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Public School Choice, Outside Options, and Public School Enrollment

Susha Roy
Harvard University

In this paper, I study the effect of winning the public school choice lottery on public school enrollment. In particular, I look at how different outside options affect how sensitive students are to receiving their first choice in the public school lottery, focusing on three measures of outside options: ability to afford private schools, geographic convenience of private schools, and zoned-school quality. Using rich administrative data from applications submitted through a centralized enrollment system in Tulsa Public Schools (TPS), I find that overall, students who do not get assigned to their top choice school in a public school choice program are 15 percentage points more likely to leave the public school system entirely than those who do get an offer at their top choice. This effect is driven by higher-income students: these students, who are more likely to be able to afford private schools, are 33 percentage points more likely to leave the public school system if they do not get an offer at the public school they rank first than those who do get a spot. Geographic convenience of private schools and zoned-school quality do not differentially affect students' enrollment decisions once they receive a school assignment. These effects are important to understand as districts undergo efforts to increase participation in school choice programs, while seeking to maintain district enrollment. They also provide useful insights about how attrition may affect estimates of the impact of choice schools on student outcomes.

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Susha Roy
PhD Candidate
Harvard Graduate School of Education
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Abstract

In this paper, I study the effect of winning the public school choice lottery on public school enrollment. In particular, I look at how different outside options affect how sensitive students are to receiving their first choice in the public school lottery, focusing on three measures of outside options: *ability to afford* private schools, *geographic convenience* of private schools, and *zoned-school quality*. Using rich administrative data from applications submitted through a centralized enrollment system in Tulsa Public Schools (TPS), I find that overall, students who do not get assigned to their top choice school in a public school choice program are 15 percentage points more likely to leave the public school system entirely than those who do get an offer at their top choice. This effect is driven by higher-income students: these students, who are more likely to be able to afford private schools, are 33 percentage points more likely to leave the public school system if they do not get an offer at the public school they rank first than those who do get a spot. Geographic convenience of private schools and zoned-school quality do not differentially affect students' enrollment decisions once they receive a school assignment. These effects are important to understand as districts undergo efforts to increase participation in school choice programs, while seeking to maintain district enrollment. They also provide useful insights about how attrition may affect estimates of the impact of choice schools on student outcomes.

I. Introduction

Existing research shows that school choice, in many cases, can exacerbate racial segregation and social stratification across schools (Cullen et al, 2005; Urquiola, 2005; Phillips, Larsen & Hausmen, 2015). This research shows that participation in school choice programs and the potential benefits—like attending better schools—are not evenly distributed across all families. Some theories and empirical research point to information and bureaucratic barriers as the source of increased stratification (Corcoran et al. 2018; Gross et al. 2015; Jochim et al. 2014; Lareau et al. 2006; Zimmerman, Vaughan 2013). But another consideration is the various outside options that families have. If families face different options, within and outside of the public school choice system, then solving for information and bureaucratic within a public choice system could still lead to increases in stratification in and across the public and private sectors. For example, in a stylized world in which all families prefer to send their kids to the "best school", providing perfect information to families would increase demand at the "best school", reducing the likelihood that any individual student gets in. Students who can afford to attend private schools may turn to these options outside of the public school system if they do not get what they want in the public system. In this paper, I explore this phenomenon empirically, showing how differential access to outside options affects the behavior of families participating in public school choice systems and how that behavior, in turn, affects public school enrollment.

I study the effect of winning the public school choice lottery in Tulsa Public Schools (TPS) on public school enrollment. In particular, I look at how different outside options affect how sensitive students are to receiving their first choice in the public school lottery, focusing on three potentially meaningful measures of access to outside options including *ability to afford* private schools, *geographic convenience* of private schools, and *zoned school quality*. I posit that

students with access to private school outside options are likely to be *more* sensitive to receiving their top choice than students without outside options. In other words, students with these outside options have a higher chance of leaving the public education system entirely if they do not get exactly what they want in that system. If this happens, then increasing participation in school choice—a common policy approach for school districts seeking to make school choice programs more accessible and equitable—could have the unintended effect of driving certain students *out* of the public school system. Specifically, students with access to outside options who are more sensitive to getting their top choice could disproportionately leave the public school system, stratifying the public and private sectors further.

While the effects of school choice on participating students' achievement has been widely studied, the effect of school choice on the distribution of students across the public and private school system is, by comparison, less understood. One exception is contemporaneous work by Alcaino & Jennings (2020), who use an event study to analyzes how the growth of public charter schools is linked to public school enrollment overall. They find that public school choice, which includes public charter schools, increases public school incorporation—bringing students back into the public school system from private schools—while also increasing segregation within the public education system. In this paper, I investigate the mechanics that may lead to public school incorporation described by Alcaino & Jennings (2020), including understanding how a family's ability to afford private school plays a role in their decision to stay in or leave the public education system. I also focus on public school choice generally, not charter schools, because this type of choice is becoming increasingly common. For instance, of the 19% of students attending a public school that was not their residentially zoned option, less than a third attend charter schools (Wang et al., 2019).

Existing research by Engberg et al (2014) examines the implications of differential attrition from magnet schools on estimation of achievement impacts of these schools. However they do not explore the underlying drivers of this differential attrition extensively. Other work alludes to the fact that different families respond differently to their offers within a public school choice system but does not study it directly. Abdulkadiroglu, Angrist, and Pathak (2011) and Dobbie and Fryer (2014), for example, note that some students who do not get their top choice in the Boston and New York City choice systems respectively leave the system and attend private schools. However, this work does not estimate size of the effect of offers on enrollment and the characteristics that predict which families are more or likely to exhibit this behavior. Recent theoretical work notes that the pareto optimality achieved by strategy-proof centralized public school choice mechanisms, while preferable to manipulable mechanisms, do not reflect asymmetrical preference over options outside of the public school system (Akbarpour, 2018). For example, while all families participating in public school choice face the same incentive to rank their preferences over public options truthfully (as opposed to attempting to strategize or game the system), they may face different sensitivity to actually receiving assignment to one of those preferences.

It is important to understand how families behave in public school choice systems because public school choice is becoming an increasingly prominent and permanent feature of the U.S. public education system: 41% of families report having access to *public* school choice (Wang et al., 2019). In urban areas, that figure is even higher: more than half of families have access to some form of public school choice. So, even if parents end up sending a child to their locally zoned school, that result exists with the backdrop of a system of choice. Additionally, districts are making efforts to increase participation in choice programs as a way to combat the

documented segregating effects of existing public school choice programs, without necessarily knowing the unintended consequences of increasing participation. By examining how families behave in and interact with systems of public school choice, future efforts to improve existing choice systems can be made with a more comprehensive understanding of both the likely intended and unintended consequences. This means helping districts manage competing efforts to increase access to high quality schools for all students, reduce stratification and segregation across schools, and keep up public school enrollment. Centralized school assignment mechanisms, which are becoming a more widely used way to manage public school choice, allow for rigorous analysis of choice systems by leveraging lotteries and other rules that introduce as-good-as-random variation into school assignment across entire districts.

This study takes place in Tulsa Public Schools (TPS), a medium-large public school district that uses a centralized mechanism to assign students to schools. The centralized enrollment system was introduced in an effort to streamline the public school choice process, increase participation in school choice, and ultimately make access to schools more equitably distributed across students. Under the system, families can submit up to 6 ranked choices in one centralized location online to any of the schools in the district including neighborhood schools, lottery and criteria magnet schools, and public charters. Families are not required to participate in public school choice; if they do not, they will be assigned to their local, neighborhood school—or "zoned school".

I use rich administrative data from applications submitted through the centralized enrollment system in TPS during 2019-20 as well as 2020-21 student enrollment data from TPS combined with school-level characteristics from the state. I leverage assignment by random lottery to chosen schools to identify the causal impact of receiving (or not) admission to a top

choice school on public school enrollment. My approach is similar to prior research that uses school lotteries to estimate impacts of school assignment on student achievement (Abdulkadiroglu et al., 2011; Deming et al, 2014). I then examine how this causal relationship differs between students that face different outside options, defining outside options as the school options available to students outside of the public school choice system. I explore and test the role of several different potential measures of outside options. First, I consider access to private schools by looking both at students *ability to afford* private schools, assuming that students who are higher income are more likely to be able to afford private schools that charge tuition than their low-income counterparts. Second, I consider *geographic convenience* of private schools in the Tulsa area to test whether, in addition to financial access, living closer to private school options makes students more sensitive to receiving their desired placement within the public school system. Finally, I look at how *zoned school quality*—the quality of students' local neighborhood school that they have guaranteed access to based on where they live—affects the sensitivity that students have to getting their top choice in the public choice system.

I find that overall, students who do *not* get their top choice school are 15 percentage points more likely to leave the public school system entirely. This effect is driven by higher-income students who are 33 percentage points more likely to leave the public schools if they don't get their top choice in the public school choice system. Geographic location relative to private schools, tract-level measures of income, and zoned school quality are *not* as predictive of student behavior within the choice system as individual-level measure of economic advantage. However, I do find descriptive evidence that these characteristics relate to other aspects of the choice system including the decision to participate in public school choice and which and how many schools to rank.

These findings suggest that districts seeking to improve public school choice programs by increasing participation of the students who may be able to benefit most should consider the unintended effect on district enrollment. Using my causal estimates, I predict how efforts to increase participation in school choice, without changing school enrollment caps or school quality overall, are likely to affect district enrollment in subsequent years. These calculations are based on the following logic of a dynamic problem: increasing participation in school choice—particularly by lower income students who are currently underrepresented in the choice program and that district's are more likely to target in their efforts—decreases the overall likelihood of any given student getting an offer at the school they ranked first. As a result, as participation in public school choice increases, a larger portion of students overall and, relatively more affluent students in particular, do *not* get a spot at their top choice school. An increasing share of these students, who are on average more likely to leave TPS if they do not get their top choice, end up leaving the district.

