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FULL REPORT:

Evidence on Characteristics of School Choice Participants and Effects of School Choice on Mobility in Pennsylvania

Sarah A. Cordes and Sophia Seifert

College of Education, Temple University



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Abstract

Despite the growth of public-school choice programs nationally and in Pennsylvania, little is known about the characteristics of students who participate in various choice options, what factors prompt students to exit their zoned schools for choice schools, and whether students who attend choice schools are more likely to make non-structural school moves. To explore these issues, we use a combination of descriptive and regressing analyses, drawing on rich student- and school-level data from the Pennsylvania Department of Education (PDE) and the Common Core of Data. We find that students who participate in choice are more likely to live in urban districts, qualify for free or reduced-price lunch, or to be chronically absent, are less likely to be white or an English Learner, and tend to have lower test scores, but that many of these differences are driven by geography. Specifically, when choice participants are compared to zoned school students who live in the same district or catchment area, many differences are no longer statistically significant or are greatly reduced in magnitude. The largest individual-level predictor of exit to any form of choice is residential mobility, but key differences exist in predictors of exit to brick and mortar versus cyber charter schools. While zoned school characteristics appear to be more important predictors of exit to brick and mortar charter schools, individual characteristics appear to be more predictive of exit to cyber charter schools. Finally, we find that students who attend brick and mortar charter elementary or middle schools are less likely to make non-structural school moves, but students enrolled in most other forms of choice are more likely to make such moves. Importantly, attending a cyber charter school in any grade is associated with a substantially higher probability of making a non-structural move, which may indicate that students are more dissatisfied with these schools and therefore more likely to leave, or that cyber schools appeal to a more transient population of students. This suggests both that the benefits of allowing students and families to choose their schools should be carefully weighed against the potential costs of increased mobility and that more work is needed to understand higher mobility rates among cyber charter school students.



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Julie Patton | SLDS Grant Manager | PDE Project Manager
Phone: 717.346.1085 | jupatton@pa.gov

Candy M. Miller | Research and Evaluation Manager
Phone: 717.705.6499 | c-candmill@pa.gov

Pennsylvania Department of Education | Office of Administration
333 Market Street | Harrisburg, PA 17126-0333
Phone: 717.705.6499 | Fax: 717.787.3148

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Executive Summary

Despite the growth of public-school choice programs nationally and in Pennsylvania, little is known about the characteristics of students who participate in various choice options, what factors prompt students to exit their zoned schools for choice schools, and whether students who attend choice schools are more likely to make non-structural school moves. The purpose of this report is to fill this gap in the literature by addressing the following questions that directly build on and expand the Pennsylvania Department of Education's (PDE) research agenda:

- 1. Do students who participate in different education choice options (e.g. charter, intra- and inter-district) differ from those who do not?*
- 2. What factors increase the likelihood of a student exiting their zoned school for a charter or other school choice option?*
- 3. How is attending a choice school related to student mobility? Do relationships vary by the form of choice (i.e. district versus charter)?*

To address these questions, we draw on administrative data from four different sources: longitudinal student-level administrative records from PDE, publicly available school-level data from PDE, the Education Names and Addresses database (EdNA) maintained by PDE, and the Common Core of Data (CCD). Student-level data contain information on demographics, program information (e.g. including English Learner (EL) designation), residence zip code, and student outcomes including standardized test scores. Importantly, for our analysis, these data also include information on zoned school and school attended. We supplement this with data from our other sources to construct various measures of school quality, type, and location. We then construct indicators for five types of school choice participation: brick and mortar charter, cyber charter, selective magnet schools with academic requirements (only present in Philadelphia), intra-district choice (including non-selective magnet schools), and inter-district choice.

We examine two different samples: an elementary/middle school sample and a high school sample. We limit our analysis to students in grade 4 and above because we use prior performance as one of our predictors of choice participation and students are only tested in grades 3-8. We omit students in full time special education, students enrolled in nontraditional education settings, and regional vocational schools from our analysis because the choice process for these students is likely to be different than their peers.

To examine differences between choice participants and students who attend their zoned school, we use a combination of descriptive statistics and multiple regression, both comparing the mean characteristics of these groups, as well as estimating a series of regression models where the outcome is a student characteristic such as race/ethnicity or EL status, and our independent variables are set of indicators capturing choice type. We estimate these models with both residence district fixed effects (comparing students who live in the same school district) and zoned school fixed effects (comparing students who live in the same catchment area).

To explore the factors are related to student exit from their zoned school, we estimate a series of regressions where our outcome is an indicator equal to one if a student exits their zoned school to attend a choice school in the following year and our independent variables include both individual and zoned school factors that might predict exit such as race/ethnicity, student performance, economic disadvantage, school quality, etc. As with our models exploring participation, we estimate these models with both district and zoned school fixed effects.

Finally, to explore how choice participation is related to non-structural mobility, we estimate a series of regressions where our outcome is an indicator equal to one if a student makes a non-structural move in the following year and control for a wide range of individual and school characteristics that might be related to both choice type and mobility. Our preferred models include zoned school fixed effects, so that we limit comparisons to students who live in the same catchment area and likely face a similar set of choices about where to enroll.

We find that students who participate in choice are more likely to live in urban districts, qualify for free or reduced-price lunch, or to be chronically absent, are less likely to be White or an English Learner, and tend to have lower test scores. Cyber charter attendees most closely mirror the composition of zoned school attendees and the overall student population in the state in terms of both race/ethnicity and urbanicity. Regression analyses that include district and zoned school fixed effects reveal that many of these differences are driven by geography – that is, when we compare choice participants only to zoned school students who live in the same district or catchment area, many differences are no longer statistically significant or are greatly reduced in magnitude. This suggests that at least within districts there does not appear to be any substantial inequity in access to school choice, with three notable exceptions. First, ELs are significantly less likely to participate in any form of choice, which suggests that there may be barriers to participation in terms of information or application requirements. Second, we find that high school students who attend selective magnet schools are significantly less likely to be Black or Hispanic. Third, we find consistent racial/ethnic differences in cyber charter school participation, with cyber attendees more likely to be White and less likely to be Black, Hispanic, and Asian even when accounting for geography. This suggests that more work is needed to understand drives these disparities in selective magnet and cyber charter school enrollment.

Within districts, there does not appear to be any substantial inequity in access to school choice with three notable exceptions.

When we examine exit to any form of choice, we find that the largest individual-level predictor of exit is residential mobility, with most other individual predictors either statistically insignificant or small in magnitude. However, zoned school characteristics may matter as students are less likely to exit their zoned school if it enrolls greater shares of ELs and are more likely to exit if their zoned school has higher shares of Black or Hispanic students. There is little to no relationship between school characteristics and exit among high schoolers. When we focus on exit to charter schools more specifically, we find that factors predicting exit to brick and mortar charter schools differ notably from factors that predict exit to cyber charter schools. Zoned school characteristics appear to be more important predictors of exit to

brick and mortar charter schools, while individual characteristics appear to be more predictive of exit to cyber charter schools. This could mean that students who exit their zoned school for a brick and mortar charter school are driven to do so more by the physical environment and quality of the school they attend, while students who exit from a zoned school to a cyber charter school are driven more by individual circumstances.

Finally, we find that students who attend brick and mortar charter elementary or middle schools are less likely to make non-structural school moves, but students enrolled in most other forms of choice are more likely to make such moves. This suggests that the benefits of allowing students and families to choose their schools should be carefully weighed against the potential costs of increased mobility. Importantly, attending a cyber charter school in any grade is associated with a substantially higher probability of making a non-structural move, which may indicate that students are more dissatisfied with these schools and therefore more likely to leave, or that cyber schools appeal to a more transient population of students. This highlights importance of understanding the factors that lead to higher mobility among cyber charter students in order to identify necessary changes in cyber charter school practices or target additional supports to cyber charter school students.

Students who attend brick and mortar charter elementary or middle schools are less likely to make non-structural moves, but students enrolled in most other forms of choice are more likely to make such moves.

Section 1. Introduction and RQ

Choice is an important and growing piece of Pennsylvania’s education landscape, with approximately 10 percent of K-12 students participating in some form of choice in 2017. Understanding the characteristics of students who participate in choice, what factors prompt students to exit their zoned schools for choice schools, and whether students who attend choice schools are more likely to make school moves are all important for adopting policies to promote equity and student success. If, for example, disadvantaged or historically underserved populations are disproportionately less likely to participate in choice or to exit their zoned school, this has equity implications that could be addressed through policies that facilitate better information about choice options or better access through mechanisms such as transportation. Furthermore, given that school choice may lower the costs of moving schools and the long literature documenting the negative consequences of school mobility (see for example, Schwartz, Stiefel, and Cordes, 2017; Whitesell, Stiefel, and Schwartz, 2016) it is also important to understand the overall impacts of choice on student mobility. Therefore, this study seeks to answer the following questions, which draw from and expand upon the Pennsylvania Department of Education’s (PDE) research agenda:

- 1. Do students who participate in different education choice options (e.g. charter, intra- and inter-district) differ from those who do not?*
- 2. What factors increase the likelihood of a student exiting their zoned school for a charter or other school choice option?*
- 3. How is attending a choice school related to student mobility? Do relationships vary by the form of choice (i.e. district versus charter)?*

Despite the importance of these questions, there is a relative dearth of research in these areas and none that focuses on Pennsylvania. Prior research examining school choice participants tends to focus on a single form of choice, such as charter schools, and often examines the characteristics of choice participants as part of a larger analysis exploring other issues such as cream skimming (for example, Zimmer, Gill, Booker, Lavertu, & Witte, 2009; Hoxby, 2003; Lacireno-Paquet, Holyoke, Moser, and Henig, 2002) or segregation (for example, Kotok, Frankenberg, Schafft, Mann, and Fuller, 2017; Garcia, 2008; Bifulco and Ladd, 2007). In this report, we begin to fill this gap using administrative data on the universe of Pennsylvania public school students from 2011-2017 to study characteristics of school choice participants across the state.

Section 2. Prior Literature

In recent decades, school choice has become a characteristic feature of the American public school system, with 15.4 percent of students participating in some form of public school choice as of 2016. While charter schools are the most visible form of public school choice, participation in district-run schools of choice, including magnet schools and intra- or inter-district choice, is more than double that of charter schools (Cookson et al., 2018). Despite widespread use and growing popularity of choice schools, many questions remain about which students participate in different public school choice options nationally and in Pennsylvania.

Choice participation and student characteristics

We are aware of only one study to date that examines statewide participation across all forms of public school choice, which focuses on Michigan (Edwards & Cowen, 2019). The authors found that charter school students are disproportionately Black and economically disadvantaged, while students who participate in other forms of choice are demographically similar to students from their district of residence. While informative, findings may not necessarily translate due to differences in local and policy context.

In a study of intra-district, magnet schools, and charter schools in Durham, North Carolina, Bifulco and colleagues (2009) found that choosing families did not differ from those who attended their zoned schools on most characteristics (including race/ethnicity), except for parental education, academic achievement, and distance to their zoned school. For most subgroups, students with college educated parents were more likely to transfer from their zoned schools and, in higher grades, higher achieving students were more likely to opt out. They also found that for students at all grade levels, living further from their zoned school increased the likelihood of enrolling in a choice option. However, this study is over a decade old, only considers a single urban community, and groups all forms of choice together. Our study will disaggregate exit decisions by choice type and consider communities across a state.

Other research focused primarily on brick and mortar charter schools has found that participation does vary by racial group. Nationally and in Pennsylvania, Black and Hispanic students are more likely to enroll in brick and mortar charter schools than any other groups (Frankenberg et al., 2017; Kotok et al., 2017; Monarrez et al., 2020). A study of charter transfers in Pennsylvania between 2011 and 2012 found that statewide, nearly two-thirds of students who transfer from a traditional public school to a charter school were Black (Frankenberg et al., 2017). Further, using data from 2008-2012, Kotok and colleagues (2017) found increasing mobility between traditional public schools, brick and mortar charter schools, and cyber charter schools, and that students of color were more likely to transfer to a charter from a traditional public school, compared to White students. However, students transferring to cyber charters were more likely to be White or live in rural communities (Kotok et al., 2017). These results parallel others finding that cyber charter schools in Pennsylvania are disproportionately used by White families (Mann, Kotok, Frankenberg, Fuller, & Schafft, 2016). In a study of intra-district choice in a large urban district, Phillips et al. (2015) found that students who qualify for free or reduced-price lunch or ELL services were less likely to participate.

Building on findings about Pennsylvania charter schools and other forms of choice in different states, we use more recent data to explore whether students who participate in choice differ on a variety of characteristics—including but not limited to race/ethnicity—and how these patterns differ across choice types.

Choice participation and school characteristics

Prior research has also identified a number of school characteristics that may be related to choice participation. Though studies of inter-district choice are few, evidence from multiple states suggest that students whose zoned schools are more socioeconomically or racially diverse tend to use inter-district enrollment policies to make transfers to more homogeneous schools or districts (Edwards & Cowen, 2019; Holme & Richards, 2009; Institute on Metropolitan Opportunity, 2013). Similarly, Phillips et al. (2015) found that students in a large urban district were more likely to participate in intra-district choice when they were zoned to a diverse school. However, none of these studies examine the relationship between school characteristics and choice participation in Pennsylvania, and most focus on a single urban region or metro area rather than exploring statewide enrollment patterns.

