

The adverse effects of parents' school selection errors
on academic achievement:
Evidence from the Beijing open enrollment program

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Abstract

One major concern with public school open enrollment programs is the potential for parents' school selection errors to adversely affect their children's academic achievement. In this study of the Beijing middle school open enrollment program, we estimate the degree to which children's school outcomes were negatively affected by the poor choices their parents made during the school selection process. We do this by examining parents' responses to a survey on school choices combined with actual school applications, school admission records, and High School Entrance Examination test scores for 4,717 students entering middle schools in Beijing via randomized lotteries. We find that the children of parents who made judgment errors in school selection were admitted to lower quality schools and achieved lower test scores on the High School Entrance Examination. Parents who had less education, whose children performed at lower levels in primary school, and who were less attentive to teachers' opinions about schools were more prone to make these errors. Providing assistance to parents, especially those less prepared to make informed choices about school selection, is consequently important for supporting more efficient and equitable open enrollment programs.

JEL classification: I20; I21; I28.

Keywords: Open enrollment; School choices; Student performance.

1. Introduction

Whether there are benefits from giving parents the option to choose schools for their children has been a hotly debated issue. Proponents claim that, if parents are allowed to choose, schools will compete more vigorously to attract new students by improving their academic quality (e.g., Hoxby, 2000). Because they can draw on personal knowledge of their children, parents can make better matches between students and schools than a school district. School choice programs based on randomized lotteries can also improve access to education by giving all children an equal chance of being admitted to their preferred schools.

School choice programs assume various forms such as vouchers, magnet schools, charter schools, and open enrollment. They all provide parents with an option to take their children out of the neighborhood school. The first three programs basically require parents to decide whether to remove their children from the neighborhood school or leave them there. By contrast, open enrollment programs require parents to make complex decisions by ranking accessible schools in order of preference. To do this optimally, parents need to have a clear understanding of the rules of the school assignment process, know about all candidate schools, and engage in strategic school selection and ordering based on their expectations about other parents' choices. In this demanding process, parents have ample opportunity to make technical errors about the rules as well as make errors of judgment in selecting and ordering the schools. For example, Abdulkadiroglu and Sonmez (2003) point out that the open enrollment school choice programs in Boston, Minneapolis, and Seattle ask parents to make complex school choice decisions, which can result in an inefficient allocation of school seats.¹

We focus on one such program in this paper, using data on an intra-district open enrollment system in Beijing middle schools to investigate whether the errors parents make during the school selection process are detrimental to the academic achievement of their children. In particular, we test whether children whose parents make school selection errors are assigned to lower quality schools and subsequently obtain lower test scores on the High School Entrance Examination. If errors are related to parents' own academic status and ability to make informed decisions, the resulting school assignments may increase social and academic stratification—a

¹Abdulkadiroglu et.al (2006a) proposed strategy-proof mechanisms for the New York and Boston systems in order to promote efficiency in school seat allocation.

result very much at odds with the stated egalitarian objectives of the Chinese public school system.

The contribution of this paper is to estimate the academic costs that children may bear when their parents make errors in exercising choice in the open enrollment program. We also explore the differential characteristics, preferences, and knowledge of the parents who make these errors.

A number of studies have shown that offering parents choice among schools can be beneficial to academic performance. For instance, Angrist et al. (2002) showed that the voucher program in Colombia improved academic achievement and, in the context of the U.S. debate on school choice, Altonji et al. (2005) found that attending a Catholic high school increases the likelihood of graduation. However, numerous studies have shown that school choice might have mixed results in terms of academic outcomes (Teske & Schneider, 2001). Both Behrman and King (2001) and O'Shaughnessy (2007) develop theoretical frameworks that predict mixed results. On the empirical front, Goldhaber (1996) found no benefits from the choice of a private over a public school, while Rouse (1998), Howell et al. (2002), Mayer et al. (2002), Krueger and Zhu (2002), and Hsieh and Urquiola (2006) all found no significant benefits from voucher programs except for some specific subjects or subgroups. For the case of open enrollment programs, Cullen et al. (2005) found that winning a lottery to enter the school of one's choice in Chicago had no significant effect on a wide range of traditional academic outcomes, though there were improvements in some non-traditional measures of achievement. For this program, Cullen et al. (2006) concluded that, with the exception of students who selected career academies, the observed cross-sectional increase in the graduation rate due to opting out of one's assigned neighborhood school was likely spurious. Studying an open enrollment program in North Carolina that used a lottery system, Hastings et al. (2005b) observed that attending one's first choice school only resulted in academic improvement for children of parents who placed higher value on academic quality.

An additional concern with school choice programs is that heterogeneity in parental preferences for education can result in unequal benefits across categories of parents (e.g., Ladd, 2002; Elacqua, Schneider, & Buckley, 2006; and Hsieh & Urquiola, 2006, for voucher programs; and Hastings et al., 2005a, for the North Carolina open enrollment program). As reviewed by Elacqua et al. (2006), survey responses generally show that parents of all socioeconomic backgrounds value academic quality. Black (1999) found that parents' willingness to pay for

high-performing elementary schools, as measured by test scores, was capitalized in local housing prices. Goldhaber et al. (1999) did not find strong evidence that participants in the Milwaukee school choice program systematically differed from non-participants. However, there is evidence from other contexts that parents with higher socioeconomic status or with high-performing children are more likely to take advantage of school choice options (e.g., Ladd, 2002, for voucher program participation) or to choose high-achieving schools (e.g., Hastings et al., 2005b; Cullen et al., 2005). Other studies suggest that parents with low socioeconomic background give relatively more importance to academic achievement than to student satisfaction (Jacob & Lefgren, 2007²) and value more traditional academic-oriented school curricula rather than more progressive curricula (Teske & Schneider, 2001). These studies provide evidence that parents' academic preferences are associated with socioeconomic status.

