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The Farther You Go, the Closer You Get: Understanding the Roles of Residential Mobility and Distance in Participation in Public School Choice

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Abstract

Families' abilities to participate in public school choice programs may be constrained by residential and school location. We provide some of the first evidence of the role that residential mobility and commute time to school in entry into and exit from inter-district and charter school choice. Using a unique panel of student enrollment and address data, we describe residential mobility patterns, calculate commute times, and estimate a set of hazard models predicting exit from formal choice policies for Michigan students. We find that the majority of students who exit choice programs change residences. Additionally, students have a higher probability of leaving choice programs the farther they travel to school past their assigned school. We conclude that residential mobility and commute are likely significant determinants of families' school choice decisions, especially in their decision to remain in choice programs, and should be considered in future school choice policies and research.

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Introduction

Traditionally, the particular public school that students attend is determined by the particular place in which they live. Over the past thirty years, this inextricable link has been weakened by public school choice polices that allow students to attend schools according to their needs, values, preferences, and goals—including schools outside of residential assignment zones (Levin, 2015). Forty-three states have at least one charter school, and all but three states have policies that govern inter-district and intra-district choice, permitting students to attend schools in other traditional public school (TPS) districts and other schools in their district of residence respectively (Wixom & Kelly, 2018; David & Hesla, 2018). During the 2016-17 school year, over twenty percent of U.S. public school students attended a school other than their residentially assigned school (Wang, Rathburn, & Musu, 2019).

Proponents of school choice argue that these policies create more equitable access to effective schools for families who are unable to afford homes in the most desirable districts and catchment zones (Levin, 2015). Also, they contend that school choice creates competitive pressures on existing schools to meet families' needs and improve productivity since schools must attract students to maintain enrollment (Chubb & Moe, 1990; Friedman, 1962). Therefore, school choice policies have the potential to improve student outcomes if they allow students to attend more effective schools and improve the quality of the supply of schools. Although public school choice policies are well established and widespread, the evidence concerning their effectiveness to raise student achievement for all students who participate in them as well as those who remain in the surrounding TPSs is mixed. On average, disadvantaged students in urban areas experience increases in achievement when they attend charter schools and participate in inter-district choice (Carlson, Lavery, & Hughes, 2018; Carlson & Lavertu, 2017; Harris &

Larsen, 2016; Abdulkadiroglu, Angrist, Dynarski, Kane, & Pathak, 2011). Additionally, the majority of evidence concerning competitive effects of charter schools suggests that they do not negatively impact achievement for students in TPS districts (Cordes, 2017; Winters, 2012; Imberman, 2011; Zimmer, Gill, Booker, Lavertu, Sass, & Witte, 2009; Zimmer & Buddin, 2009; Booker, Gilpatric, Gronberg, & Jansen, 2008; Sass, 2006).[1]

Although there exists evidence of positive effects of charter schools and inter-district choice, especially for disadvantaged students, participation in public school choice may be constrained by residential and school location. In order for school choice policies to increase achievement, families must prefer academic effectiveness over other school features and be able to physically access multiple schooling options in addition to having accurate information concerning school quality (Glazerman & Dotter, 2017; Chubb & Moe, 1990). Although parents have strong preferences for academic quality, they value proximity from home just as much, if not more than achievement (Edwards, 2021a; Lincove, Cowen, & Imbrogno, 2018; Glazerman & Dotter, 2017; Harris & Larsen, 2019; Denice & Gross, 2016; Hastings, Kane, & Staiger, 2005;). Families may also express their preferences for academic quality through residential decisions or may be unable to do so due to residential instability. Furthermore, many students cannot physically access schools outside of their neighborhood. Low income families may not have access to sufficient transportation to send their students to schools far from home (Urban Institute Student Transportation Working Group, 2018), and rural students may not have more

[1]Additionally, there exists an extensive literature on the effects of private school voucher programs on student outcomes. In Michigan, the context of this study, there are no voucher programs since the use of public funding for private schools is prohibited by the Michigan State Constitution. Therefore, we focus our review of the literature on evaluations of public school choice policies other than where studies of private school choice are particularly instructive.

than one accessible school in a reasonable distance from home (Catt & Shaw, 2019; Blagg & Chingos, 2017).

Although distance and residential location could be determinants in participating in public school choice, in addition to influencing its effectiveness, little research has directly examined where students live in relation to where they go to school or its role in participation in school choice programs especially outside of large, choice-rich cities or over time. To our knowledge, little evidence exists concerning the role of residential mobility in participation in public school choice. A handful of studies describe how far students travel to school and its associations with attending higher quality schools and student outcomes in Baltimore, Denver, Detroit, New Orleans, New York, and Washington, D.C. (Stein & Grigg, 2019; Urban Institute Student Transportation Working Group, 2018; Blagg, Rosenboom, & Chingos, 2018; Cordes & Schwartz, 2018; Cowen, Edwards, Sattin-Bajaj, & Cosby, 2018; Denice & Gross, 2018). Studies of parental preferences account for distance as one of many school characteristics parents may value (Edwards, 2021a; Lincove, Cowen, & Imbrogno, 2018; Glazerman & Dotter, 2017; Harris & Larsen, 2019; Denice & Gross, 2016; Hastings, Kane, & Staiger, 2005). Additionally, evidence exists concerning the lack of school choice options for students outside of choice-rich cities (Catt & Shaw, 2019; Blagg & Chingos, 2017).

This paper describes the relationships between where students live, where they go to school, and participation in inter-district and charter school choice in Michigan over six years using a rich panel of student level enrollment, achievement, and address data. Specifically, we ask:

1. How often do students participating in formal school choice policies change residences? Are residential moves associated with participation in school choice programs?

2. How far do students travel to school? How does this differ for students participating in formal school choice programs?
3. What are the roles of residential mobility and commute time to school in continued participation in formal school choice policies?

To answer these questions, we first describe the residential mobility patterns of students who participate in formal school choice policies. This is a critical piece largely unaddressed in the student mobility and school choice literatures because families can informally choose schools through residential decisions and could exit school choice due to residential instability unrelated to preferences for effective schools. Next, we estimate commute times for all Michigan students to their attended school and nearest school and examine differences for those who use inter-district and charter school choice. Finally, we explore the roles of residential mobility and commute time in continued participation in school choice using a set of hazard models.

We find that students using public school choice travel farther to school and are more likely to change residences. In addition, students who change residences have a higher probability of leaving school choice programs. In fact, residential moves accompany over half of exits from school choice programs in Michigan. Also, we find that the commute time relative to students' assigned schools may play a role in the use of and duration in choice. Students are more likely to use school choice when the nearest school in the district they live in is farther from home, and many use it to attend schools closer to home. Additionally, students have a higher probability of leaving inter-district and charter school choice when the additional commute time past their nearest school increases. Taken together, these findings imply that residential mobility and distance likely play a role in families' school choice decisions, especially in their decision to remain in formal school choice programs. Future policies and research concerning school choice should account for the roles of residential and school location

in influencing the effectiveness of school choice programs to improve access to effective schools and student outcomes.

This paper extends the current literature concerning participation in school choice programs in multiple ways. First, it provides some of the first evidence concerning the roles residential mobility and distance in who participates in and, in particular, who leaves inter-district and charter school choice programs. This paper is one also of the first to describe commute times for public school students outside of choice-rich cities, which have been the focus of nearly all school transportation studies to date. Finally, this is one of the only studies that examines the factors that predict exit from both inter-district and charter school choice within the same context.

This paper proceeds as follows: First, we discuss the prior literature concerning who participates in and exits formal school choice policies. Second, we examine the literature concerning residential mobility, commute to school, and their relationships with school choice participation. Third, we provide context concerning school choice policies in Michigan, the setting of our study. Fourth, we describe our rich panel of student-level data used in our analyses. Next, we explain the methods and results of each of our research questions. Finally, we discuss the implications of our findings for policy and future research.

Background: Determinants of Participation in Public School Choice Programs

Who Chooses?

Understanding who participates in school choice gives some insight into which types of students may have preferences for and access to school choice programs. The earliest studies that describe participation in inter-district choice use district-level data to explore student flows between districts. They show that students from districts with high achieving students and high

income families are more likely to leave their districts to attend even more advantaged districts (Carlson, Lavery, & Witte, 2011; Welsch, Statz, & Skidmore, 2010; Holme & Richards, 2009; Reback, 2008). More recent work describing participation in inter-district choice uses student-level data. A study of Colorado students finds that economically advantaged students living in high achieving districts with fewer economically disadvantaged students have a higher probability of participating in inter-district choice (Lavery & Carlson, 2015). Similarly, students that are higher achieving and more advantaged than their peers living in the same district are more likely to leave their district of residence for higher achieving, smaller, and more advantaged districts in Ohio (Carlson & Lavertu, 2017). Findings concerning inter-district choice students in Michigan are more nuanced. A higher percentage of students who begin in inter-district choice in kindergarten are White, economically advantaged, and live farther away from their assigned school (Edwards, 2021b). In particular, kindergarteners in Detroit who leave the city to attend school are more likely to be White or Asian and live closer to Detroit's borders (Lenhoff, Singer, Pogodzinski, & Cook, 2020). In contrast, students who begin using inter-district choice after attending a school in their district of residence are more likely to be low achieving, economically disadvantaged, and underrepresented minorities (Cowen, Creed, & Keesler, 2015).

In general, studies of the demographics of charter school students in California, Texas, North Carolina, and Michigan find that a high proportion of charter school students are Black, economically disadvantaged, and low achieving (Edwards & Cowen, 2019; Ni, 2012; Bifulco & Ladd, 2006; Booker, Zimmer, & Buddin, 2005). This is most likely because the majority of charter schools are located in urban areas which have more historically disadvantaged students. As of the 2017-18 school year, 56 percent of charter schools were in cities while only a quarter

of traditional public schools were located in urban areas (U.S. Department of Education, National Center for Education Statistics, 2020). Studies that compare the characteristics of students who attend charter schools and those who do not within urban districts find that the comparatively more advantaged students who are assigned to schools or districts with higher levels of disadvantaged students are more likely to attend charter schools (Ni, 2012; Bifulco, Ladd, & Ross, 2009). In sum, the literature shows that, for the most part, students participating in inter-district and charter school choice seem to be more advantaged than their peers.

Who Leaves?

If there is high attrition from inter-district choice and charter schools, the hypothetical benefits of school choice policies may not be realized. The negative effects of student mobility may outweigh any gains in achievement students experience from participating in school choice (Hanushek, Kain, & Rivkin, 2004). Furthermore, neighborhood schools may not respond to competitive pressures to improve if they know or perceive that students will eventually return to their schools (Creed, 2016). In fact, empirical evidence concerning inter-district choice participation and student achievement shows that students who begin in inter-district choice and do not return to their home districts experience increases in achievement, but those who return to their districts of residence experience small declines (Carlson, Lavery, & Hughes, 2018; Carlson & Lavertu, 2017). Students who begin using inter-district choice after attending a school in their district of residence have no change in achievement on average (Cowen & Creed, 2017).

