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Special Education and English Language Learner Students in Boston Charter Schools: Impact and Classification

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Abstract

The question of whether and how well charter schools serve special education and English Language Learners[1] remains one of most controversial in the charter school debate. This paper uses admissions lotteries to estimate the effects of Boston's charter school enrollment on student achievement and classification for special needs students. Charter attendance boosts achievement similarly for special needs and non-special needs students. Charters also increase the likelihood that special needs students meet high school graduation requirements and earn a state merit scholarship. Even the most disadvantaged special needs students benefit from charter attendance. Charter schools reduce the likelihood of special needs classifications and move special education students into more inclusive classrooms at a substantially higher rate than do traditional public schools. Differences in charter classification practices are largely unrelated to charter gains, suggesting that special needs classification is not essential for students with special needs to make progress.

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[1] I will refer to special education and English Language Learners as special needs students.

1 Introduction

A large body of evidence suggests that urban charters generate large academic gains for lottery applicants (Abdulkadiroğlu et al., 2011; Hoxby and Rockoff, 2004; Hoxby, Kang, and Murarka, 2009; Dobbie and Fryer, 2011; Angrist et al., forthcoming 2016). At the same time, critics of charter schools not only note that special needs students appear underrepresented in charters, but they also question whether charters serve these students well.[2] Perhaps urban charters' remarkable achievement gains are generated in part by a tendency to focus on non-special needs students.

This paper reports new lottery-based evidence of charter effectiveness for special needs students. The results show that special education and ELL students experience large academic gains in charter schools: over 0.26 standard deviations in math and over 0.19 standard deviations on English on the state standardized exams. These gains 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 on average 115.7 points higher on the SAT than their traditional public school counterparts.

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 large positive effects of over 0.22 standard deviations in math.English Language Learners with the lowest baseline English exam scores have the largest gains. Students with the most severe needs–special education students who spent the majority of their time in substantially separate classrooms and ELLs with beginning English proficiency at the time of the lottery–perform significantly better in charters than in traditional public schools.

I also document striking differences in special needs classification practices in Boston charter and traditional public schools. Charter enrollment nearly doubles the likelihood that a student in special education at the time of the lottery loses this classification by the beginning of the following school year. Moreover, charters are three times as likely to remove an ELL classification. Charters are also three times more likely than traditional public schools to move special education students into general education classrooms. Classification practices are weakly correlated to charter gains, suggesting that

[2]US Government Accountability Office. (2012) "Charter Schools: Additional Federal Attention Needed to Help Protect Access for Students with Disabilities." GAO-12-543. found that charters enrolled a smaller proportion of students with disabilities than traditional public schools.

The Massachusetts State Legislature passed An Act Relative to the Achievement Gap in 2010 that requires charter schools to increase their efforts to recruit and retain special education and ELL students.

special needs classification is not essential for special needs students to make progress.

Although many studies have used lotteries and other quasi-experimental methods to identify the causal effects of charter attendance, few address special needs students. My study appears to be the first to consider the causal effects of charter enrollment on special needs classification and achievement. This paper also contributes to the literature on the effect of special needs classification and practices. The literature that examines how moving ELL students from bilingual to English-only instruction classrooms affects academic outcomes finds mixed results (Farver, Lonigan, and Eppe, 2009; Francis, Lesaux, and August, 2006; Jepsen, 2010; Chin, Daysal, and Imberman, 2013). Using non-random student movement in and out of special education programs, Hanushek, Kain, and Rivkin (2002) estimate the effect of special education classification, but these estimates are not causal. Little conclusive evidence exists on which school practices or settings lead to positive academic outcomes for special needs students.

The next section provides background on Boston charter schools, discusses special needs designation, and describes the data. Section 3 introduces the empirical strategy. Section 4 reports the academic effects of charter enrollment. Section 5 investigates differences in special needs classification, and Section 6 addresses threats to validity. The final section concludes.

2 Background and Data

2.1 Boston's Charter Sector

Massachusetts uses a rigorous charter authorization and monitoring process. Since the state first allowed charters in 1995, it has unauthorized 18 schools (Massachusetts Department of Elementary and Secondary Education, 2014). The state also restricts the number of charter schools and the number of students they can enroll.

Massachusetts urban charters are also characterized by the prevalence of No Excuses pedagogy (Abdulkadiroğlu et al., 2011). This approach utilizes strict discipline, a long school day and year, selective teacher hiring, frequent testing, high expectations, teacher feedback, data-driven instruction, and tutoring (Thernstrom and Thernstrom, 2003; Carter, 2000). Past studies have documented a strong positive relationship between the use of No Excuses practices and charter school gains for the average lottery applicant in both NYC and Boston (Dobbie and Fryer, 2011; Angrist, Pathak, and Walters, 2013), but little is known about the effect of these practices on special education and ELL students

specifically.

2.2 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, partial, or substantial separate classroom inclusion. 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.

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.[3] 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.

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 help the child succeed academically.

2.3 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 over 86.1 percent of Boston charter enrollment in the 2013-14 entry

[3]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.

grades.[4] Schools are excluded from the study if they closed,[5] declined to participate,[6] had insufficient records,[7] did not have any oversubscribed lotteries,[8] or serve alternative students.[9] Appendix Table A1 describes the schools and application cohorts in the sample.