Based on these back-of-the-envelope calculation, I predict that increasing participation in the public school choice program by 25% would *cause* an additional 13% of higher-income students who participate in choice to leave the public school system in the first year. Over 5 years, efforts to increase participation could cause up to 26% of participating higher-income students to exit the public school system.

These findings have implications for policymakers as well as researchers. School district decisionmakers manage competing efforts to make school choice programs more equitable while maintaining and growing public school enrollment. My results suggest that efforts to improve equitable access to the best schools by increasing participation in school choice should be complemented by efforts to improve the desirability of schools throughout the district. Without

these complementary efforts, public school districts could lose enrollment of higher-income students and increase stratification across the public and private sectors.[1] The findings also have implications for research that leverages lotteries to estimate the causal impact of schools on student outcomes. I show that differential attrition from the public school system in response to lottery assignment exists, which may effect estimation of causal effects and should be taken into consideration.

II. School Choice in Tulsa

Public School Choice

Public school choice involves a series of decisions by students and families. First, students must choose whether or not to *participate* in the public school choice system at all. If they participate, they must *rank* schools according to their preferences about schools they would consider attending other than their guaranteed neighborhood option or "zoned school". Once they have submitted these ranked choices, an algorithm determines to which of these schools, if any, they will receive an offer. If students do not receive an offer to one of their ranked choices, they are assigned to their zoned school. With an offer in hand, families then must choose where to *enroll*. At this point, families have three options: they can either attend a school they chose and were offered a spot at, they can attend their zoned school to which they have guaranteed admission, or they can leave the public school district altogether and pursue a private school option. In this paper, I focus on the final decision about enrollment by estimating the causal effect of getting an offer at a school students' rank first on the likelihood of public school

[1] Higher-income students are 27 percentage points more likely to be white than non-white. While 58% of white students in TPS are economically disadvantaged, 86% of non-white students are economically disadvantaged.

enrollment. I do this overall and for students who are likely to have different outside options. I also provide descriptive evidence about the way that outside options appear to affect other stages of the school choice process, including participation and ranking.

TPS is a mid-large size public school district with approximately 34,000 students and 77 schools. This including 44 elementary schools, 10 middle/junior high schools, 9 high schools. There are also seven public charter schools that serve students in the district. There are also 7 alternative schools that serve K-12 students. The district also cooperates with 6 district-authorized charter schools and 1 "partner" school that serve K-12 students. TPS has 52 neighborhood schools, 6 lottery magnet, 5 criteria magnet schools. The public school choice program includes all neighborhood schools, lottery magnet schools, criteria magnet schools, alternative schools, and charter schools. TPS offers a variety of programs at it's schools, including dual language programs at 11 schools, tech career ready programs, two Montessori elementary schools, and two early college high schools. Students have guaranteed admission to their zoned school, but can apply to other schools throughout the district as well. The schools widely considered to offer the best education are the magnet schools, for which no student has guaranteed admission and that instead require students to apply through the public school choice system.

TPS manages public school choice through a centralized enrollment system—Smart Choice—that allows families to visit a single website where they can rank up to 6 schools to apply to. Students in any grade level are able to apply. As expected, students in transfer grades—including those transitioning from elementary to middle school and those transitioning from middle to high school—are more likely to participate. The choice program is also available for pre-K students, though these students do not have any guaranteed admission option. Smart

Choice utilizes the deferred acceptance algorithm, which is strategy-proof, to allocate spots. Being strategy proof means that the dominant strategy for all participants is to rank their true preferences. In other words, there is no incentive to try and "game" the system by listing a school or schools that you prefer less ahead of a school that you prefer more. Students receive a seat at the highest rank school that they can based on their lottery number and remain on the waitlist for any other schools that they ranked higher. They are removed from the list for schools ranked below the school they are assigned to. Neighborhood schools with additional spots, charter schools, and lottery magnets use lotteries to determine admission for oversubscribed spots.

Unlike the lottery magnets, to which anybody can apply and have an equal chance of admission, criteria magnets use a point system based on grades, test scores, attendance, and teacher recommendation to determine eligibility and admission. Ties are broken with the lottery. For both lottery and criteria magnets, no students have guaranteed access based on where they live. That is, to access them students *must* opt in to participate in the public school choice program.

Smart Choice allows TPS to centralize the school assignment and enrollment process, making it much easier for families to participate in school choice and making the assignment process itself more equitable. At the same time, it allows TPS to collect data about families' ranked preferences for schools that they had not previously had access to.

Outside Options

There are two types of schooling options that students may face outside the public choice system and that constitute "outside options" throughout this paper: private schools and zoned schools. First, students can leave the public school system altogether and attend a private school.

This outside option varies among students due to families' differing ability to afford private schools that charge tuition and, potentially, because of the geographic location of private schools. For example, a student who lives around the block from a well-regarded private school has a much more convenient alternative to whichever public school they are assigned to than a student who lives 5 miles away from that private school. One could imagine that the way students behave in the public choice system changes considerably if a private school is considered affordable and convenient rather than too expensive and far away.

Tulsa has over 80 private school options that range from small, alternative schools that offer special services to large, Catholic, non-denominational, or independent schools that serve all students. Many of these private schools are extremely small programs that serve fewer than 50 students and offer very specific programming to specific student populations—for example, small, religious schools or schools for students with special or alternative needs. For this paper, I focused on the larger private schools that were likely to be considered by more families interested in non-public school options. For the purposes of better understanding the private school options in the Tulsa area, I spoke with employees at TPS, many of whom have children of their own and who helped identify the most popular and well-regarded private school options in Tulsa. They identified four private elementary schools and three private secondary schools that that TPS competes with for students. These schools included Catholic, episcopal, and Montessori private schools that serve between 500-1000 students. I also looked at a handful of additional private schools that enroll more than 200 students to get a sense of the types of schools that were available outside the public school system. Overall, these private schools charged between $10,000 and $22,000 per student annually in tuition, with elementary tuition being slightly lower than middle and high school tuitions. Many of the school websites reported that they offer

financial aid for between 10-30% of attending students, depending on the school. They also often have an involved admissions process that does not allow all students to enroll. In sum, Tulsa has many well-regarded private school options available, but this type of schooling would not be affordable for all students in the school district and requires a significant time and resource investment to learn about and apply to.

I use two measures to capture the potential variation in access to private school options in this paper. First, I define access to private school based on an *ability to afford* these schools. Given that private schools charge sizable tuitions, not all families are able to afford them—even if financial aid is available for some. In a school district where 80% of students are classified as economically-disadvantaged, many families likely do not have the ability to afford anything other than free, public schools. Beyond affordability, access to private school may also be determined by the geographic closeness of other options. Therefore, I define a secondary measure of access to private school as *geographic convenience*, or the distance to the closest private school that serves the relevant grade level that a student is applying to.

In addition to private schools, the other schooling option outside of the public choice system is a student's zoned school. Students are assigned a neighborhood school—their zoned school—based on their home address. They have guaranteed access to their zoned school regardless of their participation in and the outcome of the public school choice. Because zoned schools are assigned based on a student's home address, this outside option varies among students depending on where they live. For example, some students have a zoned school with a "B" rating based on the catchment zone they live in while other students have a zoned school with an "F" rating. One could imagine that the way students behave in the public choice system

changes considerably if the guaranteed option is considered to be relatively high quality rather than very low quality.

In sum, I explore three definitions of outside options in this paper: 1. Ability to afford private school, 2. Geographic closeness of private schools, and 3. Quality of zone school. Unsurprisingly, these measures of outside options are not independent from one another. Students who are more likely to be able to afford private schools also tend to have higher quality zoned schools, on average. Low-income students, on the other hand, are more likely to live in areas with lower-rated zoned schools. For example, 15% of higher-income students have B-rated zoned schools, but only 2% of low-income students do. At the other end of the spectrum, 26% of higher-income students have F-rated zoned schools while 43% of low-income students do. Low-income students both have potentially more to gain from participating in the public school choice system *and* less ability to be choosy with regards to their school assignment.

III. Data Description

In this paper I combine five datasets: TPS' school choice application data, TPS enrollment data, school-level characteristics data about public schools from OK state, school-level characteristics data about private schools from Great Schools, and census tract data. First, I use the application data from Smart Choice that families submitted during 2019-2020 for the following 2020-2021 school year. This student-level data set includes where each student currently attends, all ranked choices and ordering, lottery number, resulting school assignment (where students received an offer), and the zoned school the student has guaranteed access to based on their home address. I merge this dataset with student enrollment data from 2019-2020 (when students were applying) *and* enrollment data from 2020-2021 (when students attended the

schools following their participation in the public school choice program). The enrollment data includes demographic information including economic disadvantage and home addresses. I merge this data with census tract data which includes neighborhood characteristics such as median income level, portion of individuals living below the poverty line, portion of students attending private schools, and other relevant measures that characterize the neighborhoods where students live.

I merge this individual-level dataset with school-level characteristic data provided both by TPS and the state of Oklahoma related to where students attended school in 2019-2020, where they were zoned to attend based on their home addresses in 2020-2021, and where they actually ended up enrolling in 2020-2021. The school-level data includes a state-assigned "letter grade" for each school and an indicator summarizing school quality, both of which are based on an index of factors reflecting school quality. It also includes the various measures included in the index and other school level characteristics like school-level math and ELA achievement and growth measures and demographic breakdowns. I use the school characteristic data to classify pre-treatment variables like transition grades and school levels to study heterogeneity in treatment across students at different parts of their K-12 trajectories. I also merge these data with data about private schools from Great Schools, which includes addresses, grades served, and school size.

To define access to outside options, I use three main measures. First, I use an indicator of economic disadvantage at the student level as well as neighborhood census tract median income as a measure of *ability to afford* private schooling or some other form of non-public (and therefore not free) type of schooling. [2] I refer to those who are economically-disadvantaged

[2] I used a variety of tract-level measures including median income, housing ownership as a measure of individual affluence. However, there was too much individual-level variation within tract for tract-level measures to predict

during the 2019-20 pre-treatment year as low-income and those who are not classified as economically-disadvantaged as higher-income.[3] Second, I use student addresses and school address data from Great Schools to identify how far students live from private schools as a measure of *geographic convenience* to outside options. I match students to the closest private school that serves students in the grade they will be in in the 2020-21 school year. Finally, I use the state of Oklahoma school ratings as a measure of the *zoned school quality*.[4] These are the three definitions of outside options that I explore in this paper, as described in Section II.

