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The Impact of Targeted vs. General Education Investments: Evidence from Special Education and English Language Learners in Boston Charter Schools

Elizabeth Setren*

July 25, 2019

Abstract

Using novel variation in special education and English Language Learner classification from admissions lotteries, I find that students can achieve large academic gains without specialized services. Enrolling in a Boston charter school doubles the likelihood that students lose their special education or English Language Learner status, but exposes students to a high-performing general education program that includes high intensity tutoring, data driven instruction, and increased instructional time. The positive effects extend to college: charters nearly double the likelihood that English Language Learners enroll in four-year colleges and quadruple the likelihood that special education students graduate from two-year college. A multiple instrument strategy suggests that high quality general education practices drive the gains and finds no detrimental effect from lower classification rates.

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How to allocate educational resources to serve students with large achievement gaps remains a pressing concern. The largest sources of federal funding for K-12 education, Title I for low-income students and IDEA for special education students (15.4 and 12.8 billion respectively), pay for targeted services that only affect those students (such as specially trained teachers, counselors, therapists, curriculum consultants, and paraprofessionals). State spending policies often also follow this categorical spending model which targets additional investment in low-income, special education, and English Language Learner (ELL) students towards specialized services as opposed to broader investments in school quality that would affect all students (such as increased instructional time, higher performing teachers, or tutoring programs). This funding allocation comes from a strong assumption that marginal education spending aimed to help low-performing groups of students should be focused on specialized supports instead of a balance between specialized supports and general school quality.

Policies to improve the educational and career outcomes for special education and ELL students are increasingly important as their prevalence in urban districts grows: fifty percent of Boston Public School (BPS) students have either a special education or ELL status.[1] Schools invest two to four times more per pupil for special education students and ELL students (Hayes et al., 2013; Chambers, Parrish and Harr, 2004). Even with this additional investment, the special education and ELL achievement gaps are at least double the size of the low-income and black-white achievement gaps.[2] Despite special education and ELL students' increasing prevalence, higher costs, and low academic achievement, little causal evidence exists for how to improve their educational trajectories.

To understand the tradeoffs between investments in targeted special education and ELL supports versus general school quality, we either need randomness in access to specialized supports or randomness in the allocation of funds to specialized supports and general school investments. However, schools endogenously designate students as special education and ELL based on stu-

[1] Author's calculations using the Massachusetts Department of Elementary and Secondary Education Student Information Management System data for Boston Public Schools for the 2013-2014 school year.

[2] Author's calculations using the Massachusetts Department of Elementary and Secondary Education Student Information Management System data based on high school graduation.

dent needs and ability. Additionally, families endogenously sort into schools, making it difficult to conduct this analysis.

Boston charter schools offer a unique opportunity to look at both types of random variation. First, using randomized charter admissions lotteries, I find that charter enrollment at least doubles the likelihood that a student in special education or ELL at the time of the lottery loses this classification and subsequently access to specialized services. The classification changes occur for students with a wide range of special education and ELL needs, enabling the first analysis of the impact of specialized services for students far from the qualification margin for services. Past work on ELL and special education focuses on the impact of services for marginally qualified students. Research on ELL classification for marginally qualified students finds mixed effects (Pope, 2016; Matsudaira, 2005; Robinson-Cimpian and Thompson, 2015) and Hanushek, Kain and Rivkin (2002) find that special education classification boosts math outcomes by analyzing students who move in and out of special education programs, but these movements are not random. This is also the first study to use random variation in special education classification.

Second, the Boston charter school lotteries offer variation in access to high performing schools that spend less on specialized supports (Boston charter schools) versus lower performing schools that spend more on specialized supports (BPS).[3] Boston charter schools spend 44 percent less on special education instructional spending compared to BPS (see Table A6).[4] At the same time, Boston charters implement a set of education practices that affect all students, including increased instructional time, high academic and behavioral expectations, high intensity tutoring, data driven instruction, and frequent teacher feedback. These practices have a strong positive relationship with school effectiveness in charters and yield positive effects when implemented in traditional public schools or schools converted to a charter model (Angrist, Pathak and Walters, 2013; Dobbie and Fryer, 2013; Fryer, 2014; Abdulkadiroğlu et al., 2016). However, little is known about the effect of these practices or charter schools on special education and ELL students specifically.

[3]Lottery-based evidence shows that Boston charters generate large academic gains relative to applicants' traditional public schools options (Angrist, Pathak and Walters, 2013; Angrist et al., 2016; Abdulkadiroğlu et al., 2011).

[4]Districts do not report ELL specific school expenditures. See Table A6 for detailed BPS and charter school expenditure and grant information.

Critics argue that charter schools underserve special education and ELL students because charters have lower enrollment rates of special needs students compared to district schools and charters often lack the economies of scale of traditional public school districts to provide separate classrooms and other intensive resources (Government Accountability Office, 2012; Boston Globe Editorial Board, 2015; Massachusetts Teachers Association, 2015).[5] These criticisms hold in Boston, however the lower special needs enrollment and reduced spending on intensive services stem from charters moving students to more inclusive, general education settings. As such, this paper speaks to policy debates about the tradeoffs of targeted services versus inclusion in general education classrooms.

My lottery-based estimates show that the net effect of Boston charter enrollment, including reduced access to specialized services and exposure to high quality general education practices, generates large achievement gains for students with special education or ELL classifications at the time of the lottery. The gains for these special needs students are similar to those made by non-special needs students in charter schools. Charters also significantly increase the likelihood that special needs students meet a key high school graduation requirement, become eligible for a state merit scholarship, and take an AP exam. Special education students in charters score are over twice as likely to score 1200 or higher on the SAT than their traditional public school counterparts. Charters nearly double the likelihood that ELL students enroll in four-year colleges and quadruple the likelihood of two-year college graduation for special education students.

Charters generate academic gains even for the most disadvantaged charter applicants. Special needs students who scored in the bottom third on their state exams in the year of the lottery experience gains of over 0.24 standard deviations in math. English Language Learners with the lowest baseline scores have the largest English exam gains. Students with the most severe needs at the time of the lottery – special education students who spent the majority of their time in substantially separate classrooms and ELLs with beginning English proficiency – perform significantly better in charters than in traditional public schools.

[5] I will refer to students with special education and ELL classifications at the time of the charter lottery as special needs students.

Lastly, I use a multiple instrument strategy that harnesses school-specific variation in reclassification rates and pre-lottery characteristics of charter applicants to separately estimate the academic effects of general education practices and specialized services. I find suggestive evidence that special education and ELL classification removal have weak positive effects on test scores. The weak positive correlation between individual charter schools' classification removal effects and special education and ELL achievement gains supports this finding. At the same time, school practices that predict gains for general education students also predict gains for special needs students. Together, this suggests that the achievement gains stem mostly from the general education practices and that there is a weak positive effect from reduced specialized services.

Combined, the findings show that it is feasible for special needs students to make large academic gains without special needs services in a high quality general education program and that the effects extend throughout the ability distribution and level of need. This suggests that increased focus on general school quality investments can improve special education and ELL student outcomes.

The next section provides background on Boston charter schools, discusses the special needs classification process, and describes the data analyzed here. Section 2 details my empirical strategy and reports the effect of charter enrollment on special needs classification. Section 3 reports the academic effects of charter enrollment and Section 4 investigates mechanisms. The final section concludes.

1 Background and Data

1.1 Special Needs Classification Processes

The special education classification process begins when a parent, teacher, or school staff requests an evaluation for a student. This can happen at any grade or age. After a request, the district or a private psychologist conducts an evaluation. The school holds a meeting with the parent(s) to decide the student's classification. If the student is classified, the school develops an Individualized

Education Program (IEP) that details the supports the student will receive. Students are designated to full inclusion, partial inclusion, or substantial separate classrooms. Students in full inclusion spend less than 21% of their time outside of the general education classroom. Partial inclusion students spend between 21% to 60% of their time in a separate setting, and substantially separate students spend over 60% of their time receiving special education services. Schools are required to re-evaluate students' classification and level of services every three years.[6]

To classify students as English Language Learners, Massachusetts public schools survey the parent(s) of all new students, including those coming from within the same district, to identify students whose primary language at home is not English.[7] Once identified, these students take an English Proficiency exam. A licensed ELL teacher or administrator interprets the test to decide whether the student will be classified as ELL and to determine the set of services they will receive. Every Spring, ELL students take a state standardized English proficiency exam, and their teachers and ELL specialists evaluate their results to reconsider their ELL status and services. The state has suggested guidelines for mapping the English proficiency exam scores to whether students become or remain ELL and the level of services they receive; however, schools have discretion.

Schools aim to improve English language ability of ELL students so that they no longer need the ELL classification and services. This goal of removing classification does not exist for special education students; rather, schools aim to provide the proper set of supports to enable the child succeed academically.

1.2 Classification Incentives

The financial and accountability incentives for special needs classification go in opposite directions and impact charters more than traditional public school districts. The state and local school funding formula in Massachusetts does not include special education enrollment to discourage over-classification. For the same reason, the federal Individuals with Disabilities Act (IDEA) Grant,

[6]Cullen (2003); Kubik (1999) analyze how financial incentives affect special education classification. Cullen and Rivkin (2003) overviews the classification incentives and stratification in school choice programs.

[7]The survey is offered in 28 languages and administered by specially trained professionals (including teachers, principals, and guidance counselors). The training aims to detect if families falsely report English proficiency.

which provides funding to the states for special education costs, does not consider the number of classified students in its funding formula. As a result, school funding formulas disincentivize special education classification due to higher costs for special education services.[8]

The funding formula includes lagged ELL enrollment, but districts face financial disincentives to classify students if the costs of services exceed additional funding. Massachusetts also distributes federal funding for ELL programs through a lagged ELL enrollment formula. A 2015 Massachusetts state commission found that the state formula did not provide enough funding to meet the costs of educating ELL students and recommended an additional $2,361 for each ELL student (Chang-Diaz and Peisch, 2015). This implies that schools face financial disincentives to classify both special education and ELL students. Smaller school districts, including charter school districts, face relatively larger disincentives because of economies of scale for providing special needs services.

Accountability incentives encourage schools to properly classify special needs students. The state inspects schools for proper identification of special needs and provision of services. The state accountability system considers the outcomes of special needs students in addition to overall student performance, which incentivizes providing the proper set of services for this group of students to succeed academically.[9] Charter schools face higher accountability standards and the threat of de-authorization, so these incentives affect charters more acutely than traditional public schools.

1.3 Data and Sample

To study the effect of charter attendance for special needs students, this paper uses the admissions lotteries of 30 Boston elementary, middle, and high charter schools from the 2003-04 to 2014-15 school years. These schools account for 89 percent of Boston charter entry grade enrollment in

[8]Districts in Massachusetts can also receive reimbursement for special education costs of individual students above a high threshold and Medicaid (reimburses school districts for qualifying medical services).

[9]This might also incentivize over-classification to increase the performance of special education students as a whole. The state inspections and financial disincentives counter this incentive.

2012-13.[10] Schools are excluded from the study if they closed,[11] declined to participate,[12] had insufficient records,[13] did not have any oversubscribed lotteries,[14] or serve alternative students.[15] Appendix Table A1 describes the schools and application cohorts in the sample. In having near full coverage of an entire city's charter sector, including all grade levels, this paper overcomes the common criticism of lottery-based charter school studies that the set of schools that elect to share data might differ from the rest of the city's charters.

I match lottery records to state administrative education data for detailed student demographics, enrollment, and outcomes. This data provides both baseline characteristics of students from the time of the lottery and post-lottery outcomes. It includes special education status, disability type, and level of classroom inclusion for special education students and ELL status, native language, and test scores on the annual English proficiency exam for ELLs. I categorize ELL students as beginning, intermediate, or advanced English proficient using their English proficiency exam scores and state guidelines for the amount of services to provide ELLs. I study students with special needs classifications at the time of the lottery because special needs status can change over time. Throughout the paper, mentions of special education and ELL students refer to those with baseline classifications. Similarly, analysis by level of inclusion or English proficiency refers to baseline characteristics. More details about the data and matching procedure appears in the Data Appendix.

This paper's main analysis estimates the impact of charter school attendance on academic outcomes for students by their pre-lottery special needs status. As a result, applicants who are not enrolled in Massachusetts public schools the year of the lottery are excluded because they do not have a pre-lottery special needs status. This excludes 95.4% of pre-k applicants and 70.7% of

[10]The sample expands upon the 11 Boston charter schools included in Angrist, Pathak and Walters (2013) by incorporating charter elementary schools, adding nine additional charter middle and high schools, and extending the sample to include the 2011-12 through 2014-15 school years.

[11]Uphams Corner Charter School closed in 2009. Fredrick Douglas Charter School and Roxbury Charter High School both closed in 2005.

[12]Kennedy Academy for Health Careers (formerly Health Careers Academy) and Helen Davis Leadership Academy (formerly Smith Leadership Academy) declined to participate.

[13]Boston Renaissance and Dudley Street Neighborhood Charter School had insufficient records.

[14]UP Academy Dorchester opened in 2013-14 and did not have an oversubscribed lottery.

[15]Boston Day and Evening Academy Charter serves alternative students, including those who are overage for high school, dropouts, and students with behavioral and attendance issues. In addition to serving a different population than the other Boston charters, Boston Day and Evening Academy uses rolling admissions instead of a lottery, making the school not appropriate for this paper's empirical strategy.

kindergarten applicants. These excluded applicants are used to investigate the effect of attending a charter school on special needs initial classification.

1.4 Representation of Special Needs Students

Until recently, special needs students have been underrepresented among students applying to and attending charters. In 2010, the Massachusetts state legislature passed a law that required charter schools to increase efforts to recruit and retain special education and ELL students. Figure A1 shows that the special education application gap has narrowed for both middle and high school. In Spring 2004, 22.1 percent of BPS students in 4th and 5th grades had a special education status. Comparatively, only 17.0 percent of charter applicants in those grades had a special education status. By the Spring 2014 lottery, the prevalence of special education students in middle school charter lotteries was similar to BPS: 22.6 and 23.1 percent respectively. The gap also closed for high school, with 20.3 percent of applicants with a special education status in charters, compared to 19.5 percent of BPS 8th graders. Gaps in enrollment have also narrowed. Figure A1 shows that gaps between BPS and charters remain in middle school special education enrollment in entry grades, but special education students are overrepresented in 9th grade in charters.[16]

Gaps in ELL application and enrollment rates in BPS compared to charters were historically larger, but they have also narrowed. Figure A2 shows that in Spring 2004, ELL students were almost three times more prevalent in BPS than in charter middle and high school lotteries. In the past decade, ELLs have become more prevalent in BPS, and the gap has closed. By Spring 2014, ELLs have similar prevalence in BPS and charters: 24 percent in each for high school and 30 and 27 percent respectively for middle school.

Differences between the application and enrollment trends result from parental choices in response to other school options and the sibling lottery preference. Figures A1 and A2 show that the enrollment gaps have reversed for special education students in high school. The trends are noisier for ELL students, but the middle school ELL enrollment gap has almost halved from 18

[16] I do not display the application and enrollment trends for elementary school charters because a low proportion of pre-k and kindergarten charter applicants have a pre-lottery special needs status.

percent at its peak in 2007 to 9 percent in 2014. Similarly, the high school ELL enrollment gap has halved from 9.5 percent in 2009 to 4.3 percent in 2014. Because ELL students were historically underrepresented in charters, the sibling lottery preference means that ELL students have a lower likelihood of getting a charter offer compared to non-ELL students. This likely contributes to the current ELL enrollment gap.

By Spring 2014, students across the pre-lottery levels of special education classroom inclusion and English language proficiency are, for the most part, similarly represented in charter lotteries and BPS as shown in Figures A3 and A4. Small gaps remain for substantially separate inclusion students in middle school and high school and for beginning English speakers in high school.

2 Classification

2.1 Empirical Framework & Descriptive Statistics

I use charter lottery offers as instruments to estimate the causal effect of attending charter schools in a two-stage least squares setup. The second-stage equation links charter school attendance with outcomes as follows:

$$y_{igt} = \alpha_t + \beta_g + \sum_j \delta_j d_{ij} + X_i'\theta + \tau C_{igt} + \varepsilon_{igt} \tag{1}$$

where y_{igt} is the outcome of interest for student i in grade g in year t. The terms α_t and β_g represent outcome year and grade effects. The d_{ij} are dummy variables for all combinations of charter school lotteries (indexed by j) present in the sample (henceforth referred to as experimental strata). These experimental strata control for the fact that the set of school applications determines the probability of receiving an offer. Baseline demographic characteristics from the year of the lottery, represented by vector X_i, include gender, race, subsidized lunch status, ELL, special education, and a female-minority interaction.

The treatment variable, C_{igt}, equals one if the student enrolled in a charter any time following

the lottery and until the time schools reported special needs classification.[17] For models testing charter effects on college preparation measures and high school graduation, C_{igt} indicates charter enrollment between the lottery and the test or graduation date. Standard errors are clustered on the school, grade, and year of the outcome. The parameter τ captures the causal effect of charter school enrollment. I estimate the model separately for each baseline special needs status: special education, ELL, and non-special needs.

When estimating the math or English exam effects, C_{igt} represents years spent in a charter from the time of the lottery to the the test date. Students take exams in grades 3 through 8 and grade 10, so elementary and middle school applicants who appear in multiple testing grades contribute multiple observations to the estimation. To account for this, the standard errors, ε_{igt}, are clustered on the unique student identifier in addition to the school, grade, and year of the test. For math and English test results, the parameter τ estimates the causal effect of a year of charter school attendance.

I use two instruments for charter attendance: whether a student receives a random offer on the day of the lottery (immediate offer) or whether a student receives an offer from the randomly-ordered waitlist (waitlist offer). Z_{1i} is equal to one if the applicant received an immediate offer to attend a charter and zero otherwise. Z_{2i} designates whether the applicant received a waitlist offer. Appendix Table A1 details the schools and application cohorts with immediate and waitlist offers.

The first stage equation for the instrumental variables estimation is:

$$C_{igt} = \lambda_t + \kappa_g + \sum_j \mu_j d_{ij} + X_i'\Gamma + \pi_1 Z_{1i} + \pi_2 Z_{2i} + \eta_{igt}, \tag{2}$$

where π_1 and π_2 capture the effects of receiving immediate or waitlist offers on charter attendance. Like the second-stage equation, the first stage includes year and grade effects, experimental strata dummies, and baseline demographic controls.

Because they are randomly assigned, charter offers are likely to be independent of student

[17] Students for whom C_{igt} equals zero enroll in non-charter public schools, including traditional public schools, pilot schools, exam schools, and innovation schools. For simplicity, I refer to this group by the most common type: traditional public schools.

background and ability within experimental strata. The pre-lottery demographics and test scores are similar for offered and non-offered students, as shown in Columns (3) and (4) of Table 1. Differences in baseline characteristics by offer status are small, mostly statistically insignificant, and the p-values from joint tests are high. The subset of students with baseline special needs also have comparable characteristics across offer status, as seen in Columns (6) and (7) for special education and Columns (9) and (10) for ELL.

Differences between charter applicants and Boston Public School (BPS) students are documented in the first two columns of Table 1. Lottery applicants are less likely to have a special education status than BPS students. The two populations have similar rates of ELL students (though as discussed above, this is not historically true). All levels of English proficiency are more represented in charter applicants than in BPS students. Lottery applicants have slightly higher baseline test scores compared to BPS students (0.042 and 0.093 standard deviations in math and English respectively).

Columns (5) and (6) of Table 1 shows that BPS students and lottery applicants who have special education statuses at the time of the lottery have similar demographic characteristics. Columns (9) and (10) show that the BPS and charter applicant ELLs have similar rates of female, Latino, and reduced-price lunch students, but different rates of black students. Special education and ELL charter applicants have large achievement gaps relative to the general charter lottery applicant pool and have baseline test scores one standard deviation below the state mean. However, their average test scores are 0.16 to 0.018 standard deviations higher than special education and ELL students in BPS.

Despite the positive selection on test scores, the special education and ELL students who apply to charters represent a range of needs. The charter applicant pool includes students who receive high, moderate, and low levels of services, though students from substantially separate classrooms are slightly under represented and students from partial inclusion classrooms are slightly over represented in charter lotteries relative to BPS. Also, students of all levels of English proficiency are more prevalent in charter lotteries than in BPS.

Ten percent of both BPS and charter applicants have a specific learning disability, the most

common disability type (see Table A2).[18] Four percent of BPS and charter applicants also have the second most common disability, communication impairment, which includes articulation, language, or voice impairments and stuttering. Health, intellectual, physical, and sensory impairments and multiple disabilities each comprise under one percent of both BPS and charter applicant students and have similar rates in both populations. Autism, developmental delay, emotional impairment, and intellectual impairment each comprise one to three percent of the BPS population and are underrepresented in charter lotteries.[19]

Immigrant students comprise about a third of the ELL population in both BPS and charter lotteries (see Table A2). Elementary school-aged immigrant ELL students are more prevalent in charter lotteries than BPS while high school-aged immigrant ELL students are underrepresented. Spanish speakers comprise almost 60 percent of BPS students and charter applicants and 13 percent of the charter applicant sample. A variety of other languages comprise the rest of the ELL students, with Haitian Creole and Chinese as the next most common.