A handful of studies examine how many and which students leave school choice programs. Overall, disadvantaged students have a higher probability of exiting school choice. In a study of private school choice, Cowen, Fleming, Witte, and Wolf (2012) find that Black students, students with lower achievement, and students attending schools with a higher

proportion of voucher students were more likely to exit Milwaukee's private school voucher program and return to public schools. Two papers describe the characteristics of students who leave inter-district choice. In Colorado, four out of five students continued to enroll in a TPS district other than the one they lived in. Students were more likely to exit if they were low income and lived in low-poverty districts (Lavery & Carlson, 2015). In contrast, over 60 percent of students who began in inter-district choice in kindergarten had exited by 5th grade in Michigan. Black, economically disadvantaged, and lower achieving students, especially those who were attending schools with low achieving and high risk students, had a higher probability of exiting (Cowen, Creed, & Keesler, 2015). We directly build on the Michigan study by incorporating commute times and residential mobility into the model and estimating these models for students who begin in charter schools as well.

To our knowledge, few studies directly examine the characteristics of students who exit charter schools. Taken together, they find that non-White, low achieving, and low income students are more likely to exit charter schools (Ni, 2012; Finch, Lapsley, & Baker-Boudissa, 2009). Much of the work concerning who exits charter schools focuses on whether charter schools "push out" difficult to educate students. Students with disabilities and English Learners are no more likely to exit charter schools than their more advantaged counterparts or similar students in surrounding traditional public schools (Winters, 2014; Winters, 2015). The research concerning whether students with low levels of achievement are more likely to exit charter schools is mixed. Evidence form New York City and Denver shows that lower performing students are more likely to exit charter schools while a study of a large Midwestern school district finds no statistically significant difference in achievement levels of those who leave charter schools (Winters, Clayton, & Carpenter, 2017; Zimmer & Guarino, 2013). However,

these studies find that there is no difference in exit rates between charter schools and their surrounding traditional public schools (Winters, Clayton, & Carpenter, 2017; Nichols-Barrer, Gleason, Gill, & Tuttle, 2016; Zimmer & Guarino, 2013). Thus, differences in attrition between charter school students likely reflect the characteristics of mobile students within districts.

Residential Mobility

One factor that could influence participation in school choice programs is residential mobility. Most of the work that directly examines the effects of residential mobility focuses on its impact on student performance. The findings of these studies are nuanced, but they show that residential mobility is negatively associated with achievement especially when accompanied by a change in schools. Two studies using nationally representative survey data find that students that move schools and residences experience decreases in achievement on average but moving earlier during high school is associated with increases in test scores (Pribesh & Downey, 1999; Swanson & Schneider, 1999). In an urban district in Tennessee, Voight, Shinn, & Nation (2012) find that residential mobility has a negative relationship with achievement in elementary and middle school. Similarly, students in New York City experience decreases in test scores after they move neighborhoods, but these relationships are attenuated when the residential move is accompanied with a move to a higher quality school (Cordes, Schwartz, Stiefel, & Zabel, 2016). One study estimates the causal impacts of residential and school mobility. It finds that changing residences has a negative effect on achievement unless the student did not change schools and only moved a short distance (Cordes, Schwartz, & Stiefel, 2019).

Residential Mobility and Participation in School Choice

To our knowledge, little evidence exists concerning the role of residential mobility in participation in formal school choice policies. However, it is likely that residential moves induce

entry in and exit from formal school choice programs. Families may make different choices about schools after a residential move since families prefer schools closer to home, report having difficulty transporting their students to school, and are more likely to use school choice when their default option is farther from their residence. Furthermore, residential decisions can be used to informally choose a school since a student's assigned school is determined by residence in the majority of U.S. school districts. To test our hypothesis that many families enter into or exit from formal school choice programs at the time of a residential move, we investigate whether or not changes in residence between school years are associated with changes in use of formal school choice policies. This provides some of the first evidence of the relationship between school choice use and residential mobility.

Distance

In addition to residential mobility, distance to school may also promote or restrict participation in school choice. First, distance to school choice options can serve as a barrier to using formal school choice policies since it is likely that families must travel outside of the their neighborhoods in order to participate in school choice. Studies of parent preferences in choice-rich cities like Denver, New Orleans, and Washington, D.C. show that families rank schools closer to home higher on enrollment applications indicating that they may not be willing or able to leave their neighborhoods to attend more effective schools (Lincove, Cowen, & Imbrogno, 2018; Harris & Larsen, 2019; Glazerman & Dotter, 2017; Denice & Gross, 2016). These revealed preferences are likely to be function of families' abilities (or inabilities) to transport their children to schools farther from home (Edwards, 2021a). Only six states require districts to transport students using inter-district choice and 14 states mandate that charter school students are provided transportation (McShane & Shaw, 2020). In choice-rich cities, most parents report

that they drive their children to school and that a lack of reliable transportation was a barrier to sending their children to the desired school and getting them to school regularly (Lenhoff, Singer, Stokes, & Mahowald, 2021; Jochim, DeArmond, Gross, & Lake, 2014). Furthermore, families living in high-poverty neighborhoods, those who are possibly the most likely to benefit from school choice, are less likely to have access to a car, making it difficult to attend schools outside of their neighborhoods (Urban Institute Student Transportation Working Group, 2018).

Distance may be a larger barrier to entry for students in population sparse areas since there are longer distances between schools and towns creating fewer schooling options proximal to home. If inter-district and charter school choice was made universal, about a quarter of rural elementary school students would have access to an additional schooling option within five miles from home. In contrast, almost two-thirds of urban students would have increased access to schools through universal public school choice (Blagg & Chingos, 2017). Furthermore, Catt and Shaw (2019) show that six percent of rural elementary school students and about a quarter of rural high school students in Indiana do not have a magnet, charter, or private school within a thirty minute commute from home.

Although distance from home to school choice options is likely to be a barrier to participating in school choice, long commutes to the assigned school could induce students to use school choice by lowering the opportunity costs of participation. For example, it is likely that the additional distance past the assigned school to attend a school of choice is shorter for students farther away from their assigned school. Some students may even be able to attend schools closer to home through school choice. Therefore, the additional cost in terms of distance of participating in school choice is likely lower for students who live farther away from their assigned school. In fact, the few studies that predict participation in public school choice as a

function of distance to assigned school find that students who live farther from their nearest or assigned school are more likely to use inter-district and charter school choice (Edwards, 2021b; Singer, 2020; Bifulco, Ladd, & Ross, 2009). In particular, Edwards (2021b) finds that commute time to the nearest school plays a larger role in the decision to participate in inter-district choice for rural students with one in five rural students using inter-district choice to attend a school closer to home.

To test our hypothesis that distance to school choice options inhibits participation in choice but long commutes to the assigned school could induce students to use school choice, we compare commute times to the attended school and the nearest school for students who participate in school choice and those who do not. We also calculate the percent of students using school choice to attend a school closer to home.

Prior Evidence Concerning Commutes to School

Recent evidence concerning commute times in from choice-rich cities shows that Black and economically advantaged students travel farther to school, students who travel farther to attend school attend higher quality schools as measured by test scores, types of programs offered, and resources, and students who have longer commute times are more likely to have higher rates of absenteeism (Cordes & Schwartz, 2018; Stein & Grigg, 2019; Blagg, Rosenboom, & Chingos, 2018; Cowen et al., 2018; Denice & Gross, 2018; Urban Institute Student Transportation Working Group, 2018). In particular, Stein, Burdick-Will, & Grigg (2020) predict exit from Baltimore high schools, which operate under an open enrollment system instead of residential assignment, as a function of difficulty of commute. They find that students living farther away from their school in 9th grade are more likely to transfer and attend schools closer to home. As for school choice participation, students who attend charter schools in elementary school have

longer commutes time on average, but high school students attending traditional public schools traveling as far if not farther to school than charter school students (Urban Institute Student Transportation Working Group, 2018). We add to these studies by providing some of the first estimates of commute times to school outside of cities and use them to predict exit from inter-district and charter school choice over time.

Context: Michigan, A Mature School Choice Market

For over twenty years, Michigan students have been able to attend charter schools, other schools in their district of residence, and schools in other traditional public school districts in addition to their assigned school. In 1994, the Michigan State Legislature enacted Part 6A of the Revised School Code which allows community colleges, public universities, intermediate schools districts (ISDs), and TPS districts to authorize charter schools (Michigan Department of Education, 2017). In contrast with the majority of charter school laws, public post-secondary institutions may authorize charter schools located anywhere in the state without oversight from local governments. Therefore, there is no one body that controls where schools are located, when they open, or when they close. Over 80 percent of Michigan charter schools are authorized by universities or community colleges. Furthermore, each charter school has its own application process. Although Michigan law prohibits charter schools from practicing selective enrollment policies and stipulates that they must hold a lottery to determine admission if they are oversubscribed, filling out multiple applications without a guarantee of enrollment may be prohibitive for entry into the charter sector (Michigan Department of Education, 2017). As of the 2017-18 school year, about one in ten Michigan public school students attended one of its 368 charter schools.

Since 1996, Michigan TPS districts have been able to enroll students from surrounding districts and ISDs. Under Acts 105 and 105c of the Michigan Revised School Code, also known as Michigan's Schools of Choice Program, Michigan districts may accept students from districts in their own ISD or students living in districts in contiguous ISDs respectively. 97 percent of Michigan TPS districts have participated in either 105 or 105c in the last decade with over 80 percent participating in both (Edwards & Cowen, 2020). Districts that decide to participate in Schools of Choice determine how many students they accept, which grades, programs, and schools non-resident students can enroll in, the timeframe they accept applications, and whether or not they offer transportation to non-residents. Under Michigan law, districts cannot select which non-resident students enroll in their district with few exceptions. Districts may refuse enrollment to students who have been suspended or expelled. Additionally, they do not have to accept students from districts outside their ISD with an Individualized Education Program (IEP) if they do not have an agreement with the students' district of residence. Outside of these exceptions, oversubscribed districts must hold a lottery. Districts may also enter into local cooperative agreements with other districts to enroll their students. Unlike Schools of Choice, selective enrollment practices are allowed by these local cooperative agreements (Michigan Department of Education, 2013). During the 2017-18 school year, about 13 percent of Michigan public school students use inter-district choice.

Due to its prevalence, longevity, and lack of regulation, Michigan's school choice system is an ideal setting to study the role of location in school choice participation. First, Michigan has a relatively high proportion of Michigan public school students participating in inter-district and charter school choice with substantial use of school choice outside of urban areas. Figures 1A and 1B display participation in inter-district and charter school choice by district of residence. A

higher percentage of rural students use inter-district choice than students living in other locales. Although over sixty percent of charter school students live in the Metro Detroit region, charter schools do exist in many rural districts throughout the state. In addition to its widespread use, the maturity of Michigan's school choice programs allow us to examine participation in a stabilized and developed schooling market. Finally, the absence of regulations on the supply of schools in Michigan provides conditions closest to the free market ideal of school choice. Michigan's charter school laws are considered some of the least regulated (Ziebarth, 2019; Candal, 2018). In theory, this allows for unfettered access to effective schools and the opportunity for families' schooling decisions to regulate the market, truly testing whether public school choice policies can increase access to effective schools and improve school productivity.