However, regardless of parental preferences in making school choices, two fundamental questions remain: Are parents able to understand the school admission system, comply with decision rules, and use choice options to optimize school assignment for their children? And does this ability differ across categories of parents? Some studies are optimistic about the answers to these questions. For example, Solmon (2003) showed that parents' ratings of Arizona charter schools were generally consistent with the state's assessments. Bast and Walberg (2004) reviewed survey evidence which indicated that parents did not rate schools any differently than experts did, that they chose schools according to their perceptions of academic quality, and that students' academic performance was higher in the schools of their choice. These researchers concluded that parents could indeed choose the best schools for their children. Their analysis, however, relied more on survey responses than on data for actual parental school choices. In contrast, other studies have found significant evidence that parents differ not only in their preferences but also in the degree to which they are informed about schools and the school choice programs (e.g., Betts & Loveless, 2005). Parents from disadvantaged socioeconomic groups have been found to be generally less aware of the availability of voucher programs and less informed about schools (e.g., Maddaus, 1990; National Working Commission on Choice, 2003; Schneider et al., 1997). Evidence also shows that parents' actual school choices are not always consistent with their stated preferences (e.g., Betts & Loveless, 2005; Elacqua, Schneider, & Buckley, 2006)³. Abdulkadiroglu et al. (2006b) found that a significant proportion of applicants in the

²This study focused on within-school teacher choice rather than school choice per se. Nonetheless, it sheds new light on parental preferences for academic outcomes along socioeconomic lines.

³One may justifiably question whether parents provided honest responses on the survey when asked for their preferences or whether they translated their preferences into appropriate school choices.

Boston school system acted naively when the application system called for strategic school choices, and were consequently disproportionately unassigned.

Despite the abundant literature on school choice programs, to date there are no firm conclusions on the benefits of such programs, the impact of heterogeneous parent preferences on academic outcomes, or parents' unequal capacities to make school choices. This paper makes an important contribution to this debate by measuring the cost to children of their parents' school selection errors and determining whether parents with disadvantaged status are more likely to make such errors.

We present rigorous empirical evidence on the prevalence of parents' judgment errors in school choices and their adverse effects on academic outcomes. The study uses a unique data set that combines (a) a parental survey, (b) records of parents' actual school choices, (c) information of elementary and middle schools attended, and (d) academic performance outcomes for 4,717 students who were admitted to 28 public middle schools in Beijing's Eastern City District in 1999 under a reformed school admission mechanism. Under the new mechanism, which was introduced in 1998, parents were requested to apply for school admission by ranking up to seven schools. Using the administrative records available on parental school choices, we first identify technical and judgment errors in choices that resulted in losing a round of school seat allocations despite parents' actual preferences and strategic choices. We then focus on one type of error: selecting a top-tier school as a second or later choice in the submitted sequence. Results show that this error of judgment in school choice is very frequent, particularly among parents who have lower levels of education or whose child performed low in primary school. An examination of parents' stated preferences and information demonstrates that this error was made more frequently by parents who were eager to play a strategic game of school choice but were insufficiently informed or able to do so. Such errors resulted in children being assigned to inferior schools and performing at a lower academic level.

2. Background and data

2.1. Middle school choice and admission in China

In order to equalize access to school resources across students of different socioeconomic status and ability, the government abandoned the previous merit-based middle school admission

mechanism in 1998. Instead, it introduced a preference-based random assignment of primary school graduates to middle schools.

In 1999, the Beijing Eastern City District was divided into 15 school neighborhoods based on primary school enrollment. Students in each neighborhood could apply to three to seven middle schools. Good schools were usually available to more than one school neighborhood, while low-quality schools were only available to the school neighborhood nearest to them. All schools were given neighborhood-specific enrollment quotas by the Education Bureau.

Students could apply to all the middle schools available to their particular school neighborhood, ranking them in order of preference. These choices were incorporated into a randomization procedure as follows. First, a computer-generated 10-digit number was randomly assigned to each student. Each school admitted the students who reported that particular school as their first choice (i.e., first-choice applicants), enrolling students in the order of their random numbers until the enrollment quota for each school neighborhood was filled. Thus, schools with more first-choice applicants than seats randomly chose from a pool of first-choice applicants. A school that did not fill its quota with first-choice applicants then randomly chose from the applicants who selected that school as their second choice and so on, until the quota for each school neighborhood had been met. If a student was not assigned to any of the schools to which he applied⁴, he was randomly assigned to a middle school with open seats that was available to his particular school neighborhood. Despite the general randomization, schools admitted some students without randomization if their parents were employed in the school, if the students had received a city-level prize in academic or special skill achievement, or if a considerable direct payment had been made to the school. Randomization was thus incomplete, with a fraction of the students escaping the random drawing process. Nonetheless, almost 5,000 out of the approximately 7,000 students currently in middle school were admitted through randomization.