These summary statistics show that the study sample covers students with a wide range of special education and ELL characteristics including students with low baseline test scores, high levels of special education need, and low levels of English proficiency. Given that I cannot observe student motivation and parental knowledge of students' ability, it is possible that these applicants could be positively selected in unobservable ways compared to the general BPS student body.

2.2 Special Needs Classification

Receiving a lottery offer increases the likelihood of enrolling in a charter and the amount of time spent in a charter school (see Table A3 for these first stage estimates). Special needs applicants with immediate and waitlist offers spend approximately a year and 0.64 years longer respectively in charters compared to those without offers. Immediate and waitlist offers also boost the likelihood

[18]Federal law 34 C.F.R. §§300.7 and 300.541 defines specific learning disability as "a disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, that may manifest itself in an imperfect ability to listen, think, speak, read, write, spell, or to do mathematical calculations, including conditions such as perceptual disabilities, brain injury, minimal brain dysfunction, dyslexia, and developmental aphasia."

[19]For detailed information about disability type rates by grade-level group, see Table A2.

that special needs students will enroll in charters one year after the lottery by over 60 and 39 percentage points respectively.[20] Of those students that enroll in charters, they attend charters for an average of 3.0, 2.4, and 2.7 years respectively for elementary, middle, and high school in the data.

Charters remove special needs classifications and move special education students to more inclusive settings at the time of enrollment[21] at a higher rate than traditional public schools. Column (2) of Table 2 shows that applicants with a special education status at the time of the lottery are 11.8 percentage points more likely to have their classification removed in charters than in traditional public schools.[22] Charters even remove special education status from students with more severe disabilities: applicants from substantially separate classrooms are 17.3 percentage points less likely to keep their special education status in a charter compared to a traditional public school. The classification removal effects appear consistent across disability type, though the point estimates are noisy due to relatively smaller sample sizes (see Table A4).

Charters move special education applicants to more inclusive classrooms[23] 27.1 percentage points more often than traditional public school (see Column (10) of Table 2). This means that students spend more time in a general education classroom and less time receiving services outside of the mainstream classroom. Charters move students across all ranges of need to more inclusive settings. Charters increase inclusion for students from substantially separate classrooms 66.0 percentage points more (see Column (4) of Table 2) than traditional public schools. Instead, charters place these high-need students in full inclusion classrooms 27.4 percentage points more often than traditional public schools or remove their classification entirely (see Column (8) of Table 2). Charter enrollment leads to a significant increase in classroom inclusion across all disability types (see

[20]The first stage for charter enrollment does not equal one because some students with offers elect to go to traditional public schools and some students without offers ultimately enroll by moving off of a waitlist after our data was collected.

[21]Data is collected on October 1st. Given this short time span, schools likely do not have sufficient time to alter the initial classification given at the time of enrollment before the reporting date.

[22]I consider students to have their classifications removed if they had a classification the year of the lottery, have no classification on the October 1st following the lottery, and continue to have no classification for the next two years. I follow the same practice for changes in classroom inclusion.

[23]Increased inclusion includes removing classification, moving from substantially separate inclusion to partial or full inclusion, and moving from partial inclusion to full inclusion.

Table A4).

Charters remove ELL status at the time of enrollment 31.8 percentage points more often than traditional public schools (see Table 3). Students with intermediate and advanced English proficiency drive the differences in classification. Those with beginning English proficiency rarely have their ELL classification removed at the time of enrollment. The effects are not driven by a specific language: applicants that speak Spanish, Haitian Creole, and other languages each experience significantly lower rates of maintaining their ELL classification in charters (see Table A5).

Charters classify new enrollees to Massachusetts public schools (who have not yet been evaluated for special needs services in the state) as special needs less often than traditional public schools. Only 1.4 percent of applicants who attend a traditional public school become classified as special education at the time of enrollment.[24] Attending a charter leads to an even lower special education classification rate close to zero (see Column (2) of Table 2).[25]

Traditional public schools designate 63.7 percent of non-native English speakers, the potential candidates for ELL services, as ELL. The rate is 26.1 percentage points lower in charters (see Table 3).

The classification and inclusion effects are consistent across grade-level and appear to persist for two years, though with less precision (see Tables A6 - A8).

BPS moves 3.5 percent of special education applicants to less inclusive classrooms the Fall after the charter lottery and charters do so at a similar rate (see Columns (11) and (12) of Table 2).

2.3 Explanations for Classification Removal and Increased Inclusion Effects

Learning gains cannot justify the classification differences because the special needs status changes occur at the beginning of the school year following the lottery. At this point, schools have not had time to generate substantial learning gains.

[24]The state actively recruitments students with special needs for early intervention pre-k that starts at age 3. Therefore, a large portion of students who qualify for special education services at a young age already have a classification at the time of the lottery.

[25]I find that less than 0.8 percent of charter applicants who apply from a Massachusetts public school are designated special education for the first time in the fall after the lottery. Two years after the lottery, the rate of new classifications is around 3.5 percent. There is no significant difference in the classification of latent disabilities between the charter and traditional public schools.

Massachusetts law requires schools to assess the English proficiency of all incoming non-native English speaking students. Therefore, schools assess all incoming ELLs, but charters use their discretion when interpreting the English proficiency exam and remove ELL classification 2.8 times more often than traditional public schools. This supports the idea that charters have lower preference for ELL classification. The lower special education classification in charters for new pre-k and kindergarten students also implies that charters have a lower preference for classification compared to traditional public schools.

Unlike English language proficiency, Massachusetts does not require schools to assess all new enrolled students for special education needs. Therefore, factors other than schools' classification preferences could contribute to different special education classification practices. Better transfer of student records, which include special education information, between BPS district schools compared to between BPS district schools and charter schools plays a major role in special education classification changes. As a result, charters learn of special needs classifications from voluntary parental reporting before they receive school records. The initial reliance on parental reporting could contribute to fewer students maintaining their special education classifications in charters. A survey conducted by the Massachusetts Department of Elementary and Secondary Education that resulted from this study found that the most common reason for special education classification removal was parent(s) not disclosing.[26] The reasons why parents decline reporting special education status could include stigma, individual preferences, not knowing their child received special education services, assuming the school received the records, and not understanding what special education means. Additionally, parents can refuse their child's special education classification. Parental refusal of special needs status could differ in charters compared to traditional public schools.

Charters' preference for high levels of special education inclusion, often cited in charter schools' annual reports, likely also play a role in higher levels of inclusion. Additionally, the relatively

[26]The survey investigated all cases of special education classification removal in the 2012-13 through 2014-15 school years. All sample charters participated. Forty-nine percent of the cases cited parent(s) not disclosing. The other reasons include unknown (12 percent), record error (12), student found ineligible for services after lottery by BPS (8), student transferred out of charter soon after enrolling (7), parent declined services (7), student determined ineligible by charter (3), and charter gave services later in the year (2).

smaller size of charter schools make it less likely for them to have the economies of scale to provide substantially separate and partial inclusion services to students compared to traditional public schools.

2.4 Special Needs Inputs and Implications of Special Needs Reclassification

Students who have their special needs status removed have substantially different educational experiences than those that remain classified. Schools are only legally obligated to provide special education or ELL services to students with special needs classifications. Therefore, the higher rate of classification removal in charter schools likely results in baseline special needs students receiving fewer special education and ELL services. Additionally, students who are moved to more inclusive classrooms spend less time receiving services. Classification differences likely contribute to the large differences in special needs educational inputs between charter and BPS.

Students who enroll in charters experience lower special education and ELL staff-to-student ratios (Columns (4) and (6) of Table A10). Lottery applicants who enrolled in BPS have roughly 1.9 special education and 1.5 ELL staff per 100 students. Enrolling in a charter school exposes lottery applicants to 1.1 fewer special education staff and 1.3 fewer ELL staff per 100 students. Lower counts of special needs teachers drives the lower special needs staff-to-student ratio in charters.

Despite charters having fewer classified special needs students, they employ mostly similar proportions of special needs specialists[27] and content support teachers.[28] The similar rates of specialists in charters and traditional public schools suggest that either specialists work with students who remain classified more intensively or that they also serve students without special needs classifications. Charters also spend 44 percent less on special education instructional spending compared

[27]Special needs specialists include special education and ELL directors who oversee service provision, special education diagnosticians, therapists, and counselors.

[28]Content support teachers coach teachers in how to better serve those with special education needs or limited English proficiency in the classroom or teach alongside another teacher, providing additional attention and differentiation. They could more broadly help students without special education or ELL statuses who might also benefit from the additional attention or a more accessible learning environment. In particular, these interventions could help students with baseline special education and ELL statuses who had their classification removed.

to BPS (shown in Table A11).[29]

3 Academic Effects

Charter enrollment leads to two effects for special needs students: higher likelihood of classification removal and exposure to the charter school environment. The charter school environment and classification removal could have complementary or opposing effects. The high academic and strict behavior standards common in Boston charter schools could leave special needs students behind or motivate them to meet higher expectations. Special needs students could thrive in a more inclusive classroom environment or fall behind without the specialized services they previously received.

Prior research suggests no effect or limited gains from ELL classification removal (Chin, Daysal and Imberman, 2013; Pope, 2016; Matsudaira, 2005) except Robinson-Cimpian and Thompson (2015) who estimate a negative effect on when lower ability ELLs marginally qualify for classification removal. To the best of my knowledge, no causal evidence exists for special education classification removal.[30]

In this section, I present causal estimates of the effect of charter enrollment on special needs' students outcomes which bundles the two treatments of classification removal and charter environment. In Section 4, I estimate the academic effects of classification removal and the charter environment.

3.1 Charter School Effects

Test Score Effects

Charter school attendance has large positive effects for math and English state exam scores for students with special education or ELL status at the time of the lottery. Table 4 documents the

[29]Districts do not report ELL specific school expenditures. See Table A11 for detailed BPS and charter school expenditure and grant information.

[30]Using non-random movements of students in and out of special education programs, Hanushek, Kain and Rivkin (2002) find positive impacts on math test scores.

large and statistically significant gains for special needs applicants. A year of charter attendance increases math test scores by 0.261 standard deviations for special education applicants and by 0.326 standard deviations for ELL applicants. Charters generate English score gains of 0.205 and 0.241 standard deviations for special education and ELL applicants (shown in Table 4). Positive charter effects are statistically similar for special education and non-special needs students. Point estimates for ELLs are statistically significantly larger than non-special needs effects.

One year of charter attendance narrows the ELL achievement gap by 84 percent in math and 39 percent in English.[31] The larger gap between special education and non-special needs students narrows substantially as well. With one year of charter enrollment, the special education gap decreases by 30 percent in math and 20 percent in English.

The ordinary least squares (OLS) estimates (shown in Table A12) have comparable estimates to the two-stage least squares. This suggests that the OLS is unbiased in the sample of lottery applicants. Therefore, there is not significant selection into complying with the results of the lottery: accepting a charter offer if it is received and not attending a charter if the student does not receive an offer.

The reduced form or intent to treat estimates (shown in Table A12) also have comparable estimates to the two-stage least squares. Therefore, even without accounting for lottery compliance, randomly assigned charter offers have a strong positive relation to test scores.

The effects of charter attendance appear to accumulate in the first two years and then level off. The first year of charter attendance generates gains of 0.397 and 0.457 standard deviations in math for special education and ELL applicants respectively (see Figure A5). The charter enrollment effect nearly doubles for special education students and grows by 1.6 times for ELLs in the second year. After the third year, the charter effects stabilize and are comparable to the prior year. A similar pattern occurs for the English exam.[32]

The annual English proficiency exam – which schools use to reevaluate ELL students' classifi-

[31] Achievement gaps are calculated by comparing the ELL scores in charter and traditional public schools with the non-special needs student scores in traditional public school (using Table 4 estimates).

[32] This analysis focuses on middle school applicants because they take the state standardized exam in the three years following the lottery. The test schedule for elementary and high school applicants does not lend itself to this analysis.

cation and services – also suggests that charter schools improve English skills for ELLs. Attending a charter makes students 27.5 percentage points less likely to take the English proficiency exam because charters remove ELL status at higher rates than traditional public schools (see Column (2) of Table A13). Charters likely remove classification from the ELLs with relatively higher English proficiency: leading to negative selection. Therefore if traditional public schools and charters have the same effect on English language proficiency, charters would have a negative effect on English proficiency scores. Instead, charter students perform similarly or significantly better compared to traditional public school students. This suggests positive charter effects on English proficiency (see Column (4) of Table A13).

College Preparation and High School Graduation

Charters also have positive effects on longer-term outcomes that likely have a strong, lasting link to human capital and future earnings through educational attainment. Panel A of Table 5 shows that charter special education and ELL students are 24.4 and 36.7 percentage points respectively more likely to reach a key high school graduation requirement: reaching proficiency on the 10th grade math and English exams.[33] Students who do not meet this requirement need to fulfill remedial coursework to graduate. Therefore, fulfilling this requirement keeps students on the path towards high school graduation and enables them to take more college preparation courses.

Charters also boost the likelihood that special education students and ELL students will become eligible for the Adams state merit college scholarship by 11.3 percentage points and 28.7 percentage points each. The Adams Scholarship awards free tuition to Massachusetts public universities based on 10th grade math and English exams and has stricter conditions than the proficiency graduation requirement.

Evidence in Panel B of Table 5 suggests that charter enrollment has weak positive effects on college preparation exams for special needs students. Special needs charter and traditional public school students take the SAT at similar rates, but charter enrollment has a positive effect on the

[33]This requirement is called Competency Determination.

likelihood that ELL students score above a 900 out of 1600 on the SAT.[34] Only seven percent of ELL charter applicants score above 1000 on the SAT and the likelihood of reaching 1000 is not statistically significantly different among charter and traditional public school students. Estimates of charter enrollment's impact on special education students' scoring above 800, 900, and 1000 on the SAT are positive, but not statistically significant.

Special education and ELL students are 30.8 and 28.4 percentage points more likely to take at least one AP exam in charters compared to in traditional public schools (see Panel B of Table 5). However, there is no significant effect of charter enrollment on scoring a 3 or higher, which is required to earn college credit.

Charter enrollment lowers the likelihood that special education and ELL students will graduate high school in four years by 29.9 and 18.3 percentage points respectively, though the estimate for ELLs is not significant (see Panel C of Table 5). This is surprising given the gains in reaching the proficiency graduation requirement. Angrist et al. (2016) suggest that students could take longer to graduate from charters because they need additional time to meet charters' rigorous graduation requirements or because they choose to save money by remaining in high school for an additional year rather than taking remedial coursework in colleges.

Estimates of charters' effect on five-year graduation rates supports the theory that special needs students take longer to graduate from charter schools relative to traditional public schools: Panel D of Table 5 shows no significant difference between charter and traditional public school five-year graduation rates. However, the noisy negative estimates (0.123 and 0.093 percentage points lower likelihood of graduating in five years for special education and ELL students respectively) warrant additional investigation. The difference in graduation rates is not driven by differences in dropout rates. Instead, those special needs students who do not graduate in five years appear to transfer to other schools (Panel D of Table 5).

Special education students with high levels of need can qualify for transition services from age 18 - 22 if they remain enrolled in school. Therefore, remaining in school longer could be positive

[34]The SAT score results include math and verbal sections. They exclude the writing section because it was not required in all years of the sample.

since it provides them with supports to help ease the transition to adulthood through teaching life and job skills. The students who remain enrolled after four years of high school likely qualify for these supports: they have qualifying disabilities (intellectual, communication, emotional, or learning disabilities) and high levels of need (they were enrolled in substantially separate classrooms in eighth grade). Also, over 80 percent of special education charter applicants who do not graduate in five years transfer to alternative high schools or to traditional public schools that provide transitional services.

College Enrollment and Graduation

The Boston charter schools emphasize a college preparation curriculum. Table 6 investigates whether the focus on college, higher AP taking rates, and increased scholarship qualification translate into higher college enrollment and completion rates. Since charters have a negative effect on graduating high school on time, Panel A of Table 6 shows college enrollment within 18 months of students' projected high school graduation dates. Forty-seven percent of special education applicants and fifty-six percent of ELL applicants who attend traditional public schools enroll in college, compared to sixty-four percent of their general education peers (see Column (1), (3), and (5) of Panel A of Table 6). Charters generate positive effects on college enrollment, though estimates are noisy for special education and marginal for ELL students.

Of special education college enrollees from traditional public schools, slightly more than half choose four-year institutions over two-year colleges. About two-thirds of college-enrolled ELL applicants who attended traditional public schools choose four-year colleges. Charters nearly double the likelihood that ELL applicants enroll in a four-year college. The estimates for special education students are positive, but inconclusive. The increased four-year enrollment is driven by public, in-state college enrollment. Estimates of charter school effects on two-year enrollment are close to zero, but noisy for special needs students.

Charters have a noisy, positive effect on graduation from four-year colleges and a significant positive effect on two-year college graduation for special education applicants. The ELL applicant cohort that reaches college graduation age is too small to display college graduation findings.

Despite positive effects on initial college enrollment, Column (6) of Panel B of Table 6 shows noisy zero effects of charters on college graduation for general education students.

3.2 Heterogeneity

Charters generate test score gains for even the most disadvantaged special needs students. Panel A of Table 7 shows gains of 0.256 standard deviations in math for special education students with the highest need. Students with less severe needs, those who apply from partial and full inclusion classrooms, also experience gains of 0.328 and 0.269 standard deviations respectively. English exam gains for special education students are positive and of similar magnitude across level of inclusion, but they are imprecise for substantially separate and partial inclusion students.

Those with the lowest level of English proficiency experience math and English test score gains of over 0.400 standard deviations in charters as seen in Panel B of Table 7. Charters also generate math and English test score gains for ELLs with intermediate and advanced English proficiency.

Baseline test scores provide an alternative approach to analyze whether charters benefit the neediest students. Column (2) of Table 8 shows that the bottom third of special education students, as measured by their combined pre-lottery math and English exams, score 0.255 standard deviations higher in math and 0.189 in English in charter schools. Column (4) shows that charters also have positive effects for the bottom third of ELLs. While the higher-baseline performing students also experience charter gains, the bottom third of ELLs experience the largest gains for English.

Elementary, middle, and high school charter applicants all experience positive effects even though the characteristics of students with special education and ELL classifications vary across age groups (see Table A14).

Charter gains are strongest for those with specific learning disabilities, which comprise 40 percent among charter special education applicants (see Table A15). The severity of learning disabilities varies across lottery applicants: at the time of the lottery, thirty-seven percent of students with learning disabilities come from a full inclusion classroom, 44% from partial inclusion, and 19% from substantially separate classrooms. Charters generate significant math and English gains

for ELLs who speak Spanish and Haitian Creole, the most common native languages of applicants after English (shown in Table A16). While the other disability types and other languages are not prevalent enough to estimate alone, students with non-learning disabilities and ELLs who speak a language other than Spanish or Haitian Creole both experience significant gains in math (see Tables A15 and A16).

4 Mechanisms

4.1 Classification Removal and School Environment

Do the academic gains documented above stem from general charter school characteristics that affect all attendees or from classification removal and increased inclusion? Legal requirements and best practices operate under the assumption that special needs students require services and accommodations to succeed. Does charter classification removal and increased inclusion help or hinder special needs students?

The similar charter achievement effects for special needs and non-special needs students suggest that general charter school practices have a consistent effect for both groups. However, the similar effect sizes could mask differences in the mechanisms that led to the gains. For example, positive effects of general charter school practices for special needs students could outweigh negative effects of the classification changes.

Classification Removal

I find suggestive evidence that the general charter school environment drives the academic gains and find no negative effects of lower classification rates. Figure 1 plots the relationship between test score effects of each individual charter school cohort against their reclassification effects (see Online Appendix C.1 for the detailed estimation strategy). Charter school cohorts that experienced higher reclassification rates also had higher special needs student test outcomes: test score effects have a weak positive correlation with special education increased inclusion effects and ELL clas-

sification removal effects. Test score and special education classification removal effects have a positive relationship for English and an imprecise relationship for math.[35] The weak positive correlations suggest that classification removal and increased inclusion contribute positively to student growth, but cannot fully explain the charter test score gains. Therefore, school practices other than special needs classification and services likely play an important role.

To provide additional evidence, I estimate a model with three endogenous variables: years in charter, classification removal, and the interaction of years in charter and reclassification. The coefficients on these variables show the effect of a year of charter attendance holding classification constant, the effect of classification removal, and the differential effect of classification removal between charters and BPS. This estimation requires quasi-random variation in charter enrollment and student reclassification in charters and in BPS. Unlike the lottery which randomly offers students seats at charters, schools non-randomly make reclassification decisions based upon students' needs. To address this selection issue, I harness school-specific variation in reclassification rates and pre-lottery characteristics of charter applicants. I use individual charter lottery offers and the interaction of these offers with students' pre-lottery classification removal likelihood as instruments (See Online Appendix C.2 for the full estimation strategy).[36]

The two-stage least squares estimation suggests weak positive effects of classification removal, similar to Figure 1. However, the estimates are noisy estimates for the special education sample and the ELL sample suffers from a weak instrument problem. For increased precision, I estimate the Ordinary Least Squares (OLS) version with the same lottery applicant sample.[37] OLS yields similar, but more precise estimates compared to the two-stage least squares estimation (see Columns (2)

[35]If schools that remove classification and increase inclusion more are effective due to other practices then this exercise overstates the importance of reclassification. The relationship between non-special needs test score effects and charter school reclassification effects is small and insignificant for special education and ELL classification removal, but small, positive, and marginally significant for special education increased inclusion. Therefore, there is little evidence of other school practices correlated with classification removal and increased inclusion driving the correlation between reclassification and special needs academic effects (see Figure A6).