Data

Our main sources of data are student-level enrollment and achievement records from the Michigan Department of Education (MDE) and Center for Educational Performance and Information (CEPI). These data include student demographic information (e.g., race and ethnicity, gender, disability status, English Learner status, and economically disadvantaged status[2]), student test scores on state standardized achievement exams (either the Michigan Educational Assessment Program, MEAP, or the Michigan Student Test of Educational Progress, M-STEP), and student addresses geocoded at the census block level for all Michigan public school students from 2012-13 to 2017-18. Additionally, we use a school-level data made publicly available by MDE, CEPI, and Michigan's Department of Technology, Management, and Budget that includes each district and school's sector, address, and educational settings as well as district boundaries.

[2] In Michigan, students are considered economically disadvantaged if they qualify for free or reduced lunch, receive food (SNAP) or cash assistance (TANF), or they are homeless, migrant, or in foster care.

To create our full analytic sample, we begin with 8,808,831 student-year observations between the 2012-13 and 2017-18 school years of students attending a traditional public school or a charter school offering a general education setting. First, we exclude less than two percent of observations for the following reasons: 67,352 observations of students attending schools in juvenile detention centers, boarding schools, virtual schools, and other residential schools since these students do not commute to school; 64,680 observations of students who either attend a school that changes districts or live in a census block where the district of residence changes during the panel since these changes could induce them to technically use school choice without switching schools or residences; 12,931 observations for students who do not have a school in their district of residence that offers his or her grade and therefore must participate in school choice by definition; 3,270 observations that we are unable to calculate the distance from the student's residence to either their attended or nearest school; 2,675 student-year observations that are reported in a grade higher than the terminal grade of their attended school. Next, we remove 2.4% of observations where a student was held back or skipped a grade since an abnormal grade progression could induce a change in schools for different reasons that most students in the sample. Finally, we exclude 2.1% of observations for homeless students since they do not have a stable residence by definition. Our final analytic sample consists of 8,331,445 student-year observations representing almost 2.2 million unique students. We draw from this sample for each of our subsequent analyses.

The main focus of our paper are the relationships between use of choice, residence, and school attended. We study two forms of public school choice: charter school and inter-district choice. We consider all other public school students, those attending a school in the district that

they live in, their resident district, as not participating in a formal public school choice policy.[3] We determine whether a student attends a TPS or charter school using information about schools made publicly available by MDE and CEPI. We determine a student's district of residence using the coordinates of the population weighted centroid of their resident census block and district boundaries. We consider a student to be a non-resident, one using inter-district choice, if they are attending a TPS in a district other than the one they live in.

In Table 1, we present the summary statistics for students in the most recent school year of our sample, 2017-18, as well as differences between students attending charter schools, students using inter-district choice, and students attending a school in their district of residence. Overall, a higher percentage of students using formal school choice policies come from disadvantaged backgrounds and have lower average achievement compared to resident students. Differences are smaller between resident and non-resident students. Additionally, a higher percentage of non-resident students live in rural areas compared to resident students. In contrast, the majority of charter school students live in cities, have low levels of achievement, and are Black and economically disadvantaged.

RQ 1: How often do students participating in formal school choice policies change residences? Are residential moves associated with participation in school choice programs?

We hypothesize that many families enter into or exit from formal school choice programs at the time of a residential move. To test this hypothesis, we first describe the role of residential mobility in school choice decisions. Students in our analysis are considered to be residentially mobile if they live in a different census block than the previous year regardless of whether the new residence is within the boundaries of the same district. Moving residences, even when it

[3] We note that attending a school in the district of residence does not mean that families are not actively choosing a school. It is likely that they chose their residence so they could send their children to their desired school.

does not change their district of residence, could change the student's assigned school as well as the distance to other schooling options. We determine that students leave their initial choice at time *t* if they no longer using the form of choice they used at time *t-1.* For example, if a student leaves a non-resident school to attend a charter school, they would be leaving their initial choice. In contrast, if a student switches from one charter school to another charter school, they would not be leaving their initial choice. However, if a non-resident student moves into the district they are attending school in and continue to attend school there after they move, they would leave choice although they did not switch schools.

5.2% of student-year observations have multiple addresses within the same school year. To deduplicate the addresses, we first drop observations with residences in a district that does not match the reported district of residence from MDE when the student has an observation that does match it since that is likely to be the address at the time the school data was collected. Next, we drop excess observations that have commute times that are over an hour to their attended school when the student has one that is closer because it is likely that they lived at the closer address when attending the reported school. Third, we drop observations where a student does not live in the district they attend but has an observation with an address in the district they attend. Finally, we drop the remaining duplicated observations at random since we have no indication of when or how long they lived at a given residence within a school year.

To answer our research questions, we first show the differences in residential mobility rates and exit from students' initial choices by participation in formal school choice policies. Then, we examine how the characteristics of residentially mobile students differ from students who do not switch residences. Finally, we describe the relationships between school attended, moving residences and exit from the students' initial choice. We accomplish this using two

different samples drawn from our full analytic sample. First, we examine residential mobility and participation in school choice between two school years for all students. Specifically, this sample includes all students in our main sample that attend a Michigan public school in both 2016-17 and 2017-18. While this sample permits us to describe residential mobility across all grades for the majority of students in Michigan, it does not allow us to examine residential mobility over time or account for a student's initial choice. Thus, we also explore residential mobility and choice use for students who begin kindergarten in the first year of our panel and follow them through 5th grade, the last year of our panel.

In Table 2, we display the percent of students who are residentially mobile and the percent who exit choice for both samples by their initial choice. Across all forms of choice, less than 20 percent of students were residentially mobile between 2016-17 and 2017-18, but almost half of kindergarten students moved residences at least once by 5th grade. In both samples, a slightly higher percentage of students who attended a non-resident or charter school were residentially mobile. As for exit from initial choice, the percentage of resident students who move residences is much larger than the percent that no longer attend a school in their district of residence. However, the percentages of students who change residences and exit their initial choice are similar for students using inter-district and charter school choice. This implies that most exits from formal school choice programs may be accompanied by residential moves.

Next, we compare the characteristics of residentially mobile and immobile students by their initial choice. Table 3 displays these average differences in student demographic characteristics for those who are residentially mobile and those who are not between 2016-17 and 2017-18.[4] Across all initial choices, a higher percentage of residentially mobile students are

[4] Differences are similar for the kindergarten sample. However, kindergarten students do not have test scores for most of the panel, especially at the time of initial choice. Results are available by request.

Black and economically disadvantaged and live in cities compared to other students using the same form of choice. Residentially mobile students also have average test scores prior to moving residences that are 0.2 to 0.3 standard deviations lower than their immobile counterparts. Additionally, residentially mobile students are much more likely to exit their initial choice. For example, only four percent of students who live in the same residence between 2016-17 and 2017-18 and use inter-district choice in 2016-17 no longer use it during the next school year while almost 60 percent of students who move residences exit inter-district choice. However, a smaller percentage of resident students who change residences exit their initial choice compared to students using formal school choice policies. Taken together, the evidence from Tables 2 and 3 show that not only are students participating in school choice are more residentially mobile and that residentially mobile students are more likely to exit their initial choice, but residentially mobile choosers have a higher rate of exit from their initial choice than residentially mobile students attending a school in their district of residence.

Now that we established that students participating in school choice are more likely to be residentially mobile and exit their initial choice when residentially mobile, we examine the percentage of exits from the initial choice that are accompanied by a residential move. Table 4 describes residential mobility patterns for those who leave their initial choice. Almost two-thirds of students who no longer attend a school in resident district move residences. A similar percentage of students who leave inter-district choice are residentially mobile. About half of charter school students who exit the charter sector move residences. Because students who move residences can attend the same school or district but enter or exit inter-district choice, we also calculate the percent of students who move residences and exit choice separately for those who attend the same school district between years and those who do not. Higher percentages of

students who exit their resident district or inter-district choice during the 2016-17 school year move residences and attend a school in the same district the next school year than change districts. Furthermore, one in five students who uses inter-district choice in kindergarten eventually moves into the district that they were using inter-district choice to attend. Overall, the findings of Table 4 show that the majority of students who leave their initial choice also move residences with many who leave their initial choice actually attend the same school. Taken together, the findings of Tables 2, 3, and 4 suggest that many exits from formal school choice programs may be accompanied by a residential move.

RQ 2: How far do students travel to school? How does this differ for students participating in formal school choice programs?

The relationship between where families live and their decisions to use and continue participating in formal school choice policies may not only be shaped by residential mobility but by the distance between schooling options and their residences. Thus, we also examine differences in commute times and distances from home to school between students participating in school choice and those who do not. We calculate commute times (in minutes) and commute distances (in miles) by car using Here Application Program Interface (API) from the population weighted centroid of the student's home census block to their attended school as well as the nearest TPS in their district of residence offering their grade, our proxy for assigned school.[5]

[5] Although we do not have exact addresses for students, we believe that using the population weighted centroid of the student's resident census block provides reliable estimates for the following reasons. First, over half of U.S. census blocks are smaller than a tenth of a square mile, implying that our calculations should be within 528 feet of the actual address on average (Federal Communications Commission, 2015). To investigate errors associated with addresses coarsened to the block level and disparities in these errors between urban and rural locales in our sample, we calculated the geodetic distance from the population-weighted centroid of each student's census block to the population-weighted centroid of the nearest census block within the same school district. This distance should provide an estimate of the possible size of the measurement error since the population weighted centroid of a student's census block should be closer to their home than the population weighted centroid of the next census block. We find that the median distance between census blocks for students in our full sample is less than a tenth of a mile. Because census blocks are larger in area in rural locales (Federal Communications Commission, 2015), we

Estimating the commute time to students' nearest schools allows us to determine how much farther students are traveling to use school choice options and test our hypothesis that students who live farther from their assigned school are more likely to use school choice. We use the nearest school instead of the assigned school because we do not have data concerning student's assigned schools or catchment zones for all districts in Michigan over time. We determine the student's nearest school by calculating the geodetic distance to each school offering his or her grade in their district of residence. We consider the school with the shortest distance to be the nearest school.

We calculate commute time and distance by car using the fastest route assuming normal traffic when the student leaves home at 8am on a weekday to best estimate travel conditions during the morning commute to school. Since commutes cannot be calculated for past dates, we estimate commutes times on a weekday at the end April between 2019 and 2021. Although there have been changes to traffic patterns in the years between the beginning of our panel, September 2012, and when we calculated the commute times, we do not believe that these changes are large enough to bias our estimates. Furthermore, these estimates do not account for extreme weather conditions found at other times in the school year in Michigan, allowing them to be comparable with other states. We consider our calculated commute times to be estimates of students' actual commute since we do not know the student's exact address, the mode of transportation students

also examine distance between census blocks in rural districts. We find that the median distance is about three tenths of a mile with less than one percent of rural students living in a census block that has a distance to the center of the next census block over one mile. Because these distances are fairly small, we conclude that using the population weighted centroids of the student's resident census block to estimate commute times should provide fair estimates in cities as well as in rural areas. To account for the differences in the size of the census blocks between rural and urban areas and the larger errors in actual address, we focus our comparisons of travel times between students who use school choice and those who do not within locales. When the centroids do not fall on a road, we use the nearest road to the centroid to calculate drive time.

used to get to school, the exact time they leave or arrive to school, accurate weather conditions, or whether there was a significant change in traffic patterns during our panel.