I use enrollment data from 2020-2021 to identify students who ended up enrolling in a public school (or not). Students who do not appear in the 2020-2021 enrollment dataset are presumed to have left the district. I have "exit codes" for students that leave TPS that are recorded by the district. These provide a snapshot of why students left the district and where they enrolled in order to confirm, anecdotally, that students who do not enroll did pursue private school options.

There are two main data limitations. First, charter schools are not required to report directly to TPS, so enrollment, demographic, and other student-level data for students who attend charter schools within TPS is unobserved. As a result, I exclude students that rank charter schools from the analysis. These students are included in the enrollment summary below. Second, I do not have pre-treatment demographic data for students applying from outside the district and who do not end up enrolling. This includes students applying to Pre-K or

individual behavior. The individual level binary indicator of economic disadvantage ended up being a much stronger predictor of behavior than tract-level continuous variables.

[3] Economic disadvantage is defined by income and household size, and aligns to 185% of the federal poverty line. More information can be found here: https://sde.ok.gov/economically-disadvantaged. In 2019, a family of 4 was considered economically disadvantaged if they made less than $47,637 per year.

[4] I used several available measures of school quality including the OK state overall index score (continuous measure from 0-1), assigned letter grade (A, B, C, D, F, assigned based on the index score), proficiency and growth measures, and measures of student demographic characteristics.

kindergarten who have never been enrolled in TPS before or students who currently attend private schools, apply to TPS school through the school choice program, but end up not enrolling. As a result, these students are excluded from the analysis about the effect of outside options on public school enrollment.

IV. School Attributes, Participation, and Rankings in Public School Choice

The importance of public school choice in TPS is evident by examining Table 1. Notably, the schools that have the highest ratings in the district—the magnet schools—are those that are only accessed by participating in the district's choice program. While there is variation in the quality of schools, the most common rating of neighborhood schools is a D or F. Of the 73 schools that received state assigned ratings in 2019-20, 29 (40%) received a D grade and 28 (38%) received an F grade. Only one school in the district—a criteria magnet school—received an A rating (criteria magnet schools are not included in main analysis of this paper because the assignment mechanism does not leverage a lottery). Overall, 74% of students in TPS attend schools that were rated a D or an F in 2019-20 (see Appendix Table 1A)[5]. In other words, even if students are unlikely to be able to attend a criteria magnet school based on their achievement, many students would be able to access schools with higher ratings—whether they be lottery magnets, charters, or other neighborhood schools outside of their catchment zone—by participating in the public school choice system.

[Insert Table 1 here]

[5] More information about the OK school report cards can be found here: https://sde.ok.gov/sites/default/files/documents/files/Frequently Asked Questions - School Report Card_0.pdf

Table 2 further shows that the racial and socioeconomic make up of schools that can only be accessed by participating in school choice is disproportionately whiter and higher income than the rest of the district. While the magnet schools show the most stark underrepresentation of BIPOC and low-income students, there is also variation in the quality of neighborhood schools, with higher-quality neighborhood schools more likely to serve more affluent students and white students than lower-quality neighborhood schools. The disproportionate representation by Race and Ethnicity and SES in TPS' higher rates schools motivates a need to better understand how students interact with the systems of school choice.

[Insert Table 2 here]

Despite the higher ratings of certain schools that may only be accessible by participating school choice, not all students who could theoretically benefit participate. Table 3 shows how participation in TPS' school choice program varies by student characteristics and by different transition points. Many of these relationships are statistically significant. For example, 11% of Black students participated in choice, compared to a 15% of all white students and this difference is statistically significant. The difference in participate are more evident when focusing on students in transition years—that is, those who will have to go to a new school the following year and where participation overall is higher. Overall, 44% of students in these grades participate in the public school choice program. However, only 31% of Black students in transition grades participated, while 50% of white students did. Similarly, only 40% of low-income students in transition years participated in public school choice while 60% of higher-income students did.

These differences are larger during the middle to high school transition than they are during the elementary to middle school transition grades.

Overall, white students and higher-income students participate in public school choice more, even though these students are likely to have better outside options, both in terms of access to private schools and zoned school quality. On the other hand, students with lower-rated zoned schools do not participate noticeably more than those with relatively higher rated zoned schools, even though they may have more to gain from participating. These patterns provide suggestive evidence that the decision to participate, for some families, is about expanding the pool of school options. For other families, including those with lower-rated zoned schools, information or other barriers may prevent them from taking full advantage of the choice system at the participation stage of the choice process. The differences in participation and relative under-participation of students who could, in theory, benefit the most from public school choice undergird TPS' efforts to increase participation in the choice system.

[Insert Table 3 here]

The decision to participate in school choice is followed up by decisions about how to rank schools. Outside options—both within and beyond the public school system—may affect the how students rank schools. For example, Table 4 shows that on average, students that participated in the public school choice program ranked 2.6 different schools. However, this number was higher, on average, for students whose zoned school is lower quality. This suggests that, conditional on participating in school choice, families may rank choices considering the quality of their zone school option. For example, if a family has a B-rated zoned school, there

may only be one other school in the public school choice program that they consider to be better than this zoned option. As a result, they may only rank one school in the public school choice process. On the other hand, if a family lives in a catchment area with an F-rated zoned school, they may rank numerous options because many other schools in the district would be preferrable to their zoned school. Students who are higher income also rank more schools on average, which may be a result of the strategy to simply expand the pool of options. These patterns provide suggestive evidence that factors such as information and outside options could shape the decisions that families make at the *ranking* stage of the school choice process.

In addition to the way that outside options shape families' behavior, Table 4 also highlights the fact that despite the higher ratings of criteria magnet schools on average, 44% of students that participate in school choice rank neighborhood schools as their top choice. This reflects both that there is, at least perceived, variation within the quality of neighborhood schools that students throughout the district have guaranteed access to and, perhaps, that family preferences are not always perfectly aligned with assigned measures of "quality". For example, schools that have lower achievement scores may have other desirable offerings such as dual language programming or a Montessori curriculum that is of interest to families.

[Insert Table 4 here]

After submitting their rankings, families receive an offer to a school. 70% of students who participated in the public school choice program in 2019-20 got admitted to their top choice school and 73% of students ended up enrolling in the public school system the following year.

Overall, parents are much more likely *not* to enroll in public school during pre-K years. The public school enrollment rate for students applying to pre-K through the unified enrollment system was only 6%. For elementary school applicants, 57% enrolled in public schools; for middle school applicants, 70% enrolled in public schools; for high school applicants, 74% enrolled in public schools in 2020-21. This makes sense because pre-K is not mandatory and admission is not guaranteed.

These descriptive results show that the way that students interact with the public school choice program vary considerably by different student and school characteristics. They also offer suggestive evidence that the outside options that students face could affect the way that they behave with and interact with systems of public school choice at the participation, ranking, and enrollment stages of the choice process. To summarize, higher-income students are more likely to *participate* in school choice programs and thereby reap the benefits of attending their top choice schools, which tend to have higher achievement scores and higher overall quality ratings as determined by OK state. Conditional on participation, students with lower-quality zoned schools *rank* more schools in their application. One way to think about this is that the number of public school options that are preferable to their guaranteed zoned school is higher for students with lower-quality zoned schools. For the remainder of the paper, I will focus on causal estimation of how students behave during the *enrollment* stage of the public school choice process, examining how—conditional on participating in the public choice system and the ranked preferences they submitted—the offer they receive and their outside options change their enrollment decision.

V. Empirical Strategy

I begin by estimating the effect of winning the public school lottery on the likelihood of enrolling in a public school following the standard approach used in lottery-based studies (Abdulkadiroglu, 2011; Deming et al., 2014). Specifically, I estimate:

$$Y_{ij} = \beta_0 + \beta_1 W_{ij} + \gamma_j + \epsilon_{ij}$$

Where Y is an indicator for enrollment in public school in 2020-21 for student *i* in risk set *j*. W_{ij} is a variable indicating where student *i* placed among schools ranked. γ_j is a set of risk set fixed effects. ϵ_{ij} is a stochastic error term.

The exact definition of this independent variable depends on the specification. In my preferred specification, W_{ij} is equal to one if student *i* received admission to his/her top choice school. I also estimate a specification that non-parametrically estimates the effect of getting each rank place, including a separate dummy for each potential rank, though my main results focus on the top choice because, empirically, this appears to be the margin on which families are most sensitive.

In addition to estimating the relationship between winning and losing using different definitions of the independent variable W_{ij}, I test different definitions of risk sets. In my most conservative estimation, the risk set is defined by students who share the same exact rankings over the same schools and therefore face the same probability of getting placed in their first, second, third choice and so on. The benefit of controlling for the entire risk set is that it is possible to estimate the effect of getting the 2nd and 3rd choice and model how sensitivity changes across the choices. However, it also creates small risk sets and in some cases could exclude

potential variation from students who do not have the same risk set as any other student. Abdulkadiroglu et al. (2011) use this approach. I define a second risk set by students that share the same top ranked school and who therefore face the same probability of getting their top choice, but may have different schools ranked second and beyond and therefore a different probability of getting any specific school beyond their top choice. The benefit of using the top choice is that it is consistent with the treatment, which I define as receiving access to a top choice school. Empirically, students are most sensitive with their top choice, so focusing on a comparison between those who receive admission to their top choice vs. not is meaningful. Deming et al. (2014) use this approach.