One study does examine parental perceptions of school characteristics in Pennsylvania. Goyette, Farrie, and Freely (2012) surveyed families in the Philadelphia metropolitan area and found that as more Black students enrolled in predominantly White schools, White residents' perceptions of school quality declined, even if other indicators of school quality did not change. The authors conclude that these perceptions of school quality may drive White families to make racially-motivated school enrollment choices. In order to explore whether these perceptions align with actual enrollment decisions, we consider how zoned school characteristics relate to Pennsylvania families' decisions to transfer out of their zoned school.

Finally, it is worth highlighting that this report also explores enrollment in magnet schools. Much of the magnet school literature focuses on school segregation, due to the history of using magnet schools as a part of post-*Brown* desegregation plans. Such studies tend to find that magnet schools are more integrated than traditional public schools, but this integration may come at the cost of increased segregation among other schools (Harris, 2018; Rossell, 2017). However, one study of segregation and magnet schools also explored participation. Using magnet school application data from Philadelphia for the 1991 and 1992 school years, Saporito (2003) found that White students were more likely to apply to a magnet school if their zoned school enrolled high shares of students of color but that application decisions among students of color did not vary by the racial composition of their neighborhood school. The study also found that all students were more likely to apply to magnet schools if their zoned school served higher shares of economically disadvantaged students, but this pattern was stronger among economically advantaged students. Though relying on data that is now thirty years old, these findings suggest that magnet school participation in Philadelphia—and other Pennsylvania communities—may have important equity implications. As such, our study will explore whether Pennsylvania students who attend magnet schools are different from those who do not. As part of this analysis, we will examine Philadelphia's system of selective magnet schools separately from non-selective magnet schools.

Choice participation and mobility

Existing evidence on school choice and mobility is limited to charter schools in urban districts and focuses on the question of whether charter schools are more likely to “push-out” low performing students rather than mobility *per se* (Winters, Clayton, & Carpenter, 2017; Zimmer & Guarino, 2013). Both of these studies find that low-performing students are equally likely to exit charter and traditional public schools. However, these studies do not provide insight into the effects of school choice on student mobility more broadly or to suburban and rural districts, where there may be fewer school choice options and transportation may prove more of an obstacle to mobility.

Section 3. Data, sample, measures

Data

Data for this report come from four different sources: administrative records from the PDE, publicly available school-level data from PDE, the Education Names and Addresses database (EdNA) maintained by PDE, and the Common Core of Data (CCD). Administrative records from the PDE include unique student identifiers, demographic and program information including English Learner (EL) designation and eligibility for special education services, student outcomes including standardized test scores, and residential zip codes. Importantly for our analyses, these data also include information on both students' zoned schools and the school in which they actually enroll, which we used to construct measures of choice participation.

There is some degree of error in the zoned school data, however. For example, students who attend magnet schools have that magnet school recorded as their zoned school and there are other students assigned to zoned schools that do not serve their grade. In these cases, we assigned students what we believe is most likely to be their zoned school based on their prior zoned school and residence zip code. A detailed discussion of this process is included in Appendix B. While this does introduce some measurement error, we did not detect any systematic differences among those with incorrect zone information, except that they were slightly more likely to live in urban districts and qualify for free or reduced-price lunch, which likely reflects that magnet schools are overwhelmingly located in urban districts.

Publicly available data from PDE were used to construct school quality variables, including high school graduation rates, average teachers' years of experience, and share of teachers in a school with a graduate degree. EdNA data were used to identify charter schools and define cyber charter schools. Finally, data from the CCD were used to identify school locale (urban, suburban, and rural), magnet schools, school grade levels, and school location (latitude and longitude), which were used to calculate distance between students' residence zip code and both their zoned school and school attended.

Sample

We examine two different samples: an elementary/middle school sample and a high school sample. We separate high school from elementary and middle school because students and families may make decisions about high school differently. For example, they may be willing to travel further to attend a high quality high school than to attend a high quality elementary or middle school. Further, there tend to be more choice options available at the high school level. Our high school sample includes all students attending schools identified by the CCD as a high school. Our elementary/middle sample includes students in grades 4 and above who attend an elementary or middle school, also as identified by the CCD. We exclude students in grades K-3 because we use prior performance as one of our predictors of choice participation and students are only tested in grades 3-8. We use data from 2011 to construct lagged student characteristics for some of our models but exclude 2011 from most of our analyses because of a high rate of missing or incorrect information about zoned schools in this year.¹

We omit students in full time special education because the choice process for these students is likely to be fundamentally different than for their peers in general or part-time special education. We also exclude students enrolled in nontraditional education settings for similar reasons. Finally, while a non-trivial number of students are enrolled in vocational schools, we also omit these students from our analysis because many of these are regional and the choice process for these students is also likely to differ from students who choose to enroll in more traditional college preparatory high schools.

Measures

CHOICE PARTICIPATION

Key to our analysis was identifying students who participate in school choice. To do so, we compared a student's zoned school to the first school where they enroll in the fall. A student was defined as

¹ More specifically, there are over 3,000 students in 2011 for whom we identified issues with their zoned school but were unable to identify their most likely zoned school, compared to 500-600 students in other years.

participating in any form of school choice if they enrolled in a school other than their zoned school. We then further divide choice participation into the following categories:

- **Brick and mortar charter:** student is enrolled in a brick and mortar charter school as designated by the EdNA database
- **Cyber charter school:** student is enrolled in a cyber charter school as defined by the EdNA database.
- **Magnet school:** student is enrolled in an opt-in specialty or magnet school as defined by CCD or school districts (see Appendix C for full list)
- **Selective Magnet:** student is enrolled in a magnet school with academic requirements. These schools are only present in the School District of Philadelphia.
- **Intra-district choice:** student is enrolled in a traditional public school in their residence district other than their zoned school.
- **Inter-district choice:** student is enrolled in a traditional public school outside of their residence district.

While we created separate measures for non-selective magnet and intra-district choice schools, we combined these measures in most of our analyses because patterns in the two groups were largely similar.

EXIT

To explore our second research question, we constructed several measures to capture exit from zoned school to attend a choice school. The most inclusive, EXITANY, is equal to one for students enrolled in their zoned school in the current year (t) and any choice school in the following year ($t+1$). We then disaggregate this measure into EXITBRICK, which is equal to one for students enrolled in their zoned school in t and a brick and mortar charter school in $t+1$, and EXITCYBER, which is equal to one for student enrolled in their zoned school in t and a cyber charter school in $t+1$.

NON-STRUCTURAL MOBILITY

To explore our third research question, we focus on non-structural moves, which occur when students move to a different school at a time that is not dictated by the grade-span of their current school. Specifically, we construct a measure of non-structural mobility that is equal to one if a student attends a different school in $t+1$ and was not enrolled in the terminal (highest) grade of their school in year t . Since current mobility is related to prior mobility, we also construct an indicator of prior non-structural (structural) mobility, which takes a value of 1 if a student has made a non-structural (structural) move in a previous year.

Section 4. Methods

Differences in school choice participation

To examine whether and how school choice participants differ from non-participants, we begin with a basic set of descriptive statistics comparing the average characteristics of students who attend their

zoned school to the characteristics of students who attend any choice school and perform a series of t-tests to determine whether these differences are statistically significant. We then further decompose choice schools into five subcategories: brick and mortar charter schools, cyber charter schools, intra-district choice (including non-selective magnets), selective schools, and inter-district choice. We explore a variety of student and geographic characteristics including student race/ethnicity, gender, economic disadvantage, EL status, SPED status, prior performance, prior chronic absenteeism, and residence district urbanicity.

Next, we examine regression adjusted differences in student characteristics by choice type using the following model:

$$\text{CHAR}_{idt-1} = \beta \text{CHOICE}_{it} + \delta_d + \theta_g + \eta_t + \varepsilon_{idt} \quad (1)$$

Where CHAR is a characteristic (i.e. race/ethnicity, prior test score, distance to zoned school, etc.) of student i , in residence district d , in the prior year ($t-1$), CHOICE is an indicator equal to one if the student attends any choice school in the current year, δ are residence district effects, θ are grade effects, and η are year effects. Student program characteristics and test scores are measured in the prior year because these measures could be affected by enrolling in a choice school. Residence district fixed effects limit comparisons to students who live in the same school district and can help account for non-random location of choice options throughout the state, different demand for choice by district, and different district policies surrounding choice enrollment. In these models, the coefficient of interest is β , which captures the difference in characteristics between students who attend choice schools and their peers in the same residence school district that attend their zoned school. For example, in models where the outcome is student race/ethnicity, β indicates whether students who attend choice schools are more or less likely to be of a particular race or ethnicity than zoned school students who live in the same school district.

We then re-estimate equation (1) replacing residence district fixed effects with zoned school fixed effects, which limits comparisons to students who live in the same catchment area. This will help shed light on the extent to which differences between participants and non-participants are driven by differences in their zoned schools or neighborhoods. For example, this can help us to understand whether differences in choice participation may be explained by zoned school quality. We then re-estimate these models replacing the single indicator CHOICE, with a series of indicators capturing the type of choice (brick and mortar charter, cyber charter, intra-district choice, selective magnet, and inter-district choice).

Predictors of student exit from zoned school

Next, we focus on students enrolled in their zoned school and explore what factors predict exit to attend a choice school in the following year using the following.

$$\text{EXITANY}_{it+1} = \beta \text{STUDCHAR}_{it} + \gamma \text{SCHOOLCHAR}_{zt} + \delta_d + \theta_g + \eta_t + \varepsilon_{izdgt} \quad (2)$$

Where EXITANY is equal to 1 if student i exits their zoned school z for any choice school in year $t+1$, **STUDCHAR** is a vector of student characteristics in year t that might predict exit such as: race/

ethnicity, eligibility for special education, ELL classification, economic disadvantage, test scores, chronic absenteeism and whether the student made a residential move between t and $t+1$, **SCHOOLCHAR** is a vector of time-varying zoned school characteristics that might influence exit including racial composition, percent economically disadvantaged, proficiency rates, distance from home zip code to school, etc., δ are residence district fixed effects, θ are grade effects, and η are year effects. Grade effects account for factors that are common to a particular grade and are related to exit, such as reaching the terminal grade of a school, and year effects account for any macro changes that might affect exit for all students across the state, such as changes in state policy. As before, district fixed effects limit comparisons to students who live in the same school district and help account for non-random location of choice schools and differences in district policies. We estimate equation (2) first with only student characteristics and district fixed effects, then add zoned school characteristics, and finally replace zoned school characteristics with zoned school fixed effects. This allows us to both explore what specific zoned school characteristics may “push” students out to attend a choice school and also the extent to which exit is predicted by unobserved characteristics of a student’s zoned school. For these models, we limit our sample to only those students who either remain in their zoned school in $t+1$ or move from their zoned school to any choice school in $t+1$.

In these models, the coefficients of interest are captured in β and γ . The coefficients in β indicate the extent to which students with a particular individual characteristic are more or less likely to exit to a choice school, while the coefficients in γ indicate the extent to which students attending a school with particular characteristics are more or less likely to exit. For example, a positive coefficient on share of poor students would indicate that students who currently attend a zoned school with higher shares of poor students are more likely to exit to a choice school in the following year.

We then re-estimate this model replacing EXIT with EXITBRICK, which is equal to 1 if a student exits to attend a brick and mortar charter school in year $t+1$. In these models, we limit our sample to students who either remain in their zoned schools or exit to a brick and mortar charter school and exclude students who exit to attend other choice schools. This allows us to interpret coefficients as the change in the probability that a student exits to attend a brick and mortar charter rather than remaining in their zoned school. We perform a similar analysis using EXITCYBER as our outcome.²

Choice school enrollment and student mobility

Finally, we explore how attending a choice school influences student mobility. The primary challenge to identifying the impact of attending a choice school is that students who exercise school choice are different from those who do not and these differences might also be related to school mobility. For example, students who exercise school choice might be more motivated and therefore more likely to switch schools in order to obtain a better educational fit. Alternatively, students who participate in choice may come from better resourced and more stable households and would therefore be less likely to switch schools. As a consequence, a simple comparison of mobility rates between students who attend a choice school and those who attend their zoned school is likely to yield biased estimates. We attempt to overcome this challenge by including a rich set of student and school controls, as well as residence district and zoned school fixed effects. Specifically, we estimate the following:

² Although the outcome is binary, all models are estimated using standard OLS rather than logit or probit models. This is because linear probability models provide consistent estimates in large samples and are easier to interpret than logit or probit estimates. A similar approach is used by Winters et al. (2017) and Zimmer & Guarino (2013) to examine differential exit from charter and traditional public schools in NYC, Denver, and a Midwest school district.

$$\text{NONSTRUCT}_{it+1} = \beta \text{CHOICETYPE}_{it} + \gamma \text{STUDCHAR}_{it} + \alpha \text{SCHOOLCHAR}_{st} + \delta_d + \theta_g + \eta_t + \varepsilon_{isdgt} \quad (3)$$

Where NONSTRUCT is an indicator equal to one if a student makes a non-structural school move between years t and $t+1$, **CHOICETYPE** is a vector of choice types (brick and mortar charter, cyber charter, etc.), **STUDCHAR** is a vector of student characteristics in year t including race/ethnicity, economic disadvantage, EL designation, eligibility for special education, and chronic absenteeism. Importantly, we include controls for prior non-structural and structural mobility, as current school moves are likely related to prior school moves (Schwartz et al., 2017) and student performance, which accounts for unobserved characteristics, such as motivation, that could bias estimates. **SCHOOLCHAR** is a vector of *current school* characteristics including proficiency, share EL, share economically disadvantaged, etc. As before, δ are residence district fixed effects, θ are grade effects, and η are year effects. We omit 8th graders from our elementary/middle school analysis because most students make a structural move at this time.