Since the size of, number of, and distance between schools varies across grades, we focus on analyzing commute times and distances for students in kindergarten, 6th grade, and 9th grade, the grades students most commonly change schools, separately. First, we present average commutes times and distances to each student's attended and nearest school for all Michigan public school students by grade for the most recent school year, 2017-18, in Table 5. We choose to focus on the most recent school year in this analysis since the commute times estimated should more accurately reflect commute times and distances in more recent years. On average, students travel 8 to 11 minutes (3 to 5 miles) to school. Students in 9th grade travel farther to school than elementary school students. This is likely a function of the number and size of high schools compared to elementary schools. Additionally, students live about 6 to 9 minutes away (2 to 4 miles) from their nearest school offering their grade in their district of residence.

Reporting state-level averages may mask differences due to access to multiple schooling and choice options. For example, rural students may have to travel farther to school than students living in cities regardless of whether or not they attend their resident school since schools are more spread out in rural areas due to population sparsity. Therefore, we compare commute times to attended school and nearest school within locales to determine how commutes to school differ for students participating in formal school choice programs in Figures 2 and 3. Furthermore, we focus on commute times in our discussion of our results since we contend that time more accurately reflects how individuals experience their commute since they account for traffic patterns, the availability of express ways, and the number of stoplights that may make commutes of the same distance take longer.

In Figure 2, we display commute times to the attended school by grade, locale, and participation in school choice programs. Across all grades and locales, students participating in formal school choice programs travel farther to school on average. In kindergarten, students using inter-district choice travel twice as far to school than students attending a school in their district of residence with slightly smaller differences in 6th and 9th grade. In kindergarten and 6th grade, non-resident students travel farther to school than charter school students on average. However, charter school students and students using inter-district choice travel similar distances on average in 9th grade. In Figure 3, we compare commute times to the nearest school between resident, non-resident, and charter school students. Average differences in time to nearest school between students who participate in school choice and those who do not are much smaller than differences in commute time to attended school. In town and rural districts, students who use inter-district choice live farther away from their nearest school than those who attend a school in their resident district. This implies that the opportunity cost of using inter-district choice may be lower for rural students whose nearest school, their likely default option, is farther away from their residence.

Since we show that there are differences in commute times to students' schools as well as nearest schools by choice use, we also explore how much longer students using formal choice policies spend commuting to school than they would if they attended their nearest school in Table 6. The additional minutes or miles a student travels are the differences between the attended school commute and the nearest school commute (attended school commute - nearest school commute). Students with negative additional commute times attend schools closer to home than their nearest school. Non-resident students travel an additional 6 to 10 minutes past their nearest school to their attended school on average. City students have the highest additional

drive time. The average additional distance traveled by charter school students ranges from 3 to 9 minutes depending on grade and locale. Some students who use formal school choice policies actually attend a school closer to home than their nearest school. In Table 6, we also report the percent of students attending schools closer to home than their nearest school. Approximately one in five non-resident students living in rural areas and towns attend a school closer to home. Similarly, over twenty percent of students attending a charter school attend a school closer to home. Taken together, the results we present in Figure 3 and Table 6 show that many students use school choice policies to attend schools closer to home or when their assigned school is far from home. This implies that proximity to home relative to their nearest or assigned school is a likely determinant in participation in formal school choice policies.

RQ3: What are the roles of residential mobility and commute time to school in continued participation in formal school choice policies?

Since we find differences in residential mobility and distance to school between students who participate in formal school choice programs and those who do not, we formally examine whether residential mobility and distance traveled to school are associated with mobility out of inter-district or charter school choice. We accomplish this by estimating a set of hazard models on the students in our full analytic sample who were in kindergarten in 2012-13, participated in either charter school or inter-district choice in kindergarten, and were in our full sample all six years of the panel.[6] We focus on kindergarten, so we know with certainty what the student's initial choice was. We exclude students who leave Michigan public schools during the panel since we cannot account for their residential mobility at the time they leave the panel. Hazard

[6] In our main specifications, we also exclude 2,300 students who attend a school that does not have test scores in at least one year of the panel because a school's average achievement level is a significant predictor of mobility. Many of these schools without test scores only offer grades K-2. Results are similar with the full sample and are available by request.

models allow us to account for the relationship between the passage of time and mobility out of schools and have been used in prior studies of mobility and exit out of school choice (Cowen, Creed, & Keesler, 2015; Lavery & Carlson, 2015; Cowen, Fleming, Witte, & Wolf, 2012; Finch, Lapsley, & Baker-Boudissa, 2009). We estimate the hazard of leaving inter-district choice and charter schools separately. We also estimate our models on the sample restricted to students who never move residences since students who move residences are likely to have different choice sets before and after moving and the distance between home and school during the previous school year may be less relevant after changing residences.

Table 7 displays the average student characteristics of the non-resident and charter school students in our sample and compares students who leave their initial choice to those who remain in it through 5th grade. The majority of students who leave either form of choice move residences at some point between kindergarten and 5th grade. Those who switch out of inter-district choice travel farther past their nearest school than students that remain. Additionally, a higher percentage of students who leave inter-district choice are economically disadvantaged.

First, we estimate the unconditional hazard of leaving inter-district or charter school choice and graph the probability of staying in the initial form of choice as Kaplan-Meier survival curves in Figures 4A and 4B respectively. For both non-resident and charter school students, the probability of remaining in their initial choice decreases over time. Next, we plot the Kaplan-Meier curves separately for students who change residence and those who do not in Figure 5. These figures show that residentially mobile students have an increased hazard of exiting their initial choice. In fact, Figure 5A shows that few students who live at the same residence between kindergarten and 5th grade leave inter-district choice; exit is driven by residentially mobile students. Figures 6A and 6B examine the unconditional hazards of leaving inter-district choice or

charter school choice by quartile of total drive time to school in kindergarten for the full sample.[7] Non-resident students who travel farther to school have an increased hazard of exiting their initial choice while there are small differences by commute time for charter school students. The differences in hazards by quartiles of additional minutes traveled to school past their nearest school are slightly larger as seen in Appendix Figure A2.

Next, we condition the student's probability of leaving their initial choice by residential mobility, distance traveled, and student and school characteristics. Formally, we estimate Equation 1 separately for students who begin in inter-district choice or charter schools:

$$h_i(t) = k(t)\exp\left(Residentmover_{it}\beta_1 + Distance_{i,t-1}\beta_2 + \boldsymbol{\gamma X_{i,t-1}} + \boldsymbol{\delta S_{i,t-1}}\right) \quad (1)$$

Where $h_i(t)$ is the hazard that student *i* fails to continue in their initial choice at time *t.* The baseline hazard function, $k(t)$ is assumed to have a Weibull distribution, as is common in most applications of survival analysis (Manton, Singer, & Woodbury, 1992).[8] $Residentmover_{it}$ equals one when a student lives in a different census block at time *t* than he or she did at time *t-1*. $Distance_{i,t-1}$ is either the overall travel time to the student's attended school, the commute time to their nearest TPS in their district of residence, or the additional travel time to the attended school past the nearest school. We estimate specifications of our main model with linear and quadratic functional forms of each distance measure as well as combinations of overall distance with either nearest or additional distance. $\boldsymbol{X_{i,t-1}}$ is a vector of student characteristics including gender, race, economically disadvantaged, English Learner, and student with disability (SWD) statuses, and locale of the student's district of residence. $\boldsymbol{S_{i,t-1}}$ includes the following school characteristics: total enrollment, the percent of female, Black, Hispanic, Asian, Other Race,

[7] Results for the same residence sample can be found in Appendix A.

[8] We choose a Weibull distribution for the hazard function since the hazard increases over time at a decreasing rate as suggested visually in the Kaplan-Meier curves and by the shape parameter. We also estimate Cox proportional hazard models. The results are similar and available by request.

economically disadvantaged, and English Learner students, the percent of students with disabilities, and the average standardized math score on state exams.[9] We also include the average drive time to school in the vector of school characteristics to help account for differences in exit rates for schools that are located far from residential areas in general. Because average drive time could be related to the number of students using choice, we also include the percent of non-resident students attending the school in $\boldsymbol{S_{i,t-1}}$ in the inter-district choice models. Standard errors are clustered at the district of residence.

Results

Table 8 Panel A displays the estimates of our coefficients of interest, $Residentmover_{it}$, and the variants of $Distance_{i,t-1}$, on the full sample of non-resident students. Across all of our specifications, moving residences is a large and significant predictor of leaving inter-district choice holding constant other risk factors including economic disadvantaged status, race, and school achievement levels and demographics. In Column 1, we show that having a minute increase in commute time is associated with a small increase in the probability of exiting inter-district choice. In contrast, students who live farther away from their nearest school in their district of residence are less likely to leave inter-district choice as shown in Column 3. This implies that students who live farther from their assigned school may have a lower opportunity cost to continue participating in inter-district choice. Because of the positive relationship between leaving inter-district choice and actual commute time and the negative relationship between exit and travel time to the nearest school, we also examine the relationship between additional distance traveled to the attended school past their nearest school for non-resident

[9] We also estimate Equation 1 with standardized ELA score instead of math score. Results are similar and available by request.

students in Column 5. For every additional minute traveled to the attended school past the nearest school, there is an increase in the hazard of exiting inter-district choice.

To further examine these relationships, we include both the actual commute time and either the commute time to the nearest school or the additional minutes traveled in the model. When both commute times to the attended and nearest school are included in the model as linear terms, their relationships with exit are the same as the models when only one of the distance measures was included. Interestingly, they are similar in magnitude in opposite directions, indicating that if distance to both the attended and nearest school increases, there would be little change in the probability of exiting. To test this, we estimate a model with commute time to the attended school and the additional commute time measure. The coefficient on commute time to the attended school represents the change in the probability of exiting if both the time it takes to get to the nearest and attended school increased. The coefficient on additional minutes represents the change in the probability of exiting if the time it takes to get to the attended school increases, holding the distance to the nearest school constant. Results of this model are displayed in Column 9. There is no significant relationship between overall drive time and exiting inter-district choice, but an increase in the additional travel time is associated with an increased hazard of leaving, indicating that relative distance past the default option, not total time traveled, influences decisions to remain in inter-district choice. The inclusion of the quadratic terms in the models in Columns 2, 4, 6, 8, and 10 does not meaningfully change the relationship between commute time and exit for any of our commute time measures suggesting that the relationship is linear.

Table 8 Panel B presents the analogous models for the sample of charter school students. Similar to non-resident students, charter school students have a higher probability of exiting the

charter sector if they move residences between time *t* and *t-1*. While students who have a longer commute to their nearest school are less likely to exit charter schools, there is no significant relationship between commute time to the attended school and exit. There is a small but positive relationship with exiting choice and additional time traveled to the attended school past the nearest school. When both overall commute time to the attended school and the additional time to school are included in the model, an increase in distance to the attended school past the nearest school is associated with an increased hazard of leaving while an increase in both the distance to the nearest and attended schools is associated with a decreased hazard of leaving. This implies that charter school students are more likely to leave the charter sector the farther their attended school is relative to their nearest school, but less likely to exit if both their nearest school and attended school are farther from home.