[36]Abdulkadiroglu, Angrist and Pathak (2014); Kling, Liebman and Katz (2007); Kline and Walters (2016); Cohodes (2015) also interact site-specific indicators and baseline characteristics with random or quasi-randomly assigned offers to generate new instruments to identify models with multiple endogenous variables.

[37]The similarity of the OLS and two-stage least squares estimates for the effect of charter attendance on test scores and on classification removal (compare Table 4 to Table A12 and Tables 2 and 3 to Tables A17 and A18) suggests that the OLS estimates are unbiased.

and (6) of Table 9). Holding classification constant, one year in a charter boosts math and English test scores of special needs lottery applicants by 0.2 to 0.3 standard deviations on average. Classification removal increases math test scores by 0.239 and 0.166 standard deviations for special education and ELL students respectively. English test scores increase by 0.321 and 0.196 standard deviations for special education and ELL students after classification removal. Special education classification removal has a similar effect in charters and traditional public schools. For ELLs, classification removal in charters has a smaller positive effect relative to classification removal in traditional public schools.

Using these results, I calculate the upper and lower bound of the effect of charter classification removal on test scores. Then, I scale the bounds by the charter classification removal effect: the percent of applicants who lost their classification in charters, but would have kept their classification in a traditional public school. This exercise shows that classification removal is linked to 0.003 to 0.063 standard deviation test score gains, which accounts for 0.9 to 25.4 percent of the charter test score effects. Therefore, both the relationships between test scores gains and classification removal and a multiple endogenous variable estimation approach suggest that the general charter school environment, and not classification removal, drive the special needs students' academic gains in charter schools.

School Quality

Charter schools that serve special needs students well also serve general education students well. Figure 2 displays the strong positive relationship between schools' special needs and non-special needs test score effects.

To contrast the relative importance of classification practices with overall school quality, I estimate a multiple endogenous two-stage least squares using years in charter, an index of school quality, and classification removal effects. I add the math and English two-stage least squares effects for non-special needs students for each individual charter school to create a school quality index (see Online Appendix C.1 for estimation strategy). The multiple endogenous variables estimates yield noisy estimates for classification removal and precisely positive estimates for school

quality. Enrolling in a school with a one standard deviation higher non-special needs student test score effect significantly increases special education and ELL students' math scores by 0.201 and 0.325 standard deviations), while classification removal has a noisy positive estimate (see Columns (3) and (7) of Table 9). The analogous OLS estimates show that classification removal has a similar effect to one standard deviation increase in school quality for special education math and a much smaller effect for ELL math and English. School quality has a smaller effect relative to classification removal on special education students' English outcomes. Since classification removal only affects a subset of students but school quality affects all applicants, even though the classification removal effects and the school quality effects have similar estimates for special education, school quality explains a larger portion of the charter test score gains. This analysis shows the importance of general education practices in explaining special needs' charter gains.

4.2 School Practices

Special needs students who apply and do not receive charter lottery offers attend schools with markedly different characteristics. Their BPS schools have more experienced, more licensed, and higher paid teachers and spend about $1,700 more per pupil relative to the Boston charter schools (see Table 10). Over half of Boston charters have a longer school year and over 95 percent of Boston charters have a longer school day compared to BPS.[38] Tutoring programs exist in all Boston charters and about a third of charters require tutoring for all students. Boston charters commonly use "No Excuses" practices, including high academic and behavior expectations, selective teacher hiring, frequent testing and teacher feedback, and data-driven instruction.

The set of school practices that positively correlate with charter school effectiveness for general education students also correlate with test score gains for special needs students. Column (3) of Table 10 displays the correlation between charter school special education math effects and school practices. Columns (4) and (5) display the analogous correlations for ELL and other students. An index of "No Excuses" school practices,[39] strict behavior code, longer school day, and emphasis

[38]BPS has 180 school days and 6.5 hours in the day.

[39]The "No Excuses" index includes equal weight for discussion of the following items in the annual school report:

for high expectations in academics, characteristics that Angrist, Pathak and Walters (2013); Dobbie and Fryer (2013) find linked to overall charter gains, are also positively correlated with special education and ELL student gains.

School characteristics that do not correlate with general education student gains, expenditure per pupil, student teacher ratio, teacher licensure, teacher experience, and teacher salary, also have a null or a negative effect on special needs student outcomes. Special needs school characteristics are weakly correlated with special needs charter effects (see Panel B of Table 10).

4.3 Peer Composition

Charter lotteries in the bottom quartile for special needs student representation have similar academic effects as those in the top quartile (see Table A19). The similar point estimates counter the idea that charter special needs gains stem from fewer special needs students in the classroom. Lotteries with an average of 41 percent of applicants with ELL status have over 0.2 standard deviation effects. Additionally, charter cohorts with the lowest special needs representation have gains of around 0.2 standard deviations, suggesting that economies of scale cannot fully explain the charter gains. The limited evidence that special needs economies of scale correlating with academic effects further supports the importance of general school practices in explaining special needs charter gains.

5 Conclusion

Enrolling in a Boston charter school exposes students to a dual treatment. Lottery estimates find that Boston charter schools remove special education and English Language Learner classifications at a higher rate than traditional public schools and move special education students to more inclusive classrooms. Additionally, students experience the charter environment, including a set

high expectations for academics, high expectations for behavior, strict behavior code, college preparatory curriculum, core values in school culture, selective teacher hiring or incentive pay, emphasis on math and reading, uniforms, hires Teach for America teachers, Teaching Fellows, or AmeriCorps members, affiliated with Teach for America alumni, data driven instruction, and regular teacher feedback.

of general education practices including high intensity tutoring, increased instructional time, high expectations, and data driven instruction.

Using randomized admission lotteries, this paper finds strong positive net effects of Boston charter schools' dual treatment for special education and English Language Learner students. Charters generate substantial gains for special needs students in math and English standardized exams, English proficiency, and college preparation, enrollment, and completion outcomes. Even the most disadvantaged special needs students perform better in charter schools compared to traditional public schools.

Charter attendance substantially decreases the special needs achievement gap. Among students attending BPS schools, special education students and ELL students score about 0.87 and 0.39 standard deviations respectively below non-special needs students in math. Since charters generate math gains of 0.268 standard deviations for special education students, one year in a charter reduces the special education achievement gap by 30.8 percent. ELL students score 0.345 standard deviations higher in charters, narrowing the ELL achievement gap by 88.4 percent.

The findings show that schools can boost special needs students' academic outcomes without the traditional set of special needs services. Frequent use of tutoring and data-driven instruction enables charters to identify and provide support to struggling students, regardless of special needs status. "No Excuses" school practices, strict behavior code, longer school day, and emphasis on high academic expectations positively correlate with charter school effectiveness for special needs and general education students.

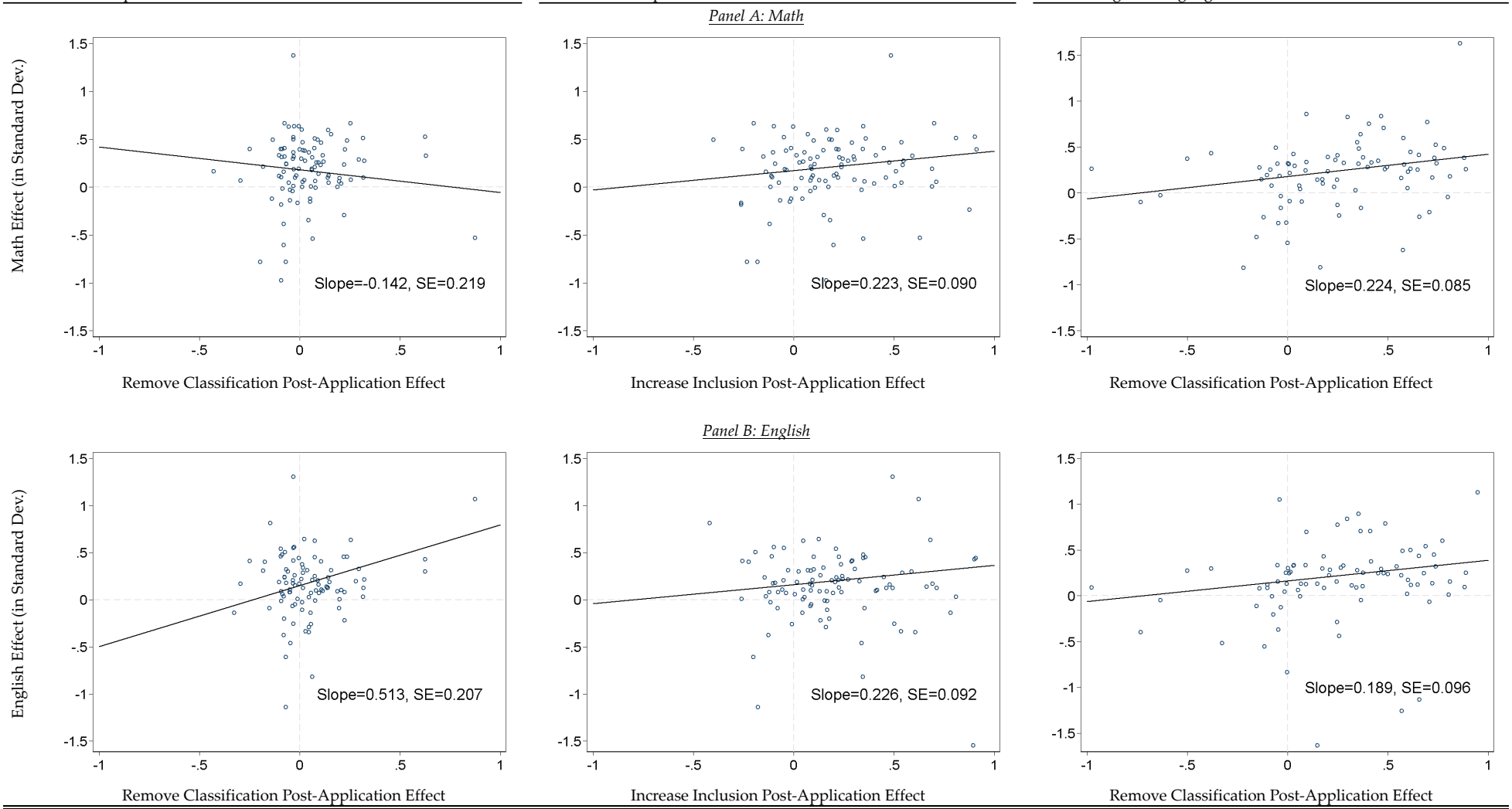
I find no evidence that classification removal or increased inclusion lowers outcomes for students. Classification removal and increased inclusion can explain between 1 and 25 percent of the special needs achievement effects. Charter schools that generate large non-special needs student gains also generate gains for special needs students. Together, these findings imply that elements of the charter school experience that affect all students, not just those classified as having special needs, drive the positive gains for special needs students.

It is worth noting that the results apply to Boston charter lottery applicants. While special needs students are currently well represented in the charter lotteries, Boston charters could have different

effects for the students who do not apply. By extension, my estimates may not reflect the effects of expanding the number of seats in Boston's charter sector or requiring charters to recruit more special needs students. Similarly, it is unknown whether these results extend to other locations: the set of general education practices employed by Boston charter schools are common among urban charter schools, but the special education and English Language Learner practices of charter schools are not well documented.

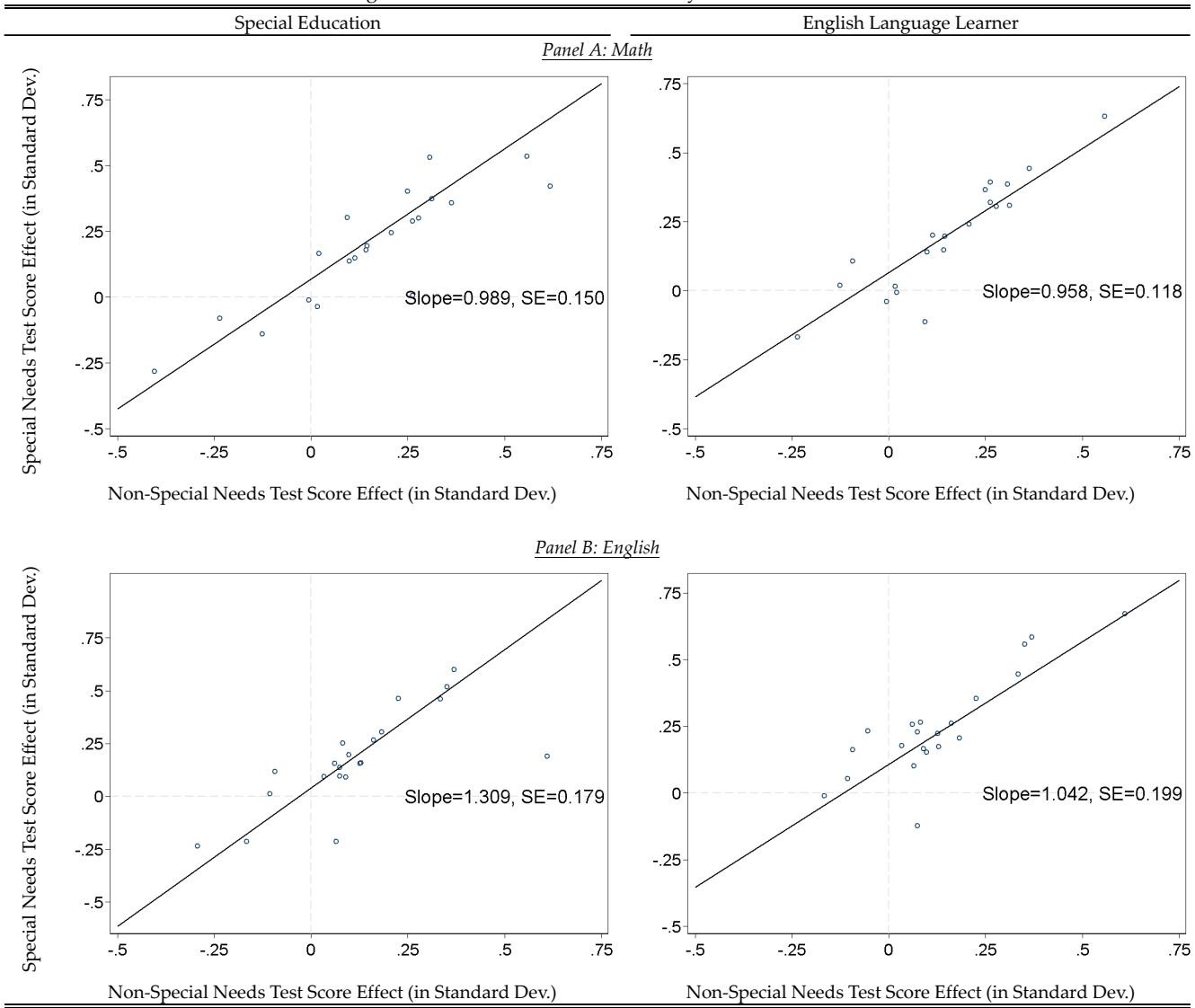
This study highlights the importance of high quality general education practices as an effective policy lever to improve special education students' and English Language Learners' outcomes. I cannot comment on the impact of an ideal implementation of specialized services or general education practices, only on one city's practices. The finding that special education students and English Language Learners can make large academic gains without specialized services in a high quality general education program calls for greater attention to general practices, in addition to the current focus on specialized supports, to improve special needs students' outcomes.

Figure 1: Correlations of Reclassification and Academic Effect Sizes by School x Cohort



Notes: This figure plots the school-specific math and English Ordinary Least Squares (OLS) effects of years in charter schools for special needs students against the school-specific post-application special needs reclassification OLS effects of charter enrollment by the fall following the lottery. The figure plots elementary, middle, and high school estimates. Each dot represents a charter school application cohort. Experimental strata with samples too small to estimate are not displayed. The fitted line is the regression of the test score effect on the reclassification effect, weighted by the inverse of the average variance of the effects.

Figure 2: Correlations of Effect Sizes by School x Cohort



Notes: This figure plots the school-specific math and English Ordinary Least Squares effects of years in charter schools for special needs students and non-special needs students. The figure plots elementary, middle, and high school estimates. Each dot represents a charter school application cohort. Experimental strata with samples too small to estimate are not displayed. The fitted line is the regression of the special needs test score effect on the non-special needs test score effect, weighted by the inverse of the average variance of the effects.

Table 1: Descriptive Statistics and Covariate Balance

	Boston Public Schools (BPS) Students	All Lottery Applicants			Special Education at Baseline				English Language Learner at Baseline			
Baseline Charateristics	Mean (1)	Non-Offered Mean (2)	Immediate Offer (3)	Any Offer (4)	BPS Mean (5)	Non-Offered Mean (6)	Immediate Offer (7)	Any Offer (8)	BPS Mean (9)	Non-Offered Mean (10)	Immediate Offer (11)	Any Offer (12)
Female	0.480	0.503	0.010	0.001	0.337	0.342	0.012	0.013	0.471	0.482	0.006	-0.012
			(0.013)	(0.013)			(0.030)	(0.030)			(0.028)	(0.028)
Black	0.392	0.461	-0.023	-0.017	0.450	0.477	0.005	-0.006	0.191	0.269	0.009	-0.002
			(0.013)	(0.013)			(0.031)	(0.031)			(0.025)	(0.024)
Latino/a	0.363	0.369	0.013	0.005	0.360	0.360	-0.015	-0.016	0.627	0.624	-0.035	-0.004
			(0.012)	(0.012)			(0.029)	(0.029)			(0.027)	(0.027)
Subsidized Lunch	0.753	0.749	0.002	-0.007	0.797	0.757	0.031	0.012	0.847	0.844	-0.003	0.001
			(0.011)	(0.011)			(0.024)	(0.025)			(0.020)	(0.018)
Baseline Math Test Score	-0.449	-0.407	0.016	-0.012	-1.181	-1.002	-0.012	0.018	-0.820	-0.736	0.017	-0.047
			(0.027)	(0.027)			(0.066)	(0.066)			(0.057)	(0.055)
Baseline English Test Score	-0.548	-0.455	-0.028	0.004	-1.424	-1.214	-0.036	0.062	-1.142	-0.980	-0.028	-0.003
			(0.028)	(0.028)			(0.069)	(0.068)			(0.062)	(0.060)
Special Education	0.226	0.192	0.007	-0.002	1.000	1.000	-	-	0.212	0.190	-0.008	0.001
			(0.011)	(0.011)			-	-			(0.022)	(0.022)
Substantially Separate Classroom	0.080	0.050	0.005	-0.004	0.355	0.260	0.016	-0.017	0.088	0.067	-0.021	-0.008
			(0.005)	(0.006)			(0.025)	(0.026)			(0.011)	(0.012)
Partial Inclusion	0.056	0.057	0.008	0.002	0.249	0.296	0.021	0.014	0.058	0.059	0.015	0.011
			(0.007)	(0.007)			(0.030)	(0.030)			(0.016)	(0.015)
Full Inclusion	0.093	0.082	-0.005	-0.001	0.411	0.425	-0.035	-0.004	0.076	0.061	0.000	-0.001
			(0.007)	(0.007)			(0.030)	(0.030)			(0.014)	(0.013)
English Language Learner	0.231	0.258	-0.008	-0.003	0.217	0.254	-0.023	-0.010	1.000	1.000	-	-
			(0.011)	(0.011)			(0.026)	(0.026)			-	-
Beginning Proficiency	0.017	0.025	-0.006	-0.007	0.015	0.024	-0.007	-0.006	0.073	0.098	-0.019	-0.028
			(0.003)	(0.003)			(0.006)	(0.005)			(0.012)	(0.013)
Intermediate Proficiency	0.071	0.121	0.002	0.005	0.094	0.144	0.008	-0.002	0.306	0.465	0.033	0.035
			(0.009)	(0.008)			(0.022)	(0.022)			(0.028)	(0.027)
Advanced Proficiency	0.049	0.058	0.001	0.004	0.026	0.029	-0.009	0.001	0.205	0.216	0.010	0.018
			(0.008)	(0.007)			(0.015)	(0.013)			(0.027)	(0.027)
Observations with School/Offer Type	194712	7591	5085	10408	43918	1458	1007	2076	44998	1956	1119	2188
P-value			0.661	0.661			0.592	0.924			0.499	0.995

Notes: This table shows descriptive statistics for Boston Public School (BPS) students and charter lottery applicants. Column (1) shows means for BPS attendees in charter application grades (Pre-K, K, 1, 3, 4, 5, and 8) for 2003-04 through 2013-14. Column (2) shows means for charter lottery applicants who did not receive offers. Columns (3) and (4) report coefficients from regressions of observed characteristics on immediate offers and any offers, controlling for experimental strata dummies. P-values come from tests of whether all non-test score coefficients equal zero. Baseline test scores are only available applicants to the 4th grade or higher. Columns (5) through (12) report analogous results for the subsample with special education classification and ELL classification in the lottery application year.