While district fixed effects help control for features of districts that might make students more or less likely to switch schools (such as ease of transfer process) and our model includes a rich set of student- and school-level controls, there may still be concerns that estimates from (3) are biased. We therefore re-estimate this model using zoned school fixed effects to further limit comparisons to students who are likely to face the same set of choices when making enrollment and mobility decisions. In these models, the primary coefficient of interest is β , which can be interpreted as causal if, controlling for student characteristics and zoned school, the type of school in which students choose to enroll plausibly random. This is a strong assumption, as there are likely factors unaccounted for in our model that explain the type of school in which students choose to enroll. Therefore, we do not try to make any causal claims about these estimates but believe that by comparing observationally similar students, our results provide more insight into the role of school choice in student mobility than could be achieved with simple comparisons.

Section 5. Results

How do school choice participants differ from students who attend their zoned schools?

TRENDS IN PARTICIPATION

As shown by Figure 1, school choice participation has changed over time. In 2012, about eight percent of Pennsylvania public school students participated in some form of public school choice, but by 2017, the share rose to more than 10 percent. This was driven, in large part, by growth in brick and mortar charter enrollment, which more than doubled over this time period. Focusing on grades six and nine, when school choice transfers are most common, suggests that these patterns differ at the middle and high school level (see Figure 2, Panels A and B). For example, in 2017, among sixth graders, brick and mortar charter schools enrolled more than twice as many students as district-managed choice schools (intra-district, magnets, inter-district) (7,723 vs. 3,489) and more than three times as many as cyber charters (2,128). However, among ninth graders, more students enrolled in district-managed choice schools (7,596) than brick and mortar charter schools (6,769) or cyber charters (4,697). This suggests that although brick and mortar charter schools are the prevalent choice option in the state, many types of public school choice are popular among Pennsylvania families, particularly at the high school level.

CHARACTERISTICS OF CHOICE PARTICIPANTS

Students who participate in choice differ from those who attend their zoned schools on a number of dimensions, but these differences are relatively stable over the course of the study (see Table 1 and Appendix Tables A1-A2). One of the most notable differences in choice participation is urbanicity of the school district (See Figure 2). While urban students are over-represented in brick and mortar schools, intra-district choice, and selective magnet schools (which are only present in Philadelphia), urban students are under-represented in inter-district choice. Of all the choice types, cyber charter schools most closely mirror the state, with suburban students slightly underrepresented at both the high school and elementary/middle school levels.

In line with prior literature, we find noteworthy variation in school choice participation by race/ethnicity (see Figure 4). Black students are overrepresented in most forms of school choice, making up more than half of brick and mortar charter school and selective magnet attendees at both the high school and elementary/middle school level and more than half of high school intra-district participants. Hispanic students are overrepresented among brick and mortar charter schools of all levels and also in elementary/middle school selective magnets. Asian students are overrepresented among selective magnet high schools and underrepresented among brick and mortar charter high schools, while White students are underrepresented in all forms of choice except inter-district enrollment, where they are overrepresented. Cyber charters attendees most closely mirror the racial/ethnic composition of zoned school attendees and the overall student population in the state.

Although brick and mortar charter schools are the prevalent choice option in the state, many types of public school choice are popular among Pennsylvania families, particularly at the high school level.

There are a number of other characteristics that differ between students who participate in choice and those who attend their zoned schools (see Table 1). Students who qualify for free or reduced-price Lunch (FRL) tend to be overrepresented among choice schools, except for cyber charters where they are slightly underrepresented. Students who are English Learners are underrepresented in cyber charters, selective magnets, and inter-district choice. However, they are overrepresented in intra-district choice and brick and mortar charter high schools. Although this may appear to be inconsistent with previous research, it likely reflects the tendency of charter schools to locate in urban districts.

Perhaps contrary to popular conception, we find that choice participants generally have lower standardized test scores than students who attend their zoned schools, which could indicate that students who participate in choice are those who did not thrive in their zoned school, that choice schools are more likely to locate near lower-quality schools, or that choice schools are themselves lower quality. We do, however, find that students who attend selective magnet schools or use inter-district choice tend to have higher than average test scores, which is perhaps unsurprising as these forms of choice may have strict admission requirements. Finally, chronically absent students are overrepresented among those who attend brick and mortar charter schools, cyber charter schools, or use intra-district choice.

REGRESSION ADJUSTED ANALYSIS

While raw differences are illustrative to paint a portrait of school choice in Pennsylvania, they may do little to shed light on individual predictors surrounding choice participation. Indeed, regression adjusted analyses suggest that many of the raw differences in school choice participation are explained by

geography – that is, when we compare choice participants to zoned school students who live in the same district or catchment area, many differences are no longer statistically significant or are greatly reduced in magnitude.

Brick and mortar charter schools

In models that do not account for location, we find that brick and mortar charter high school students are 38.9 percentage points more likely to be Black (Table 2, Panel A, Column 1). However, once we limit comparisons to students who live in the same school district, this disparity shrinks to 3.7 percentage points (Table 2, Panel B, Column 1), and when we compare students who live in the same catchment area, we find that brick and mortar charter school students are no more or less likely to be Black than zoned school students (Table 2, Panel C, Column 1). Similar patterns exist for most other racial/ethnic groups and choice types at the high school level: once we limit comparisons to zoned school students who live in the same catchment area, race/ethnicity is no longer associated with participation in brick and mortar charter schools, intra-district choice, or inter-district choice.³ We observe largely similar patterns at the elementary/middle school level (see Appendix A, Table A3), with a few small differences (e.g. brick and mortar charter school students are one percentage point less likely to be Hispanic and 1.8 percentage points more likely to be Black).

Many of the raw differences in school choice participation are explained by geography – that is, when we compare choice participants to zoned school students who live in the same district or catchment area, many differences are no longer statistically significant.

The density of school choice options available in urban communities combined with regional demographic differences may explain why racial/ethnic disparities in brick and mortar charter and intra-district choice participation largely disappear once geography is considered. The raw differences in participation—for example that Black students make up more than half of brick and mortar charter attendees statewide—are likely driven by the fact that students of color are more likely to live in cities and cities have higher concentrations of brick and mortar charter schools and intra-district choice options. White students, on the other hand, are more likely to live in communities with fewer choice options. Raw disparities may also capture differences in zoned school quality if, for example, White students are more likely to be zoned to a high quality school and students with high quality zoned schools are less likely to participate in choice. Thus, our findings suggest that brick and mortar charter schools, intra-district choice, and, to a lesser degree, inter-district choice, may not be used differently by different racial/ethnic groups when these groups have access to similar sets of choices and are zoned to schools of similar quality.

In terms of performance, we find that when we do not account for location, brick and mortar charter high school students are significantly lower performing (0.605 sds lower scores in 8th grade reading) and more likely to be chronically absent (12.5 percentage points). These differences largely disappear when comparing students who live in the same district, and reverse sign when we limit comparisons to students in the same catchment area, such that brick and mortar charter high school students have higher 8th grade reading scores (0.107 sds) and are 10.1 percentage points less likely to be chronically absent in the prior year compared to zoned school students. We note largely similar patterns among

³ The two exceptions are that brick and mortar charter school students are two percentage points less likely to be Asian and intradistrict choice students are two percentage points less likely to be Hispanic.

elementary/middle schoolers – in models that do not account for location, students who attend brick and mortar charter schools are lower performing and more likely to be chronically absent, but once we limit comparisons to students in the same district or catchment area, these patterns are reversed.

Finally, we find that across all models, students who attend brick and mortar charter elementary schools tend to live further from their zoned school, but these differences disappear once we account for residence district and zoned school. This could suggest either that students are more willing to travel to attend a charter school if they already live further from their zoned school or that they are selecting to attend a charter school that is closer to home.

Cyber charter schools

Unlike brick and mortar charter schools, the association between race/ethnicity and cyber charter school enrollment remains stable and significant across all models at grade levels. Even compared to students who live in the same district or catchment area, cyber charter high school students are six percentage points more likely to be White and less likely to be Black, Hispanic, or Asian (Table 2 and Appendix Table A3). This finding parallels other studies indicating that cyber charter enrollment in Pennsylvania follows racialized patterns and, as such, warrants further research (see Kotok et al., 2017). Cyber charter attendees also have lower academic achievement and higher rates of chronic absenteeism compared to zoned school attendees, even when compared to other students who live in the same district or catchment area. This may be because cyber charters appeal to students who have struggled in traditional school settings. However, it is noteworthy because this is the opposite of the patterns we observe in the other forms of choice, where participants tend to have higher test scores and lower rates of chronic absenteeism than zoned school attendees. Perhaps not surprisingly, we also find that cyber charter high school students live over a mile further away from their zoned school, and cyber charter elementary/middle school students live almost two miles further from their zoned school than students in the same residence district or catchment area who attend their zoned school. This could indicate that students elect to attend cyber charter schools to avoid longer commutes or issues with transportation.

When we limit comparisons to students in the same catchment area, brick and mortar charter high school students have higher 8th grade reading scores (0.107 sds) and are 10.7 percentage points less likely to be chronically absent in the prior year compared to zoned school students.

Selective magnet schools

Given that admission to selective magnets is contingent on academic achievement and attendance, it is not surprising that selective magnet attendees have higher test scores and lower rates of chronic absenteeism than zoned school attendees across all models. We also find consistent evidence that students who attend selective magnets are less likely to be ELs or students with disabilities compared to students who attend their zoned school, which could indicate that these groups are less likely to meet admissions requirements due to language or other barriers. Similar to our findings about cyber charter schools, we also find that many associations between student race/ethnicity and selective magnet attendance remained significant even after controlling for district or zoned school fixed effects. For example, compared to students who live in the same catchment area and attend their zoned school, students who attend selective magnet schools are 11.5 and 7.7 percentage points less

likely to be Black and Hispanic (respectively), while they are eight percentage points more likely to be White and Asian (Table 1). At the elementary/middle school level, the picture looks quite different: compared to other students in their zoned school catchment, selective magnet attendees are 6.4 percentage points more likely to be Black, three percentage points less likely to be White students, and similarly likely to be Asian and Hispanic (Appendix Table A3). Because selective magnet schools are only available in Philadelphia and managed by the local school district, these divergent patterns may be due to unique local context. Furthermore, since there are only 3 selective magnet schools serving elementary/middle school it is hard to draw broad conclusions based on our sample.

One consistent finding across choice types is that ELs are less likely to participate.

English Learners

One consistent finding across choice types is that ELs are less likely to participate. In models comparing students to peers in the same district or catchment at both grade levels, ELs were less likely to participate in all forms of choice, with the exception of intra-district choice where differences were insignificant. While the differences in participation may appear small, given that ELs only make up roughly 3.2 percent of our sample, the gap is notable. For example, nearly all models indicate that brick and mortar charter school students are around two to four percentage points less likely to be ELs. This lower likelihood of participation among ELs may be due to language-related barriers. Specifically, if information about choice school enrollment processes are not available in multiple languages or if choice school staff only speak English, this may limit ELs access to choice schools. Similarly, applications may not be broadly translated and distributed in other languages.

What predicts student exit from zoned school to a charter or other choice school?

The largest individual-level predictor of student exit from a zoned school to a choice school is residential mobility – elementary/middle schoolers who make a residential move are around 2.7 percentage points more likely to exit their zoned school to attend a choice school (Table 3) and high schoolers are 4.2 percentage points more likely (Table 4). This is perhaps not surprising for two reasons. First, some students may exercise school choice to remain in their current school following a residential move outside of their catchment area. Second, the cost of switching to a choice school may be lower in years where students are making a residential move because they may need to change schools regardless. The only other consistent and moderately sized individual predictor of exit is EL designation, with ELs at both the elementary/middle and high school levels 1.2-1.3 percentage points less likely to exit to attend a choice school than similar students in their same district or zoned school. Similar to our findings about participation, this may reflect additional barriers faced by these students in the application and transfer process. Although several other student characteristics such as poverty and race are statistically significant predictors of exit to a choice school, none of them are large or meaningful. For example, poor students and part-time special education are only 0.4 percentage points more likely to exit to a choice elementary/middle school.

Among elementary and middle schoolers, we also find that several dimensions of zoned school composition predict exit. For each 10 percentage point increase in EL students at their zoned school, students are 1.2 percentage points less likely to exit, which could reflect that EL students are themselves more likely to attend schools with other EL students. Conversely, a 10 percentage point increase in

Black or Hispanic students in their zoned school increases the probability of student exit by 0.92 and 1.33 percentage points, respectively. That is, among elementary and middle schoolers, students are more likely to exit to a choice school if their zoned school has higher shares of Black or Hispanic students. This is somewhat consistent with prior work finding that students in racially diverse schools are more likely to exercise choice, but warrants further exploration. There is little to no relationship between school characteristics and exit among high schoolers.

The largest individual-level predictor of student exit from a zoned school to a choice school is residential mobility.

These results describe factors that predict exit to any form of choice and may mask important differences by type of choice. We therefore examine the factors that predict exit to brick and mortar and cyber charter schools, which are the largest forms of choice across the state.