The commute time from home to school at time *t-1* may not be relevant to school choice decisions at time *t* if students no longer live at the same residence. Therefore, we also estimate a version of Equation 1 on the sample of students who live at the same address between kindergarten and 5th grade without the residential mobility indicator. Results of this specification are presented in Table 9. For non-resident students, the direction of the relationships between all the commute time measures and exiting are in the same direction as the models estimated on the full sample, but their magnitudes are larger. Additionally, there is some evidence that some of these relationships are quadratic in nature. Still, when both overall and additional commute time are in the model, only additional commute time is statistically significant. Similarly, the relationships between commute times and the probability of exit are larger in magnitude and statistically significant for charter school students who do not change residences. In the model with both overall and additional commute time, only additional commute time is statistically

significant. These results indicate that the commute time to school relative to the default option may be more important when making school choice decisions than overall distance especially for families whose residence is stable over time.

Discussion

In this paper, we provide some of the first evidence of the differences in residential mobility and commute times for students who use inter-district and charter school choice and their roles in continued participation in formal school choice programs. Our findings show that both residential mobility and commute time are likely determinants of participation in school choice. The majority of students who leave their initial choice also move residences, and many who leave their initial choice actually attend the same school but move into or out of the district where they are attending school. As for distance, we find that many families use inter-district or charter school choice to attend schools closer to home or when their assigned school is farther from home. Similarly, students are more likely to exit their initial choice when the commute time to their attended school relative to their nearest school is longer. Taken together, these results imply that families not only consider overall distance but focus on distance to school relative to the distance to the default option when making school choice decisions.

Because of the importance of location in families' school choice decisions, it is unlikely that the existence of school choice policies alone will increase equitable access to effective schools or force schools to compete for students, even if families prefer high quality schools. Families are likely weighing the proximity of the school against the increases in quality their child may experience if he or she attended a school farther away from home. In particular, they may be considering the distance relative to other schooling options just as much if not more than overall distance to school, indicating that they are accounting for other choices when making

their decisions. Furthermore, exit from choice may not be a result of school preferences, but of residential mobility.

One possible policy that could mitigate the role of residential location in participation in school choice policies is the provision of transportation. School choice theorists claim that increased access and competition would be limited without an expanded school transportation system (Levin, 2015; Chubb & Moe, 1990). If parents are not personally responsible for transporting them to and from school every day, they may be more willing and able to send their children to schools farther from home. In fact, recent evidence from New York City finds that being eligible for the school bus mitigates the negative effects of distance on choice of school (Trajkovski, Zabel, & Schwartz, 2021). Furthermore, families may be able to continue to participate in choice programs after a residential move if there is guaranteed transportation. However, few states mandate that schools provide transportation for students participating in school choice (McShane & Shaw, 2020). More empirical evidence is needed concerning the effects of transportation on student outcomes and its cost-effectiveness to determine its feasibility as a policy solution.

Our results also show that it is imperative that future work describing use of school choice policies or their effectiveness in increasing student outcomes should account for residential mobility and distance. For example, research that describes access to school choice options (i.e., Catt & Shaw, 2019; Blagg, & Chingos, 2017) should consider relative distance to school in addition to overall distance to various school choice options. Additionally, work examining differential exit from choice options should account for different residential mobility patterns between sectors. Finally, the literature concerning the effectiveness of school choice programs must incorporate the role of location and specifically residential mobility. A theory of

school choice that does not account for physical access to schooling options, families' preferences for proximity, and their residential choices will not accurately reflect the factors that influence families' decisions.

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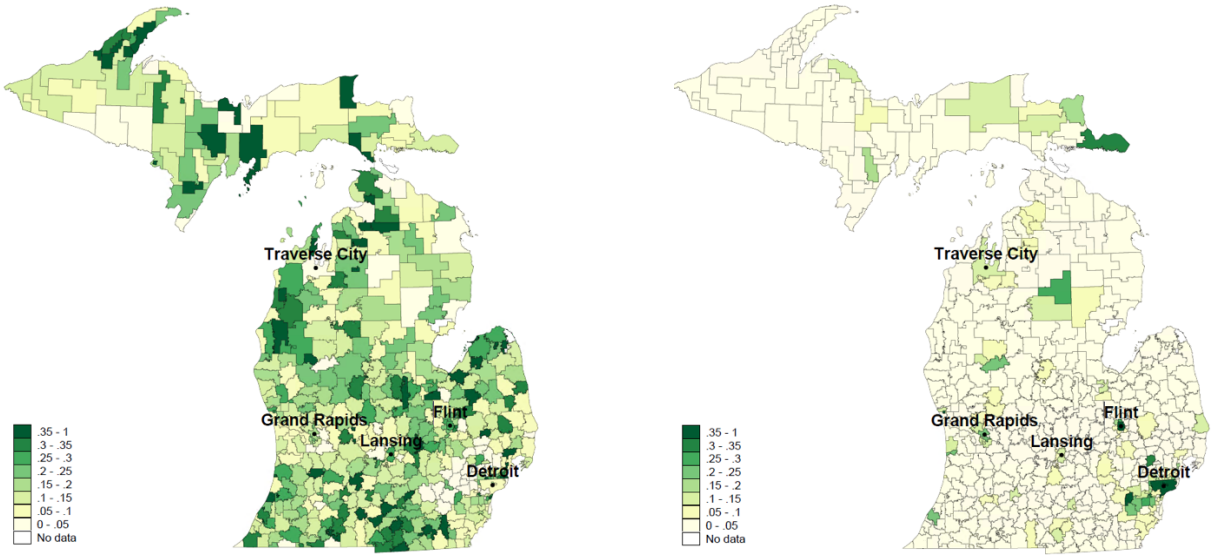
Tables and Figures

Figure 1: 2017-18 Participation in School Choice by District of Residence

1A: Inter-District Choice *1B: Charter School Choice*



Note. The denominator of the proportions in Panels A and B include all residents regardless if they attend a traditional public school or charter school.

Table 1: 2017-18 Student Characteristics by Choice Use

	Full Sample	Resident	Non-Resident	Charter
Number of Students	1,356,085	1,064,568	169,793	121,724
Percent of Sample	100%	78%	13%	9%
Female	49%	49%	50%	50%
White	67%	71%	69%	30%
Black	17%	13%	17%	53%
Hispanic	8%	8%	8%	10%
Asian	4%	4%	2%	4%
Other Race	5%	4%	5%	4%
Econ. Dis.	51%	47%	52%	76%
SWD	13%	13%	13%	12%
EL	7%	7%	4%	12%
City	27%	23%	27%	62%
Suburb	44%	46%	37%	28%
Town	12%	13%	13%	4%
Rural	17%	18%	23%	5%
Avg. Std. Math Score	0.03	0.07	0.00	-0.31
Avg. Std. ELA Score	0.02	0.06	0.02	-0.26

Note. Non-residents are defined as students who attend a traditional public school that is not in their district of residence. Econ. Dis., EL, and SWD stand for Economically Disadvantaged, English Learner and Student with Disability respectively. Locale is determined by the National Center of Education Statistics locale code of the student's district of residence. ELA is an abbreviation for English Language Arts. Math and ELA test scores are from the Michigan Student Test of Educational Progress (M-STEP) and are standardized within grade, subject, and year at the state level. Test scores are available only for students who were in grades 3 through 8 in 2017-18 with valid test scores.

Table 2: Residential and Choice Mobility Behaviors by Initial Choice

	Mobility between 2016-17 and 2017-18			Mobility between Kindergarten and 5th Grade		
	N	Changes Residences	Exits Initial Choice	N	Changes Residences	Exits Initial Choice
Resident	953,714	12%	3%	66,493	43%	15%
Non-Resident	143,791	15%	12%	7,977	49%	44%
Charter	111,238	19%	17%	8,546	56%	43%

Note. Non-residents are defined as students who attend a traditional public school that is not in their district of residence. Columns 1-3 include students who are in our full sample during the 2016-17 and 2017-18 school years and a student is considered to change residences if they live in a different census block in 2017-18 than they did in 2016-17. Columns 4-6 contain students who are in kindergarten in the initial year of the sample, 2012-13 and are in our sample all years of the panel. A student is considered to change residences if they live in a different census block than they did in kindergarten at any time before 6th grade. Rows represent choice in the initial year of the sample. We consider students who are no longer using the same choice policy to attend school to exit their initial choice. Students who use the same choice but change schools or district are not considered to exit their initial choices.

Table 3: 2016-17 Student Characteristics by Residential Mobility between 2016-17 and 2017-18

	Resident		Non-Resident		Charter	
	Same Residence	Changes Residence	Same Residence	Changes Residence	Same Residence	Changes Residence
Number of Students	843,583	110,131	122,918	20,873	89,932	21,306
Pct. Exit Initial Choice	1%	19%	4%	59%	11%	40%
Female	49%	49%	50%	51%	50%	50%
White	73%	60%	71%	65%	32%	21%
Black	12%	23%	15%	20%	50%	66%
Hispanic	7%	9%	8%	8%	10%	7%
Asian	4%	2%	2%	1%	4%	2%
Other Race	4%	6%	5%	6%	4%	4%
Econ. Disadvantaged	41%	68%	45%	64%	70%	84%
Student with Disability	12%	15%	13%	14%	12%	12%
English Learner	7%	8%	4%	3%	13%	9%
City	22%	31%	27%	31%	61%	69%
Suburb	48%	40%	37%	37%	30%	24%
Town	13%	14%	13%	13%	4%	3%
Rural	17%	15%	23%	19%	5%	3%
Std. Math Score	0.12	-0.27	0.04	-0.19	-0.28	-0.54
Std. ELA Score.	0.11	-0.26	0.05	-0.15	-0.22	-0.49

Note: Non-residents are defined as students who attend a traditional public school that is not in their district of residence. Columns represent choice in the initial year of the sample, 2016-17. A student is considered to change residences if they live in a different census block in 2017-18 than they did in 2016-17. Students who use the same choice but change schools or district are not considered to exit their initial choices. Locale is determined by the National Center of Education Statistics locale code of the student's district of residence. ELA is an abbreviation for English Language Arts. Math and ELA test scores are from the Michigan Student Test of Educational Progress (M-STEP) and are standardized within grade, subject, and year at the state level. Test scores are available only for students who were in grades 3 through 8 in 2016-17 with valid test scores.