Table 2: Effect of Charter Enrollment on Special Education Classification

		Any Special Education		Substantially Separate Classroom		Partial Inclusion		Full Inclusion		Classification Removed or Moved to More Inclusive Classroom		Moved to Less Inclusive Classroom	
Baseline Status		Trad. Public mean (1)	Charter effect (2)	Trad. Public mean (3)	Charter effect (4)	Trad. Public mean (5)	Charter effect (6)	Trad. Public mean (7)	Charter effect (8)	Trad. Public mean (9)	Charter effect (10)	Trad. Public mean (11)	Charter effect (12)
All Special Education		0.890	-0.118							0.151	0.271	0.035	0.001
			(0.032)								(0.035)		(0.014)
	N		3153								3153		3153
Substantially Separate Classroom		0.967	-0.173	0.834	-0.660	0.049	0.028	0.051	0.274	0.114	0.380		
			(0.036)		(0.065)		(0.039)		(0.052)		(0.063)		
	N		808								808		
Partial Inclusion		0.914	-0.079			0.627	-0.526	0.173	0.374	0.225	0.409	0.024	-0.004
			(0.048)				(0.069)		(0.063)		(0.066)		(0.021)
	N		1004								1004		1004
Full Inclusion		0.823	-0.126					0.617	-0.029	0.117	0.080	0.070	0.016
			(0.052)						(0.062)		(0.043)		(0.028)
	N		1278								1278		1278
New Students to MA Public Schools (No Prior Special Ed. Evaluation)		0.014	-0.011	0.001	-0.002	0.003	0.003	0.008	-0.008				
			(0.006)		(0.002)		(0.004)		(0.005)				
	N		2665										

Notes: This table reports two-stage least squares estimates of the effects of Boston charter enrollment on special education classification and level of classroom inclusion in the fall following the charter lottery. Traditional public means show the proportion of charter applicants that do not enroll in charter schools with a given special education status. Immediate and waitlist offer dummies instrument for enrollment in charter schools. Estimation is run separately for each baseline classroom inclusion type. Students in full inclusion spend less than 21% of their time outside of the general education classroom. Partial inclusion students spend between 21% to 60% of their time in a separate setting, and substantially separate students spend over 60% of their time receiving special education services. Moved to a more inclusive classroom reflects moving from substantially separate to partial or full inclusion or moving from partial to full inclusion. Effects persist for up to two years following the charter application. All models control for gender, ethnicity, female x minority interaction, baseline special education, baseline ELL, baseline subsidized lunch, experimental strata, year-applied dummies, and grade-applied dummies. Standard errors are clustered by school-grade-year.

Table 3: Effect of Charter Enrollment on English Language Learner Classification

		Remain English Language Learner	
		Trad. Public mean	Charter effect
Baseline Status		(1)	(2)
All English Language Learners		0.825	-0.318
			(0.044)
	N		3763
Beginning Proficiency		0.996	-0.037
			(0.030)
	N		287
Intermediate Proficiency		0.954	-0.343
			(0.055)
	N		1810
Advanced Proficiency		0.589	-0.270
			(0.076)
	N		1008
New Non-native English Speaking Students		0.637	-0.261
(No Prior English Lang. Learner Evaluation)			(0.061)
	N		856

Notes: This table reports two-stage least squares estimates of the effects of Boston charter enrollment on English Language Learner classification in the fall following the charter lottery. Immediate and waitlist offer dummies instrument for enrollment in charter schools. Estimation is run separately by baseline English proficiency level. Effects persist for up to two years following the charter application. Standard errors are clustered by school-grade-year. See Table 2 notes for detailed regression specifications.

Table 4: Test Score Effects of Years in Charter by Baseline Special Needs Status

		Special Education		English Language Learner		Non-Special Needs	
		Trad. Public mean	Charter effect	Trad. Public mean	Charter effect	Trad. Public mean	Charter effect
		(1)	(2)	(3)	(4)	(5)	(6)
Math		-0.982	0.261	-0.503	0.326	-0.113	0.268
			(0.053)		(0.045)		(0.023)
	N		4824		5404		16643
English		-1.146	0.205	-0.728	0.241	-0.113	0.163
			(0.054)		(0.043)		(0.022)
	N		4829		5416		16622

Notes: This table reports the two-stage least squares estimates of the effects of years spent in charter schools on test scores. Traditional public means show the average score of charter applicants that do not enroll in charter schools. Immediate and waitlist offer dummies instrument for years spent in charter schools. Columns (1) and (2) show estimates for applicants with baseline special education status, columns (3) and (4) for applicants with baseline English Language Learner classification, and Columns (5) and (6) for other students. All models control for gender, ethnicity, female x minority interaction, baseline special education, baseline ELL, baseline subsidized lunch, experimental strata, year-applied dummies, and grade-applied dummies. Estimates pool post-lottery outcomes for test-taking grades. Standard errors are clustered by student identifier and school-grade-year.

Table 5: Effects of Charter Enrollment on College-Preparedness and High School Completion by Special Needs Status

	Special Education		English Language Learner		Non-Special Needs	
	Trad. Public mean (1)	Charter effect (2)	Trad. Public mean (3)	Charter effect (4)	Trad. Public mean (5)	Charter effect (6)
Panel A: High School Performance						
Meet High School Proficiency Graduation Requirement	0.376	0.244	0.561	0.367	0.766	0.154
		(0.110)		(0.162)		(0.054)
Eligible for State Merit Scholarship	0.042	0.113	0.128	0.287	0.257	0.340
		(0.051)		(0.129)		(0.058)
N		1007		484		3892
Panel B: SAT and AP Exams						
Take SAT	0.433	0.090	0.561	-0.005	0.632	0.124
		(0.100)		(0.160)		(0.054)
SAT Score 800 or Higher	0.133	0.054	0.264	0.089	0.463	0.205
		(0.077)		(0.148)		(0.057)
SAT Score 900 or Higher	0.070	0.067	0.137	0.216	0.302	0.194
		(0.059)		(0.109)		(0.055)
SAT Score 1000 or Higher	0.032	0.039	0.071	-0.066	0.168	0.131
		(0.041)		(0.100)		(0.045)
Take AP	0.100	0.308	0.325	0.284	0.349	0.279
		(0.081)		(0.150)		(0.059)
Number of AP Exams	0.188	0.526	0.772	-0.030	0.823	1.016
		(0.186)		(0.586)		(0.218)
AP Score 3 or Higher	0.039	0.058	0.148	0.020	0.155	0.112
		(0.048)		(0.143)		(0.048)
N		1369		691		4685
Panel C: High School Graduation						
Graduate in Four Years	0.567	-0.299	0.656	-0.183	0.701	-0.013
		(0.105)		(0.137)		(0.048)
N		1369		691		4685
Panel D: Status in Year After Projected Four-Year High School Graduation						
Graduate in Five Years	0.666	-0.123	0.726	-0.093	0.778	0.056
		(0.101)		(0.122)		(0.044)
Remain Enrolled in Same School	0.083	0.046	0.045	-0.009	0.036	-0.030
		(0.065)		(0.062)		(0.027)
Transfer to Another School	0.090	0.090	0.109	0.108	0.078	-0.011
		(0.045)		(0.074)		(0.026)
Drop out of High School	0.151	-0.030	0.121	-0.005	0.106	-0.025
		(0.070)		(0.083)		(0.030)
N		1185		546		4188
Panel E: Status in Two Years After Projected Four-Year High School Graduation						
Graduate in Six Years	0.685	-0.037	0.727	-0.065	0.798	0.029
		(0.098)		(0.134)		(0.044)
N		961		363		3579

Notes: This table reports the two-stage least squares estimates of the effects of charter enrollment on longer-term outcomes. Immediate and waitlist lottery offer dummies instrument for any charter enrollment by the end of 10th grade. The 10th-grade state standardized exam score determines whether students meet the high school proficiency graduation requirement (called Massachusetts Competency Determination) and the State Merit College Scholarship (John and Abigail Adams Scholarship). The latter has higher standards for eligibility. SAT scores are out of 1600 and include the math and verbal sections. Students who do not take the SAT are coded as "0" for the SAT score indicator variables. Panel A's sample includes students projected to graduate in Spring 2008 – 2016. Panel B and four-year graduation includes students projected to graduate in Spring 2008 - 2017. Panel D is restricted to students projected to graduate in 2008 – 2016. Panel E is restricted to students projected to graduate in 2008 – 2015. All models control for gender, ethnicity, female x minority interaction, baseline special education, baseline ELL, baseline subsidized lunch, experimental strata, year-applied dummies, and grade-applied dummies. Standard errors are clustered by 10th grade school and year.

Table 6: Effects of Charter Enrollment on College Enrollment and Graduation by Special Needs Status

	Special Education		English Language Learner		Non-Special Needs	
	Trad. Public mean	Charter effect	Trad. Public mean	Charter effect	Trad. Public mean	Charter effect
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: College Enrollment within 18 Months of Projected 4-Year High School Graduation						
Any	0.470	0.060	0.558	0.254	0.639	0.145
		(0.106)		(0.160)		(0.054)
Two-year	0.248	0.014	0.230	-0.012	0.202	-0.072
		(0.100)		(0.128)		(0.046)
Four-year	0.254	0.099	0.377	0.300	0.486	0.187
		(0.098)		(0.155)		(0.055)
Four-year Public	0.098	0.128	0.185	0.337	0.219	0.128
		(0.081)		(0.159)		(0.053)
Four-year Private	0.171	-0.046	0.220	-0.036	0.292	0.055
		(0.092)		(0.150)		(0.062)
Four-year Public in MA	0.087	0.111	0.179	0.318	0.190	0.102
		(0.076)		(0.159)		(0.053)
N		1207		550		4280
Panel B: College Graduation in Four Years						
Any	0.094	0.123			0.182	-0.021
		(0.095)				(0.061)
Two-year	0.039	0.117			0.057	-0.003
		(0.055)				(0.034)
Four-year	0.077	0.105			0.174	-0.024
		(0.083)				(0.061)
N		625				2544

Notes: This table reports the two-stage least squares estimates of the effects of charter enrollment on college enrollment and graduation. Immediate and waitlist lottery offer dummies instrument for any charter enrollment by the end of 10th grade. College enrollment and graduation data come from the National Student Clearinghouse. Panel A investigates college enrollment for students projected to graduate high school in Spring 2008 - 2016. Panel B displays estimates for college graduation for students projected to graduate high school in Spring 2008 - 2014. All models control for gender, ethnicity, female x minority interaction, baseline special education, baseline ELL, baseline subsidized lunch, experimental strata, year-applied dummies, and grade-applied dummies. Standard errors are clustered by 10th grade school and year.

Table 7: Test Score Effects of Years in Charter for Special Needs Subgroups

Panel A: Baseline Special Education Level of Classroom Inclusion

		Substantially Separate Classroom		Partial Inclusion		Full Inclusion	
		Trad. Public mean	Charter effect	Trad. Public mean	Charter effect	Trad. Public mean	Charter effect
		(1)	(2)	(3)	(4)	(5)	(6)
Math		-1.392	0.256	-1.148	0.328	-0.606	0.269
			(0.114)		(0.093)		(0.072)
	N		1004		1656		2090
English		-1.614	0.204	-1.243	0.171	-0.791	0.216
			(0.135)		(0.104)		(0.065)
	N		1004		1658		2092

Panel B: Baseline English Language Learner English Proficiency Level

		Beginning Proficiency		Intermediate Proficiency		Advanced Proficiency	
		Trad. Public mean	Charter effect	Trad. Public mean	Charter effect	Trad. Public mean	Charter effect
		(1)	(2)	(3)	(4)	(5)	(6)
Math		-1.392	0.404	-0.652	0.370	-0.129	0.296
			(0.138)		(0.062)		(0.072)
	N		289		2710		1799
English		-1.961	0.498	-0.904	0.315	-0.251	0.162
			(0.145)		(0.057)		(0.063)
	N		292		2719		1801

Notes: This table reports two-stage least squares estimates of the effects of years spent in charter schools for baseline special needs subgroups: by special education level of classroom inclusion and by English proficiency level. The sample includes elementary, middle, and high school lottery applicants. Standard errors are clustered by student identifier and school-grade-year. See Table 4 notes for detailed regression specifications.

Table 8: Test Score Effects of Years in Charter by Pre-lottery Test Performance and Special Needs Status

	Special Education		English Language Learner		Non-Special Needs	
Pre-lottery Test Performance within Special Needs Status	Trad. Public mean (1)	Charter effect (2)	Trad. Public mean (3)	Charter effect (4)	Trad. Public mean (5)	Charter effect (6)
			Panel A: Math			
Bottom third	-1.699	0.255	-1.337	0.248	-0.905	0.357
		(0.088)		(0.090)		(0.040)
N		1360		1491		5077
Middle third	-1.067	0.219	-0.539	0.334	-0.100	0.284
		(0.078)		(0.065)		(0.032)
N		1540		1613		5285
Top third	-0.302	0.314	0.254	0.328	0.592	0.185
		(0.069)		(0.061)		(0.026)
N		1597		1706		5123
			Panel B: English			
Bottom third	-1.812	0.189	-1.474	0.400	-0.789	0.175
		(0.110)		(0.073)		(0.040)
N		1418		1486		5021
Middle third	-1.187	0.114	-0.722	0.305	-0.080	0.173
		(0.077)		(0.076)		(0.028)
N		1487		1580		5224
Top third	-0.443	0.131	0.009	0.140	0.451	0.106
		(0.064)		(0.056)		(0.026)
N		1592		1617		5213

Notes: This table reports the two-stage least squares estimates of the effects of years spent in charter schools on test scores by baseline test performance and special needs status. Columns (1) and (2) report estimates for the baseline special education students by terciles of their baseline math and English test scores. Columns (3) and (4) report these estimates for baseline English Language Learners and Columns (5) and (6) for baseline non-special needs students. The sample includes elementary, middle, and high school lottery applicants. Standard errors are clustered by student identifier and school-grade-year. See Table 4 notes for detailed regression specifications.

Table 9: Multiple Endogenous Variable Test Score Estimates

	Special Education Test Scores				English Language Learner Test Scores			
	Endogenous Variables Include: Classification Removal		Endogenous Variables Include: School Quality		Endogenous Variables Include: Classification Removal		Endogenous Variables Include: School Quality	
	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS
Endogenous Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
				Panel A: Math				
Charter Enrollment	0.204	0.229	0.164	0.187	0.344	0.292	0.212	0.206
	(0.040)	(0.018)	(0.039)	(0.016)	(0.049)	(0.027)	(0.040)	(0.017)
First-stage F	9.213		8.786		4.330		5.477	
Remove Classification	0.275	0.231	0.334	0.214	0.537	0.124	0.130	0.028
	(0.339)	(0.071)	(0.360)	(0.056)	(0.233)	(0.043)	(0.115)	(0.032)
First-stage F	8.567		10.178		1.040		26.639	
Charter X Remove Classification	0.014	-0.031			-0.222	-0.071		
	(0.100)	(0.049)			(0.119)	(0.033)		
First-stage F	13.623				3.026			
School Quality Index			0.201	0.203			0.325	0.337
			(0.070)	(0.029)			(0.079)	(0.044)
First-stage F			9.662				13.826	
Overid. p-value	0.210		0.346		0.046		0.157	
N			3693				3830	
				Panel B: English				
Charter Enrollment	0.167	0.193	0.154	0.176	0.279	0.224	0.195	0.176
	(0.043)	(0.018)	(0.042)	(0.018)	(0.051)	(0.022)	(0.046)	(0.017)
First-stage F	9.472		8.920		4.296		5.371	
Remove Classification	0.315	0.319	0.324	0.270	0.467	0.159	0.228	0.085
	(0.341)	(0.065)	(0.356)	(0.057)	(0.255)	(0.043)	(0.122)	(0.034)
First-stage F	8.434		10.152		1.104		27.272	
Charter X Remove Classification	-0.004	-0.057			-0.128	-0.051		
	(0.115)	(0.048)			(0.129)	(0.030)		
First-stage F	13.358				3.037			
School Quality Index			0.062	0.071			0.222	0.187
			(0.075)	(0.031)			(0.080)	(0.037)
First-stage F			9.689				14.057	
Overid. p-value	0.398		0.409		0.025		0.036	
N			3705				3844	

Notes: This table displays multiple endogenous variable two-stage least squares (2SLS) and Ordinary Least Squares (OLS) estimates of two separate models which investigate mechanisms behind the charter test score effects. Columns (1) and (5) display the 2SLS estimates of a model with three endogenous variables: years in charter, classification removal by the fall following the lottery, and the interaction of the two. Columns (3) and (7) display the 2SLS estimates of a model with the following endogenous variables: years in charter, classification removal by the fall following the lottery, and a school quality index. The school quality index is the sum of the non-special needs math and English individual school 2SLS effects relative to Boston Public Schools. Instruments for both models include individual charter offers and individual charter offers interacted with a predicted reclassification index. See the online appendix for details about the predicted reclassification index. The even numbered columns display the OLS version of the previous column.The sample includes middle, and high school lottery applicants with baseline test scores and special education or ELL classifications at the time of the charter application. All models control for gender, ethnicity, female x minority interaction, baseline special education, baseline ELL, baseline subsidized lunch, experimental strata, year-applied dummies, and grade-applied dummies. Estimates pool post-lottery outcomes for test-taking grades. Standard errors are clustered by student identifier and school-grade-year.

Table 10: School Characteristics and their Correlation with Individual Charter School Test Score Effects

			Correlates of School Practices and Charter Effectiveness by Special Needs Group		
School Practices	Boston Public Schools Mean (1)	Charter Sample Mean (2)	Special Education (3)	English Language Learner (4)	Non-Special Needs (5)
Panel A: General School Characteristics					
"No excuses" index		0.826	0.285	0.505	0.884
		(0.120)	(0.446)	(0.104)	(0.304)
Strict behavior code		0.818	0.187	0.194	0.247
		(0.395)	(0.094)	(0.042)	(0.072)
Longer school year		0.591	-0.010	0.130	-0.036
		(0.503)	(0.065)	(0.078)	(0.061)
Longer school day		0.955	0.335	0.409	0.433
		(0.213)	(0.032)	(0.051)	(0.025)
Emphasize high academic expectations		0.955	0.335	0.409	0.433
		(0.213)	(0.032)	(0.051)	(0.025)
Total per pupil expenditure	$18,766	$17,079	0.000	0.000	0.000
		($2,438)	(0.000)	(0.000)	(0.000)
Student to teacher ratio	12.678	12.126	-0.006	-0.015	-0.008
	(1.790)	(3.092)	(0.015)	(0.004)	(0.012)
% of Teachers licensed in teaching assignment	94.974	52.265	-0.003	-0.005	-0.003
	(4.554)	(17.173)	(0.002)	(0.003)	(0.001)
Years of teaching experience in Massachusetts	12.353	2.625	-0.023	-0.085	-0.061
	(3.355)	(1.489)	(0.026)	(0.029)	(0.016)
Average teacher salary	$78,237	$65,380	0.000	0.000	0.000
		(10774.157)	(0.000)	(0.000)	(0.000)
Panel B: Special Needs School Characteristics					
Special education compliance index	0.685	0.723	-0.323		
		(0.041)	(0.517)		
English Language Learner compliance index	0.511	0.696		0.335	
		(0.066)		(0.629)	
Special education remove classification effect		0.068	-0.069		
		(0.111)	(0.419)		
Special education increased inclusion effect		0.225	0.379		
		(0.229)	(0.194)		
English Language Learner remove classification effect		0.300		0.347	
		(0.193)		(0.260)	
Special education instructional spending per pupil	$2,299	$988	0.000		
	(2,008)	(519)	(0.000)		
Special needs staff to student ratio	0.030	0.015	-1.445	6.048	
	(0.012)	(0.011)	(4.034)	(4.894)	
N	114	22		22	

Notes: This table reports coefficients from regressions of school-specific treatment effects for each special needs subgroup on 2012-13 school practices in Columns (3) - (5) (one regression for each school practice and student type combination). School-level BPS data is weighted by the proportion of lottery applicants who enrolled in the school. Only district-level data was available for total per pupil expenditure and the compliance indices. All costs are in 2015 CPI-U adjusted dollars. Column (2) displays the mean characteristics for sample charter schools with lottery cohorts with test results (those that reach grade 3 or higher by 2013-2014). Data come from charter school annual reports, Massachusetts Department of Elementary and Secondary Education School District Profiles, Education Personnel Information Management System, School District Expenditures, and Charter School End of Year Financial Reports. Data also come from MA DESE charter inspections including Renew Inspection Reports, site visits, Summary of Reviews, and Coordinated Program Reviews. See the Data Appendix for information on the "no excuses" index.