In all cases, I exclude students who applied to criteria magnets because the assignment mechanism for these schools does not rely on a lottery. As a result, students who receive a spot in the criteria magnets, by definition, differ in their observed (and likely unobserved) characteristics from students that do not receive a spot in criteria magnets, undermining the random source of variation that justifies a causal interpretation. I also exclude charter school applicants because I am unable to observe their enrollment in 2020-21 school year because the charters do not report to TPS. Finally, I remove "accidental" applicants—those who ranked their zoned school first and therefore face an admission probability of 1, unlike other students in the risk set who do not have guaranteed admission. By making these exclusions, I aim to maximize the internal validity of my results. At the same time, it limits the sample.

To summarize, the sample is composed of all students that participated in the public school choice program for whom I have pre-treatment demographic information and who ranked schools that (i) they were eligible for and (ii) used lotteries to determine placement. This includes 2,060 students in the 2019-20 enrollment cycle. Using data about these students, my empirical

approach compares students with the same rankings over public schools and who only differ by whether they are randomly assigned to receive an offer to attend their top choice school. The outcome variable of interest is whether students enroll in a public school (any public school) in the year following their participation in the public school choice program. Therefore, the causal relationship of interest is whether winning (losing) the public school choice lottery increases (decreases) the likelihood of public school enrollment. The identifying assumption is that, conditional on having the same ranked choices over public schools, students have the same expected likelihood of enrolling in public schools. This assumption is believable because the source of variation is a random lottery. I also test the validity of this randomization by replacing the outcome Y_{ij} with pre-treatment demographic variables including indicators for race and ethnicity and economic disadvantage. These observable characteristics should not have any association with the lottery result if randomization was done correctly, which is what I find (see Appendix Table 2).

While criteria magnets are the district's highest quality schools, on average, my analysis excludes these schools for two reasons. First, the criteria aspect of the application process means that many students who may like to go to these schools do not even apply so there is a lot of selection into applications. Second, because assignment is not determined by random lottery, my estimation strategy and associated causal interpretation would be inappropriate. While studying the impact of criteria magnet programs or exam school programs that use screeners to select students is important, that is *not* the goal of this paper. Instead, I focus on schools that any student in the district truly has access to—those that are assigned by random lottery—in order to better understand behavior within a system of public school choice that is defined by expanding access to schools for all students, not just those who are "gifted." Understanding these systems

has widespread implications for more students without requiring additional efforts or changes to curriculum or programming. These types of public school choice systems and assignment mechanisms are also increasingly common.

After estimating the effect of winning the lottery on public school enrollment overall, I analyze how outside options contribute to this result. I estimate the differential effect of winning the lottery on public school enrollment for students based on the different measures of outside options outlined in Section II. For example, I estimated the differential effect of winning the lottery on low-income and higher-income students, respectively. Higher-income students are relatively more likely to have the means to access school options outside of the public school system, whereas low-income students are more likely to have to stay within the public system regardless of their placement. To estimate these different effects of getting a preferred placement on public school enrollment for low-income and higher-income students, I estimate the following:

$$Y_{ij} = \beta_0 + \beta_1 W_{ij} + \beta_2 X_{ij} + \beta_3 (W_{ij} * X_{ij}) + \gamma_j + \epsilon_{ij}$$

Here, X_{ij} is an indicator variable for students outside options (e.g. higher-income students or students with a higher-rated zoned school). Therefore, β_3 represents the differential effect of winning the lottery for higher-income students on public school enrollment. If this coefficient is significant, it implies that there is a significantly different relationship between getting a top choice placement for students with different outside options. In other words, higher-income students are more sensitive to getting their top choice than poorer students and are more likely to leave the school district if they do not get a placement that they want.

VI. Results

A. Main Results

Table 5 shows the effect of placement in the public school choice system on the likelihood of enrolling in the public school system using two specifications for two samples of interest. Overall, I find a significant positive (negative) impact of winning (losing) the public school choice lottery on enrollment in public schools. The most econometrically conservative approach in Column 1, which estimates treatment effects using the full risk set on my analytic sample, shows that students who do not receive a spot at their top choice are 15 percentage points less likely to enroll in public schools than students who do receive a spot at their top choice. Of students who received an offer at their top choice, 84% enroll in public schools. For students who did *not* receive an offer at their top choice, only 69% enroll in public schools overall.

Including fixed effects for the full choice risk sets means that the treatment effect is estimated between students who ranked the exact same number and ordering of schools and only differ in whether they received assignment at their top choice or not. This estimate is the most econometrically conservative. The second column includes fixed effects for the top choice risk sets meaning it compares students who had the same top ranked school and either did or did not get offered a spot in that school based on their lottery number. Because I focus on the effect of getting a top choice placement relative to any other placement, the top choice risk set is a suitable specification. Most importantly, the results are consistent across different definitions of risk sets.

Columns 3 and 4 show the treatment effect for all students that applied to schools that used lottery assignments, including those who are entering the district for the first time. Most of

these students are Pre-K and Kindergarten students. Because I do not observe pre-treatment demographic information for these students, I am unable to estimate the differential treatment effect based on access to outside options that are defined by demographic characteristics later in the paper. Therefore, they are not part of my final analytic sample. However, I can estimate the main results for this full group to get a sense of whether this larger sample shows noticeably different behavior patterns than the final analytic sample. I do not find different patterns; the findings are consistent for this larger sample. Specifically, students within this larger sample are 17 percentage points more likely to leave the public school district if they are not assigned to their top choice school. In this larger sample, students who received an offer at their top choice have a 50% likelihood of enrolling in public schools. For students who did *not* receive an offer at their top choice, only 34% enroll in public schools overall.

The low average enrollment rate overall for the larger sample is driven by pre-K applicants. Pre-K is not mandatory or guaranteed and may have been particularly less desirable during the pandemic. Only 6% of pre-K applicants ended up enrolling in public schools in 2020-21 while 66% of the K-12 students in my sample enrolled in public schools during 2020-21. I show the main effects broken out by school level in Appendix Table 5.C. Elementary school students have a slightly higher treatment effect (21 percentage points) than Pre-K, middle, and high school students (12-14 percentage points) and the estimation for high school students has less power because many students in these grades applied to schools that did not use lottery assignment—like criteria magnet schools—and were therefore excluded from the sample. However, a large effect of getting an offer at one's top choice remains, regardless of school level and despite differences in enrollment rate overall. Furthermore, while CoVid likely caused

overall lower enrollment rates during the 2020-21 school year, the treatment effects are still internally valid because they leverage randomized variation caused by the lottery.

I also include 3 different definitions of the independent variable in Appendix Tables 5.A, and 5.B. In Appendix Table 5.A, I estimate the combined effect of receiving an offer at ones first or second choice school. In Appendix Table 5.B, I estimate separate coefficients for students receiving a spot at each of the possible choices using an indicator variable for each possible rank offer (e.g. got1, got2). I only include the first two indicators (e.g. got3, got4, got5, got6 are not included) because most applicants apply to fewer than 3 schools and almost all receive one of their top two choices. Importantly, the results are very stable across these different specifications once the top choice risk set is accounted for. These results are large and statistically significant, showing that students overall are indeed quite sensitive to getting the schools that they want in the public school choice system.

[Insert Table 5 here]

B. Outside Options

To better understand what drives the main results, I examine how students' outside options affect the way they respond to getting a place in their top ranked school. I find that students who are more likely to be able to afford private schools—higher-income students—are significantly more sensitive to getting their top choice in the public school choice system than low-income students. On the other hand, living closer to private school options and zoned school quality have no effect on students' decision to enroll in public schools. These results are shown in Table 6.

The most econometrically conservative estimate in Column 1 shows that higher-income students are 25 percentage points more likely to leave the public school system if they do *not* win the lottery than low-income students. This results is significant at the $p<0.001$ level. On the other hand, low-income students are only 8 percentage points more likely to enroll in public schools if they get placed in their top choice school and this result is not statistically significant. The overall treatment effect shown in the lower panel of Table 6 indicates that higher income students who receive a placement at their top choice school are 33 percentage points more like more likely to leave the public schools if they do not get assigned to their top choice school than if they do.

Unlike ability to afford private school, geographic convenience of private schools and zoned school quality do *not* affect how students respond to their placement in the public school choice system. That is: there is no significant difference in public school enrollment between students who receive their top choice and those who do not depending on how close students live to private schools or the rating of the zoned school that students have guaranteed access to. This result can be seen in Columns 2 and 4, in which these two additional measures of access to outside options are included in the specification. The coefficients on the interaction between getting a spot at a top choice school and distance to private school or zoned school quality yield no significant results. It could be that

My theory was that being higher-income is necessary but not sufficient for leaving the public schools system. Being closer to private schools may have made those options more salient to students and made leaving the public school system more desirable. On the other hand, students with higher-rated zoned schools could have been less inclined to leave the public school

system if they do not get their top choice in the lottery, because their zoned school option is perceived to be adequate. This is not the case.

It could be that my available measures of outside options do not accurately capture meaningful differences to families. For instance, I use the letter grades assigned by the state of Oklahoma as my measure of school quality because this measure incorporates a variety of factors including achievement and growth and behavioral outcomes that may be important to parents. These letter grades are posted on the TPS school finder website so that parents who are seeking to learn about school options in the area may see them meaning that they are potentially salient to parents in terms of their perception of the quality of schools. Still, this measure may not accurately capture how families develop an understanding of school quality. In a series of robustness checks, I include estimation using other definitions of zoned school "quality", including a continuous index measure of school quality assigned by OK, individual measures of proficiency and growth like percent of students achieving below basic and percent of students achieving advanced in math and reading, and school demographic characteristics like percent of student population that is economically disadvantaged. The results are included in Appendix Tables 7.A, 7.B, and 7.C. While there may be other definitions of quality that are meaningful to families, but are not capture in the state's measures, I consistently find no statistically significant results across different available measures of quality.

When it comes to distance to private school, I tried two different definitions of private school. In the first, I used distance to the closest private school—any private school—that serves the grade the student was applying for, using Great Schools' database. This included very small, specialized schools. Because it seemed unlikely that very small, specialized schools were driving any exit from TPS, I created a subset of larger, more well-known, and popular private schools

based on conversations with colleagues at TPS. I then calculated the distance to the closest one of these specific private schools. It could be that as-the-crow-flies distance to private school is not the most salient way of capturing geographic convenience. Perhaps driving time is more relevant. In addition to using the distance to the closest school directly, I created a measure of the number of these private school options within a half mile, ¾ of a mile, 1 mile, and 1.5 miles of where the students live, assuming that having multiple private school options within walking distance may make these options more desirable to families. In all cases, the estimated treatment effects were small and insignificant.