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.

The main results estimate the impact of charter school attendance on academic outcomes for students by their pre-lottery special needs status. As a result, the main analysis sample excludes applicants who are not enrolled in Massachusetts public schools the year of the lottery because they do not have a baseline classification. This excludes 95.4% of pre-k applicants and 70.7% of kindergarten applicants. These applicants are used to investigate the effect of attending a charter school on initial classification as special needs.

2.4 Representation of Special Needs Students in Charters

Special needs students were historically underrepresented in charter school applications and enrollments relative to BPS. 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

[4]Specifically, the sample accounts for 77.2 percent of high school, 94.5 percent of middle school, 100 percent of kindergarten entry, and 60.3 percent of pre-k entry. The rate for pre-k is relatively low because UP Dorchester did not have oversubscribed lotteries in 2013-14 and Boston Renaissance lottery records are incomplete.

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

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

[7]Boston Renaissance had insufficient records.

[8]UP Academy Dorchester's did not have any oversubscribed lotteries.

[9]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.

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: 21.6 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.[10]

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 18.0 percent at its peak in 2007 to 9.3 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.[11]

[10] 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.

[11] Students with developmental delay are slightly over-represented in middle school charter lotteries. Students with autism and intellectual disabilities are slightly underrepresented in middle school charter lotteries relative to BPS. For the past ten years, there has been similar representation for students with physical, health, sensory, neurological, communication, and multiple disabilities in middle school lotteries. Students with learning disabilities have been similarly represented in middle school lotteries since Spring 2009.

Students with learning disabilities are over-represented in high school charter lotteries relative to BPS. Students with autism and developmental delay are slightly underrepresented in high school charter lotteries. All other disability types

3 Empirical Framework

I use two-stage least squares (2SLS) analysis with randomly assigned charter lottery offers as instruments to estimate the causal effect of attending charter schools for the pool of applicants. The second-stage equation links charter school attendance with outcomes as follows:

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

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} denotes charter attendance at the time of the outcome. When math or English exam scores are the outcome, C_{igt} represents years spent in a charter at 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_{igst}, are clustered on the unique student identifier in addition to the school, grade, and year of the test.

The other outcomes, English proficiency exam score, high school graduation, college preparation measures, and special needs reclassification, do not have multiple observations per student. For these outcomes, C_{igt} is an indicator for any charter enrollment following the lottery and until the time of the outcome.[12] Standard errors are clustered on the school, grade, and year of the outcome. The parameter τ captures the causal effect of charter school attendance.

were similarly represented in high school charter lotteries compared to BPS by Spring 2014. Over the past ten years, students with physical, health, sensory, neurological, and multiple disabilities have been similarly represented in high school charter lotteries and in BPS.

Students who speak Haitian Creole have been similarly represented in charter lotteries and BPS for the past ten years. Chinese speaking students remain underrepresented in charter lotteries. Spanish speaking students historically were underrepresented in lotteries and now apply to charters at similar rates as their prevalence in BPS.

Subsidized lunch status students were historically underrepresented in charter lotteries, but became similarly represented in middle school charter lotteries by Spring 2011 and in high school lotteries by Spring 2006.

Further information about application trends for these subgroups is available at the request of the author.

[12]Students for whom C_{igt} equals zero enroll in other non-charter public schools. These include mostly traditional public schools. Other less common models, pilot schools, exam schools, and innovation schools, are also included. For simplicity, I refer to this group as traditional public schools.

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 IV estimation is:

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

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.

The randomness of the lottery makes it likely that charter offers are independent of student 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 charter applicant pool has a smaller proportion of substantially separate and full inclusion special education students and similar rates of partial inclusion 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.

Special needs applicants have substantially lower baseline test scores on average than the full lottery applicant pool as described in Columns (5) and (8) of Table 1. This achievement gap is large, particularly for special education students. Compared to the full lottery applicant sample, the baseline math scores are 0.595 standard deviations lower for special education students and 0.329 standard deviations lower for ELL students.

4 Academic Effects

4.1 Charter School Effects

Receiving a lottery offer increases the time spent in charters and the likelihood of enrolling in a charter. These first stage estimates, which are strong for both special and non-special needs students, appear in Table A5. Special needs middle school applicants with immediate and waitlist offers spend over a year and 0.66 years longer respectively in charters compared to those without offers. Elementary and high school special needs applicants who receive offers also spend substantially more time in charters. Immediate and waitlist offers also boost the likelihood that special needs students will enroll in charters one year after the lottery by over 58 and 35 percentage points respectively. 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.

Charter school attendance has large positive effects for math and English state exam scores for special needs students. Table 2 documents the large and statistically significant gains for elementary, middle, and high school special needs applicants. A year of charter attendance increases math test scores by over 0.223 standard deviations for middle and high school special education applicants and by 0.309 standard deviations for elementary school special education applicants. ELL students score over 0.307 standard deviations higher on math in charters relative to traditional public schools.