EXIT TO BRICK AND MORTAR VERSUS CYBER CHARTER SCHOOLS

Overall, zoned school rather than individual characteristics appear to be better predictors of student exit to attend brick and mortar charter schools. Among elementary and middle school students, we find that students whose zoned schools have higher shares of poor, EL, and Asian students as well as schools with higher average levels of teacher experience are less likely to exit, while students whose zoned schools that have higher shares of Black and Hispanic students are more likely to exit (Table 5), with similar patterns among high schoolers. While zoned school quality (as measured by test scores) does not appear to predict exit among elementary/middle schoolers, high schoolers are less likely to exit zoned schools with higher graduation rates (Appendix Table A4).

Few student-level characteristics have a meaningful relationship with the likelihood that a student exits to attend a brick and mortar charter school, with residential mobility serving as the largest predictor. Elementary and middle school students who make residential moves are 1.4-1.6 percentage points more likely to exit to a brick and mortar charter school and high school students are 1.3-1.4 percentage points more likely. This is a much smaller magnitude than is observed in the models predicting exit to any choice, which suggests that many students who exit their zoned school to attend an intra-district or inter-district choice school following a residential move, may be doing so avoid making a school move.

Importantly, we find that while race/ethnicity is a statistically significant predictor of exit, the magnitudes are small. For example, Black students at both grade levels are only 0.4-0.5 percentage points more likely to exit to attend a brick and mortar charter school than similar peers in their residence district or catchment area. While this may initially appear inconsistent with prior work showing racial/ethnic differences in brick and mortar charter participation, that is not necessarily the case. Since our models include district and zoned school fixed effects, we have largely accounted for the tendency of charter schools to open in urban districts and near schools with large populations of students of color. Further, these models examine student exit from zoned schools to brick and mortar charter schools, which does not address whether Black students are more likely to enroll in brick and mortar charter schools initially.

Elementary/middle schoolers who are chronically absent are 1.5-1.6 percentage points more likely to exit to a cyber charter school and high schools are 2.2 percentage points more likely.

There are some notable differences in factors that predict exit to cyber charter schools versus exit to brick and mortar charter

schools (Table 6 and Appendix Table A5). First, while residential moves are also a statistically significant predictor of exit to cyber charter schools, the magnitude is much smaller, with high schoolers who make a residential move only 0.7 percentage points more likely to exit to a cyber school. Interestingly, the pattern for elementary/middle schoolers is reversed, so those who make residential moves are 0.1 percentage points less likely to exit to attend a cyber charter. This is perhaps unsurprising, as students can attend a cyber charter school regardless of location. Second, while chronic absenteeism is associated with a small or no increase in the probability of exit to brick and mortar charter schools, it is positively related to exit to cyber charter schools. Specifically, elementary/middle schoolers who are chronically absent are 1.5-1.6 percentage points and more likely to exit to a cyber charter school and high schoolers are 2.2 percentage points more likely. This may indicate that one reason students seek out cyber charter schools is because they are having difficulty attending school in person for any number of reasons such as poor health or inadequate transportation, and believe that they will be better able to engage virtually. Finally, unlike brick and mortar charter schools, zoned school characteristics are not strong predictors of exit to cyber charter schools, as most are statistically insignificant and/or of very small magnitude. This may suggest that while decisions to exit to attend brick and mortar charter schools have more to do with a student's zoned school, decisions to exit to attend a cyber charter school have more to do with the students themselves.

How is choice school enrollment related to student mobility?

Unlike our findings about choice participation and exit where we find similar patterns across both elementary/middle and high school, the relationship between school choice and non-structural mobility differs by grade level.

ELEMENTARY/MIDDLE SCHOOL

Among those in grades 4-7, students who attend brick and mortar charter schools are significantly less likely to make non-structural moves than students who attend their zoned school or students who attend any other form of choice school (Table 7). Compared to students living in the same residence district, brick and mortar charter school students are 4.2-5.5 percentage points less likely to make a non-structural move than students who attend their zoned school, and compared to students in the same catchment area, are 4.7 percentage points less likely to make a non-structural move. Given that the average non-structural mobility rate among zoned elementary/middle school students is 7.5 percent, this is a 37 percent reduction in non-structural mobility.

Other than students in selective magnet schools, who are no more or less likely to make non-structural moves than zoned school students, students in all other forms of choice (cyber charter, intra-district choice, and inter-district choice) are all more likely to make non-structural moves, with students enrolled in cyber charters the most likely to do so. Specifically, students enrolled in cyber charter schools are 17.4-21.3 percentage points more likely to make a non-structural move compared to similar zoned school students in the same residence district and 16.7 percentage points more likely to make a non-structural move compared to similar zoned school

Students enrolled in cyber charter schools are 17.4-221.3 percentage points more likely to make a non-structural move compared to similar zoned school students in the same residence district and 16.7 percentage points more likely to make a non-structural move compared to similar zoned school students in the same catchment area – a roughly 125 percent increase in non-structural mobility.

students in the same catchment area – a roughly 125 percent increase non-structural mobility. This is a sizable and concerning difference given the well documented negative link between student mobility and outcomes. While students in inter- and intra-district choice schools are also more likely to make non-structural moves than zoned school students, the magnitude of these differences is much smaller, with inter-district choices students 3.6-4.6 percentage points more likely to make a non-structural move and intra-district choice students 2.2-2.7 percentage points more likely. Perhaps it is not surprising that inter-district choice students are somewhat more likely to make a non-structural move than intra-district choice students given that they may be traveling further and face more difficulty getting to school.

In addition to choice type, there are a number of other school characteristics related to non-structural mobility. Students in higher performing schools are less likely to make non-structural moves, while those attending schools with higher shares of Black and special education students are more likely to make non-structural moves in the following year.

■ HIGH SCHOOLERS

Unlike in elementary and middle school, we find that students who attend choice high schools of any type are more likely to make non-structural moves, with the exception of students in selective magnet and intra-district choice schools who are no more or less likely to make such moves (Table 8). Somewhat similar to our findings about elementary/middle school, we find that high schoolers (grades 9-11) enrolled in cyber charter schools and intra-district choice are most likely to make a nonstructural move – 8.4-8.8 percentage points more likely than similar zoned school students who live in the same district or catchment area. This amounts to an approximately 100 percent increase relative to the average non-structural mobility rate of 4.4 percent among zoned high school students. The relative increase in non-structural mobility among high schoolers is slightly smaller than what we find for elementary/middle school students who attend cyber charter schools, which may suggest that older students are more satisfied or better equipped to learn in an online environment, although they may still struggle to do so. Unlike our findings for elementary/middle school, we find that students who attend brick and mortar charter high schools are 2.3 percentage points more likely to make non-structural moves than students in the same catchment area. This may be because there tend to be more choice options at the high school level so students who are dissatisfied at a charter high school have more alternatives.

Unlike our findings for elementary/middle school, we find that students who attend brick and mortar charter high schools are 2.3 percentage points more likely to make non-structural moves than students in the same catchment area.

Similar to our findings about elementary/middle schoolers, we find that school quality is an important predictor of non-structural moves, as students attending schools with higher graduation rates are less likely to make a non-structural move. As in elementary/middle school, we find that students who attend schools with higher shares of Black students are more likely to make a non-structural move.

Section 6. Discussion and Implications

Our results point to three key findings. First, is the importance of geography in choice participation. While basic descriptive statistics show large differences between students who participate in various forms of choice and students who attend their zoned schools, these disparities shrink substantially or even disappear once we limit comparisons to either students who live in the same district or in the same catchment area. This does not mean that the demand for school choice is similar across different groups of students – indeed the fact that choice schools are more likely to operate in urban districts or those with high shares of students of color may indeed suggest that demand is higher in these areas or among these groups. Our findings do suggest, however, that at least within districts there does not appear to be any substantial inequity in access to school choice. There are three notable exceptions, however. First, ELs are significantly less likely to participate in any form of choice, which suggests that there may be barriers to participation in terms of information or application requirements. Second, we note substantial racial/ethnic differences in selective magnet school participation among high schoolers, as students who attend these schools are significantly less likely to be Black or Hispanic even compared to other students in their catchment area. This is notable given current national conversations about underrepresentation of these groups in selective schools and points to the need for further exploration into the cause for these disparities. Third, there are consistent racial/ethnic differences in cyber charter school participation.

Our second key finding is that factors predicting exit to brick and mortar charter schools differ notably from factors that predict exit to cyber charter schools. Zoned school characteristics appear to be more important predictors of exit to brick and mortar charter schools, while individual characteristics appear to be more predictive of exit to cyber charter schools. This could mean that students who exit their zoned school for a brick and mortar charter school are driven to do so more by the physical environment and quality of the school they attend, while students who exit from a zoned school to a cyber charter school are driven more by individual circumstances.

Finally, our findings indicate that the benefits of allowing students and families to choose their schools should be carefully weighed against the potential costs of increased mobility. In particular, while attending a brick and mortar charter elementary or middle school is associated with a lower probability of non-structural school moves, most other forms of choice are associated with a higher probability. Importantly, attending a cyber charter school in any grade is associated with a substantially higher probability of making a non-structural move, which may indicate that students are more dissatisfied with these schools and therefore more likely to leave, or that cyber schools appeal to a more transient population of students. Understanding more about the factors that lead to higher mobility among cyber charter students is an important area for future research as it could point to necessary changes in cyber charter school practices or the need for additional supports for cyber charter school students.

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Tables and Figures

Figures

FIGURE 1. Enrollment in Public Choice Schools by Choice Type, All Grades, 2012–2017

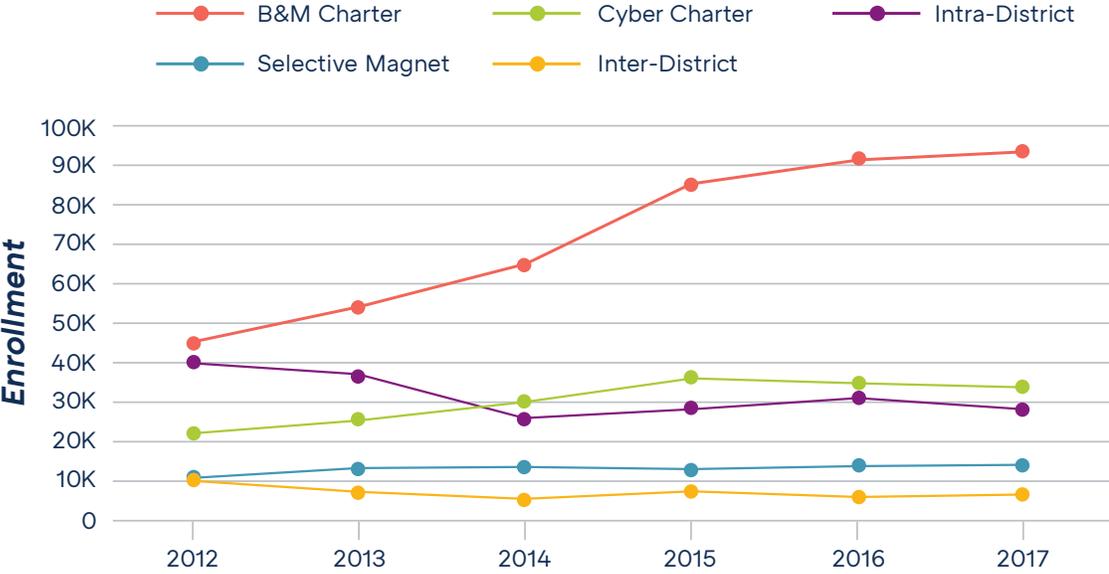
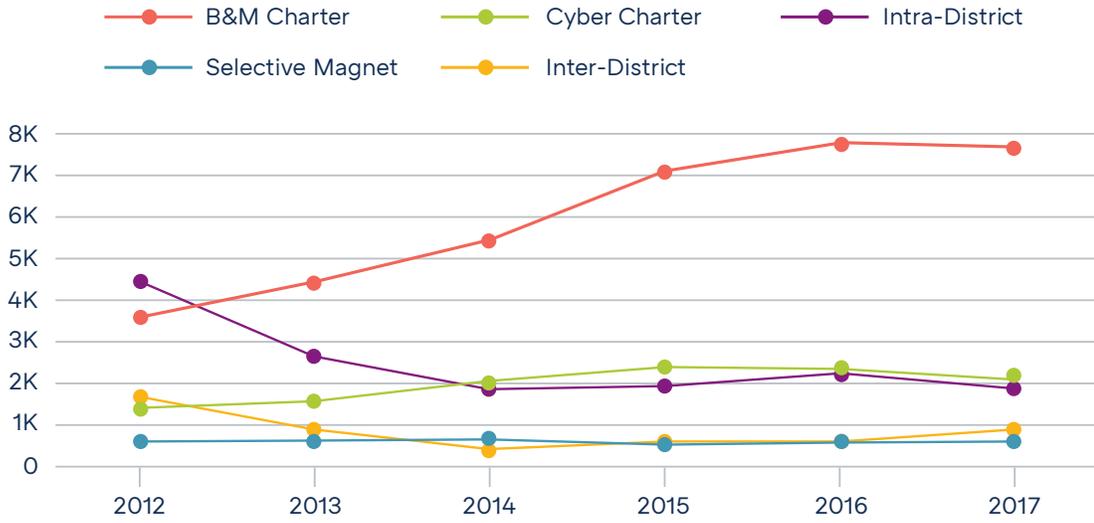


FIGURE 2. Enrollment in Public Choice Schools by Choice Type, Entry Grades, 2012–2017