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A Data Appendix

This paper utilizes data from several sources. The charter applicant information was collected from the individual charter schools. This data includes immediate and waitlist offers as well as factors that impact an applicant's ranking in the lottery, including sibling status, disqualifications, late applications, and applying from outside of Boston. Student demographic and school enrollment data comes from the Student Information Management System (SIMS), which includes all of the public school students in Massachusetts. Student standardized test scores come from the state database for the Massachusetts Comprehensive Assessment System (MCAS). The paper also uses English proficiency exam data, SAT and AP records, the Massachusetts Education Personnel Information Management Systems (EPIMS) data, and National Student Clearinghouse (NSC) data on college enrollment and graduation. This Appendix describes each data source and explains the process used to clean and match them.

A.1 Lottery Data

Massachusetts legally requires charters to admit students via lottery when there are more applicants than seats for a given grade. This paper uses charter lottery records from Spring 2004 to Spring 2014. The sample includes 10 elementary schools, 10 middle schools, five schools serving middle and high schools, and five high schools. For the full list of schools and years, see Appendix Table A1. Because of limited public pre-k enrollment, I exclude Spring 2014 pre-k lotteries from analysis due to relatively low match rates to the administrative data.

The lottery data typically includes applicants' names, dates of birth, and lottery and waitlist offer information. Offers to attend the charter school can occur on the day of the lottery (referred to here as $immediate\ offer$) or after the day of the lottery when students from the randomly sequenced waitlist are contacted as seats become available (referred to as $waitlist\ offer$).

In some years, certain schools gave all applicants offers, so only the immediate offer instru-

ment, not the waitlist offer instrument, can be used for that cohort. For a few lotteries, records did not distinguish the timing of offers, so only one instrument can be used for these cohorts. In other cases, no waitlist offers were given to non-siblings. The lotteries affected by these circumstances are noted in Appendix Table A1.

A.2 SIMS Data

This research uses SIMS data from the 2003-2004 school year through the 2014-2015 school year. Each year has a file from October and the end of the school year. The observations are at the individual student level. Each student has only one observation in each data file, except when students switch grades or schools within year. The data includes a unique student identifier known as the SASID. This identifier is used to match the SIMS data to the MCAS, English Proficiency Exam, and SAT and AP data described below.

The SIMS dataset contains grade level, year, name, date of birth, gender, race, special education and limited English proficiency status, level of classroom inclusion and type of disability for special education students, free or reduced price lunch status, school attended, suspensions, attendance rates, native language, and immigrant status. Students appear in the state administrative data if they attend a Massachusetts public school. Those who enroll in private or parochial schools or move out of state have missing outcomes data in years they are not in Massachusetts public schools. A student is coded as attending a charter in a school year if there is any record in the SIMS of attending a charter that year. Students who attend more than one charter school within a year are assigned to the charter they attended the longest. If a student attended more than one traditional public school in a year, the analysis uses the school where the student attended for the majority of the year. In the case of attendance ties, the school for the analysis sample was randomly chosen. For baseline characteristics, I designate a student as special education, ELL, or free/reduced lunch if they have this status for either the October or end-of-year file for the application year.

A.3 State Standardized Exam (MCAS) Data

Massachusetts Comprehensive Assessment System (MCAS) data is used for the 2003-04 through 2013-2014 school years. An observation in the MCAS data refers to an individual student's test score results for a given grade level and year. The MCAS math and English Language Arts (ELA) is administered in grades 3 through 8 and grade 10. Baseline math and ELA scores in the year of charter application are used to check the balance for middle and high school lotteries. The raw test scores are standardized to have a mean of zero within a subject-grade-year in Massachusetts.

The state requires special education and English Language Learners take the MCAS exam regardless of the program and services they receive. Under 0.5 percent of the special education students in my sample take an alternative MCAS exam. All ELLs in my sample are required to take the regular MCAS exam.

Qualifying special education and ELL students can receive accommodations on the MCAS exam to meet their specific accessibility needs. [40]Enrolling in a charter school does not affect the likelihood of students with special education or ELL statuses at the time of the lottery receiving testing accommodations. This finding is robust across baseline level of classroom inclusion and level of English proficiency. Therefore, accommodations do not threaten the validity of findings.

A.4 English Proficiency Exam (MEPA/ACCESS)

English Language Learners in kindergarten through 12th grade in Massachusetts take an annual English proficiency exam. From 2005-2012, the state used the Massachusetts English Proficiency Assessment (MEPA), and starting in 2013, the state switched to the Assessing Comprehension and Communication in English State-to-State for English Language Learners (ACCESS). I standardize the exam scores to center around the state mean for each year. I use state recommendations for interpreting the scores of the exam to categorize students as beginning, intermediate, or advanced English proficiency.

[40]Accommodations include changing the format of the test (e.g., paper-based vs. computer-based, large print, braille, read aloud), changing the test procedures, supports and devices to facilitate students' test responses (e.g., reference sheets, checklists, transcription).

A.5 SAT and AP Data

I use SAT and AP data files provided to the Massachusetts Department of Elementary and Secondary Education by the College Board. The data include scores on all AP and SAT tests for students projected to graduate in 2008 through 2015. For students who took the SAT more than once, their data includes only the most recent exam score.

A.6 Staff Data

I develop school level totals of full-time equivalent teachers and staff by various categories using the Massachusetts Education Personnel Information Management Systems (EPIMS) data. I use the state designations for staff type (i.e.. special education therapist, ELL co-teacher/support content) and generate a total number of full-time equivalent teachers in each staff position for that school. This means that if one school has two half-time ELL teachers, they are counted as having one full-time equivalent ELL teacher. The EPIMS data ranges from the 2007-08 through the 2013-14 school years. I use a snapshot of the school staffing from October of these years.

A.7 National Student Clearinghouse Data (NSC)

College enrollment and graduation data comes from the National Student Clearinghouse (NSC) database, which contains enrollment information for 94 percent of college students in Massachusetts. The data include all students who graduated from a Massachusetts public high school from 2003-2017 and students who ever enrolled in grades 8-12 in a Massachusetts public school from 2003-2016. NSC searches used name and date of birth as criteria. The data include student unique identifiers which merge to the state administrative SIMS data. College characteristics are coded using the first college a student attends after their final observation in the SIMS.

A.8 Matching Data Sets

Lottery records were matched to the state administrative student-level data using applicants' names, date of birth, grade, and year. The applicants who uniquely and exactly match the grade, year,

name, and date of birth (if available) in the state records are assigned the matched SASID. Then the names in the lottery and SIMS data are stripped of spaces, surnames (i.e.. Jr. IV), hyphens, and apostrophes. Students who exactly match after that cleaning process are also assigned the matched SASID. Then reclink, a fuzzy matching STATA program, is used to suggest potential matches for the unmatched students. This matches students with slight spelling differences and those who appear in one grade older or younger than the lottery application grade. These suggested matches are hand checked for accuracy. The remaining unmatched students are searched for by hand in the data. Students in this category were not matched in the earlier methods because their names were misspelled or their first and last names were recorded in the wrong field.

This matching process successfully assigns most applicants a unique student identifier. Appendix Table A20 shows the match rates to the administrative data for each year. Overall, 91.2 percent of applicants to elementary lotteries, 94.9 percent of applicants for middle school, and 96 percent of applicants for high school matched. Any student who enrolls in private, parochial, or out-of-state school does not appear in the state records.

Students with offers are significantly more likely to match to the data by 4.3 percent for elementary school and 3.8 percent for middle school. There is no significant difference for high school. This means that elementary and middle school applicants without offers are slightly more likely to go to private, parochial, or out-of-state schools. As a result, my findings show causal estimates for the set of students who ultimately enroll in Massachusetts Public Schools.

A.9 Sample Restrictions

Appendix Table A21 shows the sample restrictions imposed upon the raw lottery records. The sample excludes duplicate applicants within an individual school's lottery and applicants who receive higher or lower preference in the lottery. Those with higher or lower preference include late applicants, those who apply to the wrong grade, out-of-area applicants, and siblings. These groups generally have no variation in offer status. If a student applied to multiple charters in different years, I keep only the first application year for that student. Except for estimating the effect

of charter attendance on initial special needs designation for new Massachusetts public school students, the sample is further restricted to those with baseline demographics data. With the restrictions imposed, the original raw elementary school sample of 13,281 is narrowed to 6,569. For middle and high school, the raw samples of 24,170 and 18,688 are restricted to 9,501 and 6,555 respectively.

B Threats to Validity

B.1 Selective Attrition

At the time of the lottery, students with and without random charter offers should be similar. Differential attrition by offer status may lead to selection bias. For example, if not receiving a charter offer makes students less likely to attend Massachusetts public schools, not receiving an offer may alter the likelihood that a student appears in the data.[41] Differential attrition generates selection bias. To test for selection bias, I test the impact of charter offers on the probability that lottery applicants contribute to state math and English exam scores and whether they have a non-missing special needs status post-lottery.[42] Small differences in the follow-up rates by offer status imply that limited selection bias from differential attrition.

Differential attrition for middle and high school lottery applicants with baseline special needs is not statistically significant, as documented in Table A22. Elementary school lotteries have some differential attrition. Special needs students with charter offers are marginally more likely to take a state math or English exam. These differences are fairly small. Elementary ELL students with charter offers are 2.8 percentage points more likely to contribute to exam data than students without charter offers, 83 percent of whom take the exams. These relatively small differences seem unlikely to explain the elementary school exam results. For classification, 21.2 and 8.1 percent respectively of the non-offered special education and ELL elementary applicants attrit from the data, compared to essentially none of those with offers. These differences are significant and substantial, but they

[41] Students who leave the state or enroll in private or parochial schools do not appear in the data.

[42] Post-lottery is defined as the October 1 after the lottery occurs.

are not large enough to explain the ELL classification effect or to fully explain the special education classification effects.

B.2 School Switching

Charter critics often argue that large achievement gaps between charter and district schools stem in part from charters encouraging lower performing students to leave. This paper's results are not directly affected by whether students enroll or remain in charter schools because the lottery offer status comparisons (the two-stage least squares reduced forms) drive the estimates. The group with lottery offers includes those who enroll and remain in charters as well as those who switch to other schools. Similarly, the group without lottery offers includes some students who manage to eventually enroll in a charter school.

However, excess school switching in charters could potentially inflate my estimates if students who leave would generate negative peer effects (i.e. through disruption). Therefore, Table A23 investigates whether students in charters and traditional publics move schools one year following the lottery at different rates. The lottery applicant population appears very mobile: roughly 50 percent of special needs elementary and middle and 30 percent of high school traditional public school students switch schools.

For elementary and middle school, a large portion of these school moves are mechanical. When I exclude applicants who need to switch schools because they reach the highest grade offered in their school, 30.8 percent of special education and 21.2 percent of ELL elementary applicants in traditional publics switch schools. Similarly, switch rates drop to around 15 percent for middle school special needs applicants in traditional public schools.

The switching rate for elementary and middle school special education students is not statistically significantly different in charter compared to traditional public schools. Elementary ELL students are 13.8 percentage points less likely to switch schools in charter schools. In middle school, ELL switching rates in charter schools are marginally significantly lower by 6.3 percentage points.

Special education high school applicants are 29.9 percentage points more likely to switch in charters, more than double the school movement rate in traditional public schools. The differential switching comes from two early years. Without these years in the sample, the switching rates of special education students in charters and traditional public schools are not statistically significantly different, and the test score findings are essentially unchanged.

The estimates for ELL high school students are noisy, but not significantly different across school type. Since special needs students are overall similarly or less mobile in charters, it is unlikely that high mobility out of charters drives the main results.

B.3 Fallback Schools of Charter Applicants

Differences in the quality of students' fallback schools if they do not get into charters could potential explain some of the findings. For example, perhaps charters are not similarly effective at serving special education students, ELLs, and general education students, but the counterfactual school for a special education or ELL charter applicant performs considerably worse than the fallback option for a general education charter applicant.

To investigate this, I estimate OLS value-added for schools attended by untreated charter lottery compliers. I ran 2SLS regressions of school-value added interacted with a traditional public school indicator on a set of variables equal to one minus a charter enrollment indicator. I used lottery offers as instruments and controlled for demographics and experimental strata. School value-added estimates come from OLS regressions of test scores on a set of school indicator variables, controlling for lagged test scores and student demographics.

I find no statistically significant differences between the untreated complier means fallback schools of special education, ELL, and non-special needs students (see Table A24). Therefore, there is no evidence that differences in students' fallback school quality contribute to the findings and charters appear to serve special education, ELL and general education applicants similarly well.

C Estimation of Mechanisms

C.1 School and Cohort-Level Reclassification and Academic Effects Estimation

I use the following model to estimate the individual charter school cohort academic effects displayed in Figure 1:

$$y_{igt} = \sum_t \sum_s \rho_{st} C_{igst} + X_i^{'} \theta + \alpha_t + \beta_g + \sum_j \delta_j d_{ij} + \varepsilon_{igt} \tag{3}$$

where y_{igt} represents student i's test score in grade g and year t and C_{igst} denotes the years student i spent in charter school s by year t and grade g. Similarly, I estimate individual charter cohort reclassification effects using

$$r_{igt} = \sum_t \sum_s \vartheta_{st} C_{igst} + X_i^{'} \theta + \alpha_t + \beta_g + \sum_j \delta_j d_{ij} + \varepsilon_{igt} \tag{4}$$

where r_{igt} indicates reclassification at enrollment for student i and C_{igst} indicates charter enrollment in the year after the lottery. I estimate equations (3) and (4) separately by baseline special needs status. Two-stage least squares estimates using individual school immediate and waitlist offers and OLS estimates yield similar results. I focus on the OLS estimates for precision. Figure 1 plots the cohort test score effects $\hat{\rho_{st}}$ against the reclassification effects $\hat{\vartheta_{st}}$.

C.2 Multiple Endogenous Variable Empirical Strategy

The individual charter lottery offers randomize not only whether students can enroll in charters, but also student exposure to different reclassification rates. The interaction of individual charter offers with students' reclassification likelihood captures variation in classification removal for similar students. I use individual charter lottery offers and the interaction of these offers with students' pre-lottery classification removal likelihood as instruments for charter enrollment, classification removal, and the interaction of charter enrollment and classification removal. In a constant effects

framework, these instruments identify causal effects for charter compliers. Heterogeneous effects across the interacted characteristics make the estimates difficult to interpret (Kline and Walters, 2016; Hull, 2015; Kirkeboen, Leuven and Mogstad, 2016), but test score effects are not statistically significantly different across baseline level of classroom inclusion, English proficiency, or test score terciles (see Tables 6 and 7).

To create the pre-lottery reclassification likelihood variable, I estimate the relationship between students' baseline characteristics (represented by T_i) and an indicator for whether school change their classification in the Fall of the following year, L_i using the following model

$$L_i = \lambda T_i + \alpha_t + \beta_g + \varepsilon_{itg}. \tag{5}$$

First, I estimate the model for Boston 5^{th}, 6^{th}, and 9^{th} grade students who do not apply for charter schools.[43] I use the full range of available baseline student characteristics from the prior grade, including gender, race, free or reduced price lunch, suspensions, days truant, and test scores. I estimate the model separately for the different types of reclassification (special education classification removal, special education increased inclusion, and ELL classification removal). The estimation for special education students includes baseline level of classroom inclusion and the estimation for ELLs includes an indicator for native Spanish speakers and the baseline English proficiency exam. The model also controls for year and grade effects using α_t and β_g.

I use the estimates from equation (5) which show how each student characteristic relates to likelihood of classification removal in charter application grades in Boston to predict the likelihood that charter applicants will have their special needs classification changed. Then, I center this pre-lottery reclassification likelihood variable around the BPS mean for L_i within a grade-year.[44]

The second stage equation links charter attendance and classification removal to test score outcomes as follows:

[43] I focus on middle and high school applicants for this analysis so that I can include baseline test scores in equation (5) .

[44] Figure A7 plots the proportion of students with classification changes by pre-lottery reclassification likelihood for treated compliers, untreated compliers, and the full lottery applicant sample. It shows the positive relationship between the predicted reclassification likelihood index and the proportion of students reclassified.

$$y_{igt} = \tau_1 C_{igt} + \tau_2 R_{igt} + \tau_3 C_{igt} R_{igt} + \gamma L_i + \alpha_t + \beta_g + \sum_j \delta_j d_{ij} + X_i' \theta + \varepsilon_{igt} \tag{6}$$

where y_{igt} is the test score of student i in grade g and year t. I estimate the three endogenous variables C_{igt} (years in charter), R_{igt} (an indicator for classification removal or increased inclusion by October 1st following the lottery), and $C_{igt}R_{igt}$ (their interaction). I also control for pre-lottery reclassification likelihood (L_i), year and grade effects, experimental strata, and a vector of pre-lottery demographic characteristics. Middle school applicants have multiple observations – one for each grade in which they take the exam – so I cluster standard errors by student and the school, grade, and year of the test. I estimate each model separately for the different types of classification removal(special education and ELL) and restrict the sample to students with the corresponding baseline special needs status.

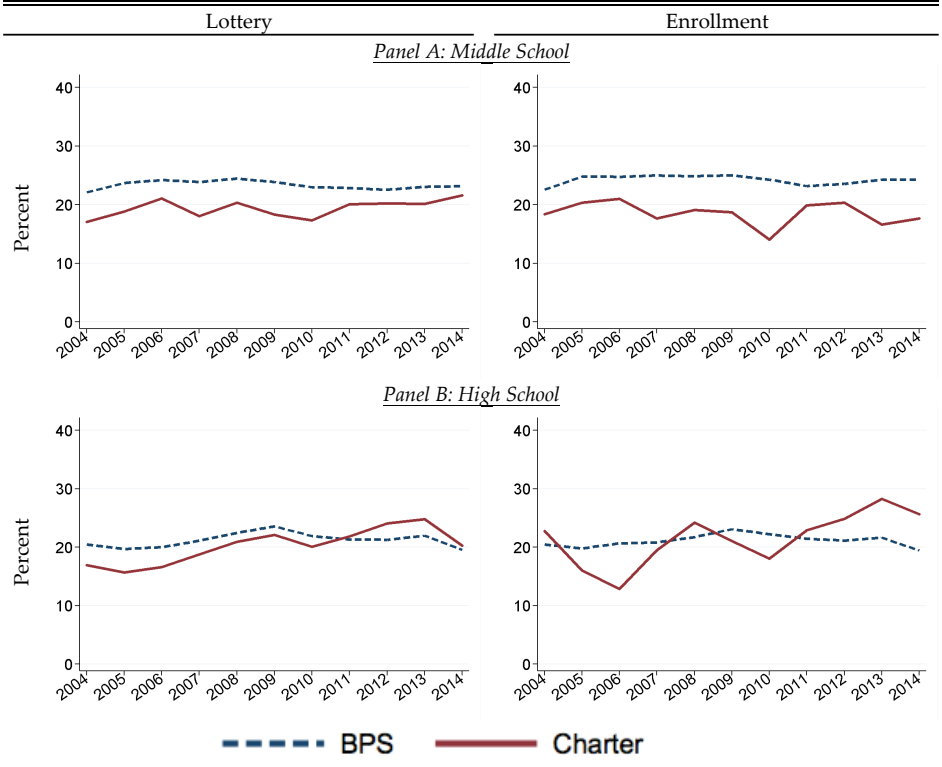
The first stage for years spent in charter can be written as follows:

$$C_{igt} = \sum_k \rho_k Z_{ki} + \sum_k \psi_k Z_{ki} L_i + \varphi L_i + \lambda_t + \kappa_g + \sum_j \mu_j d_{ij} + X_i' \Gamma + \eta_{igt}, \tag{7}$$

where ρ_k represents the effect of receiving an offer, Z_{ki}, from charter school k on charter attendance and ψ_k captures the effect of a one standard deviation increase in pre-lottery reclassification likelihood, L_i, on charter attendance for students with offers at charter school k.[45] The first stages for R_{igt} and $C_{igt}R_{igt}$ have analogous specifications. The new set of instruments yield charter effect estimates similar to the main estimates.