This system is similar to the “universal open-enrollment school choice system” that exists in many other countries. Like other open-enrollment school choice systems, Beijing’s school assignment mechanism does not encourage truthful revelation of preferences by design. Consider this simplified example: in one neighborhood with four schools, all parents have the same ordered preference, ranking schools 1, 2, 3, 4 from most to least desirable. Reporting truthful preferences in fact might not maximize the outcome for all applicants. Since the schools randomly choose

⁴ This would happen if for each of his preferred schools his neighborhood quota was met before his random number was reached.

from applicants selecting them as first choice, students who only slightly preferred School No. 1 to School No. 2 might get a higher expected return by reporting School No. 2 as their first choice, thereby ensuring a higher chance of admission, rather than competing with the whole neighborhood for admission to School No. 1. With risk aversion, deviation from true preferences and selection of School No. 2 as first choice are even more reasonable. As a result, School No. 2 might also become completely filled in the first round. This implies that applicants who chose School No. 1 as their first choice should not select School No. 2 as their second choice even though that would be their true preference. Indeed, School No. 2 would no longer have seats available by the second round, and an invalid choice in the second round might increase the risk of being assigned to School No. 4, the least preferred school. To summarize, with this current mechanism in place, parents' school choices reflect strategic behaviors rather than personal authentic preferences for schools. Lack of full information about the schools or inaccurate expectations of the chances of entering each school might result in parents making judgment errors when submitting their school choices that could be detrimental to final school assignment. Along these lines, Abdulkadiroglu et al. (2006b) observed that, in the Boston system, parents who were less experienced with selection strategies lost their priority school to parents who had more sophisticated strategic behaviors and their children were disproportionately not assigned to their anticipated schools because of a mechanism that was not strategy-proof.

In 1999, the Education Bureau of Beijing's Eastern City District distributed a brochure to the parents of primary school graduates that introduced the general procedure of the preference-based randomization for middle school admission, as well as qualifications for direct enrollment without randomization. Middle schools available to each neighborhood and the neighborhood quota for each school were also included in the brochure. However, any further instruction was left to each primary school, and different primary schools clearly had different levels of involvement in assisting parents with their decisions. In short, there was no organized individual assistance for parental school choice at the district level.

2.2. Data

In early 2002, a census was conducted by the Education Bureau of Beijing's Eastern City District in its 28 public middle schools. The census covered all 7,102 students enrolled in the third and last year of middle school as well as their parents and teachers. Dropping out and repeating grades are almost non-existent in these middle schools; inter-district transfers are

extremely rare and can only be justified by parents changing jobs or moving away. Hence, our survey population is essentially the population of students who entered middle school in 1999. A questionnaire directed to parents collected information on household wealth, parents' education levels, and retrospective information on factors affecting parents' school choices and their preparedness for making school choice decisions in 1999. Access to administrative data on parents' actual school choice sequences, students' primary school affiliations and test scores, and students' performance on the High School Entrance Examination (HSEE)⁵ allows us to measure school achievement outcomes.

For this research, we consider only the 4,717 students who were enrolled in the middle schools via the standard school selection and randomization process.⁶ Some 10% of the students transferred schools after the randomization. Although they escaped the (probably unfavorable) outcome of the randomization process, we retain them for the analysis because their transfer was an endogenous choice to switch out of the assigned schools. To simplify the discussion, within a certain school neighborhood, schools that were oversubscribed in the first round are designated as Type A; schools that were undersubscribed in the first round but oversubscribed in a subsequent round are designated as Type B; and schools that were undersubscribed in all rounds are designated as Type C. School neighborhoods contained 1 to 3 Type A schools, 1 to 2 Type B schools, and 1 to 2 Type C schools.

3. Evidence of errors in parents' school choices

We examine the school applications filled in by parents in 1999, the second year of implementation of the open enrollment program. These applications reflect some combination of the parents' true preferences over schools and their strategies in ordering schools to optimize their children's final school assignments. Observationally, we cannot distinguish true preferences from strategic choices; however, it is not the purpose of this analysis to question parents' preferences and strategies. Nevertheless, some school choice patterns reveal errors, that are not consistent with any true preferences and meaningful strategies. Such errors are detectable because they led to invalid entries in the application sequence (i.e., entries that could not possibly result in a school

⁵ This exam is taken at the end of the third (final) year of middle school; in our sample that corresponds to June 2002.

⁶ Excluded from this sample are the 2385 children who circumvented the system altogether and 231 students whose first choice was a school that could accommodate all first choice students and hence did not undergo the randomization process. These exclusions are made because our objective is to trace the consequences of parents' errors made during the process of school assignment through choice-based randomization.

assignment), which may have been detrimental to the final school assignment outcome. These errors fall into two categories: technical errors and obvious errors of judgment.

Two types of technical errors in the application process are easily detected: repeated choice of a school and applying to schools not accessible to a particular neighborhood. Repeated choice reflects a misunderstanding of the school admission process. If a child missed a school of his or her choice in a given round, the school must have been filled and would then not be available again in a later round. Applying to a non-accessible school can only be explained as a misinformed choice. Both of these simple technical errors wasted an application opportunity and forfeited the corresponding round of choice. Table 1 indicates that only 59 and 303 out of the total 4,717 applicants reported repeated choices or selected schools that were not accessible to the neighborhood, respectively. Together, this is less than 8% of the applicants, indicating that parents largely understood the basic logic of the open enrollment system.

