characters. 708 names (42%) share one of the top 10 most popular surnames.[12]

Table A3 repeats the IK estimations on the main outcome variables as in Table 2, by dropping potential mismatches. Column 1 drops all names of two characters, which are more likely to be a mismatch than the names of three characters. Column 2 drops all names with a top-10 most popular surname, regardless of the number of characters in the name. Column 3 drops names that consist of only two characters *and* a popular surname, which should be the names that are most likely to be a mismatch. The estimates are consistent with our main results. The eligibility for attending a magnet elite high school significantly raises the probability of attending such a school, but it does not improve students' academic performance in high school. The eligible students may be more likely to sit in the CEE, but their scores seem *lower*.

Appendix D. The threshold of attending magnet school for free

Fig. 1 shows two thresholds of attending a magnet school: the lower one with an additional and significant amount of "selection-fee", and the higher one without extra fees. We do not exploit the higher threshold for two reasons. First, as explained in details in Section 3 and Appendix A, the higher threshold is related to the change in the probability of data attrition. Second, for students whose HSEE score is just *below* the higher threshold but above the threshold with a fee, essentially all of them pay the fee and attend a magnet school. As a result, there is little difference in the probability of attending a magnet school around the higher threshold. This threshold is not informative to evaluate the treatment effect of attending magnet school.

Fig. A2 plots the probability of magnet school attendance around the higher threshold: 0.329 in the year of 2006, 0.372

[12] The top 10 most popular surnames are Zhang, Wang, Li, Liu, Chen, Yang, Zhao, Huang, Zhou, and Wu, according to the census report: http://www.sootoo.com/content/524698.shtml.

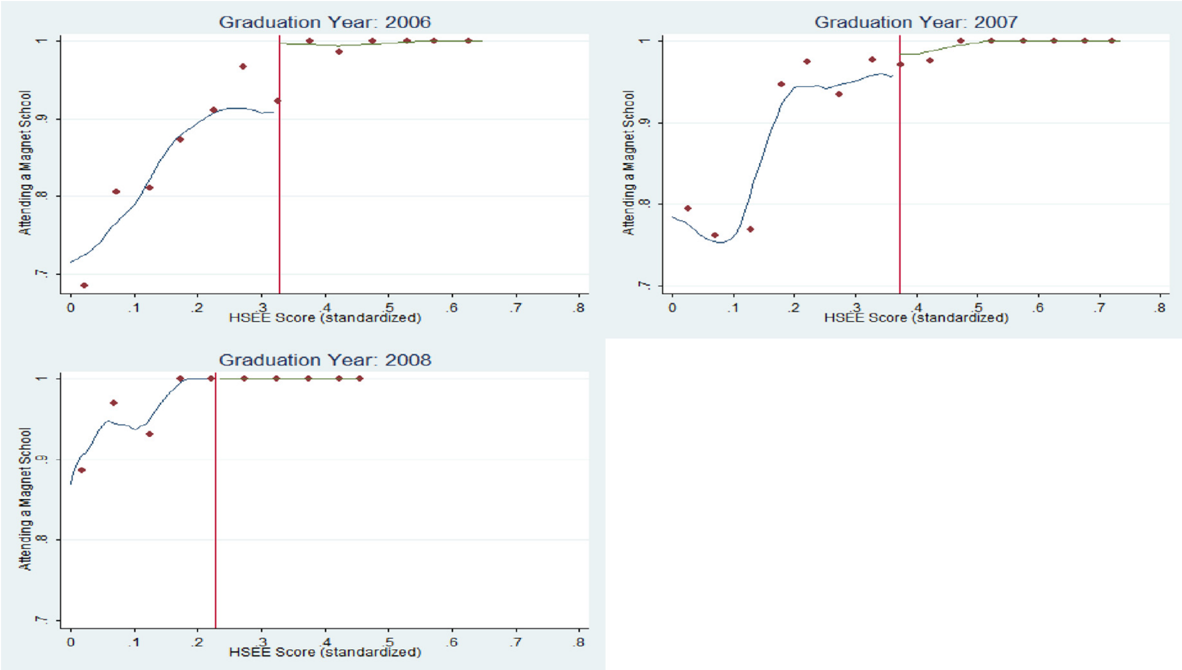

Fig. A2. Probability of attending a magnet school and HSEE scores, around the higher thresholds.