Overall, my findings indicate that the 15 percentage point coefficient found in the main results are driven largely by higher-income students, who are more likely to be able to pursue private school options outside of the public school system than their low-income counterparts. While the indicator for economic disadvantage is a blunt measure of student income level, the fact that there is such a strong relationship despite its coarseness is telling. For example, it is possible that many students who are not classified as economically-disadvantaged do not have the means to afford private school options that charge tuition. Still, on average, the higher-income students demonstrate a significantly different pattern of behavior in response to their school assignment than those who are low income.

I did pursue other measures of student income, including census tract-level data on median income, poverty rates, and home ownership. However, there was too much individual-level variation within tract for tract-level measures to predict individual behavior. For example, even in tracts with low median income, there are higher-income students. For these students, the salient measure of private school access is their own income, not the income of their neighbors. While the tract may overall have lower rates of private school enrollment, the higher income

students within that tract may behave differently in the public school choice program regardless of the behavior of their neighbors. Therefore, the tract-level measures may not predict the individual level behavior. In sum, the individual level binary indicator of economic disadvantage ended up being a much stronger predictor of behavior than tract level continuous variable.

[Insert Table 6 here]

C. Additional Results

Table 7 and Table 8 show the effects estimated above broken down by school level and transition grades to explore whether there are distinct patterns in families' responses to the school choice process at various points throughout the student trajectories. As mentioned previously, parents are much more likely not to enroll in public school during pre-K years (6% of applicants ended up enrolling in TPS in 2020) compared to between 55-70% for elementary, middle, and high schools. This makes sense given both that pre-K is not mandatory and that the data were generated during 2020, when parents were more likely to not enroll their Pre-K students anywhere due to CoVid-19. Because of the very large difference in enrollment based on school level, I explored whether the sensitivity to winning and losing the lottery also varied for students across these levels.

Families are most sensitive to getting their top choice during elementary school, with lottery winners being 18 percentage points more likely to enroll in public school than those who lose (Column 1). For middle and high school, this effect is 11 and 15 percentage points respectively (Columns 3 and 5). It's possible that the differences in treatment effect is partly driven by the fact that the high school choice is more dominated by the criteria magnet schools, which were excluded from this analysis to assure the internal validity of the results.

While elementary school families have the largest sensitivity to getting their top choice in the public school choice system overall, the differential sensitivity based on ability to afford private school shows a different pattern. I find that higher-income students are *more* sensitive to receiving their top choice school during middle and high school than they are elementary school level, as shown in Columns 2, 4, and 6 of Table 7. That is, higher-income families do not have a statistically different reaction to getting a placement in their top choice school at the elementary school level. However, higher-income families are 34 percentage points and 29 percentage points more likely to enroll in public schools if they get their top choice at the middle and high school level, respectively.

[Insert Table 7 here]

Transition grade applicants are slightly more likely to enroll in public schools overall and are not significantly more (or less) sensitive to receiving their top choice school, as shown in Columns 1 and 3 of Table 8. As shown in Table 8, 72% of transition grade students end up enrolling in public schools the year following their participation in the public school choice program while 66% of non-transition grade students do the same. However, the coefficient on getting a top choice placement is not statistically different between these two groups of applicants. This could be because students who are seeking to switch schools at a non-typical time, those in non-transition year grades, have a particular desire to leave their current school and seek a new option. The specific "treatment" of getting into a top choice school may not be the relevant margin for these students.

Higher income students in transition grades *are* particularly sensitive to getting their top choice relative to low-income students, and relative to non-transition grade students. In

particular, higher income students in transition grades who do not get an offer from their top choice school are 44 percentage points less likely to enroll in public schools the year following the public school choice lottery. For non-transition grade students, the effect is 20 percentage points and is not statistically significant. This pattern of behavior could reflect that transition years are at a natural point in their school trajectories that makes switching schools and leaving the school district potentially less disruptive for students who have the ability to afford to leave the school district. Therefore, outside options may be particularly salient for students who are applying to school through the public school choice program during transition grades. Similarly, students who apply to TPS that do not currently attend TPS schools—for example, students who currently live within the district boundaries but do not attend public schools—are much more sensitive to getting their top choice. However, there are relatively few of these students, and I cannot observe the demographic information about these students.

[Insert Table 8 here]

VII. Predicting Enrollment Impact

To make the impacts described above more clear, I calculate the effects in terms of the actual number of students who leave the district. Specifically, of the 2060 students included in the causal analysis (those applied to choice schools that used a lottery to determine assignment), 81% or 1,663 got a placement at their top choice school. 19% or 397 students did not get a placement at their top choice school. Of the students that did not receive an offer at their top choice school, 119 did not end up enrolling in public schools. Based on the coefficients above, I estimate that 67 (or 17%) of the students who did not receive a placement at their top ranked

school did not enroll in public schools *because* they did not receive their top choice. That is, they were induced to leave because they did not receive a spot at their top choice but would have stayed had they received an offer at their most preferred public school. As explored above, these students are more likely to be higher-income students who are more likely to be able to afford private school options. Specifically, my estimates suggest that 42 higher income students left the public school district *because* of their assignment.

Having estimated the effect of winning the public school choice lottery and gaining a placement at a top choice school on likelihood of public school enrollment, it is possible to make some predictions about how public school enrollment may be affected by efforts to increase participation in school choice in the future. I perform some simple, stylized calculations to estimate the expected effect of district efforts to increase participation in school choice based on my causal estimates. My goal is to answer the question: how many students *would* leave the public school system if participation in school choice increases by x%? These calculations are based on the following logic of a dynamic problem: increasing participation in school choice—particularly by lower income students who are currently underrepresented in the choice program and who TPS are more likely to target in their efforts—decreases the overall likelihood of any given student getting an offer at the school they ranked first. As a result, as participation in public school choice increases, a larger portion of students overall and, relatively more affluent students in particular, do *not* get a spot at their top choice school. An increasing share of these students, who are on average more likely to leave TPS if they do not get their top choice, end up leaving the district.

To illustrate this relationship, I identify the sample most sensitive to receiving their top choice in the public school choice: higher-income students who applied to schools that use

lottery assignment mechanisms. There are 493 of these students in the 2019-20 data. These higher-income students had a 74% chance of getting accepted at their top choice school in the 2019-20 enrollment cycle. I use this number to find the relationship between public school choice participation rates and the overall acceptance rate at a top ranked school. This can be summarized by the following equations:

$$A(S) = \frac{0.74}{S(b,x)}$$

$$S(b,x) = 1 + (1-b)x$$

Where A is the overall rate of acceptance at the school a student ranked first as a function of S, the public school choice program participation rate, relative to 2019 participation. S is a function of *b,* the base participation rate in 2019, and *x*, a target increase in participation that can be chosen by the school district. In the baseline year, S = 1. But in following years, the district could choose to set a goal to increase participation in school choice, for example, by 25% (not including students who are already participating). In this scenario, S(*b,x*) = S(0.13, 0.25) = 1 + (1-0.13)(0.25) = 1.22.[6]

If S = 1.22 then A = 0.61, indicating that 61% of applicants would be expected to receive admission to their top ranked school if participation increased by 25%, preferences across school remained stable, and seats at each school remained stable. Equivalently, 39% of applicants would *not* receive a spot at their top ranked school. If the district increased participation by 50%, S(0.13, 0.5) = 1.44 and A = 0.58 indicating that 51% of applicants would be expected to receive

[6] I scale the increase in participation by the current participation rate in order to avoid participation rates of over 100%. For example, if I simply increased participation by 25% each year without taking into account the baseline participation rate, then participation would be >100% after 4 years. By incorporating baseline participation rates into the calculation, participation rate is capped at a maximum of 100%.

a spot at their top ranked school and 49% of applicants would *not* receive a spot at their top ranked school.

I then use the treatment effect coefficient for higher-income students estimated in Section —0.331—to predict the number of these students who would leave the school district as a result of increased participation in public school choice. This can be summarized by the following function:

$$F(S, C, \beta) = (C) * \big(1 - A(S)\big) * (\beta)$$

This formula calculates the number of students that are predicted to leave the district *F* as a function of participation in the public school choice system, S, a constant number of higher-income students, C, and the causal coefficient for higher-income students who get their top choice, β, estimated in this paper.

To fix ideas, I calculate the number of additional students expected to leave the school district for two example participation increase targets, 25% and 50%.

$$F(S(b, 0.25), C, \beta) = (493) * (0.39) * (0.331)$$

$$F(25\%) = 64\ students$$

$$F(1.50) = (493) * (0.49) * (0.331)$$

$$F(50\%) = 80\ students$$

These simple calculations attempt to quantify in student terms the likely effect on enrollment of increasing participation in public school choice. Specifically, assuming that the number of seats at schools remains the same and that preferences are stable across schools, a 25% increase in public school choice participation would decrease the top choice acceptance rate from 74% to 62% for higher income students, which would cause 64 higher-income students who apply to lottery-based public schools to leave the school district. This represents 13% of the higher-income applicants in the affected sample and does not include any effect on the criteria magnets or charter schools. Similarly, a 50% increase in public school choice participation would decrease the top choice acceptance rate from 74% to 58% for higher income students, which would cause 80 higher-income students to leave the school district. This represents 16% of the higher-income applicants in the affected sample. These estimates are specific to higher-income students—those who my analysis suggests may have access to options outside of the public school system and are more sensitive to receiving their top choice.