Table 4: Residential Behaviors by Initial Choice for Students who Leave their Initial Choice

	Mobility between 2016-17 and 2017-18			Mobility between Kindergarten and 5th Grade		
	Resident	**Non-Resident**	**Charter**	**Resident**	**Non-Resident**	**Charter**
Number of Students	32,055	17,446	18,783	9,927	3,480	3,662
Same Residence	36%	29%	54%	36%	25%	49%
Changes Residence, New District	26%	29%	46%	27%	28%	51%
Changes Residence, Same District	38%	42%	N/A	37%	47%	N/A

Note. Non-residents are defined as students who attend a traditional public school that is not in their district of residence. Columns 1-3 include students who are in our full sample during the 2016-17 and 2017-18 school years and a student is considered to change residences if they live in a different census block in 2017-18 than they did in 2016-17. Columns 4-6 contain students who are in kindergarten in the initial year of the sample, 2012-13, and are in our sample all years of the panel. A student is considered to change residences if they live in a different census block than they did in kindergarten at any time before 6th grade. We consider students who are no longer using the same choice policy to attend school to exit their initial choice. Students who use the same choice but change schools or district are not considered to exit their initial choices. Changes Residence, New District refers to students who move, but attend a school in a different district than they did the previous year.

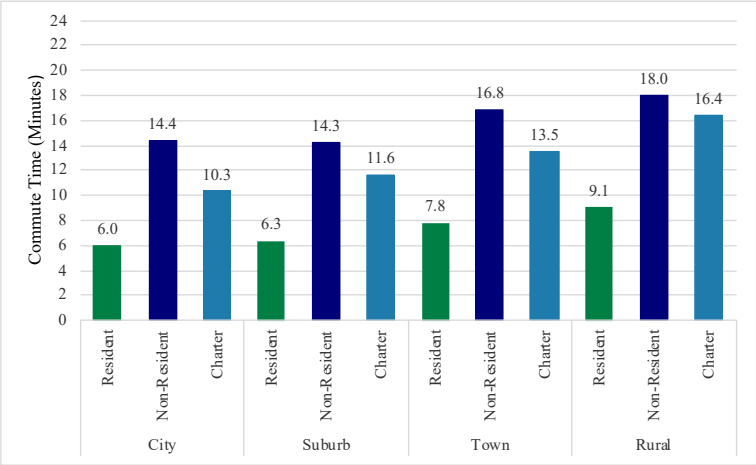
Table 5: 2017-18 Average Commute Times and Distances to Attended and Nearest School by Grade

	Kindergarten	**6th Grade**	**9th Grade**
Number of Students	100,279	108,231	109,155
Min. to Attended School	8.6	9.5	10.7
Miles to Attended School	3.7	4.2	4.6
Min. to Nearest School	6.1	7.5	8.8
Miles to Nearest School	2.4	3.1	3.5

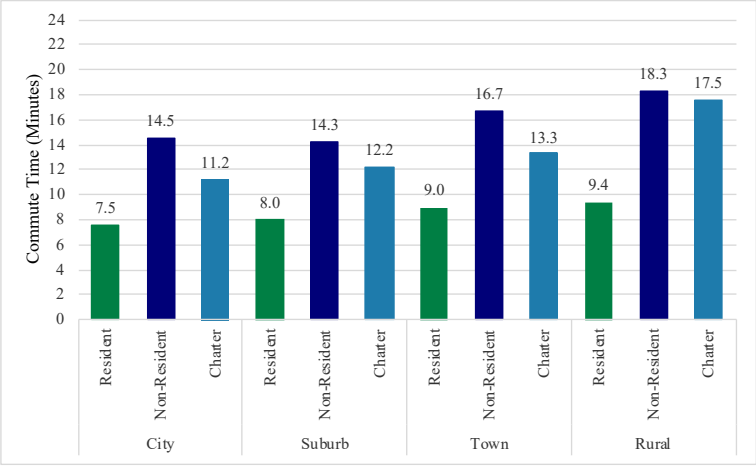
Note: Commute times and distances are calculated using HERE API assuming normal traffic at 8 am on a weekday in April between 2019 and 2021. We determine the student's nearest school, our proxy for assigned school, by calculating the geodetic distance to each school offering his or her grade in their district of residence. We consider the school with the shortest distance to be the nearest school.

Figure 2: Average Commute Time to Attended School by Grade, Locale, and Choice

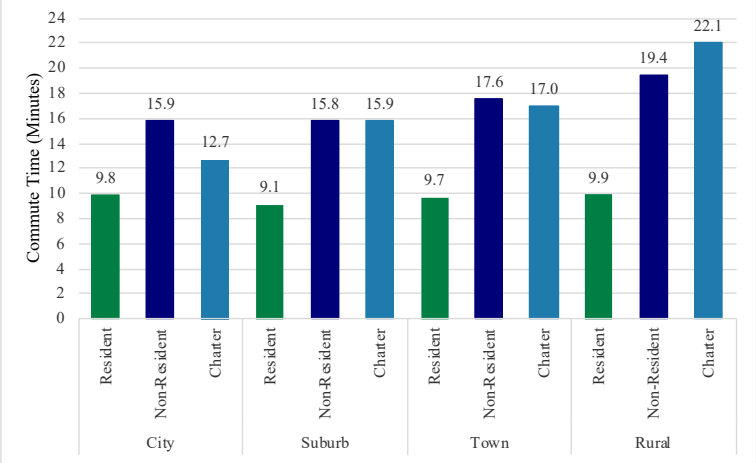
Panel 2A: Kindergarten



Panel 2B: 6th Grade



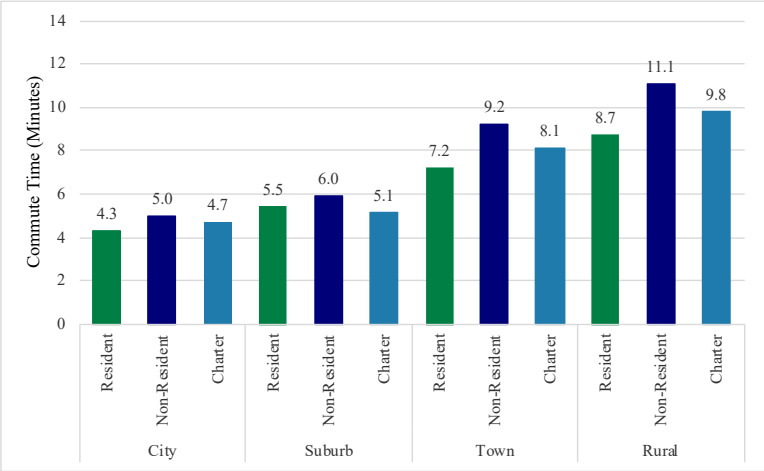
Panel 2C: 9th Grade



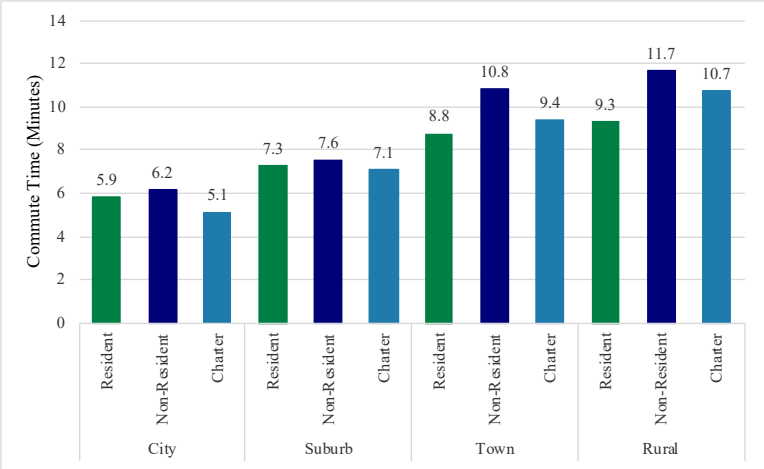
Note. Non-residents are defined as students who attend a traditional public school that is not in their district of residence. Locale is determined by the National Center of Education Statistics locale code of the student's district of residence. Commute times and distances are calculated using HERE API assuming normal traffic at 8 am on a weekday in April between 2019 and 2021.

Figure 3: Commute Time to Nearest School By Grade, Locale, and Choice

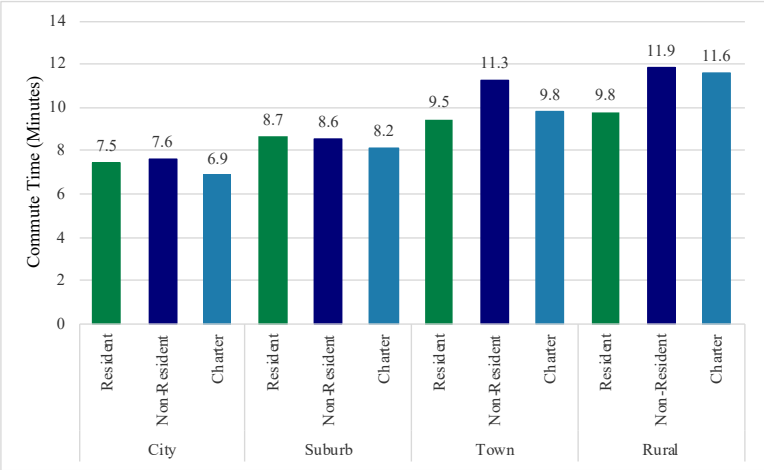
Panel 3A: Kindergarten



Panel 3B: 6th Grade



Panel 3C: 9th Grade



Note. Non-residents are defined as students who attend a traditional public school that is not in their district of residence. Locale is determined by the National Center of Education Statistics locale code of the student's district of residence. Commute times and distances are calculated using HERE API assuming normal traffic at 8 am on a weekday in April between 2019 and 2021. We determine the student's nearest school, our proxy for assigned school, by calculating the geodetic distance to each school offering his or her grade in their district of residence. We consider the school with the shortest distance to be the nearest school.

Table 6: Additional Distance Traveled Past Nearest School by Grade, Locale, and Choice

	Non-Resident				Charter			
	City	**Suburb**	**Town**	**Rural**	**City**	**Suburb**	**Town**	**Rural**
Kindergarten								
Additional Minutes	9.6	8.4	8.0	7.5	5.9	6.7	4.9	6.9
Additional Miles	5.3	4.6	5.6	4.9	2.9	3.6	3.3	5.0
Pct. Attending Closer to Home	8%	12%	19%	19%	22%	18%	32%	27%
6th Grade								
Additional Minutes	9.0	6.7	6.2	7.0	5.9	5.1	3.3	6.7
Additional Miles	5.2	3.8	4.5	4.6	3.1	3.2	2.1	4.7
Pct. Attending Closer to Home	11%	17%	25%	21%	22%	25%	35%	29%
9th Grade								
Additional Minutes	8.3	7.2	6.4	8.0	4.6	6.8	6.6	8.6
Additional Miles	4.9	4.3	4.9	5.3	2.8	4.5	5.1	6.5
Pct. Attending Closer to Home	14%	18%	26%	20%	28%	19%	28%	27%

Note: Non-residents are defined as students who attend a traditional public school that is not in their district of residence. Locale is determined by the National Center of Education Statistics locale code of the student's district of residence. Additional Minutes and Miles are the difference between the commute to the attended school and the student's nearest school. Commute times and distances are calculated using HERE API assuming normal traffic at 8 am on a weekday in April between 2019 and 2021. We determine the student's nearest school, our proxy for assigned school, by calculating the geodetic distance to each school offering his or her grade in their district of residence. We consider the school with the shortest distance to be the nearest school. We determine the percent of students attending school closer to home using additional commute time in minutes. Negative additional minutes means that the student attends a school closer to home than the nearest school in their district of residence.