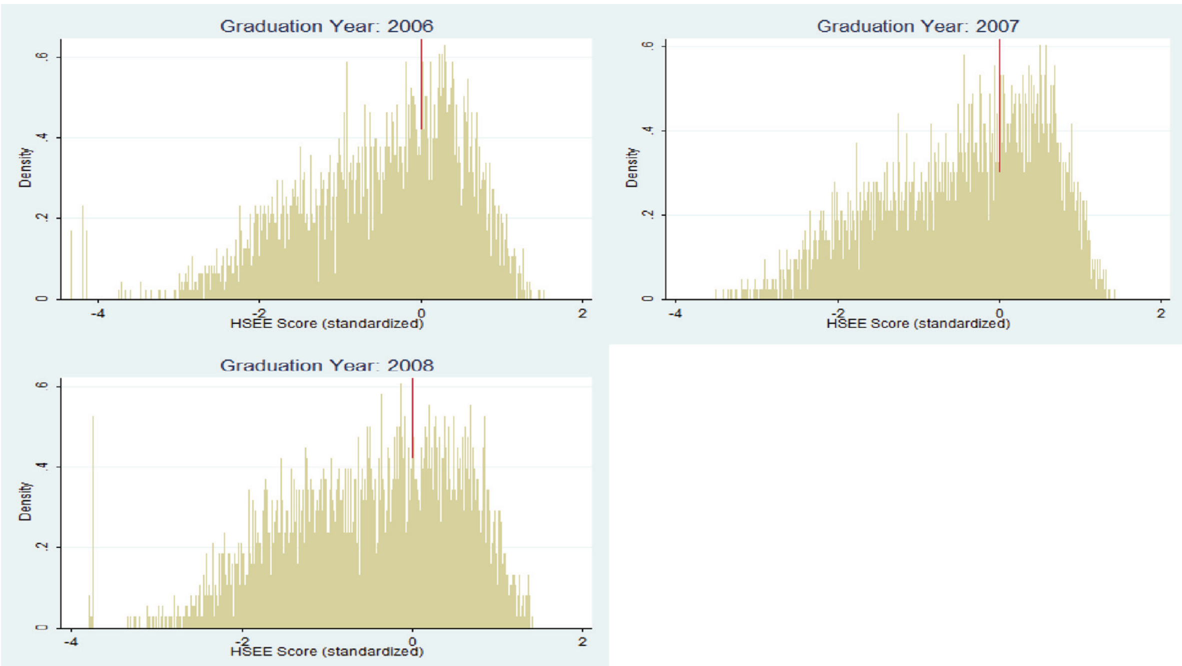

Fig. A3. Histograms of HSEE scores.

in 2007, and 0.227 in 2008. On the left side of these thresholds are the students who at least pass the lower threshold of attending a magnet school by paying a fee, with a positive standardized HSEE. Given this lower bound, we again conduct our analysis within the following symmetric intervals centered on the higher threshold, [0, 0.658] in 2006, [0, 0.744] in 2007, and [0, 0.454] in 2008. Fig. A2 shows no discernible jump in the probability of attending a magnet school around these higher thresholds: essentially all students around these thresholds attend a magnet school. Table A4 repeats the IK estimations on the main outcome variables as in Table 2 around these higher thresholds.

Table A7
RD estimates of the effects of magnet eligibility.