An obvious error of judgment consists of selecting a Type A school as a second or later choice in the application sequence, regardless of parents' preferences and strategies. Since a Type A school was oversubscribed in the first round, selecting such a school for the second or later rounds resulted in wasting an application opportunity. However, this characterization of a school comes from an ex-post equilibrium between applications and available seats; thus, we cannot expect parents to form expectations about such a complex outcome. A more obvious error of judgment is choice of a subset of Type A schools—widely known as “top-tier schools”—as a second or later choice in the application sequence. As the “top-tier school” title was granted by the government and was widely known to the public, the well-established reputation of these schools left little room for misinformation or incorrect expectations about their popularity. The ex-post number of applications relative to the number of seats available illustrates this point. The four schools known as top-tier schools in the district were selected as first choice by 2 to 4.5 times as many students as the schools had seats available. Most of the other Type A schools were oversubscribed by a factor ranging from 1.5 to 2. As these numbers indicate, the popularity of top-tier schools is so overwhelming that there was no chance of any open seat in the second round of choice.

Chances of getting into the top-tier schools were understood to be small, even in the first round. Moreover, primary school teachers had strongly cautioned parents against reporting these schools as a second or later choice. Even so, 2,676 out of 4,717 (57%) applicants reported a top-tier school as their second or later choice, resulting in a missed selection opportunity. These

parents were either taking a wild gamble about the behavior of other parents or, more likely, they did not understand the system fully.

Given the small number of technical errors, we focus the rest of the paper on what is an obvious error of judgment, the selection of a top-tier school as a second or later choice.

4. The cost of errors in open enrollment

We now analyze how these errors of judgment in the school choice sequence can result in the assignment of students to schools of lower quality, which in turn can hurt their future middle school examination performance. To understand the mechanism by which these errors occur, consider the selection and school assignment process described in Section 2. Parents were allowed to make three to seven ordered school choices. When examining all these choices, however, we found that, ex-post, at most three schools of each choice sequence were valid (Authors, 2007). “Valid” here means that the school still had available seats at the round corresponding to the choice. Thus, any choice sequence made by parents that reported a Type A school as first choice fell into one of the following three patterns:

- (a) Parents’ second valid choice was oversubscribed but not their third. The student went through a second randomization over the B choice; if not selected, the student ended up in the parents’ third valid choice. This sequence can be summarized as ABC (or ABB, if the third valid choice was a B school not yet oversubscribed).
- (b) Parents’ second valid choice could accommodate all of the applicants in that round (even though it might not in later rounds). The student entered the school and no further choice mattered. This sequence can be summarized by A0B or A0C, where the 0 notation means that the student did not have to go through another randomization before being admitted by schools B or C.
- (c) Finally, none of the other requested schools were available when the student’s turn came up, and he or she ended up in the chosen C school (or was randomly assigned if parents had not indicated a C school). In this case, the choice sequence can be summarized as A0C or A00 (if there were more than one C schools in the student’s neighborhood and he or she did not choose one of them). The student was randomized by A, but then missed all subsequent opportunities until he or she could enter school C without randomization.

Given all schools available for each neighborhood, all these combinations add up to 137 distinct paths that we call selection channels. Note that two students with the same selection channel faced exactly the same *ex-ante* probability of entering any of the two or three schools recorded in the channel.

Invalid choices affected the selection channel in that they postponed the round at which other schools would be considered. The risk here was that the B schools filled up during that round and became invalid choices at a later stage.

To the extent that this classification of schools based on their popularity corresponds to differences in school resources, invalid choices should send children to schools with lower resources. This is verified by estimating the following model:

$$x_i^s = \alpha + \delta I_i^e + \varepsilon_i, \quad (1)$$

where x_i^s is a characteristic of the school to which child i was assigned, I_i^e an indicator for making the error of selecting a top-tier school as second or later choice, and ε_i is unobserved heterogeneity.

Results in Panel A of Table 2 show that reporting a top-tier school as one's second or later choice was negatively correlated with the level of resources at the school to which the child was eventually assigned, as measured by the teacher-student ratio, the percentage of teachers with quality rank III or higher,⁷ and teachers' years of experience. It was also negatively correlated with observable indicators of school performance such as the school reputation category,⁸ its average performance on the HSEE in 1999 (the year in which the students entered middle school), its average performance on the HSEE in 2002 (which was achieved by these students), and the school value-added, an index of academic quality estimated by the Authors (2007).⁹ Students

⁷The official evaluation of teacher quality has four tiers, ranging from rank I (lowest) to rank IV. These ranks are determined by municipal officials via strict evaluation procedures and based on various indicators of performance.

⁸The school reputation category is a four-level classification of a school's comprehensive quality established by the district Education Bureau before the reform, with 1 indicating the lowest category and 4 the highest. This classification was abolished after the 1998 reform.

⁹This is the school fixed effect on student performance estimated in the following regression framework: $y_{icsn} = v_c + \gamma_s + \eta_n + X_i\beta + \varepsilon_{icsn}$, where y_{icsn} is the HSEE score of child i , from neighborhood n , having chosen the selection channel c , assigned to school s , and X includes student performance upon graduating from primary school and other individual and family characteristics. The identification of γ_s is due to the random assignment to a school within the given selection channel.

subjected to this mistake were also more likely to end up in schools with peers from lower socioeconomic and academic backgrounds, as shown by the negative correlation between the indicator of making this mistake and the school's average parent years of education, and the negative correlation between the indicator of making this mistake and the average elementary school graduation test scores of the students in the school. These results are robust to the inclusion of many individual and parent characteristics and school neighborhood fixed effects (Panel B), and to restricting the sample to students who did not transfer out of their assigned school (Panel C). The orders of magnitude of these effects are not trivial. For individual school resources, they are in the 5-10% range of mean values. But for the school value-added, which is the aggregate measure of school quality, reporting a top-tier school as one's second or later choice is associated with a loss of 25-30% of its mean value.