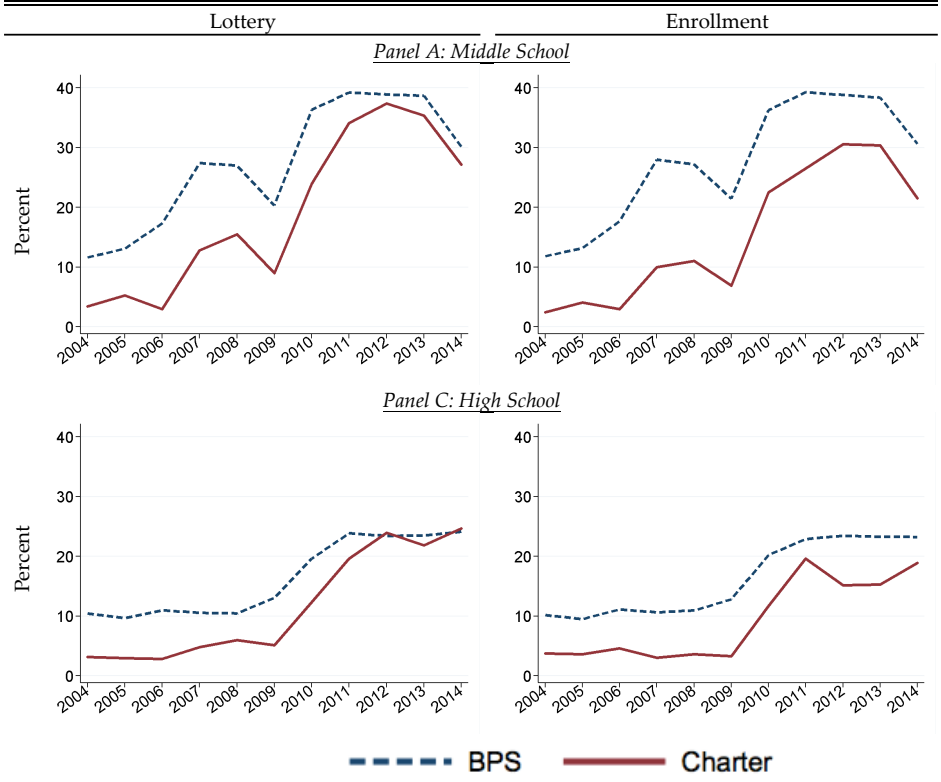
[45]Student sorting into charter schools based on classification removal rates poses a potential threat to the use of school interactions as instruments. There is no clear evidence of this: the average predicted reclassification index of applicants is not correlated with charter special education increased inclusion effects or the charter ELL classification removal effects.

Figure A1: Special Education Prevalence in Charters and Boston Public Schools (BPS)



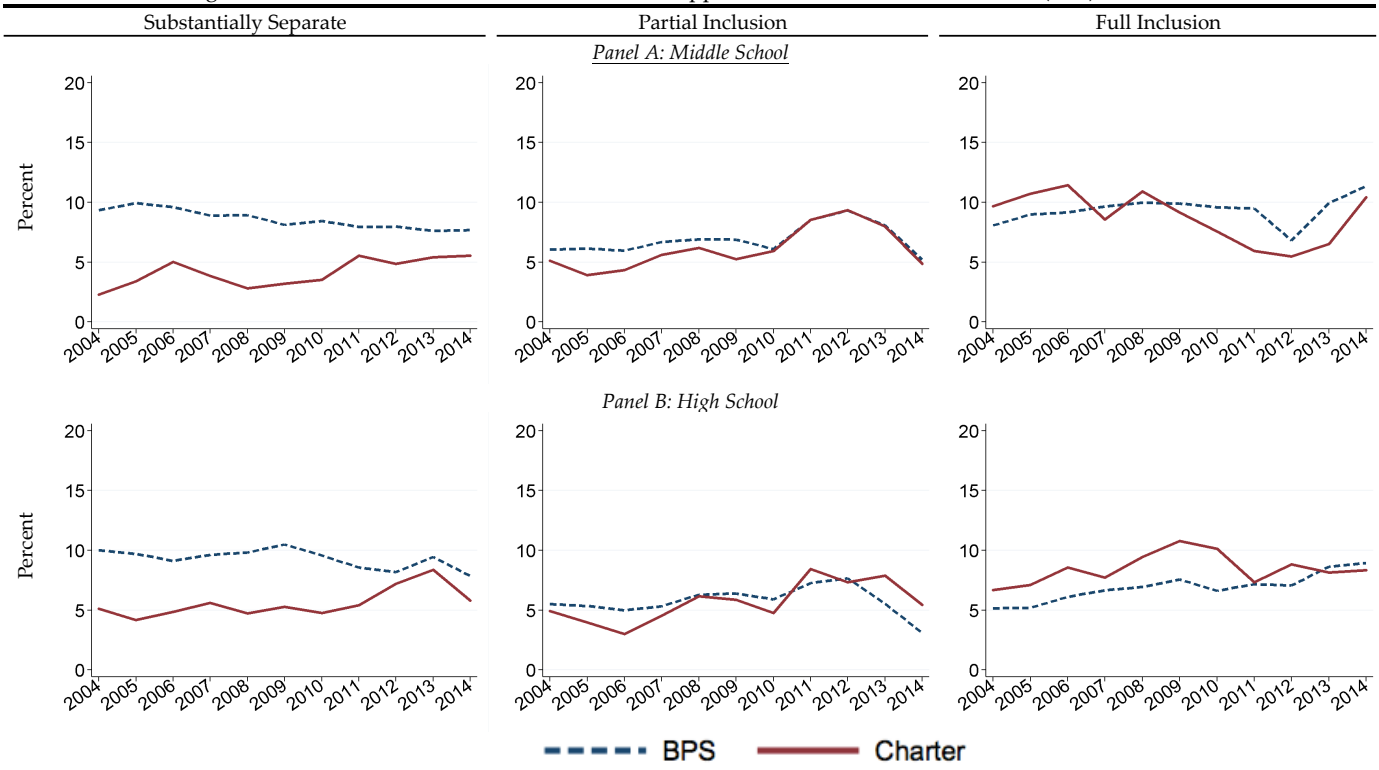
Notes: The graphs on the left plot the percent of students with a special education status at the time of the lottery for charter applicants and Boston Public School (BPS) students in charter application grades (4, 5, and 8). The graphs on the right plot the percent of students with special education status at the time of the lottery for charter enrollees and BPS students in charter entry grades (5, 6, and 9). Using the special education status at the time of the lottery ignores any post-lottery changes to classification.

Figure A2: English Language Learner Prevalence in Charters and Boston Public Schools (BPS)



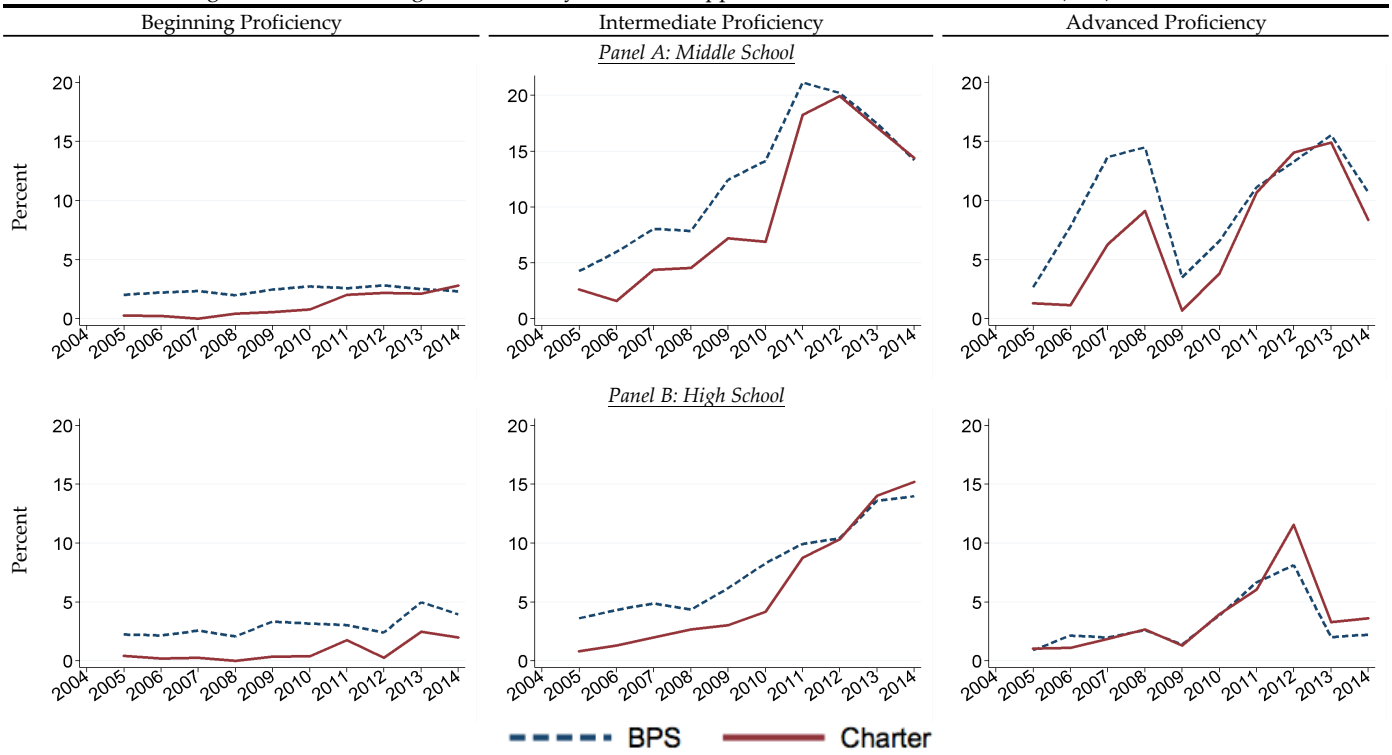
Notes: The graphs on the left plot the percent of students with English Language Learner (ELL) status at the time of the lottery for charter applicants and Boston Public School (BPS) students in charter application grades (4, 5, and 8). The graphs on the right plot the percent of students with ELL status at the time of the lottery for charter enrollees and BPS students in charter entry grades (5, 6, and 9). Using the ELL status at the time of the lottery ignores any post-lottery changes to classification.

Figure A3: Baseline Level of Inclusion of Charter Applicants and Boston Public School (BPS) Students



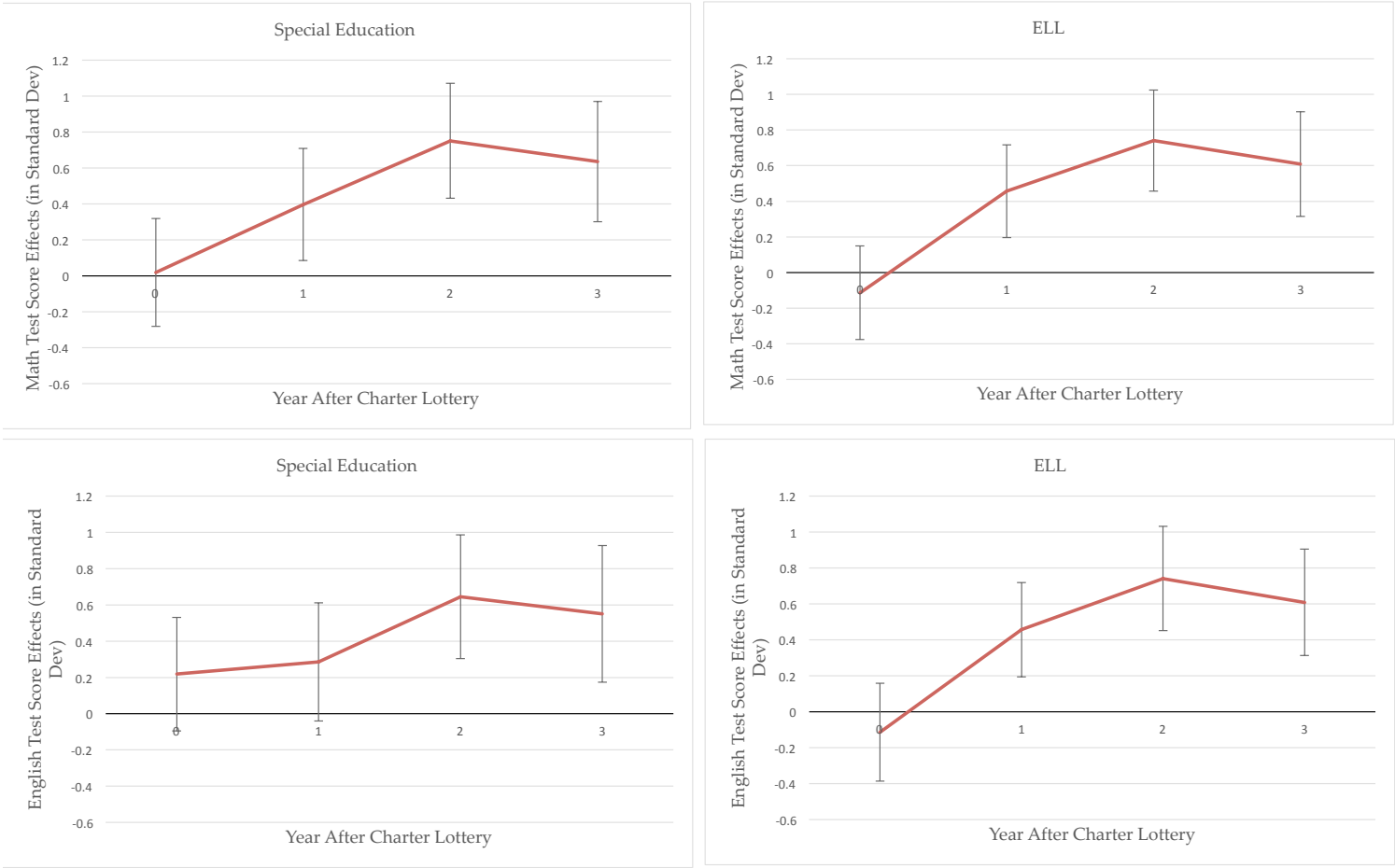
Notes: This figure plots the percent of students with special education substantially separate, partial, and full classroom inclusion at the time of the lottery for charter applicants and Boston Public School students in charter application grades (4, 5, and 8).

Figure A4: Baseline English Proficiency of Charter Applicants and Boston Public School (BPS) Students



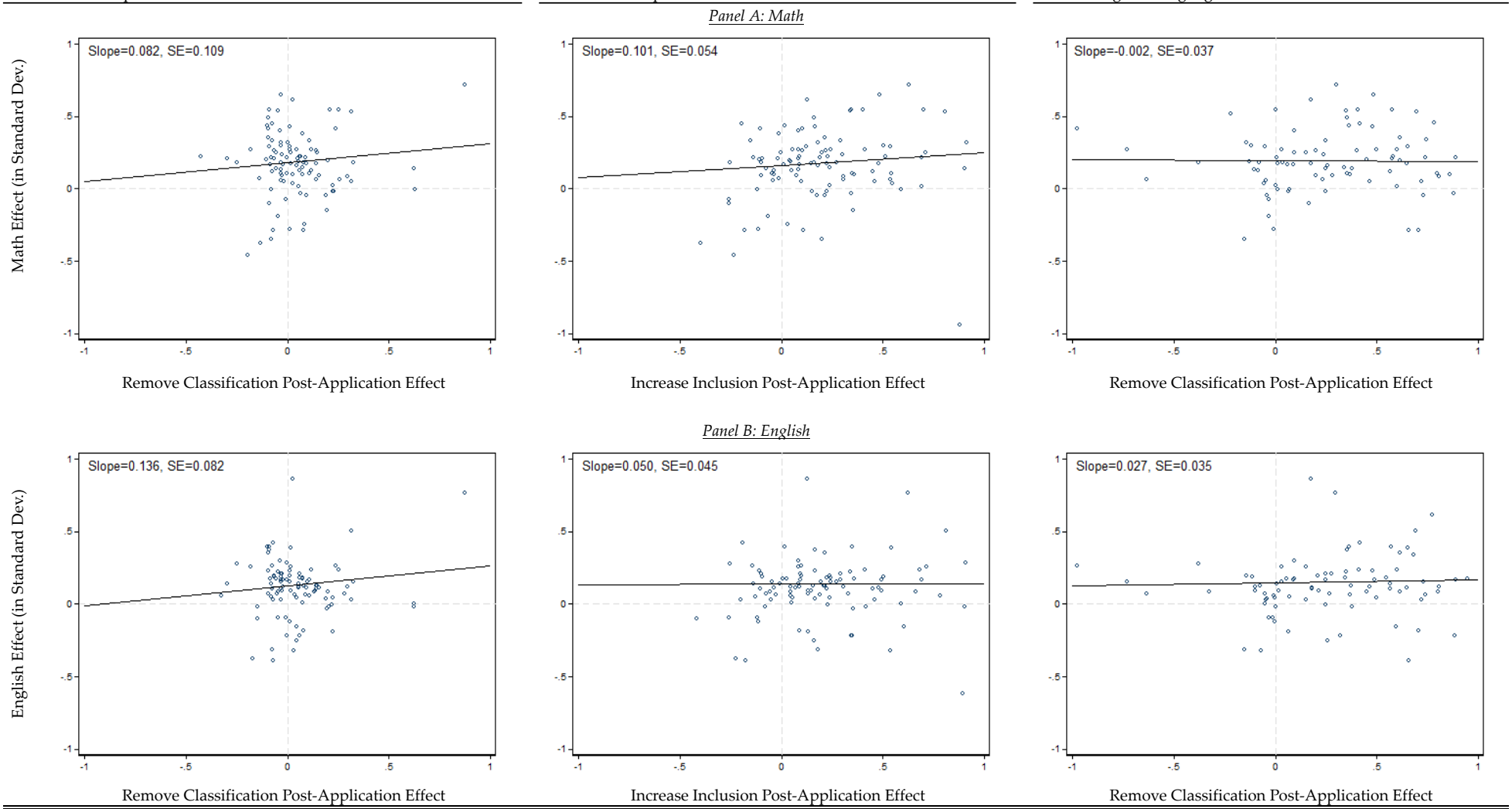
Notes: This figure plots the percent of students with beginning, intermediate, and advanced English proficiency at the time of the lottery for charter applicants and Boston Public School students in charter application grades (4, 5, and 8). English proficiency is measured by the required annual state exam for English Language Learners.

Figure A5: Test Score Effects of Charter Enrollment by Years Following Lottery



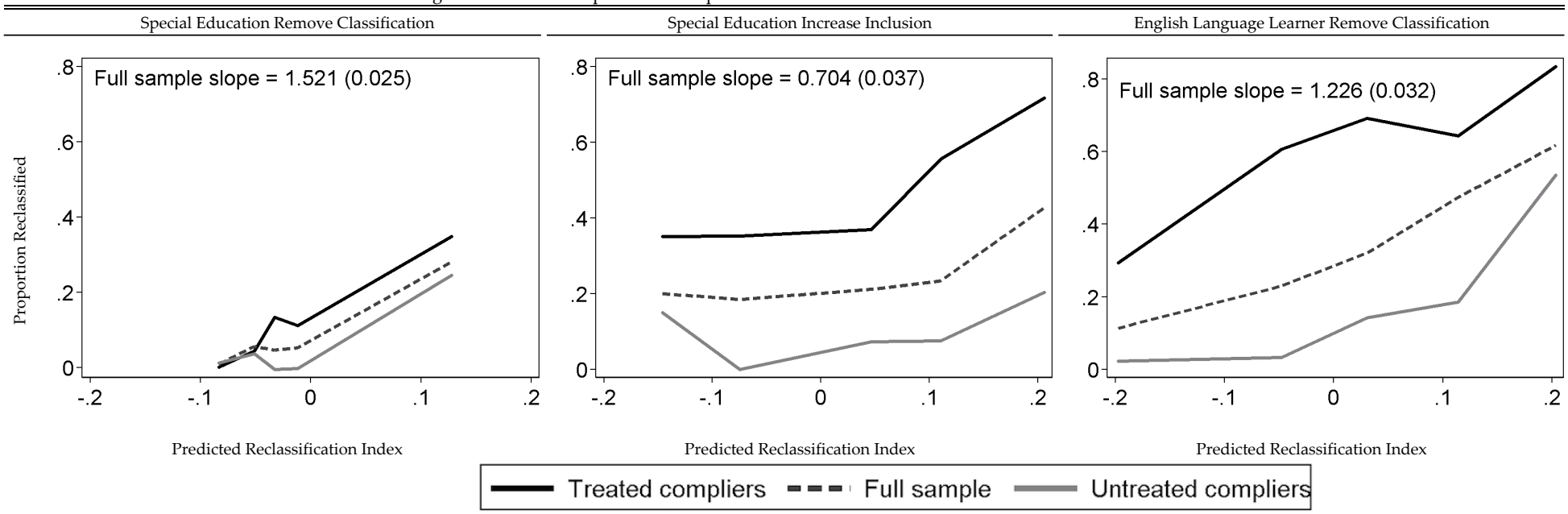
Notes: This figure shows the two-stage least squares estimates of charter enrollment on math test scores for pre-lottery special education and ELL middle school applicants. Each data point reflects a separate estimation for 0, 1, 2, and 3 years after the lottery. The baseline year is represented by year 0. Error bars report the 95 percent confidence intervals. Immediate and waitlist offer dummies instrument for years spent in charter schools. All models control for gender, ethnicity, female x minority interaction, baseline special education, baseline ELL, baseline subsidized lunch, experimental strata, year-applied dummies, and grade-applied dummies. Standard errors are clustered by school-grade-year.