Panel A: 6th Grade



Panel B: 9th Grade

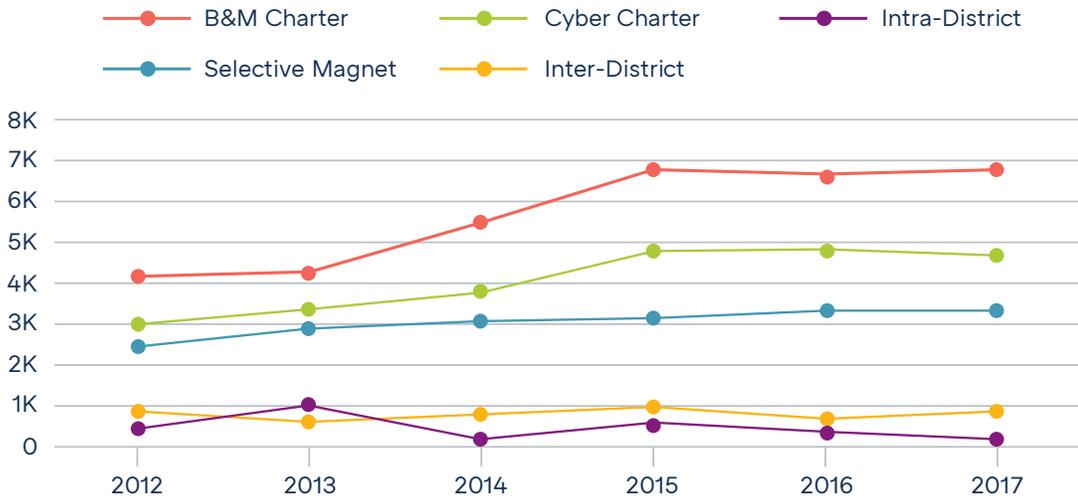
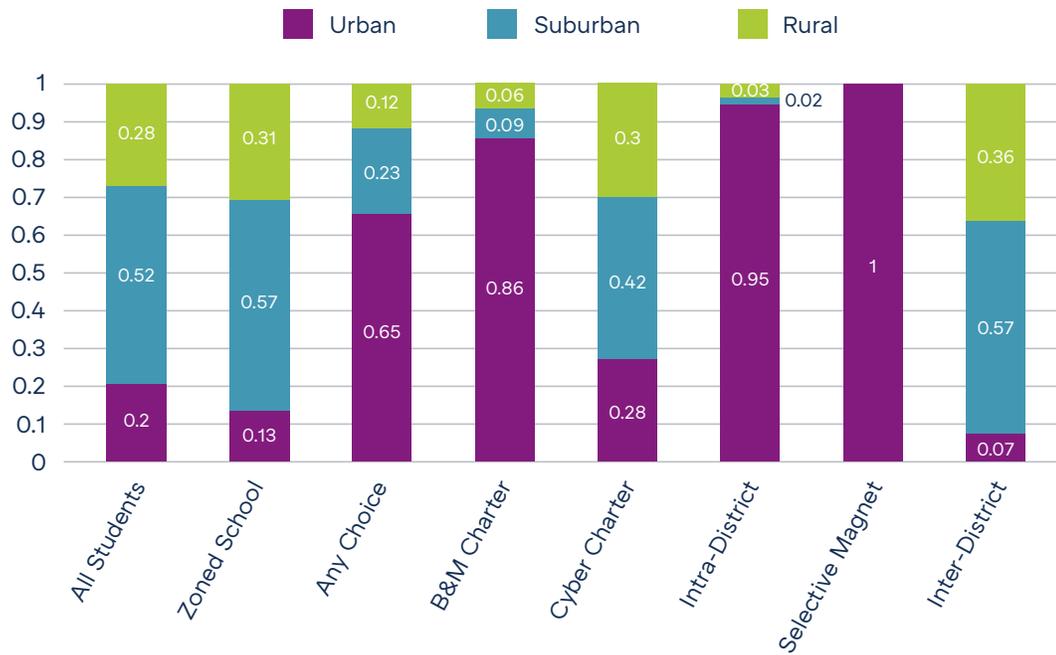


FIGURE 3. School Choice Enrollment by Urbanicity, 2017

Panel A: Elementary/Middle



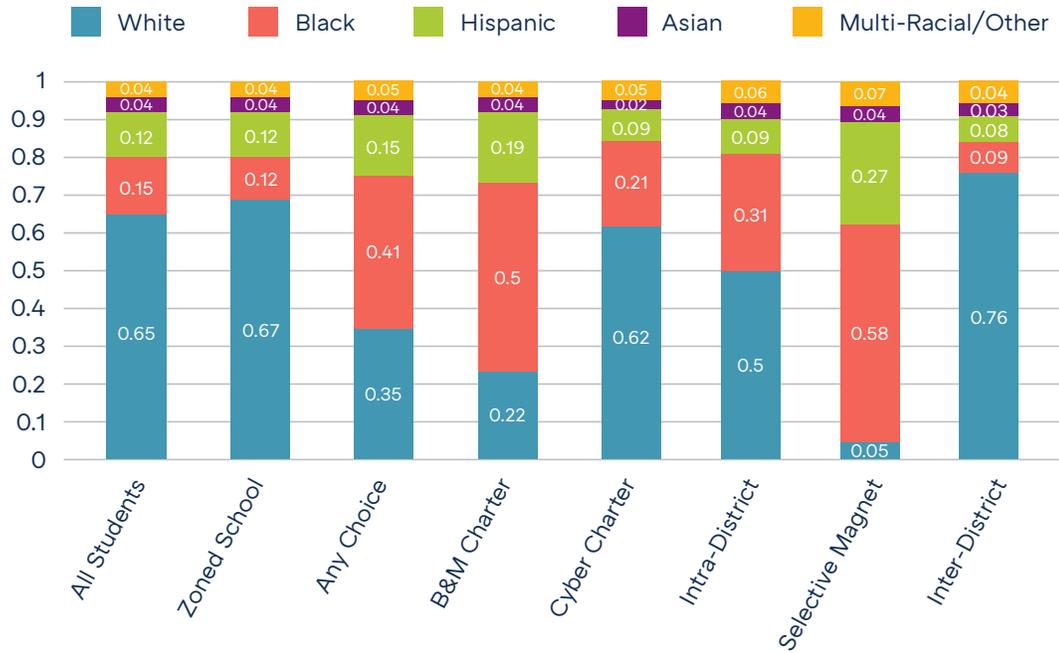
Panel B: High School



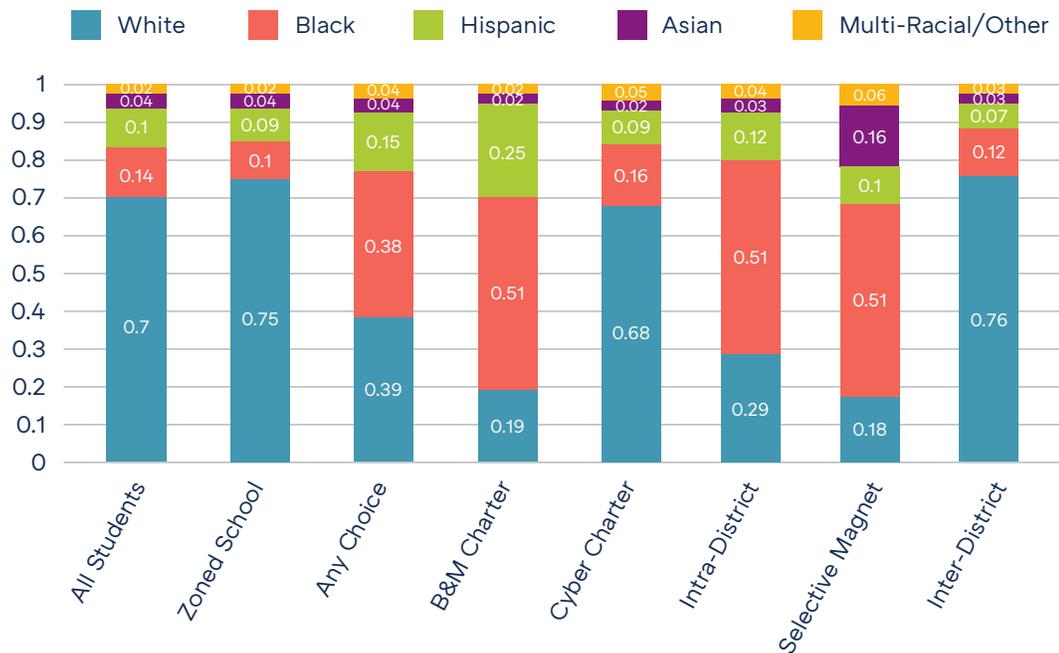
Note: Percentages may not total to 100 due to rounding

FIGURE 4. School Choice Enrollment by Race/Ethnicity, 2017

Panel A: Elementary/Middle



Panel B: High School



Note: Percentages may not total to 100 due to rounding

Tables

TABLE 1. Student Characteristics by School Choice Type, 2017

	All Students	Zoned School	Any Choice	B&M Charter	Cyber Charter	Intra-District	Selective Magnet	Inter-District
Panel A: Elementary/Middle								
Female	0.49	0.49	0.50	0.51	0.50	0.46	0.55	0.47
White	0.65	0.67	0.35	0.22	0.62	0.50	0.05	0.76
Black	0.15	0.12	0.41	0.50	0.21	0.31	0.58	0.09
Hispanic	0.12	0.12	0.15	0.19	0.09	0.09	0.27	0.08
Asian	0.04	0.04	0.04	0.04	0.02	0.04	0.04	0.03
Multi-Racial/Other	0.04	0.04	0.05	0.04	0.05	0.06	0.07	0.04
Qualifies for FRL	0.51	0.50	0.65	0.76	0.46	0.45	1.00	0.48
English Learner	0.04	0.04	0.04	0.04	0.01	0.05	0.00	0.01
Special Education	0.17	0.16	0.21	0.17	0.21	0.33	0.06	0.26
Chronically Absent	0.12	0.12	0.16	0.17	0.15	0.13	0.18	0.11
Math Z-Score	0.02	0.06	-0.43	-0.46	-0.69	-0.19	-0.21	0.08
Reading Z-Score	0.02	0.05	-0.34	-0.37	-0.54	-0.16	-0.06	0.10
Urban	0.23	0.20	0.58	0.72	0.29	0.45	1.00	0.05
Suburban	0.53	0.55	0.32	0.26	0.44	0.40	0.00	0.56
Rural	0.23	0.25	0.10	0.03	0.27	0.15	0.00	0.39
Observations	1,162,804	1,061,257	101,547	64,734	15,538	16,471	720	4,267
Panel B: High School								
Female	0.49	0.48	0.54	0.52	0.56	0.50	0.60	0.50
White	0.70	0.75	0.34	0.19	0.68	0.29	0.18	0.76
Black	0.14	0.10	0.41	0.51	0.16	0.51	0.51	0.12
Hispanic	0.10	0.09	0.16	0.25	0.09	0.12	0.10	0.07
Asian	0.04	0.04	0.05	0.02	0.02	0.03	0.16	0.03
Multi-Racial/Other	0.02	0.02	0.04	0.02	0.05	0.04	0.06	0.03
Qualifies for FRL	0.46	0.42	0.68	0.82	0.35	0.53	1.00	0.49
English Learner	0.03	0.03	0.04	0.06	0.01	0.06	0.03	0.01
Special Education	0.16	0.16	0.18	0.21	0.23	0.17	0.06	0.25
Chronically Absent	0.22	0.21	0.30	0.35	0.28	0.36	0.20	0.21
Math Z-Score, 8th	0.05	0.10	-0.35	-0.58	-0.54	-0.45	0.35	0.03
Reading Z-Score, 8th	0.05	0.10	-0.28	-0.52	-0.38	-0.41	0.37	0.05
Urban	0.21	0.13	0.73	0.86	0.28	0.95	1.00	0.07
Suburban	0.51	0.57	0.16	0.09	0.42	0.02	0.00	0.57
Rural	0.28	0.31	0.11	0.06	0.30	0.03	0.00	0.36
Observations	565,845	481,601	84,244	28,398	17,540	12,603	13,537	3,021

Note: Among elementary/middle school students, all differences between choice types and zoned schools are statistically different except: percent Asian and percent multi-racial/other in B&M charter; percent multi-racial/other, percent chronically absent, PSSA math scores, and percent in a suburban community in inter-district; and percent Asian in intra-district and selective magnet. Among high school students in 2017, all differences between choice types and zoned schools are statistically different except: percent female, White, Asian, Multi-racial/other, chronically absent, and suburban in inter-district.