This analysis can be extended to show potential trends over subsequent years. For the purposes of this exploration, I assume stable preferences across schools, as the school district seeks to increase participation in public school choice among its low-income student population. I also assume a stable number of higher income students who participate in public school choice each year. Figure 1 shows the inverse relationship between participation rates and acceptance rates at top ranked schools over time and Figure 2 shows the predicted number of higher-income students that leave the school district each year as participation in public school choice increases and acceptance rates decrease. Under these assumptions, by Year 5, up to 30% of higher-income students participating in public school choice would leave the district as a result of not getting an offer at their most preferred school.

[Insert Figures 1 & 2 here]

VIII. Discussion and Conclusion

In this paper, I estimated the causal effect of winning (losing) the public school choice lottery on enrollment in public schools. I then explored how this causal effect varies for students who have different outside options. I found that the effect depends on students' income, positing that higher-income students have the ability to afford private school options if they do not get a placement in their most desired school. In particular, students who are relatively more affluent are significantly more likely to leave the public school system if they do not get a spot at a school that they prefer than low-income students. These findings have implications for decisionmakers in school districts as well as researchers.

Decisionmakers in school districts manage competing efforts to make school choice programs more equitable while maintaining and growing public school enrollment. My results suggest that efforts to improve equitable access to the best schools by increasing participation in public school choice programs is warranted: in TPS, low-income students and students of color have disproportionately low participation in the public school choice program despite having, on average, lower-rated zoned schools. Therefore, these students have the opportunity to benefit from participating in public school choice. Having alternative, higher-rated school options throughout the district that use lottery assignment ensures that increasing participation in the school choice program could improve representation of low-income students and students of color at higher-rated schools throughout the district. In other words, increasing participation in the public school choice program—particularly for low-income students and students of color—

could lead to more students going to schools that they prefer and that the district and state consider "better."

Still, my results show that there is a cost to these sorts of equity improvements. As more students participate in public school choice, students who can afford private school options may be compelled to leave the public school system entirely. My results show that if districts focus on efforts to increase participation in public school choice, higher income students who are more sensitive to getting a placement that they desire could leave the district at high rates each year, increasing stratification across the public and private school sectors. This is not a necessity—it assumes that preferences are stable across schools, that the number of seats at the most desired schools remains fixed, and the pool of schools that are a part of the school choice program are not changing and improving. The true set of conditions are unlikely to be this stable. However, it does underscore the importance of pursuing multiple approaches to improving the public school system in order to manage competing efforts to improve equity and access while keeping up enrollment. That is, efforts to increase participation in public school choice should be complemented by efforts to improve neighborhood schools in order to increase the overall number of "desirable" seats, relative to the outside options available in the area.

It is helpful to consider for whom the effects discussed in this paper apply. The causal effects I estimate are relevant for students whose underlying preferences include both public and private schools. For students who strictly prefer private, school assignment will have no effect on students' decision of where to enroll—these students, regardless of the public school they receive an offer from, will always enroll in private schools. For students who strictly prefer public schools, school assignment will also have no effect on enrollment—these students will always enroll a public school. The significant causal effect identified in this paper suggests that for some

students, underlying preferences across all potential schools includes both public and private options. As a result, their assignment to a specific public schools can causally sway them to either stay in the public school system or leave it. In order to increase participation in the public school choice system while also maintaining public school enrollment, districts must increase the number of seats at desirable schools relative to private schools so that preferences for schools continue to straddle the public and private sector and students continue to get placed in public schools that they prefer, relative to the private school options they may also consider.

This insight has direct implications for "rightsizing" efforts that are sometimes considered by school districts. Rightsizing refers to limiting the number of seats at specific schools in order to avoid draining neighborhood schools of students and associated resources. For instance, if there is one, most desired choice school in a district, increasing participation in school choice could increase the number of applicants for that school. The district could either decide to increase the number of seats at that school in order to allow more students to attend or it could "right size" the school—keeping the number of seats fixed even as demand for the school increases. One potential benefit of right-sizing is that it stops the concentration of resources at individual schools in a district. However, if students are sensitive to their school assignment—as I have shown they are—rightsizing efforts may be misguided. Limiting enrollment at sought-after schools may not be an effective way to ensure that neighborhood schools are not drained of students unless these approaches are also matched with investments in schools that increase their perceived quality to potential enrollees. If they are not, then families who do not receive access to their top choice schools may simply leave the public school district altogether.

In addition to informing district policy, this paper has implications for research that leverages lotteries to estimate the causal impact of schools on student outcomes. Another way to understand the causal effects estimated in this paper is that they quantify differential attrition of public school lotteries. I show that attrition from the public school system varies systematically by student income level. This suggests that causal estimates of the impact of choice schools are likely to be affected by differential attrition. In other words, comparing student outcomes for students who do and do not get access to specific public schools due to the lottery may be undermined by the fact that certain students leave the sample entirely depending on their assignment to treatment. Based on this finding, it is important to either limit treatment effects to students who can be shown *not* to experience differential attrition based on observable characteristics or to seek out outcome variables that are available for the entire sample (e.g. from the National Student Clearinghouse)—not just those who remain in public administrative data records.

There are several clear limitations to these findings. First, while the school choice and application data used in this study were collected before CoVid-19 impacted schools, the enrollment data comes from 2020-21. While my empirical strategy leverages random variation from the lottery, enhancing the internal validity of the results, it is possible that overall enrollment patterns are unusual this year and sensitivity to getting a top choice may be particularly strong (or weak). For example, on the one hand, families may be over all more likely to pursue options outside of the public school system in response to distance learning mandates. On the other hand, some families may have less discretionary income to spend on education this year due to financial stresses and may therefore be less sensitive than they would be in a typical year.

Additionally, as mentioned throughout this paper, the estimates are based on a subsample of students in TPS who participated in choice but did not apply to criteria magnet schools or charter schools. While these exclusions were necessary for the internal validity of my estimates, they do limit the wider application of the results.

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Table 1 – Enrollment and School Characteristics by School Type

	Enrollment	Enrollment as percent of total	Per Pupil Expenditure	State Assigned Indicator	State Assigned Rating	Percent performing below basic Math	Percent performing below basic ELA
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Total	37,258	100%	$ 9,882.20	0.27	D	42%	44%
Alternative	501	13%	$13,809.29	0.12	F	56%	65%
Criteria Magnet	3,641	10%	$ 9,562.71	0.59	B	18%	27%
Lottery Magnet	4,777	13%	$ 9,108.31	0.52	C	24%	28%
Neighborhood	25,505	68%	$11,093.68	0.23	D	53%	53%
Charter	2,834	8%	Not available	Not available	Not available	Not available	Not available

Notes: This table is based on data from OK state, which provides a school report card for public schools in the state, not including charter schools. Column 5 reports the mode rating for schools of the given type.

Table 2 – School Demographic Characteristics by School Type

	Percent Hispanic	Percent Black	Percent White	Percent Multiple Races	Percent Native American	Percent Asian	Percent economically disadvantaged	Percent ELL	Percent IDEA
Total	37%	23%	23%	10%	5%	2%	80%	25%	17%
Alternative	36%	28%	20%	9%	6%	0%	84%	16%	24%
Criteria Magnet	23%	25%	34%	11%	5%	2%	57%	5%	12%
Lottery Magnet	37%	15%	33%	10%	5%	1%	60%	14%	13%
Neighborhood	39%	24%	19%	11%	4%	2%	86%	30%	19%
School Rating									
A	17%	29%	37%	9%	5%	4%	49%	0%	4%
B	19%	15%	47%	12%	6%	1%	50%	6%	14%
C	20%	14%	45%	14%	6%	1%	62%	14%	15%
D	39%	25%	18%	10%	5%	2%	90%	27%	21%
F	30%	34%	18%	11%	5%	2%	91%	21%	22%
Charter	?	?	?	?	?	?	?	?	?

Notes: This table uses 2019-20 enrollment data provided by TPS. Charter schools do not report to TPS, hence the demographic data is only available for the non-charter public schools.

Table 3 – Participation in School Choice 2019-20

	Overall	Transition Grades	Elementary → Middle	Middle → Higher
Total	13%	44%	45%	43%
Female	14%	45%	46%	45%
Black	11%	31%	28%	33%
Hispanic	15%	50%	51%	50%
White	15%	50%	53%	48%
Asian	9%	28%	32%	22%
Native American	14%	43%	44%	41%
Multi Race	13%	39%	40%	38%
Low-income	13%	40%	41%	38%
Higher-income	15%	60%	61%	63%
ELL	12%	41%	47%	28%
IDEA	11%	30%	33%	24%
Magnet Schools	15%	85%	88%	84%
Zoned School Rating				
B	11%	49%	N/A	49%
C	17%	60%	61%	N/A
D	12%	40%	42%	39%
F	14%	44%	43%	50%
N	34,424	4,665	2,415	2,250

Notes: These data come from TPS enrollment data combined with Smart Choice applications submitted during the 2019-20 enrollment cycle for the 2020-21 school year. Transition grades refer to the highest grade of the school a student attends in 2019-20 when they apply. Pre-K students are not included as transition grade applicants because it is not clear what the total size of the potential applicant pool is. The school letter grades are state-assigned school quality ratings for the schools students would be zoned to in 2020-21 if they did not participate in the public school choice program.

Table 4 – Rankings by Student Characteristics

		Top Choice							
	Average # schools ranked	Charter	Criteria Magnet	Lottery Magnet	Neighborhood	Applied criteria magnet	Applied to charter	Got top choice	Enrolled in Public 2020-21
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(9)	(10)
Total*	2.6	11%	26%	26%	37%	38%	26%	70%	73%
Black	3	13%	36%	16%	35%	48%	22%%	62%	67%
Hispanic	2.5	13%	20%	36%	31%	37%	28%	69%	75%
White	2.5	4%	31%	21%	43%	39%	13%	76%	75%
Asian	2.4	38%	16%	46%	6%	43%	8%	62%	79%
Native American	2.5	6%	24%	27%	43%	36%	18%	72%	77%
Multiple Races	2.8	8%	25%	18%	49%	34%	23%	73%	71%
Female	2.6	10%	28%	26%	36%	40%	26%	70%	74%
Low Income	2.6	10%	20%	28%	41%	34%	27%	71%	76%
Higher Income	2.7	10%	41%	20%	30%	51%	24%	67%	66%
ELL	2.4	16%	12%	35%	36%	29%	32%	70%	74%
IDEA	2.6	10%	17%	31%	42%	31%	27%	66%	73%
Magnet School students	2.9	1%	52%	43%	3%	68%	22%	79%	87%
Zoned School Letter Grade									
B	2.2	2%	51%	12%	35%	55%	6%	76%	83%
C	2.5	1%	30%	22%	47%	35%	8%	78%	75%
D	2.7	10%	27%	22%	41%	37%	14%	72%	75%
F	2.7	14%	21%	32%	33%	37%	22%	68%	70%

Notes: Each cell can be read as [cell value] of [row heading] did [column heading].