Table 7: 2012-13 Kindergarten Student and School Characteristics by Mobility and Initial Choice

	Full Sample						Same Residence Sample					
	Non-Resident			*Charter*			*Non-Resident*			*Charter*		
	Full	**Stays**	**Switch**	**Full**	**Stays**	**Switch**	**Full**	**Stays**	**Switch**	**Full**	**Stays**	**Switch**
Student Characteristics												
Number of Students	6,268	3,599	2,669	7,955	4,640	3,315	3,234	2,813	421	3,524	2,604	920
Switches Residences	48%	22%	84%	56%	44%	72%	N/A	N/A	N/A	N/A	N/A	N/A
Min. to Attended Sch.	14.9	14.4	15.5	11.0	11.1	11.0	14.7	14.2	17.9	10.9	10.7	11.4
Min. to Nearest Sch.	7.2	7.6	6.7	5.2	5.4	4.9	7.8	8.0	6.8	5.5	5.6	5.2
Additional Minutes	7.6	6.8	8.7	5.9	5.7	6.1	6.9	6.2	11.1	5.4	5.1	6.3
Female	49%	50%	49%	50%	51%	50%	49%	49%	49%	50%	50%	50%
White	78%	80%	75%	33%	32%	33%	81%	82%	76%	41%	39%	45%
Black	11%	9%	13%	52%	52%	53%	8%	7%	13%	41%	43%	37%
Hispanic	6%	5%	6%	7%	8%	5%	5%	5%	7%	8%	9%	6%
Asian	2%	2%	1%	4%	4%	4%	2%	2%	2%	5%	5%	7%
Other Race	5%	4%	5%	5%	4%	5%	4%	4%	3%	5%	4%	6%
Econ. Dis.	43%	38%	51%	73%	71%	75%	35%	33%	44%	62%	63%	60%
Student with Disability	10%	10%	11%	7%	8%	6%	10%	10%	16%	8%	8%	7%
English Learner	3%	3%	3%	10%	11%	7%	4%	3%	5%	13%	15%	10%
City	22%	21%	24%	61%	62%	60%	19%	19%	19%	55%	58%	47%
Suburb	41%	39%	43%	29%	28%	30%	38%	38%	42%	32%	29%	38%
Town	12%	12%	11%	5%	5%	4%	12%	12%	10%	6%	6%	6%
Rural	25%	28%	22%	5%	5%	5%	31%	31%	29%	7%	7%	8%

Note: The same residence sample only includes students who live at the same residence all years of the panel. Non-residents are defined as students who attend a traditional public school that is not in their district of residence. A student is considered to switch residences if they live in two different census blocks during the panel. Commute times are calculated using HERE API assuming normal traffic at 8 am on a weekday in April between 2019 and 2021. We determine the student's nearest school, our proxy for assigned school, by calculating the geodetic distance to each school offering his or her grade in their resident district. We consider the school with the shortest distance to be the nearest school. Additional Minutes are the difference between the commute to the attended school and the student's nearest school. Econ. Dis. stands for Economically Disadvantaged. Locale is determined by the National Center of Education Statistics locale code of the student's resident district. ELA is an abbreviation for English Language Arts. Math and ELA test scores are from the Michigan Student Test of Educational Progress (M-STEP) and are standardized within grade, subject, and year at the state level.

Figure 4: Kaplan-Meier Survival Probabilities for All Students (Survival=remain in initial choice). Kindergarten to 5th Grade

Figure 4A: Non-Resident Students

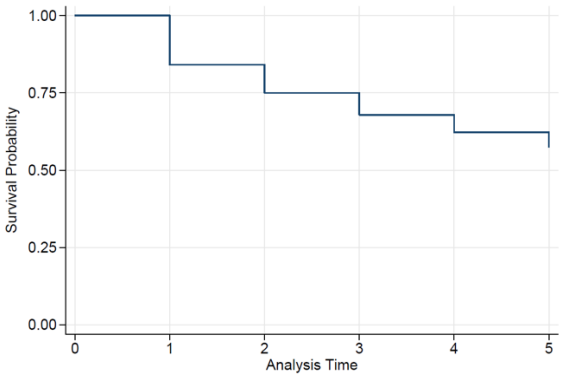
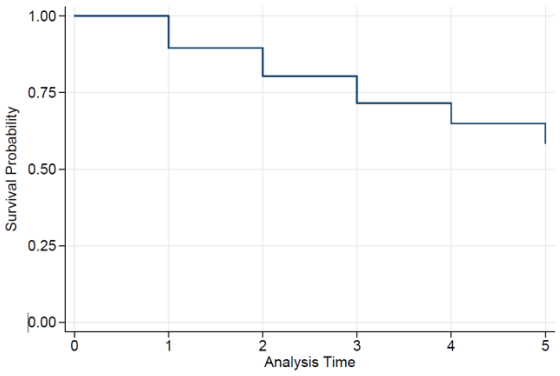


Figure 4B: Charter School Students



Note: Non-residents are defined as students who attend a traditional public school that is not in their resident district. The unit of Analysis Time is years starting with the 2012-13 school year and ending with the 2017-18 school year. Survival probability is the probability of remaining in the same choice between each year.

Figure 5: Kaplan-Meier Survival Probabilities by Residential Mobility (Survival=remain in initial choice). Kindergarten to 5th Grade

Figure 5A: Non-Resident Students

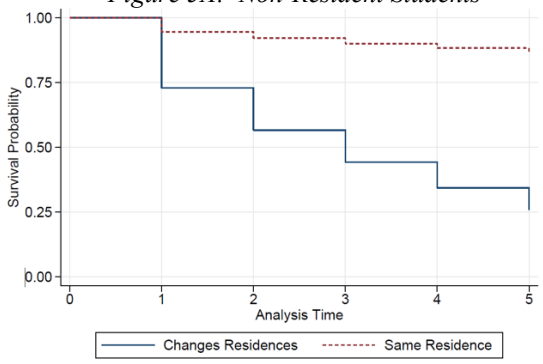
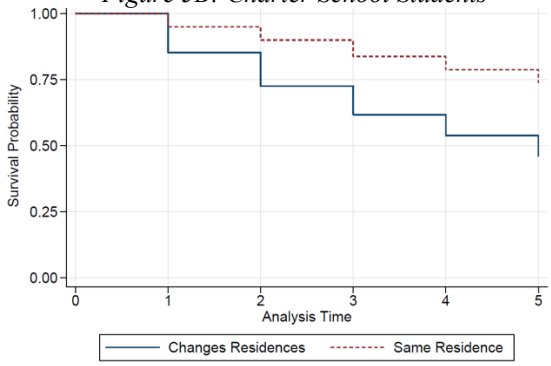


Figure 5B: Charter School Students



Note: Non-residents are defined as students who attend a traditional public school that is not in their resident district. The unit of Analysis Time is years starting with the 2012-13 school year and ending with the 2017-18 school year. Survival probability is the probability of remaining in the same choice between each year. We consider a student to change residences if they do not live in the same census block all years of the panel.

Figure 6: Kaplan-Meier Survival Probabilities by Attended School Driving Time Quartile (Survival=remain in initial choice). Kindergarten to 5th Grade

Figure 6A: Non-Resident Students

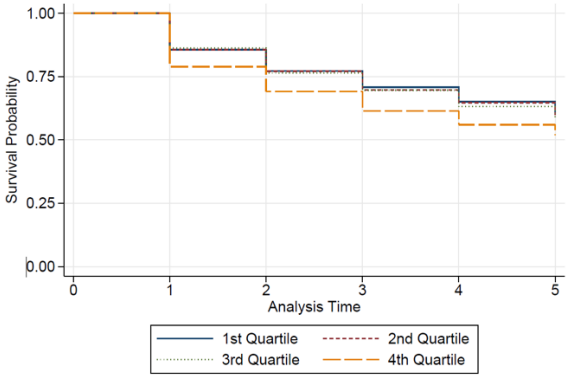
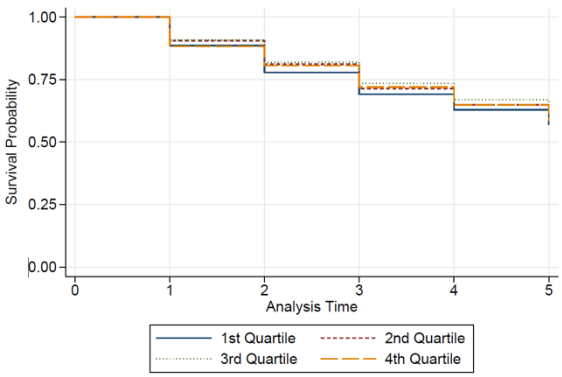


Figure 6B Charter School Students



Note: Non-residents are defined as students who attend a traditional public school that is not in their resident district. The unit of Analysis Time is years starting with the 2012-13 school year and ending with the 2017-18 school year. Survival probability is the probability of remaining in the same choice between each year. Quartiles are determined using the commute time to attended school in kindergarten. Commute times and distances are calculated using HERE API assuming normal traffic at 8 am on a weekday in April between 2019 and 2021.

Table 8: Predicting Exit from Initial Choice from Kindergarten to 5th Grade: Full Sample

Panel A: Non-Resident Students

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Resident Mover	2.964***	2.964***	2.973***	2.974***	2.959***	2.958***	2.958***	2.959***	2.958***	2.958***
	(0.054)	(0.054)	(0.054)	(0.054)	(0.054)	(0.054)	(0.054)	(0.054)	(0.054)	(0.054)
Min. to Attended School	0.011***	0.011*					0.011***	0.011*	-0.001	-0.004
	(0.003)	(0.006)					(0.003)	(0.006)	(0.005)	(0.009)
Min. to Nearest School			-0.011***	-0.011			-0.012***	-0.010		
			(0.004)	(0.008)			(0.004)	(0.009)		
Additional Min.					0.0111***	0.012***			0.012***	0.014**
					(0.002)	(0.004)			(0.004)	(0.006)
Min. to Attended School Sq.		-0.000						0.000		0.000
		(0.000)						(0.000)		(0.000)
Min. to Nearest School Sq.				-0.000				-0.000		
				(0.000)				(0.000)		
Additional Min. Sq.						-0.000				-0.000
						(0.000)				(0.000)
Constant	-3.471***	-3.473***	-3.328***	-3.330***	-3.437***	-3.437***	-3.430***	-3.439***	-3.430***	-3.404***
	(0.384)	(0.388)	(0.383)	(0.384)	(0.384)	(0.384)	(0.385)	(0.389)	(0.385)	(0.392)