Because these are partial correlations, we cannot overlook the fact that they may pick up some unobserved genuine preferences. But the stability of the estimated coefficients to the inclusion of many individual characteristics indicates that the confounding factors (i.e., the unobserved preferences), if any, are not correlated with any of these characteristics. Thus, we are confident that we are measuring a genuine and large effect of parental error in the school choice process on the resulting quality of the school to which the student is assigned.

Did parents' judgment errors in the 1999 school choice process result in lower HSEE performance in 2002? In and of themselves, errors do not directly affect students' performance, but they do affect the school to which the student is assigned—a possibly important factor in student performance. We seek to measure this indirect effect. However, the difficulty of analyzing the indirect role of a choice error on performance is that the errors themselves are often correlated with many unobserved individual characteristics also affecting performance. To see this, consider the following simple model:

$$y_i = I_i^s \mu_s + ability_i + \varepsilon_i^s = I_i^c v_c + ability_i + \varepsilon_i^c \quad (2a)$$

$$I_i^c = f(\text{preference}_i, I_i^s, \varepsilon_i^s) \quad (2b)$$

$$E(ability | I^e = 0) \geq E(ability | I^e = 1) \quad (2c)$$

where y_i is child i 's performance, μ_s and v_c are vectors of school and channel fixed effects, I^s and I^c are vectors of 0/1 elements that indicate his or her assigned school and selection channel, and ε^s , ε^c , and ε^e are random noise. Equation (2a) first shows performance as a

function of a school fixed effect and individual ability. Because schools are randomly assigned within a selection channel, performance can also be written as a function of a selection channel fixed effect and ability, with an additive random noise. Equation (2b) shows the selection channel being determined by unobserved preference and error of judgment I_i^e . Equation (2c) formalizes the assumption that making an error of judgment is correlated with ability.

Consider now the two following reduced-form regression models:

$$y_i = I_i^c v_c + I_i^e \delta + \varepsilon_i \quad (3)$$

and
$$y_i = I_i^e \hat{\delta} + \varepsilon_i. \quad (4)$$

Given the underlying true model (2), the parameters on the error variable I^e in (3) and (4) can be expressed as:

$$\delta = E(y_i | I^c, I^e = 0) - E(y_i | I^c, I^e = 1) = [E(\text{ability} | I^c, I^e = 0) - E(\text{ability} | I^c, I^e = 1)]$$

and
$$\hat{\delta} = E(y_i | I^e = 0) - E(y_i | I^e = 1)$$

$$= [E(I^c v_c | I^e = 0) - E(I^c v_c | I^e = 1)] + [E(\text{ability} | I^e = 0) - E(\text{ability} | I^e = 1)].$$

Therefore, $\hat{\delta}$ in model (4) captures both the indirect effect of I^e on performance through its effect on the selection channel and school assignment, and the effects of individual characteristics (ability) correlated with I^e and with the student's academic performance. But δ in model (3) only accounts for the individual characteristics that are orthogonal to the effects of I^e via the selection channel.

Table 3 reports estimations of models (3) and (4). Performance is measured by a student's overall HSEE score across all five subjects (Chinese, Math, English, Physics, and Chemistry) in 2002. Column (1) shows a very strong negative correlation between "reporting a top-tier school as second or later choice" and HSEE performance. However, once we control for the selection channel in column (2), the correlation becomes positive and only marginally significant. These results are robust to the addition of a rich set of individual and parental characteristics including student gender, elementary school affiliation, and performance, and

parents' age, income, education, and profession-based socioeconomic status (columns (3) and (4)). In particular, column (3) indicates that controlling for individual characteristics alone does not significantly affect the estimated parameters. Results are also similar when the sample is restricted to students who stayed in their assigned schools (columns (5) and (6)). The model is also estimated controlling for the assigned school fixed effects rather than selection channel fixed effects, as suggested by equation (2a). Results in column (7) similarly show no residual correlation between making an error in the choice sequence and performance, once we control for assigned school.

These results suggest that the negative correlation between judgment errors in school choices and eventual student performance is unlikely to be spurious and due to unobserved factors in performance; it comes instead from school assignment. Even though the simple model (2 a, b, c) above shows that we cannot completely isolate errors from genuine preferences, the stability of the estimated coefficients to the inclusion of many individual characteristics (in column (3)) indicates that the preference would have to be uncorrelated with all of these characteristics.

The reduction in the overall test score associated with parental error in open enrollment is 8.3 points. While this number seems small relative to the average score of 414 points, it can make an important difference in the outcome of the exam when considering the 61-point difference between the thresholds for entering the district's top high schools and the passing grade for entering any high school. Recall, also, that this analysis compares students whose parents made this particular well-identified error with all other students, including the many parents who made invalid choices by underestimating the popularity of other schools. The comparison is consequently not between making this error and only having valid choices in one's sequence.

In conclusion, we find a strong relationship between errors of judgment in school choice and examination performance, and this relationship stems from the detrimental consequences of these errors on school assignments. Clearly, the parents' school choice errors under the open enrollment system are very costly in terms of the future academic success of their children.