* this includes only non-PreK applicants for whom we have demographic information

Table 5—Effect of Winning Lottery on Public School Enrollment

	Sample with Demographic Info		Full Choice Sample (Includes Pre-K)	
	(1)	(2)	(3)	(4)
VARIABLES	Full Risk Set	Top Choice Risk Set	Full Risk Set	Top Choice Risk Set
Got Top Choice	0.147***	0.171***	0.165***	0.156***
	(0.0480)	(0.0292)	(0.0402)	(0.0229)
Constant	0.0694***	0.0674***	0.333***	0.340***
	(0.0408)	(0.0265)	(0.0327)	(0.0193)
Top Choice Risk Set		X		X
Full Risk Set	X		X	
Observations	2060	2060	3615	3615
R-squared	0.539	0.106	0.603	0.236

Notes: The dependent variable is an indicator for public school enrollment in 2020-21. The independent variable is an indicator variable for students who were offered a spot at the school that they ranked first. Full risk set fixed effects are defined by students who ranked the same schools in the same order. Top choice risk set fixed effects are defined by students who share the same first ranked school and therefore have the same likelihood of getting a spot at this school. Columns 1 & 2 are estimated using the final analytic sample. Columns 3 & 4 are estimated using all students that participated in public school choice, including those for whom pre-treatment demographic characteristics are not observed. This is mostly the case for Pre-K students.
Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 6—Differential Impact of Winning Lottery on Public School Enrollment with Outside Options

VARIABLES	(1) Full Risk Set	(2) Full Risk Set	(3) Top Choice Risk Set	(4) Top Choice Risk Set
Got top choice	0.0793	0.170	0.110***	0.156
	(0.0491)	(0.182)	(0.0324)	(0.107)
Higher income	-0.306***	-0.289***	-0.224***	-0.220***
	(0.0861)	(0.0920)	(0.0528)	(0.0571)
Higher income * Got top choice	0.252***	0.241**	0.193***	0.196***
	(0.0948)	(0.102)	(0.0572)	(0.0624)
Distance to private school		-0.0192		-0.00955
		(0.0300)		(0.0190)
Distance to private school * got top choice		0.0144		0.00137
		(0.0313)		(0.0199)
C-rated zoned school		0.334**		0.179*
		(0.158)		(0.0988)
C-rated zoned school * Got top choice		-0.276		-0.0997
		(0.182)		(0.112)
D-rated zoned school		0.199		0.131
		(0.143)		(0.0862)
D-rated zoned school * Got top choice		-0.0766		-0.0279
		(0.162)		(0.0963)
F-rated zoned school		0.289**		0.186**
		(0.139)		(0.0896)
F-rated zoned school * Got top choice		-0.201		-0.0737
		(0.158)		(0.0991)
Constant	0.777***	0.607***	0.743***	0.626***
	(0.0423)	(0.161)	(0.0293)	(0.0959)
Full Risk Set	X	X		
Top Choice Risk Set			X	X
Observations	2060	2060	2060	2060
R-squared	0.553	0.561	0.120	0.128
Got Top Choice Treatment Effects				
Low Income	0.0793	0.170	0.110	0.156
	0.0491	0.182	0.0324	0.107
Higher Income	0.331***	0.410***	0.303***	0.352***
	0.0879	0.161	0.0504	0.0986

Notes: Top choice risk sets are defined by students who share the same first ranked school and therefore have the same likelihood of getting a spot at this school. Full risk sets are defined by students who ranked the same schools in the same order. The sample only includes students for whom there is data on economic disadvantage, that is,

those who have ever been enrolled in the school district. Therefore, students who applied to Pre-K are not included because we do not observe their level of economic disadvantage in the pre-treatment period. The treatment effects shown in the lower section are linear combinations of the above coefficients, provided for ease of interpretation.
Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 7—Effect of Winning Lottery on Public School Enrollment by School Level

VARIABLES	Elementary School Applicants		Middle School Applicants		High School Applicants	
	(1)	(2)	(3)	(4)	(5)	(6)
Got Top Choice	0.175*	0.156	0.109*	0.0376	0.148	0.000511
	(0.0949)	(0.115)	(0.0591)	(0.0545)	(0.110)	(0.105)
Higher Income		-0.0261		-0.370***		-0.487***
		(0.179)		(0.110)		(0.151)
Higher Income * Got Top Choice		0.0524		0.340**		0.278
		(0.186)		(0.132)		(0.188)
Constant	0.649***	0.662***	0.751***	0.832***	0.741***	0.923***
	(0.0809)	(0.0988)	(0.0487)	(0.0452)	(0.0959)	(0.0928)
Full Risk Set	X	X	X	X	X	X
Observations	1123	1123	558	558	279	279
R-squared	0.697	0.697	0.267	0.306	0.300	0.398

Notes: The dependent variable is public school enrollment. Top choice risk set fixed effects are included. The interaction between higher income and got top choice shows the differential effect of getting an offer at a top choice school for higher-income students. Robust standard errors in parentheses. Observations do not sum to the entire analytic sample because there are some students at the Pre-K level who are in the analytic sample, but are not included in the above regressions. *** p<0.01, ** p<0.05, * p<0.1

Table 8—Effect of Winning Lottery on Public School Enrollment, by Transition Grade

VARIABLES	Transition Grade Students		Non-transition Grade Students	
	(1)	(2)	(3)	(4)
Got Top Choice	0.154**	0.0997	0.166**	0.112
	(0.0709)	(0.0647)	(0.0736)	(0.0792)
Higher Income		-0.444***		-0.199
		(0.132)		(0.125)
Higher Income * Got Top Choice		0.398**		0.161
		(0.154)		(0.136)
Constant	0.719***	0.790***	0.662***	0.728***
	(0.0589)	(0.0539)	(0.0626)	(0.0682)
Full Risk Set	X	X	X	X
Observations	674	674	1386	1386
R-squared	0.476	0.513	0.618	0.623

Notes: Transition year applicants are those who are at the highest grade of their current school so will have to switch schools the following year. It does not include pre-K students because I do not observe economic disadvantage for these students in the pre period. The dependent variable is public school enrollment. Top choice risk set fixed effects are included. The interaction between higher income and got top choice shows the differential effect of getting an offer at a top choice school for higher-income students. *Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1*

Figure 1: Participation & Acceptance Rate

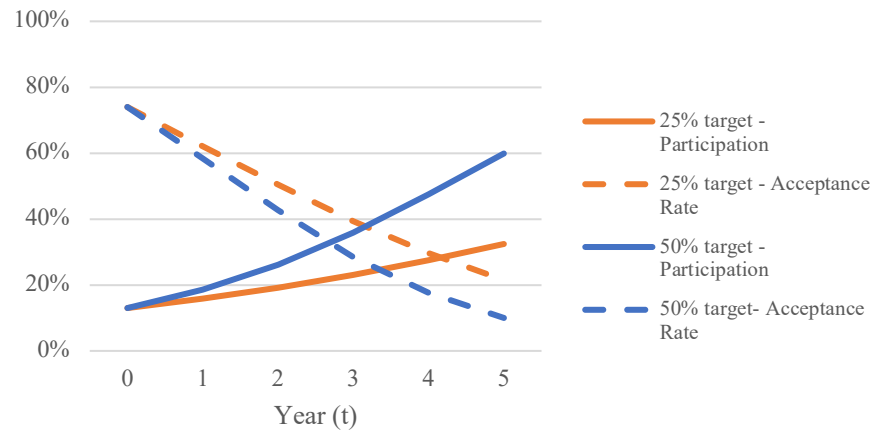
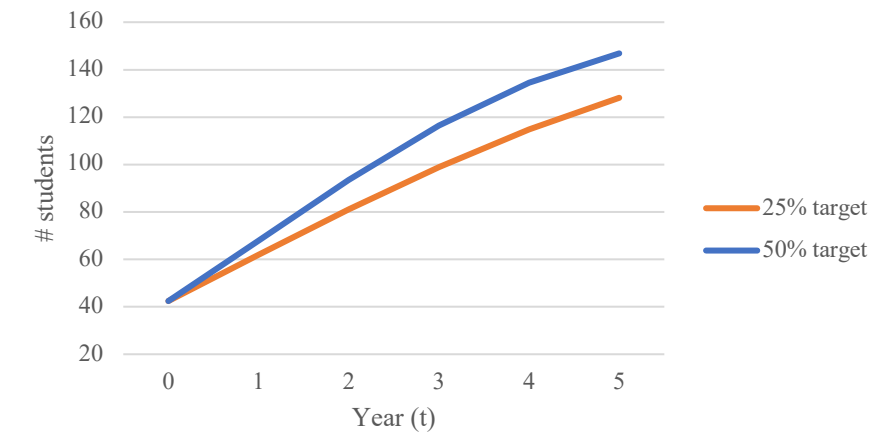


Figure 2: Predicted # of Higher-Income Students Leaving Public Schools Annually



Appendix

Table 1.A—Enrollment by Quality Rating

School Grade	# Schools	Enrollment
A	1	1,297
B	7	4,141
C	8	3,337
D	29	13,979
F	28	10,891

Notes: School letter grades are assigned by OK state. More information can be found here: https://oklaschools.com/