Panel B: Charter School Students

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Resident Mover	1.613***	1.613***	1.613***	1.612***	1.609***	1.609***	1.610***	1.609***	1.610***	1.611***
	(0.087)	(0.087)	(0.085)	(0.085)	(0.087)	(0.087)	(0.087)	(0.086)	(0.087)	(0.086)
Min. to Attended School	0.004	0.002					0.004	0.003	-0.016**	-0.025***
	(0.004)	(0.005)					(0.004)	(0.005)	(0.007)	(0.009)
Min. to Nearest School			-0.019***	-0.007			-0.020***	-0.008		
			(0.007)	(0.013)			(0.007)	(0.013)		
Additional Min.					0.007**	0.011***			0.020***	0.022***
					(0.003)	(0.004)			(0.007)	(0.007)
Min. to Attended School Sq.		0.000						0.000		0.001***
		(0.000)						(0.000)		(0.000)
Min. to Nearest School Sq.				-0.001				-0.001		
				(0.001)				(0.001)		
Additional Min. Sq.						-0.000*				-0.001***
						(0.000)				(0.000)
Constant	-3.798***	-3.792***	-3.711***	-3.764***	-3.759***	-3.772***	-3.702***	-3.747***	-3.702***	-3.669***
	(0.381)	(0.381)	(0.388)	(0.387)	(0.384)	(0.381)	(0.388)	(0.388)	(0.388)	(0.387)

Note: Total Observations Panel A: 24,397. Panel B: 32,315. Standard errors clustered at the resident district level in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Student's gender, race, economically disadvantaged, English Learner, and disability statuses, the locale of the student's resident district and the following school characteristics total enrollment, the percent of female, Black, Hispanic, Asian, Other Race, economically disadvantaged, and English Learner students, the percent of students with disabilities, the average standardized math score on state exams, and the average drive time at time t-1 are included as covariates. In Panel A we also include the percent of non-resident students at time t-1 as a covariate. A student is considered be resident mover if they live in a different census block at time t than they did at t-1. Commute times are calculated using HERE API assuming normal traffic at 8 am on a weekday in April between 2019 and 2021. We determine the student's nearest school, our proxy for assigned school, by calculating the geodetic distance to each school offering his or her grade in their resident district. We consider the school with the shortest distance to be the nearest school. Additional Minutes are the difference between the commute to the attended school and the student's nearest school.

Table 9: Predicting Exit from Initial Choice from Kindergarten to 5th Grade: Same Residence Sample

Panel A: Non-Resident Students

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Min. to Attended School	0.043***	0.103***					0.0427***	0.104***	-0.016	0.044
	(0.006)	(0.016)					(0.007)	(0.016)	(0.014)	(0.033)
Min. to Nearest School			-0.062***	-0.067**			-0.059***	-0.051		
			(0.013)	(0.033)			(0.013)	(0.038)		
Additional Min.					0.044***	0.081***			0.059***	0.060***
					(0.006)	(0.010)			(0.013)	(0.019)
Min. to Attended School Sq.		-0.001***						-0.001***		-0.001
		(0.000)						(0.000)		(0.001)
Min. to Nearest School Sq.				0.000				-0.000		
				(0.001)				(0.002)		
Additional Min. Sq.						-0.001***				0.000
						(0.000)				(0.001)
Constant	-4.242***	-4.800***	-3.358***	-3.342***	-4.055***	-4.262***	-3.961***	-4.583***	-3.961***	-4.560***
	(1.221)	(1.205)	(1.208)	(1.197)	(1.217)	(1.201)	(1.214)	(1.192)	(1.214)	(1.240)

Panel B: Charter School Students

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Min. to Attended School	0.018***	0.023*					0.019***	0.021	-0.012	-0.023
	(0.006)	(0.013)					(0.006)	(0.013)	(0.012)	(0.018)
Min. to Nearest School			-0.030***	0.010			-0.032***	0.005		
			(0.011)	(0.027)			(0.010)	(0.027)		
Additional Min.					0.022***	0.033***			0.032***	0.038***
					(0.005)	(0.007)			(0.010)	(0.011)
Min. to Attended School Sq.		-0.000						-0.000		0.001*
		(0.000)						(0.000)		(0.000)
Min. to Nearest School Sq.				-0.002				-0.002		
				(0.001)				(0.001)		
Additional Min. Sq.						-0.001*				-0.001***
						(0.000)				(0.000)
Constant	-4.996***	-5.019***	-4.864***	-5.070***	-4.938***	-4.950***	-4.898***	-5.078***	-4.898***	-4.838***
	(0.755)	(0.762)	(0.750)	(0.743)	(0.753)	(0.759)	(0.754)	(0.744)	(0.754)	(0.772)

Note: Total Observations Panel A: 15,043. Panel B: 15,768. Standard errors clustered at the resident district level in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Student's gender, race, economically disadvantaged, English Learner, and disability statuses, the locale of the student's resident district and the following school characteristics total enrollment, the percent of female, Black, Hispanic, Asian, Other Race, economically disadvantaged, and English Learner students, the percent of students with disabilities, the average standardized math score on state exams, and the average drive time at time t-1 are included as covariates. In Panel A we also include the percent of non-resident students at time t-1 as a covariate. Commute times are calculated using HERE API assuming normal traffic at 8 am on a weekday in April between 2019 and 2021. We determine the student's nearest school, our proxy for assigned school, by calculating the geodetic distance to each school offering his or her grade in their resident district. We consider the school with the shortest distance to be the nearest school. Additional Minutes are the difference between the commute to the attended school and the student's nearest school.

Appendix A

Figure A1: Kaplan-Meier Survival Probabilities by Attended School Driving Time Quartile (Survival=remain in initial choice). Kindergarten to 5th Grade for Same Residence Sample

Figure A1a: Same Residence Non-Resident Students

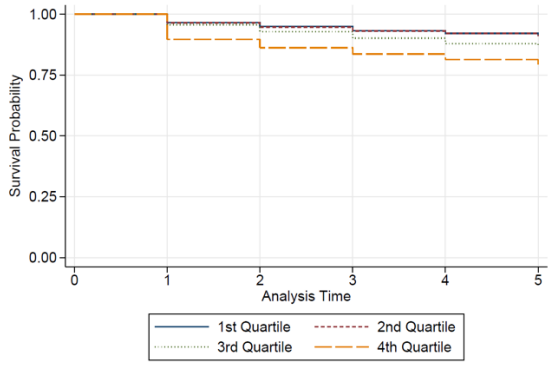
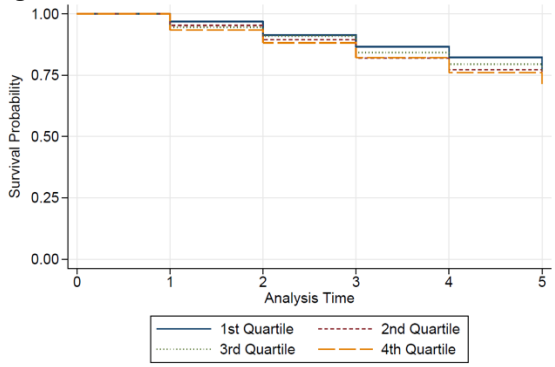


Figure A1b: Same Residence Charter School Students



Note: Students in the sample live at the same residence all analysis years. Non-residents are defined as students who attend a traditional public school that is not in their resident district. The unit of Analysis Time is years starting with the 2012-13 school year and ending with the 2017-18 school year. Survival probability is the probability of remaining in the same choice between each year. Quartiles are determined using the commute time to attended school in kindergarten. Commute times and distances are calculated using HERE API assuming normal traffic at 8 am on a weekday in April between 2019 and 2021.

Figure A2: Kaplan-Meier Survival Probabilities Additional Driving Time Quartile (Survival=remain in initial choice). Kindergarten to 5th Grade

Figure A2a: Full Sample Non-Resident Students

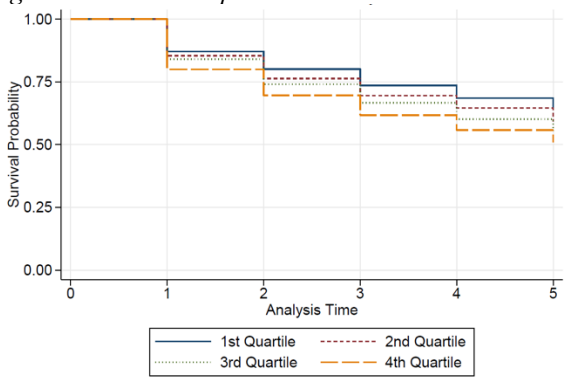


Figure A2b: Full Sample Charter School Students

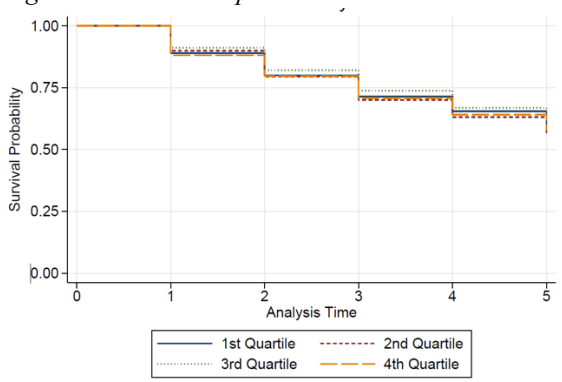


Figure A2c: Same Residence Non-Resident Students

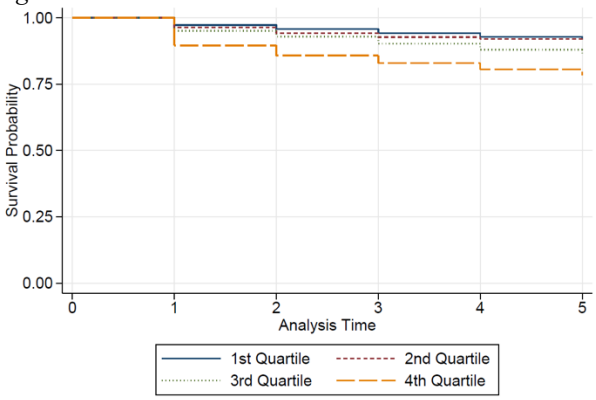
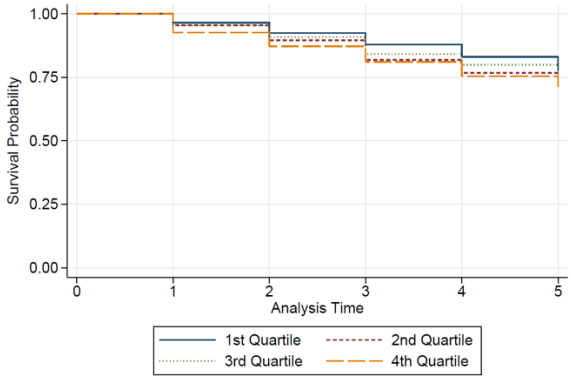


Figure A2d: Same Residence Charter School Students



Note: Students in the same residence sample live at the same residence all analysis years. Non-residents are defined as students who attend a traditional public school that is not in their resident district. The unit of Analysis Time is years starting with the 2012-13 school year and ending with the 2017-18 school year. Survival probability is the probability of remaining in the same choice between each year. Quartiles are determined using the additional commute time to attended school past the nearest school in kindergarten. We determine the student's nearest school, our proxy for assigned school, by calculating the geodetic distance to each school offering his or her grade in their resident district. We consider the school with the shortest distance to be the nearest school. Commute times and distances are calculated using HERE API assuming normal traffic at 8 am on a weekday in April between 2019 and 2021.