5. Parents most likely to make errors of judgment

We found that errors in school choices were made quite frequently by parents. Thus, an important question arises: does the likelihood that parents make these errors in the school choice

process vary according to family and academic backgrounds? Answer to this question has important implications for equity in access to education, an avowed objective of the Chinese public education system. To explore the answer, we relate the probability of making an error in school choice to academic and family backgrounds, including the student's standardized primary school test scores, gender, and parents' income and education. Primary school and school neighborhood fixed effects are also included in the regressions.

Results in Table 4 show that the tendency to make technical errors in school applications is not associated with a student's individual characteristics or family background. Parents with different socioeconomic status apparently had the same level of understanding of the basic rules of the school choice and admission mechanism. However, this was not the case for parents who erroneously reported a top-tier school as a second or later choice in the application sequence. Parents with a higher level of education or parents whose children had higher primary school performance were less likely to report a top-tier school as their second or later choices. This may be attributed to the higher care that parents give to this process because of their heavy investment in their children's education. Still, a child's higher primary school performance might also capture some unobserved family characteristics as well as innate abilities. Although not reported here, results are robust to using a logit or linear probability specification, and to the inclusion of additional controls such as parents' age, party affiliations, and years of residency in the city.

6. Relationship between errors in choice and preferences and knowledge

Is the tendency to make judgment errors about school choices related to particular parental preferences and knowledge level? To answer this question, we look at the main factors that parents considered when making their prioritized school choices (preferences) as well as the knowledge they had about these factors. In our survey data, preference and knowledge factors are grouped under three categories: school physical conditions, school academic quality, and strategy in school choice. Parents were asked to rank a total of nine possible factors in making their school selection. For each factor, parents were also asked to recall if, in 1999 when they made the school choices, they knew the corresponding information for each school they selected. Thus, all parents' information about schools is retrospective. We focus on the knowledge parents had on their second and third choice schools.¹⁰

¹⁰Survey questions beyond third-choice schools were incompletely answered. We also included parents' first choice, and their fourth to seventh choices, respectively, in the model, and did not find significant differences with the results using information regarding second and third choices only.

Sample averages in Table 5 reveal that parents had very limited knowledge about their second-choice schools, with only 32% of the parents in the sample claiming to be informed about the school's location. Parents also demonstrated limited knowledge and preparation for playing the school choice game, with only 28% claiming that they had listened to teachers and other parents' opinions about schools, and only 30% stating that they had some sense about the admission quota and their chance of entry for their second-choice school. Corresponding knowledge for their third choice school was even poorer. This could explain why errors in school choices were so prevalent. In terms of preferences, parents clearly gave overwhelming importance to teacher quality (73% named this among their first three factors in selecting schools) and to school reputation and performance. However, corresponding knowledge was also lacking: only 25% of the parents said they knew the reputation and previous performance of their second-choice school.

We examine the differences in preferences and knowledge between parents who made errors in choosing top-tier schools as their second or later choice and all other parents, while controlling for school neighborhood. Compared to all other parents, we observe that parents who made this error claimed to care more about the possibility that their child would enter the school of their choice and about other parents' strategies (column (1)). Yet they seem less informed and thus less prepared to make strategic choices themselves. We use a two-step approach to better understand who these parents are. First, we compare parents who selected a top-tier school anywhere among their choices to those who did not (column (3)) and then we identify from among them those who made errors of judgment in placing the top-tier school too late in the choice sequence (column (2)). As expected, parents who selected a top-tier school clearly gave more importance to the academic quality of the school and less to its physical conditions. However, those among them who erroneously selected the school as a second or later choice rather than solely as their first choice cared somewhat less about academic quality and school conditions in general, while being more concerned with playing a strategic game. This is seen by the higher number that explicitly declared that "other parents' strategies" and "school admission quota and chance of entry" were among the three main factors in their school selection. Yet, for reasons that we cannot identify with the given information, their behaviors did not match their ambitions and gamesmanship because they were less likely to be knowledgeable of teachers' or other parents' opinions about their school choice. In fact, these parents' choices were not strategic, making more erroneous choices than others despite their stated preferences.

In the last row of Table 5, we see that more errors of judgment were made by parents who left fewer blank slots in their applications. This suggests that trying to make an unnecessarily large number of ordered choices was overwhelming for parents and created confusion, increasing the incidence of errors. The open enrollment program allowed parents to make as many school choices as there were schools available in their school neighborhood; this should have been optimal under perfect information and rationality. However, evidence suggests that limiting the number of choices in a world of imperfect information and strategic behavior could have reduced the number of errors parents made in the choice sequence.

7. Policy implications

The results discussed in this paper have implications for educational policy in China and in other countries as well. Even though the analysis is for the Eastern City District of Beijing, the open-enrollment school system there resembles programs in the United States¹¹ and in other parts of the world, where parents select from a variety of schools and rank the order their applications, a step which ultimately proves critical to the students' final school assignment. China may be unique in one sense because parents traditionally place enormous value and importance on education. The long historical emphasis on education, the one-child policy, the importance of school performance in a child's future career development,¹² and the relatively high level of parents' education¹³ all contribute to parents' high level of attention devoted to their children's education and school choice. Therefore, compared with populations facing open enrollment programs in other parts of the world, parents in our sample are likely to pay greater attention to school choices, given adequate accessibility to relevant information. Yet, the parents we observed were not able to make open enrollment choices without committing errors. This suggests that the school choice problem is likely to exist at an even larger scale in some other countries. The Chinese experiment thus deserves close attention. Results from this case study indicate that offering parents choice among schools is not enough to achieve desirable academic outcomes.