Figure A6: Correlations of Reclassification and General Education Academic Effect Sizes by School x Cohort



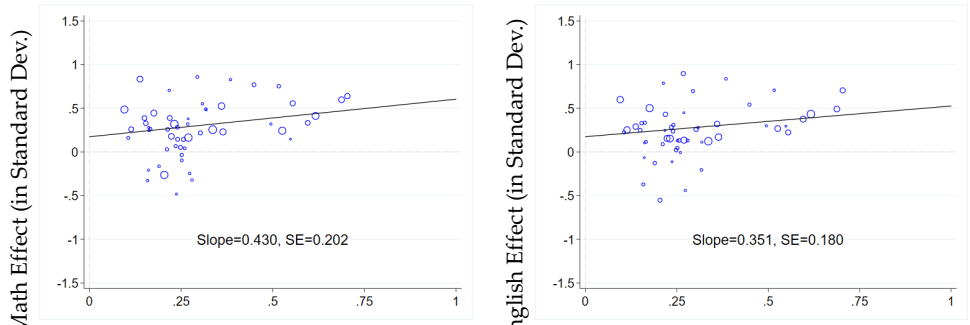
Notes: This figure plots the school-specific math and English Ordinary Least Squares (OLS) effects of years in charter schools for non-special needs students against the school-specific post-application special needs reclassification OLS effects of charter enrollment by the fall following the lottery. The figure plots elementary, middle, and high school estimates. Each dot represents a charter school application cohort. Experimental strata with samples too small to estimate are not displayed. The fitted line is the regression of the test score effect on the reclassification effect, weighted by the inverse of the average variance of the effects.

Figure A7: Relationship between Proportion Reclassified and Predicted Reclassification Index



Notes: This figure displays the proportion of students reclassified by predicted reclassification index value (grouped into five bins).

Figure A8: Correlations of Charter Academic Effect Sizes by the Average Proportion of Students in Grade with the Same Language as ELL Students



Notes: This figure plots the school and cohort-specific math and English Ordinary Least Squares (OLS) effects of years in charter schools for English Language Learner students against the average proportion of students in the individual charter school grade that speak the same non-English. Languages include Spanish, Haitian Creole, and Chinese. All other non-English languages individually comprise a small portion of the sample. Students who speak other non-English languages are considered to speak the same language in the proportion (signaling the school has a critical mass of non-common languages). The figure plots elementary, middle, and high school estimates. Each dot represents a charter school application cohort. Experimental strata with samples too small to estimate are not displayed. The fitted line is the regression of the test score effect on the average proportion of same language speakers, weighted by the inverse of the variance of the academic effects.

A1: Lottery Participation by Schools and Cohorts

Panel A: Elementary School

Application Year/School	Bridge Boston	Brooke East Boston	Brooke Mattapan	Brooke Roslindale	Codman	Conservatory Lab	Dorchester Collegiate Academy	KIPP	Match Community Day	Neighborhood House
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Entry Grade	Pre-K	K	K	K	Pre-K	Pre-K	4	K	Pre-K & 2	Pre-K
2003										Not open
2004				No records						Y
2005						No records	Not open			Y*
2006	Not open	Not open	Not open		Not open				Not open	Y*
2007				Y						Y
2008				Y				Not open		Y
2009				Y**		Y+	No records			Y
2010				Y		Y*	No records			Y
2011	Y+		Y+	Y		Y	No records		Y	Y
2012	Y	Y+	Y	Y*		Y	Y		Y	Y
2013	Y	Y	Y	Y	Y+**	Y	Declined		Y	Y
2014	Y	Y	Y	Y	Y+	Y+		Y	Y	Y
N	561	2300	1296	785	114	739	52	159	1082	1932

Panel B: Middle School

Application Year/School	Dorchester Prep (UCS)	Brooke Roslindale	Brooke Mattapan	Brooke East Boston	Excel East Boston	Excel Orient Heights	Lucy Stone (UCS)	Mission Hill (UCS)	KIPP Boston	UP Academy Boston
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Entry Grade	5	5	5	5	5	5	5	5/6	5	6
2003								Y*		
2004		No records						Y*		
2005					No records			Y*		
2006		Y**	Not open				Not open	Y		
2007	Not open	Y		Not open		Not open		Y	Not open	
2008		Y			Y			Y		
2009		Y			Y			Y		
2010					Y			Y		Not open
2011		Not entry grade	Y		Y		Y	Y		Y
2012	Y		Y	Y**	Y	Y	Y	Y	Y*	Y
2013	Y		Y	Y	Y	Y	Y	Y	Y*	Y
2014	Y**		Y**	Y	Incomplete records		Y**	Y**	Y	Y**
N	1035	254	738	367	519	333	1430	2291	429	1021

Panel C: Combined Middle and High Schools (5th-6th - 12th Grades)

Application Year/School	Academy of the Pacific Rim	Boston Collegiate	Boston Prep	Codman Academy	Match MS
	(1)	(2)	(3)	(4)	(5)
Entry Grade	5/6	5	6	5/6	6
2003		Y	Not open		
	No records		Incomplete		
2004		Y	records		Not open
2005	Y	Y	Y**		
2006	Y	Y	Y		
2007	Y	Y	Y	Not entry	
2008	Y	Y	Y	grade	Y
2009	Y	Y	Y		Y
2010	Y	Y	Y		Y
2011	Y	Y	Y		Y
2012	Y	Y	Y		Y
2013	Y	Y	Y		Y
2014	No records	Y	Y+	Y	Y
N	1852	3025	1636	69	2137

Panel D: High School

Application Year/School	Boston Green Academy	City on a Hill	City on a Hill II	Codman Academy	Match HS
	(1)	(2)	(3)	(4)	(5)
Entry Grade	9	9	9	9	9
2003		No records		Incomplete records	Y
2004		Y*		Y**	Y
2005		Y		Incomplete records	Y
2006	Not open	Y			Y
2007		Y	Not open	No record	Y
2008		Y*		Y	Y
2009		Y		Y	Y
2010		Y		Y	Y
2011	Y	Y		Y	
2012	Y**	Y		Y	Not entry grade
2013	Y	Y	Y**	Y	
2014	Y**	Y	Y	Y	
N	901	4624	1102	1737	2766

Notes: This table shows study charters and their application cohorts. The counts contain the number of students applying to each school in the study sample, not including siblings, out of area applicants, duplicates, disqualified applicants, and students not matched to the state data. In 2012, Uncommon Schools (Roxbury Prep, Dorchester Prep, and Grove Hall) held a joint lottery. APR had 6th grade lotteries from 2005-2007 and 5th grade lotteries from 2007-2014. Roxbury Prep began using 5th grade lotteries in Spring 2012. This table excludes closed schools and schools that did not provide usable lottery records.

* Only ever offer information is available.

** There is no variation in waitlist offers.

+ Lotteries for additional entry grades are included in the analysis sample.

Table A2: Special Education and English Language Learner Descriptive Statistics

	All Grades		Elementary School		Middle School		High School	
Baseline Characteristics	Boston Public Schools (BPS) Students (1)	All Lottery Applicants (2)	Boston Public Schools (BPS) Students (3)	All Lottery Applicants (4)	Boston Public Schools (BPS) Students (5)	All Lottery Applicants (6)	Boston Public Schools (BPS) Students (7)	All Lottery Applicants (8)
			Panel A: Special Education Characteristics					
Special Education	0.226	0.196	0.191	0.158	0.235	0.198	0.221	0.205
Disability Type								
Autism	0.012	0.006	0.030	0.017	0.011	0.005	0.007	0.002
Communication Impairment	0.043	0.040	0.043	0.048	0.052	0.045	0.026	0.031
Developmental Delay	0.015	0.012	0.102	0.081	0.005	0.007	0.000	0.000
Emotional Impairment	0.027	0.017	0.002	0.003	0.027	0.017	0.036	0.020
Health Impairment	0.007	0.007	0.001	0.003	0.008	0.009	0.008	0.007
Intellectual Impairment	0.028	0.016	0.000	0.001	0.030	0.014	0.036	0.022
Neurological Impairment	0.003	0.002	0.001	0.000	0.003	0.002	0.003	0.002
Physical Impairment	0.004	0.004	0.004	0.003	0.005	0.006	0.002	0.001
Sensory Impairment	0.003	0.001	0.002	0.001	0.003	0.001	0.002	0.001
Specific Learning Disability	0.098	0.100	0.002	0.008	0.110	0.101	0.114	0.126
Multiple Disabilities	0.005	0.005	0.000	0.001	0.006	0.008	0.003	0.002
			Panel B: English Language Learners (ELL) Characteristics					
ELL	0.231	0.230	0.361	0.454	0.249	0.257	0.148	0.125
Immigrant and ELL	0.076	0.074	0.036	0.087	0.082	0.078	0.081	0.065
Spanish Speaker and ELL	0.135	0.133	0.173	0.258	0.153	0.151	0.089	0.070
Haitian Creole Speaker and ELL	0.014	0.005	0.020	0.013	0.016	0.004	0.007	0.002
Chinese Speaker and ELL	0.021	0.037	0.019	0.057	0.023	0.046	0.017	0.017
Other Language and ELL	0.152	0.154	0.278	0.325	0.166	0.172	0.079	0.078
N	194712	17999	23858	1943	110289	9501	60565	6555

Notes: This table displays the proportion of students with each disability and ELL characteristic in BPS and the charter school lotteries for charter application grades (Pre-K, K, 1, 3, 4, 5, and 8). Students can have more than one disability type and can speak more than one language.

A3: Effect of Lottery Offer on Charter Enrollment and Years in Charter

	Special Education		English Language Learner		Non-Special Needs	
	Immediate Offer	Waitlist Offer	Immediate Offer	Waitlist Offer	Immediate Offer	Waitlist Offer
	(1)	(2)	(3)	(4)	(5)	(6)
Years in Charter	0.966	0.638	1.105	0.701	1.147	0.737
	(0.062)	(0.063)	(0.080)	(0.065)	(0.046)	(0.043)
N	4877		5433		16675	
Enroll in Charter	0.512	0.342	0.593	0.431	0.546	0.358
	(0.036)	(0.035)	(0.042)	(0.038)	(0.027)	(0.025)
N	3131		3711		9546	

Notes: This table reports the first stage estimates for the effect of lottery offers on years spent in charter schools and an indicator for charter enrollment by the fall following the lottery. Standard errors are clustered by school-grade-year for enroll in charter and bystudent identifier and school-grade-year for years in charter.

Table A4: Post-Application Special Education Classification by Disability Type

		Any Special Education		Classification Removed or Moved to More Inclusive Classroom	
Disability type		Trad. Public mean (1)	Charter effect (2)	Trad. Public mean (3)	Charter effect (4)
Learning		0.907	-0.068	0.153	0.208
			(0.044)		(0.052)
	N		1643		1643
Communication		0.843	-0.107	0.188	0.374
			(0.068)		(0.075)
	N		654		654
Other		0.910	-0.175	0.138	0.285
			(0.054)		(0.067)
	N		1031		1031

Notes: This table reports the two-stage least squares estimates of the effects of Boston charter enrollment on special education classification and level of classroom inclusion in the fall following the charter lottery. Immediate and waitlist offer dummies instrument for enrollment in charter schools. Estimation is run separately by disability type. Disability types in the "Other" category had smaller samples. Standard errors are clustered by school-grade-year. See Table 2 notes for detailed regression specifications.

Table A5: Post-Application English Language Learner Classification by Native Language

	Spanish		Hatian Creole		Other	
	Trad. Public mean	Charter effect	Trad. Public mean	Charter effect	Trad. Public mean	Charter effect
	(1)	(2)	(3)	(4)	(5)	(6)
Keep ELL Classification	0.841	-0.274	0.886	-0.383	0.812	-0.264
		(0.040)		(0.064)		(0.069)
N		2173		607		929

Notes: This table reports the two-stage least squares estimates of the effects of Boston charter enrollment on English Language Learner classification in the fall following the charter lottery. Immediate and waitlist offer dummies instrument for enrollment in charter schools. Estimation is run separately by native language. Languages in the "Other" category had too few students to individually estimate. Standard errors are clustered by school-grade-year. See Table 2 notes for detailed regression specifications.

A6: Effect of Charter Enrollment on Special Education Classification Two Years After Application

		Any Special Education		Substantially Separate Classroom		Partial Inclusion		Full Inclusion		Move to More Inclusive Classroom	
Baseline Status		Trad. Public mean (1)	Charter effect (2)	Trad. Public mean (3)	Charter effect (4)	Trad. Public mean (5)	Charter effect (6)	Trad. Public mean (7)	Charter effect (8)	Trad. Public mean (9)	Charter effect (10)
All Special Education		0.866	-0.078							0.314	0.203
			(0.039)								(0.054)
	N		2176								2176
Substantially Separate		0.979	-0.026	0.704	-0.337	0.079	0.010	0.145	0.260	0.245	0.295
Classroom			(0.039)		(0.105)		(0.058)		(0.093)		(0.101)
	N		549								549
Partial Inclusion		0.910	-0.144			0.408	-0.200	0.371	0.129	0.461	0.273
			(0.061)				(0.083)		(0.094)		(0.088)
	N		701								701
Full Inclusion		0.756	-0.060					0.474	0.131	0.244	0.060
			(0.072)						(0.080)		(0.072)
	N		884								884
New Students (No Prior		0.154	-0.027	0.011	-0.014	0.011	-0.018	0.067	0.002		
Special Ed. Evaluation)			(0.023)		(0.005)		(0.007)		(0.021)		
	N		1138								

Notes: This table reports two-stage least squares estimates of the effects of Boston charter enrollment on special education classification and level of classroom inclusion two years following the charter lottery. Immediate and waitlist offer dummies instrument for enrollment in charter schools. Estimation is run separately by baseline classroom inclusion type. All models control for gender, ethnicity, female x minority interaction, baseline special education, baseline ELL, baseline subsidized lunch, experimental strata, year-applied dummies, and grade-applied dummies. Standard errors are clustered by school-grade-year.

A7: Effect of Charter Enrollment on English Language Learner Classification Two Years After Application

	Remain English Language Learner	
	Trad. Public mean	Charter effect
Baseline Status	(1)	(2)
All English Language Learners	0.615	-0.403
		(0.068)
N		2314
Beginning Proficiency	0.982	-0.203
		(0.128)
N		146
Intermediate Proficiency	0.760	-0.439
		(0.106)
N		1128
Advanced Proficiency	0.270	-0.224
		(0.068)
N		642
New Non-native English Speaking Students	0.565	-0.336
(No Prior English Lang. Learner Evaluation)		(0.093)
N		308

Notes: This table reports two-stage least squares estimates of the effects of Boston charter enrollment on English Language Learner classification two years following the charter lottery. Immediate and waitlist offer dummies instrument for enrollment in charter schools. Estimation is run separately by baseline English proficiency level. Standard errors are clustered by school-grade-year. See Table 2 notes for detailed regression specifications.

A8: Post-Application Special Education Classification

	Any Special Education		Substantially Separate Classroom		Partial Inclusion		Full Inclusion		Move to More Inclusive Classroom	
Baseline Status	Trad. Public mean (1)	Charter effect (2)	Trad. Public mean (3)	Charter effect (4)	Trad. Public mean (5)	Charter effect (6)	Trad. Public mean (7)	Charter effect (8)	Trad. Public mean (9)	Charter effect (10)
Panel A: Elementary School										
All Special Education	0.907	-0.190							0.161	0.294
		(0.069)								(0.125)
N		254								254
Substantially Separate Classroom	0.903	-0.016	0.629	-0.401	0.016	0.066	0.177	0.556	0.226	0.539
		(0.107)		(0.169)		(0.093)		(0.124)		(0.175)
N		72								72
Partial Inclusion	0.895	-0.445			0.500	-0.551	0.289	0.226	0.342	0.464
		(0.226)				(0.222)		(0.254)		(0.287)
N		49								49
Full Inclusion	0.910	-0.144					0.690	0.034	0.060	0.141
		(0.136)						(0.171)		(0.131)
N		126								126
New Students (No Prior Special Ed. Evaluation)	0.014	-0.011	0.001	-0.002	0.003	0.003	0.008	-0.008		
		(0.006)		(0.002)		(0.004)		(0.005)		
N		2665								
Panel B: Middle School										
All Special Education	0.927	-0.161							0.125	0.301
		(0.044)								(0.049)
N		1726								1726
Substantially Separate Classroom	0.976	-0.140	0.897	-0.683	0.036	0.016	0.028	0.259	0.071	0.286
		(0.064)		(0.098)		(0.066)		(0.076)		(0.092)
N		403								403
Partial Inclusion	0.935	-0.143			0.665	-0.645	0.156	0.413	0.193	0.462
		(0.066)				(0.087)		(0.079)		(0.084)
N		611								611
Full Inclusion	0.886	-0.226					0.692	-0.100	0.097	0.117
		(0.077)						(0.090)		(0.059)
N		683								683
Panel C: High School										
All Special Education	0.841	0.030							0.180	0.112
		(0.103)								(0.092)
N		1173								1173
Substantially Separate Classroom	0.975	-0.442	0.819	-0.468	0.071	-0.171	0.042	0.065	0.130	0.101
		(0.077)		(0.123)		(0.095)		(0.077)		(0.126)
N		333								333
Partial Inclusion	0.884	0.270			0.589	-0.472	0.179	0.633	0.254	0.470
		(0.185)				(0.191)		(0.172)		(0.177)
N		344								344
Full Inclusion	0.726	0.335					0.511	0.341	0.156	-0.147
		(0.187)						(0.198)		(0.132)
N		469								469

Notes: This table reports two-stage least squares estimates of the effects of Boston charter enrollment on special education classification and level of classroom inclusion in the fall following the charter lottery. Traditional public means show the proportion of charter applicants that do not enroll in charter schools with a given special education status. Immediate and waitlist offer dummies instrument for enrollment in charter schools. Estimation is run separately for each baseline classroom inclusion type. Students in full inclusion spend less than 21% of their time outside of the general education classroom. Partial inclusion students spend between 21% to 60% of their time in a separate setting, and substantially separate students spend over 60% of their time receiving special education services. Moved to a more inclusive classroom reflects moving from substantially separate to partial or full inclusion or moving from partial to full inclusion. Effects persist for up to two years following the charter application. All models control for gender, ethnicity, female x minority interaction, baseline special education, baseline ELL, baseline subsidized lunch, experimental strata, year-applied dummies, and grade-applied dummies. Standard errors are clustered by school-grade-year.

A9: Post-Application English Language Learner Classification

	Remain English Language Learner	
	Trad. Public mean	Charter effect
Baseline Status	(1)	(2)
Panel A: Elementary School		
All English Language Learners	0.900	-0.198
		(0.075)
N		818
Beginning Proficiency	0.989	-0.033
		(0.029)
N		110
Intermediate Proficiency	0.986	-0.126
		(0.074)
N		349
Advanced Proficiency	0.739	-0.604
		(0.297)
N		25
New Non-native English Speaking Students	0.637	-0.261
(No Prior English Lang. Learner Evaluation)		(0.061)
N		856
Panel B: Middle School		
All English Language Learners	0.794	-0.328
		(0.059)
N		2231
Beginning Proficiency	1.000	0.000
		(0.000)
N		130
Intermediate Proficiency	0.953	-0.420
		(0.075)
N		1105
Advanced Proficiency	0.570	-0.199
		(0.085)
N		774
Panel C: High School		
All English Language Learners	0.802	-0.375
		(0.140)
N		714
Beginning Proficiency	1.000	-0.042
		(0.047)
N		47
Intermediate Proficiency	0.921	-0.384
		(0.143)
N		356
Advanced Proficiency	0.618	-0.152
		(0.375)
N		209

Notes: This table reports two-stage least squares estimates of the effects of Boston charter enrollment on English Language Learner classification in the fall following the charter lottery. Immediate and waitlist offer dummies instrument for enrollment in charter schools. Estimation is run separately by baseline English proficiency level. Effects persist for up to two years following the charter application. Standard errors are clustered by school-grade-year. See Table 2 notes for detailed regression specifications.

A10: Effect of Charter Enrollment on the Staff-to-Student Ratios Students Experience

	All Staff		Special Education Staff		English Language Learner Staff	
	Trad. Public mean	Charter Effect	Trad. Public mean	Charter Effect	Trad. Public mean	Charter Effect
	(1)	(2)	(3)	(4)	(5)	(6)
Total Staff	0.120	0.045	0.019	-0.011	0.015	-0.013
		(0.011)		(0.001)		(0.001)
Teachers	0.079	0.013	0.010	-0.010	0.003	-0.002
		(0.004)		(0.001)		(0.001)
Specialists	-	-	0.003	-0.001	0.000	0.000
				(0.000)		(0.000)
Content Support	-	-	0.004	0.002	0.001	0.001
				(0.001)		(0.001)
N (students)				14346		

Notes: This table shows two-stage least squares estimates of the effect of charter enrollment on the staff-to-student ratios. Immediate and waitlist offer dummies instrument for any charter enrollment in the year following the lottery. The sample includes all lottery applicants applying in the 2007-08 through 2013-14 school years. Staffing and student counts data are collected in October of each year. Standard errors are clustered by school-grade-year. See Table 2 notes for detailed regression specifications.