TABLE 2. School Choice and Student Characteristics, High School, Grades 9–12, 2012–2017

Student Characteristics	Black (1)	Hispanic (2)	White (3)	Asian (4)	EL (5)	SPED (6)	8th Grade Zread (7)	Chronic Abs. (8)	Dist. to Zoned Schl. (9)
Panel A: Raw Differences									
B&M Charter	0.389*** (0.001)	0.175*** (0.001)	-0.559*** (0.001)	-0.009*** (0.000)	0.039*** (0.001)	0.035*** (0.001)	-0.605*** (0.003)	0.125*** (0.001)	-0.724*** (0.008)
Cyber Charter	0.047*** (0.001)	0.005*** (0.001)	-0.055*** (0.002)	-0.021*** (0.000)	-0.012*** (0.000)	0.042*** (0.001)	-0.414*** (0.004)	0.132*** (0.002)	1.461*** (0.044)
Intra-district	0.430*** (0.002)	0.008*** (0.001)	-0.459*** (0.002)	0.002*** (0.001)	0.021*** (0.001)	0.033*** (0.002)	-0.415*** (0.005)	0.124*** (0.002)	-1.052*** (0.008)
Selective	0.401*** (0.002)	0.012*** (0.001)	-0.561*** (0.002)	0.125*** (0.001)	-0.001 (0.001)	-0.103*** (0.001)	0.355*** (0.004)	-0.044*** (0.001)	-1.522*** (0.004)
Inter-district	0.015*** (0.003)	-0.025*** (0.002)	0.013*** (0.003)	-0.008*** (0.001)	-0.012*** (0.001)	0.079*** (0.003)	-0.034*** (0.011)	0.029*** (0.003)	8.523*** (0.196)
Observations	3,280,502	3,280,502	3,280,502	3,280,502	3,162,624	3,162,624	2,147,613	2,920,748	3,159,184
Panel B: District Fixed Effects									
B&M Charter	0.037*** (0.013)	0.033*** (0.008)	-0.034** (0.015)	-0.036** (0.017)	-0.034* (0.019)	-0.014 (0.013)	0.057 (0.079)	-0.088 (0.064)	0.086 (0.120)
Cyber Charter	-0.041*** (0.006)	-0.024*** (0.004)	0.064*** (0.011)	-0.020*** (0.006)	-0.027*** (0.010)	0.029*** (0.009)	-0.195*** (0.053)	0.072*** (0.018)	1.602*** (0.087)
Intra-district	0.064 (0.047)	-0.010 (0.012)	-0.031** (0.013)	-0.021 (0.025)	-0.018 (0.025)	-0.005 (0.024)	0.083 (0.074)	-0.086** (0.043)	-0.291 (0.220)
Selective	-0.055*** (0.009)	-0.117*** (0.004)	0.067*** (0.006)	0.087*** (0.008)	-0.081*** (0.010)	-0.163*** (0.007)	1.177*** (0.036)	-0.316*** (0.030)	-0.582*** (0.070)
Inter-district	-0.014 (0.021)	-0.021*** (0.007)	0.038* (0.022)	-0.004 (0.006)	-0.014*** (0.005)	0.079*** (0.017)	0.007 (0.057)	0.015 (0.012)	8.803*** (1.257)
Observations	3,280,502	3,280,502	3,280,502	3,280,502	3,162,624	3,162,624	2,147,613	2,920,748	3,159,184
Panel C: Zoned School Fixed Effects									
B&M Charter	-0.004 (0.017)	0.021 (0.014)	0.005 (0.016)	-0.025** (0.010)	-0.038*** (0.011)	-0.018** (0.009)	0.107*** (0.038)	-0.101*** (0.024)	0.116 (0.111)
Cyber Charter	-0.047*** (0.006)	-0.019*** (0.004)	0.062*** (0.007)	-0.016*** (0.002)	-0.023*** (0.003)	0.032*** (0.004)	-0.209*** (0.018)	0.076*** (0.007)	1.393*** (0.087)
Intra-district	0.010 (0.021)	-0.017 (0.016)	0.007 (0.017)	-0.001 (0.013)	-0.014 (0.015)	-0.011 (0.014)	0.144*** (0.044)	-0.107*** (0.021)	-0.216** (0.093)
Selective	-0.115*** (0.033)	-0.066*** (0.025)	0.077*** (0.016)	0.084*** (0.014)	-0.076*** (0.019)	-0.166*** (0.011)	1.173*** (0.030)	-0.314*** (0.019)	-0.567*** (0.085)
Inter-district	-0.021 (0.020)	-0.021*** (0.007)	0.043* (0.023)	-0.003 (0.005)	-0.016*** (0.004)	0.077*** (0.017)	0.040 (0.059)	0.009 (0.013)	8.811*** (0.631)
Observations	3,280,502	3,280,502	3,280,502	3,280,502	3,162,624	3,162,624	2,147,613	2,920,748	3,159,184

Robust standard errors in parentheses. *p < 0.05; **p < 0.01; ***p < 0.001

Notes: All models include grade and year effects. Models in Panel B include residence district fixed effects and models in Panel C include zoned school fixed effects. Program characteristics (EL and SPED), test scores, and chronic absenteeism are measured in prior year. Distance to zoned school is the Euclidean distance from the centroid of student's zip code to their zoned school. Standard errors are clustered at the residence district level for results in Panel B and at the zoned school level for results in Panel C.

TABLE 3. Exit to any choice school, Elementary and Middle Schoolers, 2012–2016

Dependent variable: Choice school, t+1	(1)	(2)	(3)
Student characteristics			
Poor	0.003* (0.002)	0.004** (0.002)	0.004*** (0.000)
Black	0.013* (0.008)	0.003** (0.002)	0.002** (0.001)
Hispanic	0.010 (0.007)	0.004* (0.002)	0.004*** (0.001)
Asian	-0.003 (0.003)	-0.000 (0.001)	-0.000 (0.001)
Other race	-0.000 (0.002)	-0.002 (0.002)	0.000 (0.001)
Female	0.003*** (0.001)	0.003*** (0.001)	0.003*** (0.000)
EL	-0.014*** (0.005)	-0.013*** (0.005)	-0.013*** (0.002)
SPED	0.004** (0.002)	0.005* (0.003)	0.004*** (0.001)
Chronically Abs.	0.008 (0.007)	0.007 (0.008)	0.007*** (0.001)
Avg. Zmath & Zread	0.002 (0.004)	0.002 (0.004)	0.002*** (0.000)
Residential move	0.027*** (0.003)	0.027*** (0.003)	0.025*** (0.002)
School characteristics			
Distance		0.000** (0.000)	
Average proficiency		0.005 (0.007)	
Share poor		-0.018* (0.011)	
Share EL		-0.115** (0.047)	
Share Black		0.092*** (0.019)	
Share Hispanic		0.133*** (0.038)	
Share Asian		-0.012 (0.028)	
Share other race		0.087* (0.046)	
Average years of teacher experience		-0.000 (0.000)	
Share of teachers with graduate degree		0.012 (0.011)	
Zoned district fixed effects	X	X	
Zoned school fixed effects			X
Observations	2,487,753	2,487,753	2,487,753

Robust standard errors in parentheses. *p < 0.05; **p < 0.01; ***p < 0.001

Notes: All models include grade and year effects. Residential move is an indicator equal to 1 if a student lives in a different zip code in t+1. Distance to zoned school is the Euclidean distance from the centroid of student’s zip code to their zoned school. Standard errors are clustered at the zoned district level for models in columns 1 and 2 and at the school level for model in column 3.

TABLE 4. Exit to Any Choice, High Schoolers, 2012–2016

Dependent variable: Choice school, t+1	(1)	(2)	(3)
Student characteristics			
Poor	0.002*** (0.001)	0.002*** (0.001)	0.002*** (0.001)
Black	0.002 (0.003)	-0.001 (0.001)	0.000 (0.001)
Hispanic	-0.001 (0.001)	-0.001 (0.002)	-0.001 (0.001)
Asian	-0.005* (0.003)	-0.004** (0.002)	-0.004*** (0.001)
Other race	0.001 (0.002)	0.001 (0.001)	0.001 (0.001)
Female	0.006*** (0.001)	0.006*** (0.001)	0.006*** (0.000)
EL	-0.013*** (0.004)	-0.011*** (0.003)	-0.012*** (0.002)
SPED	-0.001 (0.001)	-0.001 (0.001)	-0.001* (0.001)
Chronically Abs.	0.026*** (0.001)	0.026*** (0.001)	0.026*** (0.001)
Avg. Zmath & Zread	-0.004*** (0.000)	-0.004*** (0.000)	-0.004*** (0.000)
Residential move	0.042*** (0.003)	0.041*** (0.003)	0.041*** (0.002)
School Characteristics			
Distance		0.000* (0.000)	
Graduation Rate		-0.032* (0.019)	
Share poor		0.005 (0.011)	
Share EL		0.037 (0.079)	
Share Black		0.007 (0.052)	
Share Hispanic		-0.069 (0.051)	
Share Asian		-0.164* (0.090)	
Share other race		0.014 (0.034)	
Average years of teacher experience		-0.002 (0.002)	
Share of teachers with graduate degree		0.039 (0.025)	
Zoned district fixed effects	X	X	
Zoned school fixed effects			X
Observations	1,204,995	1,204,995	1,204,995

Robust standard errors in parentheses. *p < 0.05; **p < 0.01; ***p < 0.001

Notes: All models include grade and year effects. Residential move is an indicator equal to 1 if a student lives in a different zip code in t+1. Distance to zoned school is the Euclidean distance from the centroid of student’s zip code to their zoned school. Standard errors are clustered at the zoned district level for models in columns 1 and 2 and at the school level for model in column 3.

TABLE 5. Exit to brick & mortar charter, Elementary/Middle Schoolers, 2012–2016

Dependent variable: Choice school, t+1	(1)	(2)	(3)
Student characteristics			
Poor	-0.002** (0.001)	-0.001** (0.001)	-0.001*** (0.000)
Black	0.012* (0.007)	0.005*** (0.002)	0.004*** (0.001)
Hispanic	0.014 (0.009)	0.007** (0.003)	0.007*** (0.001)
Asian	-0.008 (0.006)	-0.005 (0.004)	-0.005*** (0.001)
Other race	-0.002 (0.002)	-0.002 (0.002)	-0.001 (0.001)
Female	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)
EL	-0.002 (0.001)	-0.002 (0.001)	-0.003** (0.001)
SPED	-0.001 (0.001)	-0.000 (0.000)	-0.000 (0.000)
Chronically Abs.	0.001 (0.001)	-0.001 (0.002)	-0.002*** (0.001)
Avg. Zmath & Zread	-0.001 (0.001)	-0.000 (0.000)	0.000 (0.000)
Residential move	0.016** (0.007)	0.015** (0.006)	0.014*** (0.001)
School Characteristics			
Distance		0.000 (0.000)	
Average proficiency		-0.014 (0.010)	
Share poor		-0.019*** (0.005)	
Share EL		-0.054 (0.035)	
Share Black		0.053*** (0.012)	
Share Hispanic		0.101*** (0.024)	
Share Asian		-0.039*** (0.011)	
Share other race		-0.130** (0.056)	
Average years of teacher experience		-0.001* (0.000)	
Share of teachers with graduate degree		0.013** (0.006)	
Zoned district fixed effects	X	X	
Zoned school fixed effects			X
Observations	2,429,615	2,429,615	2,429,615

Robust standard errors in parentheses. *p < 0.05; **p < 0.01; ***p < 0.001

Notes: All models include grade and year effects. Residential move is an indicator equal to 1 if a student lives in a different zip code in t+1. Distance to zoned school is the Euclidean distance from the centroid of student’s zip code to their zoned school. Standard errors are clustered at the zoned district level for models in columns 1 and 2 and at the school level for model in column 3.

TABLE 6. Exit to cyber charter school, Elementary/Middle Schoolers, 2012–2016

Dependent variable: Choice school, t+1	(1)	(2)	(3)
Student characteristics			
Poor	0.001*** (0.000)	0.001*** (0.000)	0.002*** (0.000)
Black	-0.003*** (0.000)	-0.004*** (0.001)	-0.004*** (0.000)
Hispanic	-0.002*** (0.000)	-0.002*** (0.000)	-0.002*** (0.000)
Asian	-0.002* (0.001)	-0.002* (0.001)	-0.002*** (0.000)
Other race	0.000 (0.001)	0.000 (0.001)	0.000 (0.000)
Female	0.002*** (0.000)	0.002*** (0.000)	0.002*** (0.000)
EL	-0.007*** (0.000)	-0.007*** (0.000)	-0.007*** (0.000)
SPED	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)
Chronically Abs.	0.016*** (0.000)	0.016*** (0.000)	0.015*** (0.000)
Avg. Zmath & Zread	-0.002*** (0.000)	-0.002*** (0.000)	-0.002*** (0.000)
Residential move	-0.001 (0.000)	-0.001 (0.001)	-0.001*** (0.000)
School Characteristics			
Distance		0.000** (0.000)	
Average z-score		0.001** (0.001)	
Share poor		-0.001 (0.001)	
Share EL		-0.001 (0.005)	
Share Black		0.007*** (0.001)	
Share Hispanic		0.005 (0.004)	
Share Asian		-0.005 (0.003)	
Share other race		0.002 (0.006)	
Average years of teacher experience		-0.000** (0.000)	
Share of teachers with graduate degree		0.001 (0.001)	
Zoned district fixed effects	X	X	
Zoned school fixed effects			X
Observations	2,416,793	2,416,793	2,416,793

Robust standard errors in parentheses. *p < 0.05; **p < 0.01; ***p < 0.001

Notes: All models include grade and year effects. Residential move is an indicator equal to 1 if a student lives in a different zip code in t+1. Distance to zoned school is the Euclidean distance from the centroid of student’s zip code to their zoned school. Standard errors are clustered at the zoned district level for models in columns 1 and 2 and at the school level for model in column 3.