¹¹Even though the specific priority rules of many U.S. open enrollment programs differ from the ones discussed here, they do share common concerns about a non-strategy-proof mechanism and the resulting inefficiency of allocating school seats. Open enrollment is the most prevalent form of non-traditional parental school choice in the U.S.

¹²In China, academic promotion, especially promotion to higher education, is predominantly determined by standardized examinations. A student's school performance also plays an important role in the job market competition. It is widely believed that students' test scores are greatly determined by the quality of schools that students attend. Under the one-child policy, most Chinese parents consider their only child as their "only hope for the future," and thus try their best to choose an appropriate school for their child.

¹³In this district, 93% of the students have at least one parent who completed high school, and 35% of the students have at least one parent who received some years of higher education.

Helping parents fully understand the school allocation mechanism, systematically disclosing important school information, and explaining to parents how to effectively exploit the process for their children's benefit should be integral to all open enrollment school choice programs. Providing this multi-layered assistance is particularly important for parents with lower academic levels and with children who have achieved lower levels of primary school performance.

8. Conclusions

This paper measures the negative effect of parents' school choice judgment errors on children's academic achievement, using data from an open enrollment system in Beijing. Our rich dataset includes parents' responses to census questions on preferences and knowledge in making school choices, actual parental school choices, children's school assignments, and academic achievements from administrative records for 4,717 students. The specific error we analyze consists of selecting a top-tier school as a second or later choice when it had been well advertised that this category of schools would likely already be filled; thus, parents lost a round of school assignments and the subsequent chances of admission to a good school were reduced. We find that this error is costly for children's eventual academic success. Children whose parents made this error were admitted to schools with fewer and lower quality resources, lower reputation, inferior performance on the High School Entrance Examination, and 25-30% lower "value-added" as an aggregate measure of quality. The loss in HSEE test score for these children was 8 points compared to a 61-point difference in scores for entering the top high schools and the passing grade to enter any high school. Children of parents who failed to take into account the fact that more desirable schools would be filled first under the randomization process were thus admitted to lower-quality schools and had lower scores on the High School Entrance Examination which are of crucial importance for future academic achievements.

We show that parents with lower education levels or parents with children who had low performance in primary school were more likely to make this error in school choice, possibly exacerbating social and academic stratification across schools. We find that the parents who made the error reported being more concerned about their children's chance of admission and other parents' strategies, but at the same time were less informed about teachers' and other parents' opinions about the schools. Ambition for the welfare of their children was not matched by careful inquiries about schools to make better-informed choices.

By way of epilogue, we note that, as of 2008, Beijing Middle Schools continue to admit students using an open enrollment system, with parents ranking schools of their choice and schools randomly selecting students when applicants exceed available seats. Adjustments to the system made since our survey have addressed concerns with equity rather than efficiency. To reduce backdoor admissions that bypassed randomization, a two-level randomization procedure was introduced in 2008, randomly allocating first the “priority students” recommended by primary schools, and then proceeding with the rest of the student body. Regarding efficiency in parents’ choices, the primary schools and teachers remain the main resources to assist parents with their school choices. The primary schools usually organize parents meetings during the period of middle school applications, explaining to parents the policies and rules of the open enrollment system and answering their questions. To improve school selection, parents have been strongly advised to focus their attention on the school of their first choice, and teachers concentrate their assistance to that choice. But we know from this paper that choices beyond the first school do matter for student assignment. The key question of advice on strategy with school choices beyond the first choice remains unresolved. To reduce unnecessary complexity, parents have also been advised to limit their choice of schools down from seven to five. But few other efforts have yet been made to reduce parents’ errors of judgment and their costly consequences. The results obtained in this paper thus maintain their full value.

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Table 1. Prevalence of errors in school choices

	Technical errors		Error of judgement: Reporting a top-tier school as 2nd or later choice
	Repeated choice	School not accessible	
Number	59	303	2676
Percentage	1	6	57
Observations	4717	4717	4717

Table 2. Univariate analysis of the correlations between school choice errors and characteristics of the assigned school

Dependent variable	Teacher-student ratio	Percent of teachers rank III & IV	Average years of teaching	School reputation category ¹	School value-added index ²	Average HSEE score 1999	Average HSEE score 2002	Average peers' elementary school score ³	Average peers' parental education
Panel A - No control variables									
Reporting a top-tier school as 2nd or later choice (0/1)	-0.0007* [0.0004]	-1.59*** [0.54]	-0.59*** [0.14]	-0.17*** [0.02]	-4.03*** [0.41]	-3.70*** [0.59]	-5.61*** [0.43]	-0.07*** [0.0044]	-0.20*** [0.02]
Panel B - With individual and parent characteristics, and neighborhood fixed effects									
Reporting a top-tier school as 2nd or later choice (0/1)	-0.0021*** [0.0004]	-1.65*** [0.49]	-0.80*** [0.12]	-0.13*** [0.03]	-4.58*** [0.42]	-3.77*** [0.65]	-6.29*** [0.45]	-0.08*** [0.0047]	-0.19*** [0.03]
Panel C - Sample restricted to the students that did not transfer out of the assigned schools. With controls.									
Reporting a top-tier school as 2nd or later choice (0/1)	-0.0026*** [0.0004]	-1.92*** [0.51]	-0.98*** [0.13]	-0.11*** [0.03]	-4.66*** [0.42]	-3.52*** [0.65]	-6.33*** [0.44]	-0.08*** [0.0046]	-0.17*** [0.03]
Mean value of dependent variable (standard deviation)	0.069 (0.014)	29.6 (17.9)	16.61 (4.73)	2.18 (0.82)	15.3 (14.1)	509.7 (19.9)	405.2 (14.8)	-0.01 (0.15)	12.9 (0.8)

Standard errors in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%

¹School reputation category is a four-level classification, with 1 indicating the lowest reputation, and 4 indicating the highest reputation.