A11: School Finances

	Total		Special Education	
	Boston Public Schools	Boston Charter Schools	Boston Public Schools*	Boston Charter Schools
	(1)	(2)	(3)	(4)
	Panel A: Per Pupil Expenditures			
Total	$19,214	$16,759		$1,361
		(2,502)		(713)
Total Instructional Spending	$8,913	$9,769	$2,365	$1,325
	(2,395)	(1,470)	(2,365)	(692)
Retirement & Insurance	$3,282	$1,345		-
		(410)		
Other Teaching Services	$1,307	$872	$504	$168
	(842)	(652)	(725)	(209)
Professionals	$309	$360	$5	$72
	(183)	(489)	(62)	(146)
Paraprofessionals	$974	$249	$498	$17
	(772)	(398)	(697)	(49)
Contractors	$120	$204	$6	$76
	(373)	(331)	(015)	(144)
Classroom & Specialist Teachers	$6,051	$5,521	$1,567	$808
	(1069)	(844)	(1,231)	(605)
Professional Development	$310	$190	$86	$16
	(134)	(205)	(75)	(52)
Pupil Services	$2,601	$1,994		$36
		(726)		(110)
Operations & Maintenance	$1,249	$1,020		-
		(517)		
Administration	$557	$2,632		-
		(1,471)		
Guidance, Counseling, & Testing	$117	$715	$23	$210
	(346)	(419)	(291)	(196)
Instructional Leadership	$821	$1,627	$159	$100
	(400)	(0,641)	(231)	(117)
Materials, Equipment, & Tech	$308	$843	$27	$22
	(406)	(588)	(035)	(45)
	Panel B: Federal and State Grants Per Pupil			
Federal Grants	$1,396	$1,257	$389	$246
		(683)		(115)
State Grants	$89	$6		
		(15)		
Medicaid Reimbursement			$119	$24
			-	(35)

Notes: This table shows the per pupil expenditures and grants per pupil for total spending and special education spending for the 2013-14 school year in 2015 CPI-U adjusted dollars. Districts do not report English Language Learner specific school expenditures. Total enrollment is used to calculate special education spending per pupil (instead of special education enrollment). Items without school-level BPS data do not have standard deviations. If school-level Boston Public Schools (BPS) data is available, BPS statistics are weighted by the proportion of lottery applicants that enroll in individual BPS schools.

A12: Test Score Effects of Years in Charter by Baseline Special Needs Status

		Special Education		English Language		Non-Special Needs	
		Trad. Public mean	Charter effect	Trad. Public mean	Charter effect	Trad. Public mean	Charter effect
		(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Ordinary Least Squares Estimates							
Math		-0.983	0.231	-0.504	0.257	-0.113	0.184
			(0.017)		(0.019)		(0.011)
	N		4826		5407		16648
English		-1.147	0.192	-0.729	0.212	-0.114	0.134
			(0.017)		(0.017)		(0.009)
	N		4831		5419		16627
Panel B: Reduced Form Estimates							
Math		-0.868	0.203	-0.432	0.270	-0.045	0.246
			(0.047)		(0.049)		(0.027)
	N		4826		5407		16648
English		-1.065	0.171	-0.669	0.197	-0.059	0.145
			(0.048)		(0.046)		(0.024)
	N		4831		5419		16627

Notes: Panel A reports the Ordinary Least Squares estimates of years spent in charter school on state standardized test scores. Panel B shows the Reduced Form estimates of the effect of getting any charter offer on state standardized test scores. Standard errors are clustered by student identifier and school-grade-year. See Table 4 notes for detailed regression specifications.

A13: Effect of Charter Enrollment on English Proficiency Exam Scores for Baseline English Language Learners

	Take English Proficiency Exam		English Proficiency Exam Score	
	Trad. Public mean	Charter effect	Trad. Public mean	Charter effect
	(1)	(2)	(3)	(4)
	0.614	-0.275	0.389	-0.001
		(0.056)		(0.085)
N		3198		1824

Notes: This table reports the two-stage least squares estimates of charter enrollment on whether English Language Learners take the annual Spring English Proficiency exam and their scores. Immediate and waitlist offer dummies instrument for charter enrollment in the year following the lottery. Students who remain classified as English Language Learners take the English Proficiency exam. Models control for gender, ethnicity, female x minority interaction, baseline special education, baseline subsidized lunch, experimental strata, year-applied dummies, grade-applied dummies, and baseline English proficiency exam score. Estimates are clustered by school-grade-year.

A14: Test Score Effects by Baseline Special Needs Status

		Special Education		English Language Learner		Non-Special Needs	
		Trad. Public mean	Charter effect	Trad. Public mean	Charter effect	Trad. Public mean	Charter effect
		(1)	(2)	(3)	(4)	(5)	(6)
				Panel A: Elementary School			
Math		-0.737	0.309	-0.326	0.386	-0.087	0.184
			(0.123)		(0.101)		(0.046)
	N		171		541		591
English		-1.186	0.478	-0.519	0.360	-0.128	0.199
			(0.148)		(0.100)		(0.046)
	N		169		539		590
				Panel B: Middle School			
Math		-1.025	0.245	-0.550	0.306	-0.129	0.257
			(0.059)		(0.052)		(0.026)
	N		3608		4369		12053
English		-1.176	0.177	-0.763	0.200	-0.102	0.142
			(0.062)		(0.050)		(0.024)
	N		3595		4373		11986
				Panel C: High School			
Math		-0.920	0.240	-0.419	0.412	-0.086	0.333
			(0.092)		(0.139)		(0.053)
	N		1030		493		3926
English		-1.069	0.160	-0.758	0.412	-0.135	0.214
			(0.099)		(0.170)		(0.042)
	N		1050		503		3974

Notes: This table reports the two-stage least squares estimates of the effects of years spent in charter schools on test scores. Immediate and waitlist offer dummies instrument for years spent in charter schools. Columns (1) and (2) show estimates for applicants with baseline special education status, columns (3) and (4) for applicants with baseline English Language Learner classification, and Columns (5) and (6) for other students. All models control for gender, ethnicity, female x minority interaction, baseline special education, baseline ELL, baseline subsidized lunch, experimental strata, year-applied dummies, and grade-applied dummies. Estimates for elementary and middle school sample pool post-lottery outcomes for grades 3-5 and 5-8 respectively. Standard errors are clustered by school-grade-year and the elementary and middle school estimates are also clustered by student identifier.

A15: Test Score Effects of Years in Charter by Baseline Special

		Learning		Other Disability Types	
		Trad. Public mean	Charter effect	Trad. Public mean	Charter effect
Exam		(1)	(2)	(3)	(4)
Math		-1.055	0.337	-0.917	0.212
			(0.068)		(0.083)
	N		2783		2316
English		-1.199	0.236	-1.110	0.180
			(0.070)		(0.090)
	N		2785		2320

Notes: This table reports the two-stage least squares estimates of the effects of years spent in charter schools on test scores for students by their baseline disability type for elementary, middle, and high school applicants. Other disability types include emotional disabilities, intellectual disabilities, autism, communication, physical disabilities, multiple disabilities, developmental disabilities, and health disabilities. Standard errors are clustered by student identifier and school-grade-year. See Table 4 notes for detailed regression specifications.

A16: Test Score Effects of Years in Charter by First Language of Baseline English Language

		Spanish		Hatian Creole		Other	
		Trad. Public mean	Charter effect	Trad. Public mean	Charter effect	Trad. Public mean	Charter effect
Exam		(1)	(2)	(3)	(4)	(5)	(6)
Math		-0.567	0.273	-0.731	0.587	-0.236	0.256
			(0.058)		(0.127)		(0.095)
	N		3120		931		1331
English		-0.786	0.210	-0.816	0.451	-0.564	0.083
			(0.056)		(0.124)		(0.107)
	N		3134		931		1329

Notes: This table reports the two-stage least squares estimates of the effects of years spent in charter schools on test scores for students by their first language for elementary, middle, and high school applicants. Languages in the "Other" category had too few students to individually estimate. Standard errors are clustered by student identifier and school-grade-year. See Table 4 notes for detailed regression specifications.

A17: Ordinary Least Squares Estimates of Charter Enrollment on Special Education Classification

		Any Special Education		Substantially Separate Classroom		Partial Inclusion		Full Inclusion		Move to More Inclusive Classroom	
Baseline Status		Trad. Public mean (1)	Charter effect (2)	Trad. Public mean (3)	Charter effect (4)	Trad. Public mean (5)	Charter effect (6)	Trad. Public mean (7)	Charter effect (8)	Trad. Public mean (9)	Charter effect (10)
All Special Education		0.890	-0.117							0.151	0.224
			(0.020)								(0.022)
	N		3153								3153
Substantially Separate		0.967	-0.126	0.834	-0.536	0.049	0.046	0.051	0.250	0.114	0.344
Classroom			(0.028)		(0.047)		(0.024)		(0.035)		(0.044)
	N		808								808
Partial Inclusion		0.914	-0.120			0.627	-0.410	0.173	0.283	0.225	0.333
			(0.028)				(0.044)		(0.037)		(0.039)
	N		1004								1004
Full Inclusion		0.823	-0.097					0.617	0.004	0.117	0.081
			(0.027)						(0.031)		(0.022)
	N		1278								1278
New Students (No Prior		-0.503	0.326	0.001	-0.002	0.003	0.001	0.008	-0.002		
Special Ed. Evaluation)			(0.045)		(0.001)		(0.003)		(0.004)		
	N		5404								

Notes: This table reports ordinary least squares estimates of the effects of Boston charter enrollment on special education classification and level of classroom inclusion in the fall following the charter lottery. Estimation is run separately by baseline classroom inclusion type. Standard errors are clustered by school-grade-year. See Table 2 notes for detailed regression specifications.

A18: Ordinary Least Squares Estimates of Charter Enrollment on English Language Learner Classification

		Remain English Language Learner	
		Trad. Public mean	Charter effect
Baseline Status		(1)	(2)
All English Language Learners		0.825	-0.312
			(0.031)
	N		3763
Beginning Proficiency		0.996	-0.050
			(0.030)
	N		287
Intermediate Proficiency		0.954	-0.335
			(0.039)
	N		1810
Advanced Proficiency		0.589	-0.255
			(0.045)
	N		1008
New Non-native English Speaking Students		0.637	-0.225
(No Prior English Lang. Learner			(0.047)
	N		856

Notes: This table reports ordinary least squares estimates of the effects of Boston charter enrollment on English Language Learner classification in the fall following the charter lottery. Estimation is run separately by baseline English proficiency level. Standard errors are clustered by school-grade-year. See Table 2 notes for detailed regression specifications.

A19: Test Score Effects of Years in Charters for Lotteries with High and Low Proportions of Special Needs Applicants

		Special Education		English Language Learner	
		Bottom Quartile	Top Quartile	Bottom Quartile	Top Quartile
		(1)	(2)	(3)	(4)
Math		0.264	0.321	0.241	0.315
		(0.036)	(0.036)	(0.049)	(0.029)
	N	5711	7148	3656	9703
English		0.196	0.207	0.152	0.199
		(0.035)	(0.035)	(0.043)	(0.028)
	N	5640	7156	3608	9706
Mean % of Lottery Applicants with Special Needs Status		13.55% (3.99)	23.32% (5.36)	14.08% (10.49)	41.22% (25.11)

Notes: This table reports the two-stage least squares estimates of the effects of years spent in charter schools on test scores for lotteries with the highest and lowest quartile of special needs representation. Immediate and waitlist offer dummies instrument for years spent in charter schools for elementary, middle, and high school lottery applicants. Standard errors are clustered by student identifier and school-grade-year. See Table 4 notes for detailed regression specifications.

A20: Match from Lottery Data to Administrative Data

	Elementary School				Middle School				High School			
			Reg of Match on Offer				Reg of Match on Offer				Reg of Match on Offer	
Lottery Year	Number of Applications (1)	Proportion Matched (2)	Immediate Offer (3)	Any Offer (4)	Number of Applications (5)	Proportion Matched (6)	Immediate Offer (7)	Any Offer (8)	Number of Applications (9)	Proportion Matched (10)	Immediate Offer (11)	Any Offer (12)
2004	150	0.867	0.139	0.074	268	0.989	-0.006	-0.007	638	0.991	-0.015	-0.010
			(0.029)	(0.071)			(0.026)	(0.013)			(0.013)	(0.015)
2005	141	0.865	-	0.090	616	0.987	0.005	0.002	601	0.990	0.000	-0.003
			-	(0.056)			(0.011)	(0.013)			(0.010)	(0.010)
2006	166	0.910	-	0.098	742	0.991	0.001	0.004	669	0.991	0.002	-0.005
			-	(0.024)			(0.008)	(0.016)			(0.010)	(0.013)
2007	303	0.901	0.077	0.043	924	0.984	0.019	0.034	997	0.978	0.008	0.013
			(0.026)	(0.031)			(0.008)	(0.013)			(0.009)	(0.009)
2008	322	0.913	0.089	0.082	1018	0.957	0.042	0.061	837	0.957	0.038	-0.002
			(0.018)	(0.025)			(0.013)	(0.019)			(0.011)	(0.030)
2009	472	0.960	0.031	0.051	1106	0.977	0.004	0.011	898	0.971	-0.017	0.023
			(0.013)	(0.015)			(0.011)	(0.010)			(0.020)	(0.015)
2010	558	0.937	0.013	0.020	1041	0.924	0.065	0.071	917	0.954	0.013	0.027
			(0.028)	(0.024)			(0.016)	(0.017)			(0.012)	(0.013)
2011	1610	0.940	0.032	0.033	2614	0.954	0.018	0.025	1234	0.930	0.012	0.020
			(0.012)	(0.011)			(0.007)	(0.007)			(0.010)	(0.013)
2012	1864	0.911	0.048	0.048	2503	0.939	0.001	0.033	1499	0.951	0.000	-0.030
			(0.014)	(0.013)			(0.011)	(0.011)			(0.008)	(0.021)
2013	1422	0.884	0.032	0.052	2712	0.902	0.045	0.078	1537	0.951	-0.003	-0.120
			(0.018)	(0.018)			(0.012)	(0.015)			(0.009)	(0.078)
2014	1085	0.890	0.009	0.020	1938	0.961	0.027	0.036	1403	0.952	0.023	0.111
			(0.022)	(0.021)			(0.007)	(0.014)			(0.010)	(0.106)
All Cohorts	8093	0.912	0.036	0.043	15482	0.949	0.023	0.038	11230	0.960	0.007	0.006
			(0.007)	(0.006)			(0.003)	(0.004)			(0.003)	(0.005)

Notes: This table summarizes the match from the state administrative data to the lottery records. The sample excludes late applicants, siblings, disqualified applicants, duplicate names, and out-of-area applicants. Columns (3) and (4) report coefficients from regressions on a dummy for a successful state data match on immediate and any charter offer dummies for the elementary school sample. Year-specific regressions control for charter school dummies. All cohort regressions control for school-by-year dummies.

A21: Sample Selection

Year of application	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	All
Panel A: Elementary School												
Total number of records	160	166	194	364	396	602	702	2899	2963	2537	2298	13281
Excluding disqualifed applications	160	166	194	360	396	602	702	2889	2956	2479	2280	13184
Excluding late applications	160	166	194	360	396	602	700	2882	2956	2470	2279	13165
Excluding out of area applications	160	160	194	357	395	590	687	2832	2874	2408	2233	12890
Excluding siblings	151	140	166	325	338	525	621	2330	2508	2101	2038	11243
Excluding records not matched to SIMS	131	123	151	296	310	507	585	2225	2336	1942	1858	10464
Keep only first year of charter application	131	123	151	273	294	491	555	1965	2069	1633	1398	9083
Excluding repeat applications	131	121	151	273	294	491	551	1954	2041	1618	1396	9021
Reshaping to one record per student	130	119	138	261	284	409	393	1336	1427	1041	918	6937
Has any demographics	130	119	150	262	285	426	484	1391	1430	1060	832	6569
Has demographics for baseline and/or year 1	29	37	54	205	228	345	392	1156	1131	874	805	5256
Has baseline demographics	1	5	3	26	56	68	62	613	472	249	388	1943
Panel B: Middle School												
Total number of records	341	739	913	1143	1422	1595	1467	4283	4312	4766	3189	24170
Excluding disqualifed applications	341	738	911	1135	1404	1594	1444	4273	4305	4760	3189	24094
Excluding late applications	340	738	909	1135	1363	1566	1397	4163	4196	4583	3187	23577
Excluding out of area applications	340	733	900	1123	1353	1548	1379	4094	4071	4513	3136	23190
Excluding siblings	300	677	836	1021	1223	1408	1249	3758	3760	4320	2865	21417
Excluding records not matched to SIMS	266	634	801	1000	1181	1378	1179	3627	3573	4016	2792	20447
Keep only first year of charter application	266	617	770	962	1093	1282	1038	3308	2962	3469	1975	17742
Excluding repeat applications	266	617	770	962	1093	1282	1038	3308	2962	3458	1960	17716
Reshaping to one record per student	265	523	586	760	868	963	812	2055	1715	1900	1176	11623
Has baseline demographics and in Boston at baseline	176	382	437	571	679	722	623	1790	1499	1594	1028	9501
Panel C: High School												
Total number of records	940	884	942	1330	1211	1300	1500	1835	2049	3280	3417	18688
Excluding disqualifed applications	940	883	942	1327	1210	1289	1500	1818	2040	3278	3417	18644
Excluding late applications	930	880	942	1327	1191	1289	1500	1818	1986	3235	3417	18515
Excluding out of area applications	930	880	939	1327	1191	1276	1465	1787	1979	3136	2762	17672
Excluding siblings	905	864	939	1298	1153	1214	1376	1727	1952	3082	2658	17168
Excluding records not matched to SIMS	858	817	919	1271	1108	1184	1335	1642	1882	2980	2571	16567
Keep only first year of charter application	858	810	910	1161	919	925	984	1208	1369	2192	1416	12752
Excluding repeat applications	858	810	910	1161	919	925	984	1208	1366	2187	1414	12742
Reshaping to one record per student	632	590	656	827	604	629	591	736	786	928	652	7631
Has baseline demographics and in Boston at baseline	508	478	536	751	487	529	503	628	735	848	552	6555

Notes: This table shows the sample restrictions imposed for lottery analysis.

A22: Attrition

	Special Education at Baseline		English Language Learner at Baseline		Non-Special Needs at Baseline	
Outcome	Trad. Public Attrition Rate (1)	Attrition Differential by Offer Status (2)	Trad. Public Attrition Rate (3)	Attrition Differential by Offer Status (4)	Trad. Public Attrition Rate (5)	Attrition Differential by Offer Status (6)
Math Exam	0.229	0.008	0.182	-0.003	0.224	-0.028
		(0.013)		(0.010)		(0.006)
		5861		6234		19442
English Exam	0.225	0.003	0.180	-0.009	0.222	-0.029
		(0.013)		(0.010)		(0.006)
		5861		6234		19442
Classification Status	0.109	-0.049	0.090	-0.042	0.101	-0.099
		(0.032)		(0.024)		(0.019)
		3245		3709		10348

Notes: This table reports the two-stage least squares estimates of the effect of years spent in charter schools on attriting from the sample for test score and reclassification outcomes. Standard errors are clustered by student identifier and school-grade-year. See Table 4 notes for detailed regression specifications.

A23: Effect of Charter Enrollment on School Switching by Baseline Special Needs Status

	Special Education		English Language Learner		Non-Special Needs	
	Trad. Public mean	Effect	Trad. Public mean	Effect	Trad. Public mean	Effect
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Elementary School						
Any Switch	0.498	0.253	0.373	-0.002	0.440	-0.120
		(0.151)		(0.057)		(0.045)
N		296		864		858
Switch excluding transitional grades	0.308	0.095	0.212	-0.138	0.230	-0.173
		(0.139)		(0.046)		(0.041)
N		296		864		858
Panel B: Middle School						
Any Switch	0.549	-0.160	0.556	-0.176	0.598	-0.393
		(0.051)		(0.043)		(0.031)
N		1820		2314		5263
Switch excluding transitional grades	0.160	0.018	0.144	-0.063	0.205	-0.119
		(0.039)		(0.032)		(0.023)
N		1820		2314		5263
Panel C: High School						
Any Switch	0.296	0.257	0.337	0.068	0.262	0.068
		(0.102)		(0.117)		(0.057)
N		1259		741		4040
Switch excluding transitional grades	0.206	0.299	0.178	0.178	0.168	0.073
		(0.099)		(0.114)		(0.055)
N		1259		741		4040

Notes: This table reports two-stage least squares estimates of the effects of Boston charter enrollment on switching schools one year following the lottery. Students who do not appear in Massachusetts public schools in October following the charter application are not counted as school switchers. The switch excluding transitional grades equals one for students who switch schools in grades other than the exit grade of their first school. It does not equal to one if the school closed the year the student switched. Standard errors are clustered by school-grade-year. See Table 2 notes for detailed regression specifications.

A24: Value-Added of Fallback Schools for Charter Applicants

	Special Education	English Language Learner	Non-Special Needs
	(1)	(2)	(3)
Untreated Complier Mean: Math	0.003	0.013	0.003
	(0.011)	(0.010)	(0.006)
N	1567	2002	4556
Untreated Complier Mean: English	-0.017	-0.029	-0.018
	(0.011)	(0.009)	(0.006)
N	1567	2002	4556

Notes: This table summarizes OLS value-added estimates for schools attended by untreated charter lottery compliers. Untreated complier means are estimates from 2SLS regressions of school-value added interacted with a traditional public school indicator on a set of variables equal to one minus a charter enrollment indicator. The model uses lottery offers as instruments and controls for demographics and experimental strata. School value-added estimates come from OLS regressions of test scores on a set of school indicator variables, controlling for lagged test scores and student demographics.