Dependent Variables	2nd-order polynomial (1)	3rd-order polynomial (2)	Dependent variables	2nd-order polynomial (3)	3rd-order polynomial (4)
Probability of attending a Magnet school	0.155**	0.272***	Math in city-exam	−0.025	−0.146
	(0.063)	(0.085)		(0.087)	(0.115)
	1690	1690		1573	1573
City-exam scores	-0.032	−0.030	Chinese in city-exam	−0.084	0.024
	(0.053)	(0.072)		(0.080)	(0.108)
	1567	1567		1575	1575
Probability of choosing Science track	0.022	−0.139*	English in city-exam	0.011	0.009
	(0.063)	(0.084)		(0.081)	(0.111)
	1651	1651		1573	1573
Probability of attending the CEE	0.067	0.057	Sciences in city-exam	−0.004	−0.135
	(0.058)	(0.079)		(0.093)	(0.121)
	1690	1690		1601	1601
CEE scores	−0.111	−0.215	Social studies in city-exam	−0.003	0.173
	(0.098)	(0.131)		(0.114)	(0.150)
	1265	1265		1598	1598

Robust standard errors in parentheses.
This table reports the coefficients associated with magnet school eligibility with selection fees, on dependent variables listed by rows. The number of observations is reported below the standard errors. The specifications are as in Eqs. (2) and (3), with various polynomials of HSEE scores interacted with the eligibility indicator. All regressions control for demographic variables and two year dummies.
*** $p < 0.01$.
** $p < 0.05$.
* $p < 0.1$.

Passing these thresholds has no significant effect on any outcome variable, including the probability of the magnet school attendance.

References

Abdulkadiroglu, A., Angrist, J. D., & Pathak, P. A. (2014). The elite illusion: Achievement effects at Boston and New York exam schools. *Econometrica, 82*(1), 137–196.

Barreca, A.I., G.R. Waddell, & J.M. Lindo (2011): *Heaping-induced bias in regression-discontinuity designs* (NBER Working Papers 17408).

Cicala, S., R.G. Fryer, & J.L. Spenkuch (2011): *A Roy model of social interactions* (NBER Working Papers 16880).

Clark, D. (2010). Selective schools and academic achievement. *The BE Journal of Economic Analysis & Policy, 10*(1).

de Janvry, A., A. Dustan, & E. Sadoulet (2012): *The benefits and hazards of elite high school admission: Academic opportunity and dropout risk in Mexico City* (Unpublished Manuscript). University of California at Berkeley.

Dobbie, W., & Fryer, R., Jr. (2014). The impact of attending a school with high-achieving peers: Evidence from New York City exam schools. *American Economic Journal: Applied Economics, 6*(3), 58–75.

Duflo, E., Dupas, P., & Kremer, M. (2011). Peer effects, teacher incentives, and the impact of tracking: Evidence from a randomized evaluation in Kenya. *American Economic Review, 101*(3), 1739–1774.

Gelman, A., & G. Imbens (2014): *Why high-order polynomials should not be used in regression discontinuity designs* (NBER Working Papers 20405).

Hahn, J., Todd, P., & Van der Klaauw, W. (2001). Identification and estimation of treatment effects with a regression-discontinuity design. *Econometrica, 69*(1), 201–209.

Imbens, G., & Kalyanaraman, K. (2012). Optimal bandwidth choice for the regression discontinuity estimator. *The Review of Economic Studies, 79*(3), 933–959.

Jackson, K. C. (2010). Do students benefit from attending better schools? Evidence from rule-based student assignments in Trinidad And Tobago. *Economic Journal, 120*(December), 1399–1429.

Lai, F., Sadoulet, E., & de Janvry, A. (2011). The contribution of school quality and teacher qualifications to student performance: Evidence from a natural experiment in Beijing Middle Schools. *Journal of Human Resources, 46*(1), 123–153.

Levin, D. (2012, November 21): "A Chinese education, for a price." *New York Times*.

Marsh, H. W, Chessor, D., Craven, R., & Roche, L. (1995). The effects of gifted and talented programs on academic self-concept: The big fish strikes again. *American Educational Research Journal, 32*(2), 285–319.

McCrary, J. (2008). Manipulation of the running variable in the regression discontinuity design: A density test. *Journal of Econometrics, 142*(2), 698–714.

National Bureau of Statistics (2009). China City Statistics Yearbook 2009.

Pop-Eleches, C., & Urquiola, M. (2013). Going to a better school: Effects and behavioral responses. *American Economic Review, 103*(4), 1289–1324.