TABLE 7. School Choice and Non-structural mobility, Grades 4-7, 2011–2016

Dependent variable: Non-structural move, t+1	(1)	(2)	(3)
Type of school choice			
Brick & mortar charter	-0.052*** (0.010)	-0.055*** (0.012)	-0.047*** (0.012)
Cyber charter	0.213*** (0.021)	0.172*** (0.022)	0.167*** (0.026)
Intra-district choice	0.022*** (0.008)	0.027*** (0.008)	0.022*** (0.007)
Selective Magnet	-0.071*** (0.013)	-0.013 (0.018)	-0.024 (0.021)
Inter-district choice	0.036*** (0.007)	0.040*** (0.007)	0.046*** (0.007)
Prior mobility			
Prior non-structural move	0.034*** (0.003)	0.032*** (0.003)	0.044*** (0.002)
Prior structural move	0.021*** (0.003)	0.019*** (0.003)	0.008*** (0.003)
School Characteristics			
Distance		0.000** (0.000)	0.000** (0.000)
Average z-score		-0.032*** (0.006)	-0.033*** (0.007)
Share poor		-0.031** (0.013)	-0.005 (0.012)
Share Black		0.081*** (0.013)	0.079*** (0.017)
Share Hispanic		0.001 (0.021)	-0.016 (0.027)
Share Asian		0.019 (0.032)	0.033 (0.045)
Share other race		0.011 (0.048)	0.092** (0.046)
Share EL		0.031 (0.054)	0.104 (0.067)
Share SPED		0.137*** (0.038)	0.137*** (0.049)
Share chronically absent		0.078** (0.032)	0.068 (0.047)
Average years of teacher experience		-0.001* (0.001)	-0.002** (0.001)
Share of teachers with graduate degree		-0.020 (0.012)	-0.015 (0.014)
Zoned district fixed effects	X	X	
Zoned school fixed effects			X
Observations	3,187,479	3,187,479	3,187,479

Robust standard errors in parentheses. *p < 0.05; **p < 0.01; ***p < 0.001

Notes: Residential move is an indicator equal to 1 if a student lives in a different zip code in t+1. Distance to zoned school is the Euclidean distance from the centroid of student’s zip code to their zoned school. All models include controls for student female, race/ethnicity, free and reduced price lunch eligibility, whether the student is eligible for SPED, EL classification, whether the student speaks a language other than English at home, whether the student is repeating the grade, whether the student is gifted, standardized reading scores, standardized math scores, and an indicator of chronic absenteeism. All models also include grade and year effects. Standard errors are clustered at the school level.

TABLE 8. School Choice and Non-structural mobility, Grades 9–11, 2011–2016

Dependent variable: Non-structural move, t+1	(1)	(2)	(3)
Type of school choice			
Brick & mortar charter	0.025** (0.012)	0.016 (0.014)	0.023** (0.011)
Cyber charter	0.145*** (0.009)	0.093*** (0.016)	0.088*** (0.014)
Intra-district choice	0.009 (0.015)	0.008 (0.015)	0.010 (0.012)
Selective Magnet	-0.028*** (0.009)	-0.018 (0.015)	0.002 (0.013)
Inter-district choice	0.077*** (0.012)	0.082*** (0.012)	0.084*** (0.012)
Prior mobility			
Prior non-structural move	0.084*** (0.006)	0.082*** (0.006)	0.093*** (0.005)
Prior structural move	0.017 (0.022)	0.019 (0.022)	0.024** (0.010)
School Characteristics			
Distance		0.000** (0.000)	0.000*** (0.000)
Graduation rate		-0.107*** (0.031)	-0.100*** (0.029)
Share poor		0.011 (0.017)	0.004 (0.014)
Share Black		0.053** (0.021)	0.061*** (0.020)
Share Hispanic		0.008 (0.029)	-0.006 (0.026)
Share Asian		0.028 (0.049)	0.006 (0.044)
Share other race		0.032 (0.201)	0.218 (0.224)
Share EL		-0.138* (0.072)	-0.100 (0.069)
Share SPED		-0.003 (0.075)	0.067 (0.072)
Share chronically absent		0.001 (0.031)	0.006 (0.027)
Average years of teacher experience		-0.002 (0.001)	-0.001 (0.001)
Share of teachers with graduate degree		-0.015 (0.023)	-0.002 (0.020)
Zoned district fixed effects	X	X	
Zoned school fixed effects			X
Observations	1,529,967	1,529,967	1,529,967

Robust standard errors in parentheses. *p < 0.05; **p < 0.01; ***p < 0.001

Notes: Residential move is an indicator equal to 1 if a student lives in a different zip code in t+1. Distance to zoned school is the Euclidean distance from the centroid of student’s zip code to their zoned school. All models include controls for student female, race/ethnicity, free and reduced price lunch eligibility, whether the student is eligible for SPED, EL classification, whether the student speaks a language other than English at home, whether the student is repeating the grade, whether the student is gifted, standardized reading scores, standardized math scores, and an indicator of chronic absenteeism. All models also include grade and year effects. Standard errors are clustered at the school level.

Appendix A

Supplementary Tables and Figures

TABLE A1. Student Characteristics by School Choice Type, 2012

	All Students	Zoned School	Any Choice	B&M Charter	Cyber Charter	Intra-District	Selective Magnet	Inter-District
Panel A: Elementary/Middle								
Female	0.49	0.49	0.48	0.50	0.50	0.45	0.55	0.47
White	0.70	0.72	0.45	0.26	0.70	0.47	0.07	0.82
Black	0.15	0.13	0.38	0.56	0.17	0.34	0.59	0.09
Hispanic	0.09	0.09	0.11	0.12	0.06	0.12	0.29	0.05
Asian	0.04	0.04	0.03	0.04	0.01	0.03	0.03	0.01
Multi-Racial/Other	0.02	0.02	0.03	0.02	0.05	0.04	0.02	0.02
Qualifies for FRL	0.43	0.42	0.58	0.68	0.34	0.62	0.64	0.40
English Learner	0.03	0.03	0.03	0.03	0.00	0.06	0.01	0.01
Special Education	0.15	0.14	0.21	0.15	0.13	0.30	0.09	0.22
Chronically Absent	0.10	0.10	0.14	0.16	0.12	0.14	0.14	0.11
Math Z-Score	0.02	0.05	-0.35	-0.41	-0.62	-0.33	-0.03	0.08
Reading Z-Score	0.02	0.04	-0.28	-0.39	-0.31	-0.31	0.18	0.08
Urban	0.22	0.20	0.51	0.67	0.28	0.52	1.00	0.06
Suburban	0.53	0.55	0.36	0.31	0.32	0.37	0.00	0.64
Rural	0.25	0.26	0.15	0.05	0.41	0.11	0.00	0.30
Observations	1,145,048	1,069,279	75,769	29,778	11,380	26,829	1,170	6,798
Panel B: High School								
Female	0.49	0.49	0.55	0.53	0.58	0.49	0.62	0.49
White	0.74	0.78	0.40	0.22	0.76	0.31	0.23	0.80
Black	0.14	0.11	0.39	0.44	0.14	0.54	0.51	0.11
Hispanic	0.08	0.07	0.14	0.30	0.06	0.09	0.09	0.05
Asian	0.03	0.03	0.05	0.02	0.01	0.03	0.16	0.02
Multi-Racial/Other	0.01	0.01	0.03	0.02	0.04	0.03	0.02	0.02
Qualifies for FRL	0.35	0.33	0.55	0.65	0.30	0.69	0.56	0.38
English Learner	0.02	0.02	0.03	0.07	0.00	0.04	0.01	0.01
Special Education	0.14	0.14	0.15	0.18	0.16	0.18	0.04	0.23
Chronically Absent	0.22	0.22	0.28	0.36	0.21	0.38	0.15	0.21
Math Z-Score, 8th	0.01	0.03	-0.17	-0.58	-0.44	-0.33	0.72	0.06
Reading Z-Score, 8th	0.01	0.03	-0.16	-0.59	-0.20	-0.31	0.60	0.02
Urban	0.19	0.14	0.72	0.88	0.23	0.93	1.00	0.07
Suburban	0.51	0.55	0.15	0.07	0.37	0.03	0.00	0.64
Rural	0.30	0.31	0.15	0.07	0.42	0.04	0.00	0.29
Observations	558,093	492,643	65,450	16,262	11,678	13,458	10,647	3,935

Note: All differences between choice types and zoned schools statistically significant except. For elementary/middle schoolers: % female in any form of choice, % multi-racial/other in inter-district, % EL and multi-racial/other in B&M charter, % Asian and % multi-racial/other in selective magnet, and percent multi-racial/other in inter-district. For high schoolers: % female and % Asian in intra-district, % female and % Black in inter-district, % chronically absent in cyber charters, and 8th grade reading and math scores in inter-district.

TABLE A2. Student Characteristics by School Choice Type, 2014

	All Students	Zoned School	Any Choice	B&M Charter	Cyber Charter	Intra-District	Selective Magnet	Inter-District
Panel A: Elementary/Middle								
Female	0.49	0.49	0.50	0.51	0.50	0.46	0.55	0.47
White	0.65	0.67	0.35	0.22	0.62	0.50	0.05	0.76
Black	0.15	0.12	0.41	0.50	0.21	0.31	0.58	0.09
Hispanic	0.12	0.12	0.15	0.19	0.09	0.09	0.27	0.08
Asian	0.04	0.04	0.04	0.04	0.02	0.04	0.04	0.03
Multi-Racial/Other	0.04	0.04	0.05	0.04	0.05	0.06	0.07	0.04
Qualifies for FRL	0.51	0.50	0.65	0.76	0.46	0.45	1.00	0.48
English Learner	0.04	0.04	0.04	0.04	0.01	0.05	0.00	0.01
Special Education	0.17	0.16	0.21	0.17	0.21	0.33	0.06	0.26
Chronically Absent	0.12	0.12	0.16	0.17	0.21	0.33	0.06	0.26
Math Z-Score	0.02	0.06	-0.43	-0.46	-0.69	-0.19	-0.21	0.08
Reading Z-Score	0.02	0.05	-0.34	-0.37	-0.54	-0.16	-0.06	0.10
Urban	0.23	0.20	0.58	0.72	0.29	0.45	1.00	0.05
Suburban	0.53	0.55	0.32	0.26	0.44	0.40	0.00	0.56
Rural	0.23	0.25	0.10	0.03	0.27	0.15	0.00	0.39
Observations	1,162,804	1,061,257	101,547	64,734	15,538	16,471	720	4,267
Panel B: High School								
Female	0.49	0.48	0.54	0.52	0.56	0.50	0.60	0.50
White	0.70	0.75	0.34	0.19	0.68	0.29	0.18	0.76
Black	0.14	0.10	0.41	0.51	0.16	0.51	0.51	0.12
Hispanic	0.10	0.09	0.16	0.25	0.09	0.12	0.10	0.07
Asian	0.04	0.04	0.05	0.02	0.02	0.03	0.16	0.03
Multi-Racial/Other	0.02	0.02	0.04	0.02	0.05	0.04	0.06	0.02
Qualifies for FRL	0.46	0.42	0.68	0.82	0.35	0.53	1.00	0.49
English Learner	0.03	0.03	0.04	0.06	0.01	0.06	0.03	0.01
Special Education	0.16	0.16	0.18	0.21	0.12	0.17	0.06	0.25
Chronically Absent	0.22	0.21	0.30	0.35	0.28	0.36	0.20	0.21
Math Z-Score, 8th	0.05	0.10	-0.35	-0.58	-0.54	-0.45	.035	0.03
Reading Z-Score, 8th	0.05	0.10	-0.28	-0.52	-0.38	-0.41	0.37	0.05
Urban	.21	0.13	0.73	0.86	0.28	0.95	1.00	0.07
Suburban	0.51	0.57	0.16	0.09	0.42	0.02	0.00	0.57
Rural	0.28	0.31	0.11	0.06	0.30	0.03	0.00	0.36
Observations	556,700	481,601	75,099	28,398	17,540	12,603	13,537	3,021

Note: All differences between choice types and zoned schools statistically significant except. For elementary/middle schoolers: % Asian in B&M charter, intra-district, or selective magnet, % multi-racial/other in B&M charter and inter-district, and % chronically absent, math scores, and % suburban in inter-district. For high schoolers: % female, % White, % Asian, % Multi-racial/other, % chronically absent, and % rural in inter-district, which were not statistically different from zoned school students.