²The school value-added index is the school fixed effect estimated in a regression of student performance based on the random school assignment, and controlling for primary school test scores, affiliations, and individual characteristics (Authors, 2007).

³Standardized score, with mean value equal to 0 and standard deviation equal to 1

Table 3. Effect of school choice errors on the HSEE score

Dependent variable: HSEE test score							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Reporting a top-tier school as 2nd or later choice	-8.30*** [2.10]	5.45* [3.29]	-8.37*** [2.18]	2.37 [3.52]	-7.62*** [2.31]	5.85 [3.88]	-1.55 [2.54]
School fixed effect							Y
Selection channel fixed effect		Y		Y		Y	
Individual & parental characteristics ¹			Y	Y	Y	Y	Y
Observations	2605	2590	2249	2238	2040	2040	2040
R-squared	0.01	0.13	0.16	0.24	0.15	0.24	0.21
Mean value of dependent variable (standard deviation)	413.5 (53.5)	413.5 (53.5)	414.4 (52.4)	414.5 (52.4)	413.6 (52.4)	413.6 (52.4)	413.6 (52.4)

Standard errors in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%

¹Individual and parental characteristics are the student's gender, elementary school affiliation and performance, his parents' age, income, education, and profession-based socioeconomic status, and the school neighborhood.

Columns (5) to (7): Students that transferred after the results of the randomization excluded.

Table 4. Heterogeneity in tendency to make school choice errors (Probit)

	Sample mean	Technical errors (1)	Reporting a top-tier school as 2nd or later choice (2)
Parent income (log)	6.9 [1.6]	0.0009 [0.0028]	0.0004 [0.0050]
Parents' years of education	12.7 [2.4]	-0.0003 [0.0016]	-0.01*** [0.0035]
Female	0.52 [0.50]	0.01 [0.0071]	0.01 [0.02]
Primary school test score	0.028 [.97]	-0.0021 [0.0036]	-0.03*** [0.0082]
Primary school fixed effects		Y	Y
Neighborhood fixed effects		Y	Y
Observations		3558	4305

Standard errors in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%

Marginal effects reported.

Table 5. Parents' preferences and knowledge of schools at time of school choice decision

Dependent variable:	Sample average ^j	Reporting a top-tier school as 2nd or later choice				Reporting a top-tier	
		(1)		(2)		(3)	
		Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
		Full sample		Sample reporting a top-tier school		Full sample	
School physical conditions							
Factor in selecting schools							
School facilities	0.09	-0.02**	[0.02]	-0.02**	[0.05]	-0.02	[0.18]
Environment around school	0.11	-0.02*	[0.07]	0.00	[0.68]	-0.04***	[0.00]
Knowledge on 2nd and 3rd choice schools							
School location and distance from home	0.32	-0.03***	[0.01]	-0.05***	[0.00]	0.03	[0.14]
Educational quality							
Factor in selecting schools							
Teacher quality	0.73	-0.01	[0.58]	-0.03**	[0.03]	0.07***	[0.00]
School reputation and previous performance	0.34	-0.01	[0.44]	-0.03*	[0.08]	0.04*	[0.07]
Knowledge on 2nd and 3rd choice schools							
School reputation and previous performance	0.25	0.00	[0.91]	-0.01	[0.33]	0.06***	[0.00]
Strategy in school choice							
Factor in selecting schools							
Other parents' strategies	0.01	0.01***	[0.00]	0.01***	[0.00]	0.00	[0.92]
School admission quota and chance of entry	0.18	0.02**	[0.05]	0.03***	[0.01]	-0.01	[0.44]
Knowledge on 2nd and 3rd choice schools							
Teacher or other parents' opinions	0.28	-0.02**	[0.02]	-0.05***	[0.00]	0.05**	[0.01]
School admission quota and chance of entry	0.30	-0.01	[0.17]	-0.02	[0.16]	0.01	[0.80]
Number of blanks left in the application	0.87	-0.73***	[0.00]	-0.31***	[0.00]	-1.64***	[0.00]

* significant at 10%; ** significant at 5%; *** significant at 1%

Each entry reports the coefficient from a regression of a selection factor/knowledge indicator on the dummy variable for reporting a top-tier school in 2nd or later choice and neighborhood fixed effects. Knowledge indicators are averages of binary responses for the 2nd and 3rd choice schools, hence taking values 0, 1/2, and 1. Selection factor indicators are equal to 1 if the issue was among the three main factors considered in selecting schools, and 0 Probit estimation and marginal effects are reported for factors in selecting school..

^jSample averages for knowledge are about the 2nd choice only; sample averages for preferences are the percentages of the sample who included the corresponding factors as among the most important three factors in school choice consideration.

Column (2): Sample restricted to students reporting at least one top-tier school in their choice sequence, comparing students who reported a top-tier school as a second or later choice in the application sequence and those who did not make this error.

Column (3): Full sample; coefficients report the difference between student who reported a top-tier school anywhere among their choices and those who did not report a top-tier school at all.