Appendix Table 2: Table Testing Randomization

VARIABLES	(1) Low Income	(2) Black	(3) Hispanic	(4) White	(5) IDEA	(6) ELL	(7) Female
got1	0.0119	-0.00715	0.0704	-0.0255	0.00112	0.0445	-0.0200
	(0.0478)	(0.0376)	(0.0515)	(0.0508)	(0.0404)	(0.0473)	(0.0570)
Constant	0.751***	0.173***	0.336***	0.288***	0.146***	0.191***	0.516***
	(0.0400)	(0.0312)	(0.0426)	(0.0423)	(0.0332)	(0.0390)	(0.0471)
Observations	2060	2061	2061	2061	2061	1984	2061
R-squared	0.599	0.605	0.567	0.569	0.437	0.497	0.441

Notes: This table displays the results from a regression of each of the observed characteristics on got top choice, account for risk sets, to assess whether the likelihood of getting a top choice varies with student characteristics. If randomization is successful, there should not be associations between getting an offer a top choice school and student characteristics. *Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1*

Appendix Table 5.A – Effect of Getting Top or Second Choice on Public School Enrollment

VARIABLES	(1) No Fixed Effects	(2) Top Choice Risk Set	(3) Full Risk Set
Got First or Second Choice	0.171***	0.184***	0.188***
	-0.0214	-0.0238	-0.0437
Constant	0.364***	0.304***	0.300***
	-0.0198	-0.0215	-0.0386
Top Choice Risk Set		X	
Full Risk Set			X
Observations	4469	3615	3615
R-squared	0.013	0.239	0.604

Notes: The independent variable is an indicator for whether a students got a spot at either their first or second most preferred schools. Robust standard errors in parentheses. *** *p<0.01,* ** *p<0.05,* * *p<0.1*

Appendix Table 5.B - Effect of Winning Lottery on Public School Enrollment

	(1)	(2)	(3)
VARIABLES	No Fixed Effects	Top Choice Risk Set	Full Risk Set
Got Top Choice	0.176***	0.191***	0.191***
	(0.0213)	(0.0440)	(0.0440)
Got Second Choice	0.118***	0.141*	0.141*
	(0.0336)	(0.0834)	(0.0834)
Constant	0.364***	0.302***	0.302***
	(0.0197)	(0.0386)	(0.0386)
Observations	4469	3615	3615
R-squared	0.014	0.604	0.604

Notes: Each of the independent variables is an indicator variable for whether the student received admission to the school they ranked at that spot. Students only receive a spot at one school. *Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.*

Appendix Table 5.C - Effect of Winning Lottery on Public School Enrollment by School Level

VARIABLES	(1) Pre-K	(2) Elementary School Applicants	(3) Middle School Applicants	(4) High School Applicants
Got Top Choice	0.129***	0.214***	0.135***	0.124
	(0.0273)	(0.0382)	(0.0511)	(0.0912)
Constant	-0.0479**	0.476***	0.715***	0.755***
	(0.0202)	(0.0333)	(0.0434)	(0.0810)
Top choice risk set	X	X	X	X
Observations	1380	1383	571	281
R-squared	0.136	0.127	0.135	0.098

Notes: This table shows the association between zoned school quality and public school enrollment. The independent variables are indicators for the school rating. The dependent variable is public school enrollment in 2020-21. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Appendix Table 6.A - Effect of Winning Lottery on Public School Enrollment by Zoned School Quality – Overall Rating Index

	(1)	(2)
VARIABLES	Full Risk Set	Top Choice Risk Set
Got Top Choice	0.228	0.327***
	(0.266)	(0.124)
Zoned School Rating Index	-0.180	0.0396
	(0.603)	(0.259)
Top Choice * Zoned School Rating Index	0.00881	-0.109
	(0.649)	(0.287)
Constant	0.652***	0.535***
	(0.231)	(0.111)
Top Choice Risk Set		X
Full Risk Set	X	
Observations	459	459
R-squared	0.696	0.229

Notes: The dependent variable is the % of students who are economically disadvantaged at a student's zoned school. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Appendix Table 6.B - Effect of Winning Lottery on Public School Enrollment by Zoned School Quality - Advanced Math Achievement

VARIABLES	(1) Full Risk Set	(2) Top Choice Risk Set
Got Top Choice	0.0413	0.195***
	(0.246)	(0.0589)
% Advanced in Math Achievement at Zoned School	-2.218	0.0176
	(1.420)	(0.494)
% Advanced Math Achievement * Got Top Choice	1.865	0.137
	(1.658)	(0.532)
Constant	0.804***	0.648***
	(0.206)	(0.0534)
Top Choice Risk Set		X
Full Risk Set	X	
Observations	317	983
R-squared	0.734	0.165

Notes: The dependent variable is the % of students achieving "advanced" in math achievement in a student's 2020-21 zoned school. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Appendix Table 6.C - Effect of Winning Lottery on Public School Enrollment by Zoned School Quality - Below Basic Math Proficiency

VARIABLES	(1) Full Risk Set	(2) Top Choice Risk Set
Got Top Choice	0.257	0.336***
	(0.210)	(0.0842)
% Below Basic Math Achievement at Zoned School	0.0280	-0.441
	(0.708)	(0.283)
Got Top Choice * & % Below Basic Math Achievement at Zoned School	0.0171	-0.460
	(1.333)	(0.485)
Constant	0.559*	0.708***
	(0.292)	(0.112)
Top Choice Risk Set		X
Full Risk Set	X	
Observations	317	317
R-squared	0.721	0.256

Notes: The dependent variable is the % of students achieving "below basic" in math achievement in a student's 2020-21 zoned school. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Appendix Table 6.D - Effect of Winning Lottery on Public School Enrollment by Zoned School Quality - Peer Economic Disadvantage

VARIABLES	(1) Full Risk Set	(2) Top Choice Risk Set
Got Top Choice	0.193	0.240
	(0.627)	(0.219)
% Low Income at Zoned School	0.173	-0.0654
	(0.781)	(0.270)
% Low Income * Got Top Choice	0.127	0.0914
	(0.823)	(0.290)
Constant	0.428	0.599***
	(0.590)	(0.203)
Top Choice Risk Set		X
Full Risk Set	X	
Observations	377	377
R-squared	0.768	0.246

Notes: The dependent variable is the % of students who are economically disadvantaged at a student's zoned school. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Appendix Table 6.E – Zoned School Quality and # of Schools Ranked

VARIABLES	(1) Overall	(2) Lower Income	(3) Higher Income
B-rated Zoned School	-0.400***	-0.172	-0.103
	(0.119)	(0.267)	(0.206)
C-rated Zoned School	-0.163*	-0.0838	0.196
	(0.0855)	(0.197)	(0.188)
D-rated Zoned School	0.0667	0.0658	0.671***
	(0.0505)	(0.157)	(0.174)
F-rated Zoned School	0.0926*	0.173	0.562***
	(0.0504)	(0.156)	(0.178)
Constant	2.615***	2.500***	2.277***
	(0.0371)	(0.152)	(0.163)
Observations	8019	4182	1904
R-squared	0.003	0.002	0.026

Notes: The dependent variable is the number of schools that students ranked. The independent variables indicate the state-assigned rating of the school that students are zoned to in 2020-21. All Students who participated in public school choice at the K-12 level, are included in this regression, including students who applied to charter and magnet schools. Students who applied to pre-K are *not included because they do not have a guaranteed zoned school for pre-K.*

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 6.F – Zoned School Quality and Public School Enrollment

VARIABLES	(1) Overall	(2) Lower Income	(3) Higher Income
B Rated Zoned School	0.765***	0.170**	0.293***
	(0.0274)	(0.0665)	(0.0580)
C Rated Zoned School	0.684***	0.108**	0.206***
	(0.0197)	(0.0492)	(0.0529)
D Rated Zoned School	0.690***	0.147***	0.149***
	(0.0116)	(0.0391)	(0.0490)
F Rated Zoned School	0.638***	0.114***	-0.0196
	(0.0116)	(0.0390)	(0.0502)
Constant	0.0629***	0.633***	0.545***
	(0.00856)	(0.0378)	(0.0461)
Observations	8019	4182	1904
R-squared	0.360	0.004	0.047

Notes: The dependent variable is enrollment in public school in 2020-21. The independent variables indicate the state-assigned rating of the school that students are zoned to in 2020-21. All students who participated in public school choice at the K-12 level are included in this regression, including students who applied to charter and magnet schools. Students who applied to pre-K are *not included because they do not have a guaranteed zoned school for pre-K.* Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Appendix Table 7.B - Effect of Winning Lottery on Public School Enrollment by Neighborhood Characteristics

VARIABLES	(1) % attending Private Schools	(2) Median Income	(3) % in Private high Schools	(4) Distance to Private School
Got Top Choice	0.167***	0.0779	0.326**	0.214**
	(0.0543)	(0.0754)	(0.136)	(0.0854)
% K-12 Enrolled in Private School	-0.00310			
	(0.00212)			
Got Top Choice * % K-12 in Private school	0.000160			
	(0.00249)			
Median income		-0.00397***		
		(0.00103)		
Got Top Choice * Median Income		0.00175		
		(0.00129)		
% 9-12 Enrolled in Private School			0.00721	
			(0.00516)	
Got Top Choice * % 9-12 in Private School			-0.0127**	
			(0.00564)	
Distance to Closest Private School				0.0421*
				(0.0238)
Got Top Choice * Distance to Closest Private School				-0.0152
				(0.0269)
Constant	0.369***	0.520***	0.637***	0.207***
	(0.0447)	(0.0619)	(0.119)	(0.0752)
Observations	3614	3614	280	3422
R-squared	0.605	0.608	0.324	0.612

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Notes: This table shows results for different definitions of outside options based on census tract characteristics. % K-12 in private schools is the portion of all K-12 aged students in the census tract who attend private schools. % 9-12 enrolled in private schools is the portion of all high school aged students in the census tract who attend private schools. These estimates include all students who participate in choice at schools that use a lottery, other than charter school applicants. For Column 4, I dropped applicants who lived more than 6.2 miles away (99^{th} percentile).