TABLE A3. School Choice and Student Characteristics, Grades 4–8, 2012–2017

Student Characteristics	Black (1)	Hispanic (2)	White (3)	Asian (4)	EL (5)	SPED (6)	Zread (7)	Chronic Abs. (8)	Dist. to Zoned Schl. (9)
Panel A: Raw Differences									
B&M Charter	0.400*** (0.001)	0.075*** (0.001)	-0.476*** (0.001)	-0.001** (0.001)	0.013*** (0.001)	0.007*** (0.001)	-0.459*** (0.003)	0.057*** (0.001)	-0.543*** (0.007)
Cyber Charter	0.061*** (0.002)	-0.021*** (0.001)	-0.037*** (0.002)	-0.023*** (0.001)	-0.021*** (0.000)	0.025*** (0.002)	-0.460*** (0.005)	0.108*** (0.002)	1.919*** (0.054)
Intra-district	0.250*** (0.002)	-0.002 (0.001)	-0.241*** (0.002)	-0.004*** (0.001)	0.011*** (0.001)	0.156*** (0.002)	-0.316*** (0.005)	0.053*** (0.002)	-0.478*** (0.017)
Selective	0.493*** (0.006)	0.158*** (0.006)	-0.657*** (0.003)	-0.004 (0.002)	-0.015*** (0.001)	-0.084*** (0.004)	0.031*** (0.010)	0.030*** (0.005)	-1.565*** (0.009)
Inter-district	-0.024*** (0.002)	-0.049*** (0.002)	0.077*** (0.003)	-0.012*** (0.001)	-0.017*** (0.001)	0.067*** (0.003)	0.029*** (0.008)	0.018*** (0.003)	5.297*** (0.120)
Observations	3796339	3,796,339	3,796,339	3,796,339	3,796,339	3,796,339	3,526,142	3,369,675	3,620,395
Panel B: District Fixed Effects									
B&M Charter	0.064*** (0.015)	-0.021*** (0.005)	-0.014 (0.013)	-0.020 (0.013)	-0.038*** (0.007)	-0.004 (0.004)	0.126*** (0.035)	-0.058*** (0.013)	0.389*** (0.143)
Cyber Charter	-0.020 (0.015)	-0.038*** (0.006)	0.060*** (0.008)	-0.017** (0.007)	-0.030*** (0.008)	0.020*** (0.003)	-0.258*** (0.028)	0.074*** (0.007)	1.998*** (0.274)
Intra-district	0.063*** (0.023)	0.001 (0.010)	-0.057*** (0.020)	-0.008 (0.007)	0.000 (0.010)	0.154*** (0.037)	-0.047 (0.067)	0.002 (0.015)	0.081 (0.073)
Selective	0.077*** (0.004)	0.059*** (0.001)	-0.091*** (0.004)	-0.036*** (0.004)	-0.075*** (0.002)	-0.090*** (0.002)	0.746*** (0.010)	-0.115*** (0.003)	-0.262*** (0.045)
Inter-district	-0.033* (0.018)	-0.025*** (0.009)	0.054** (0.023)	-0.006* (0.003)	-0.013*** (0.005)	0.070*** (0.012)	0.031 (0.057)	0.015 (0.010)	5.114*** (0.657)
Observations	3796339	3,796,339	3,796,339	3,796,339	3,796,339	3,796,339	3,526,142	3,369,675	3,620,395
Panel C: Zoned School Fixed Effects									
B&M Charter	0.018* (0.010)	-0.014** (0.007)	0.011 (0.008)	-0.011** (0.005)	-0.035*** (0.004)	-0.012*** (0.004)	0.204*** (0.020)	-0.082*** (0.006)	0.336*** (0.087)
Cyber Charter	-0.046*** (0.013)	-0.027*** (0.006)	0.068*** (0.008)	-0.013*** (0.002)	-0.026*** (0.002)	0.018*** (0.003)	-0.239*** (0.018)	0.067*** (0.004)	1.776*** (0.202)
Intra-district	0.016** (0.007)	-0.007 (0.005)	-0.019*** (0.007)	0.001 (0.003)	0.002 (0.005)	0.157*** (0.012)	0.005 (0.027)	-0.007 (0.006)	0.100*** (0.033)
Selective	0.064*** (0.021)	-0.041 (0.025)	-0.029* (0.015)	0.005 (0.005)	-0.082*** (0.017)	-0.115*** (0.011)	0.914*** (0.027)	-0.159*** (0.011)	-0.131** (0.066)
Inter-district	-0.023 (0.016)	-0.026*** (0.007)	0.049** (0.020)	-0.006** (0.003)	-0.014*** (0.004)	0.071*** (0.013)	0.021 (0.055)	0.014 (0.009)	5.339*** (0.453)
Observations	3,796,339	3,796,339	3,796,339	3,796,339	3,796,339	3,796,339	3,526,142	3,369,675	3,620,395

Robust standard errors in parentheses. *p < 0.05; **p < 0.01; ***p < 0.001

Notes: All models include grade and year effects. Models in Panel B include residence district fixed effects and models in Panel C include zoned school fixed effects. Program characteristics (EL and SPED), test scores, and chronic absenteeism are measured in prior year. Distance to zoned school is the Euclidean distance from the centroid of student’s zip code to their zoned school. Standard errors are clustered at the residence district level for results in Panel B and at the zoned school level for results in Panel C.

TABLE A4. Exit to brick & mortar charter school, High Schoolers, 2012–2016

Dependent variable: Choice school, t+1	(1)	(2)	(3)
Student characteristics			
Poor	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)
Black	0.007*** (0.003)	0.005*** (0.001)	0.005*** (0.001)
Hispanic	0.003*** (0.001)	0.003** (0.001)	0.003*** (0.001)
Asian	-0.002 (0.002)	-0.001 (0.001)	-0.001* (0.001)
Other race	0.001 (0.001)	0.001** (0.001)	0.001** (0.001)
Female	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)
EL	-0.001 (0.001)	0.000 (0.001)	-0.000 (0.001)
SPED	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
Chronically Abs.	0.004*** (0.001)	0.004*** (0.001)	0.004*** (0.000)
Avg. Zmath & Zread	-0.001*** (0.000)	-0.000*** (0.000)	-0.001*** (0.000)
Residential move	0.014*** (0.003)	0.013*** (0.003)	0.013*** (0.001)
School Characteristics			
Distance		0.000 (0.000)	
Graduation rate		-0.015* (0.008)	
Share poor		-0.006** (0.003)	
Share EL		0.056* (0.033)	
Share Black		0.043*** (0.008)	
Share Hispanic		-0.017 (0.013)	
Share Asian		-0.058*** (0.019)	
Share other race		-0.015 (0.016)	
Average years of teacher experience		-0.000 (0.000)	
Share of teachers with graduate degree		0.001 (0.002)	
Zoned district fixed effects	X	X	
Zoned school fixed effects			X
Observations	1,186,162	1,186,162	1,186,162

Robust standard errors in parentheses. *p < 0.05; **p < 0.01; ***p < 0.001

Notes: All models include grade and year effects. Residential move is an indicator equal to 1 if a student lives in a different zip code in t+1. Distance to zoned school is the Euclidean distance from the centroid of student’s zip code to their zoned school. Standard errors are clustered at the zoned district level for models in columns 1 and 2 and at the school level for model in column 3.

TABLE A5. Exit to cyber charter school, High Schoolers, 2012–2016

Dependent variable: Choice school, t+1	(1)	(2)	(3)
Student characteristics			
Poor	0.003*** (0.000)	0.003*** (0.000)	0.003*** (0.000)
Black	-0.007*** (0.001)	-0.007*** (0.001)	-0.007*** (0.001)
Hispanic	-0.004*** (0.001)	-0.004*** (0.001)	-0.004*** (0.001)
Asian	-0.004*** (0.001)	-0.004*** (0.001)	-0.004*** (0.001)
Other race	0.000 (0.001)	0.000 (0.001)	0.000 (0.001)
Female	0.005*** (0.000)	0.005*** (0.000)	0.005*** (0.000)
EL	-0.013*** (0.002)	-0.012*** (0.002)	-0.012*** (0.001)
SPED	-0.002*** (0.000)	-0.002*** (0.000)	-0.002*** (0.000)
Chronically Abs.	0.022*** (0.001)	0.022*** (0.001)	0.022*** (0.001)
Avg. Zmath & Zread	-0.004*** (0.000)	-0.004*** (0.000)	-0.004*** (0.000)
Residential move	0.007*** (0.001)	0.007*** (0.001)	0.007*** (0.001)
School Characteristics			
Distance		0.000 (0.000)	
Graduation rate		-0.007 (0.004)	
Share poor		-0.002 (0.005)	
Share EL		-0.017 (0.053)	
Share Black		-0.000 (0.010)	
Share Hispanic		-0.005 (0.015)	
Share Asian		-0.005 (0.029)	
Share other race		0.006 (0.008)	
Average years of teacher experience		0.001 (0.000)	
Share of teachers with graduate degree		0.001 (0.004)	
Zoned district fixed effects	X	X	
Zoned school fixed effects			X
Observations	1,194,388	1,194,388	1,194,388

Robust standard errors in parentheses. *p < 0.05; **p < 0.01; ***p < 0.001

Notes: All models include grade and year effects. Residential move is an indicator equal to 1 if a student lives in a different zip code in t+1. Distance to zoned school is the Euclidean distance from the centroid of student’s zip code to their zoned school. Standard errors are clustered at the zoned district level for models in columns 1 and 2 and at the school level for model in column 3.

Appendix B

Process for resolving incorrectly zoned schools

There were two primary issues with the zoned school variable:

1. Students zoned to magnet schools - this only occurred for students who were also enrolled in a magnet school.
2. Students who were zoned to schools that did not serve their grade

For these observations we identified students' most likely zoned school using the following sequential procedure. That is, we started with all students who appeared to have incorrect zoned school codes and attempted to replace them with step 1. For those students who still had incorrect zoned school codes after implementing step 1, we moved on to step 2, and so on.

1. For students who did not move zip codes, we replaced current zoned school with prior year's zoned school if it serves their current grade.
2. For students who did not move zip codes, we replaced their current zoned school with the modal zoned school in the current year (t) of students who were zoned to their same school in the previous year (t-1)
3. For high school students who had not moved zip codes since 8th grade, we replaced the zoned school with the modal zoned school in the current year (t) of students who were zoned to the same school in 8th grade, live in the same zip code in the current year, and are in the same grade in the current year.
4. For middle school students who had not moved zip codes since 4th grade, we replaced the zoned school with the modal zoned school in the current year (t) of students who were zoned to the same school in 4th grade, live in the same zip code in the current year, and are in the same grade in the current year.
5. For remaining students, we replaced the zoned school with the modal zoned school for students who live in the same zip code and are in the same grade.

Appendix C

Magnet Schools

We drew on multiple sources of data to produce our magnet school indicator. First, the CCD identified 51-53 Pennsylvania schools as magnets, depending on the year. We checked each school using district websites and/or phone calls and found that 6 of these were incorrectly identified. We then cross-referenced our remaining list with the websites of the 5 largest school districts to confirm CCD classifications for remaining schools and identify any magnet schools that may not have been included in the CCD. This resulted in a final list of 42 magnet schools and 21 selective magnet schools, which have explicit academic admission criteria and are operated by the School District of Philadelphia.

Magnet School Name	LEA	Data Source
High School of the Future	School District of Philadelphia (SDP)	School District of Philadelphia (SDP)
Paul Robeson High School for Human Services	SDP	SDP
Middle Years Alternative School	SDP	SDP
Constitution High School	SDP	SDP
Murrell Dobbins Career and Technical High School	SDP	SDP
Overbrook Educational Center	SDP	SDP
Philadelphia Military Academy	SDP	SDP
Jules E. Mastbaum Area Vocational Technical High School	SDP	SDP
Alternative Middle Years at James Martin	SDP	SDP
Building 21	SDP	SDP
The U School	SDP	SDP
The LINC	SDP	SDP
A. Philip Randolph Career and Technical High School	SDP	SDP
Fitler Academics Plus School	SDP	SDP
Widener Memorial School	SDP	SDP
Swenson Arts and Technology High School	SDP	SDP
The Workshop School	SDP	SDP
Pittsburgh Allderdice HS	Pittsburgh Public Schools (PPS)	Pittsburgh Public Schools (PPS)
Pittsburgh Allegheny 6-8	PPS	PPS
Pittsburgh Allegheny K-5	PPS	PPS
Pittsburgh Brashear HS	PPS	PPS
Pittsburgh CAPA 6-12	PPS	PPS
Pittsburgh Carmalt K-8	PPS	PPS
Pittsburgh Classical 6-8	PPS	PPS
Pittsburgh Dilworth K-5	PPS	PPS
Pittsburgh Fulton K-5	PPS	PPS
Pittsburgh Liberty K-5	PPS	PPS
Pittsburgh Linden K-5	PPS	PPS

Magnet School Name	LEA	Data Source
Pittsburgh Milliones 6-12	PPS	PPS
Pittsburgh Montessori K-5	PPS	PPS
Pittsburgh Obama 6-12	PPS	PPS
Pittsburgh Perry HS	PPS	PPS
Pittsburgh Phillips K-5	PPS	PPS
Pittsburgh Schiller 6-8	PPS	PPS
Pittsburgh Science and Technology Academy	PPS	PPS
Pittsburgh Sterrett 6-8	PPS	PPS
Pittsburgh Woolslair K-5	PPS	PPS
Building 21 Allentown	Allentown School District	CCD
Chambersburg Area Career Magnet School	Chambersburg Area School District	CCD
Grace B Luhrs Univ Elem	Shippensburg Area School District	CCD
Irving Ele Sch	Altoona Area School District	CCD
Marshall Math Science Academy	Harrisburg School District	CCD

Selective Magnet Schools (All SDP)

- Motivation High School
- High School for Creative and Performing Arts School
- Julia R. Masterman School
- Franklin Learning Center
- Girard Academic Music Program
- Academy at Palumbo
- Science Leadership Academy
- The Science Leadership Academy at Beeber
- High School of Engineering and Science
- Parkway Northwest High School
- Parkway Center City High School
- Parkway West High School
- William W. Bodine High School
- Russell H. Conwell School
- Central High School
- Walter B. Saul High School
- Philadelphia High School for Girls
- Hill-Freedman World Academy
- Academy for the Middle Years at Northwest
- Lankenau High School
- Arts Academy at Benjamin Rush

- POL PK-20 Policy
- ECE Early Childhood Education
- K12 K-12 Education
- PSE Postsecondary Education
- WRK Workforce
- LIB Public Libraries

For more information on PDE's state-level Research Agenda, visit <http://education.pa.gov/researchagenda>



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DEPARTMENT OF EDUCATION

Research and Evaluation

Pennsylvania Department of Education | Office of Administration
333 Market Street | Harrisburg, PA 17126-0333
Phone: 717.705.6499 | Fax: 717.787.3148

The mission of the Department of Education is to ensure that every learner has access to a world-class education system that academically prepares children and adults to succeed as productive citizens. Further, the Department seeks to establish a culture that is committed to improving opportunities throughout the commonwealth by ensuring that technical support, resources, and optimal learning environments are available for all students, whether children or adults.