Charters generate English score gains of 0.172 and 0.200 standard deviations for special education and ELL middle school applicants (shown in Panel B of Table 2). While English exam estimates for elementary and high schools are noisier, they are positive and mostly significant.

Positive charter effects are, with few exceptions, similar for special needs and non-special needs students. The p-values of the difference between the special education 2SLS estimates and the non-special needs estimates appear in Column (7) of Table 2. They show that except for elementary school, where special education students have larger English gains in charters than non-special needs students, charter effects are similar across the two groups. Column (8) displays the analogous p-values for ELL applicants. Except for elementary school math, where ELL students have significantly larger gains, charter gains are similar for ELL and non-special needs students.

Since the charter effects are similar across special needs status, the special needs achievement gap remains in charters. However, one year of charter attendance for a special needs student narrows the

special needs achievement gap. Most notably, after one year in a charter, ELL charter students score higher on the math exam than non-special needs students in traditional public schools for elementary and high school (seen by adding Columns (3) and (4) of Table 2 and comparing to the non-special needs traditional public school mean in Column (5)). 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 for math decreases by 27 percent for middle and high school students and by 48 percent for elementary school students. Charter attendance also narrows the gap for English, though by a lower proportion.

The Ordinary Least Squares (OLS) estimates (shown in Table A6) have comparable estimates to the 2SLS. This suggests that the OLS is unbiased. 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 A7) also have comparable estimates to the 2SLS. Therefore, even without accounting for lottery compliance, randomly assigned charter offers have a strong positive relation to test scores.

The English exam gains indicate that the ELL students improve their English proficiency more in charters. The English exam involves composition, language, reading comprehension, and literature, but the diagnostic English proficiency exam for ELL students more directly measures English language skills. Unlike the state English exam, the English proficiency test is not used for accountability. Students who remain ELLs each Spring take the English proficiency exam. Since charters remove ELL status for intermediate and advanced English language learners at higher rates than traditional public schools, charter students who take the exam have lower baseline English proficiency. Due to this selection issue, if both school types led to similar growth in English proficiency, we would expect negative charter effects. Instead, elementary and middle school charter students perform similarly and high school charter students score higher relative to traditional public school students (see Table 3 Column (2)). This suggests positive charter effects on English proficiency.

To correct for the selection issue, Column (4) displays estimates of the effect of charter enrollment on English proficiency for all baseline ELLs by imputing English proficiency exam scores for non-takers from the state English exam. This shows strong positive charter gains for English proficiency for middle school.[13]

[13]Middle school is the only school level where this estimation is possible because it is the only school level where the state English exam is offered in the year after the lottery.

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 4 shows that charter special education and ELL students are 24.2 and 38.3 percentage points respectively more likely to reach a key high school graduation requirement: reaching proficiency on the 10th grade math and English exams.[14] 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 12.7 percentage points and 29.6 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 4 suggests that charter enrollment has 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 leads special education students to score 115.7 points higher on the SAT. Special education and ELL students are 36.9 and 47.6 percentage points more likely to take at least one AP exam in charters compared to in traditional public schools. However, there is no significant effect of charter enrollment on scoring a 3 or higher, which is required to earn college credit. Columns (7) and (8) of Table 4 show the effects across special needs status are not statistically significantly different.

Charter enrollment dramatically lowers the likelihood that special education students will graduate high school in four years by 44.2 percentage points (see Panel C of Table 4). Given the gains in reaching the proficiency graduation requirement, this is perhaps surprising. However, special education students are similarly likely to graduate within five years in charters and in traditional public schools. Angrist et al. (forthcoming 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 seeking remediation at a community college. Due to a small sample size, the graduation estimates for ELL students are too noisy.

[14] This requirement is called Competency Determination.

4.2 Heterogeneity

Charters generate test score gains for even the most disadvantaged special needs students. Panel A of Table 5 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 0.306 and 0.276 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 5. 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 6 shows that the bottom third of special education students, as measured by their combined pre-lottery math and English exams, score 0.226 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.

Charter gains are strongest for those with specific learning disabilities, which are the most common disability type among charter applicants (see Table A9).[15] The estimates for other types of disabilities were imprecise. 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 A10). While the other native languages are not prevalent enough to estimate alone, ELLs who speak a language other than Spanish or Haitian Creole experience significant gains in math.

5 Classification

To estimate the effect of enrolling in a charter school on special needs classification and availability of special needs staff, I use an indicator for whether classification changed as the dependent variable in

[15] According to the federal definition given in 34 C.F.R. §§300.7 and 300.541, specific learning disability is defined 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." The severity of learning disabilities varies across students. Of the lottery applicants with a special education status at the time of the lottery, 40% of them have a specific learning disability. These students come from a range of classroom inclusion levels, a proxy for the severity of need. At the time of the lottery, thirty-seven percent come from a full inclusion classroom, 44% from partial inclusion, and 19% from substantially separate classrooms.

the 2SLS model described above. After documenting the effect of charter enrollment on classification, I estimate the partial correlations between schools' classification effects and their test score gains.

5.1 Special Needs Classification

Charters remove special needs classifications and move special education students to more inclusive settings at the time of enrollment[16] at a higher rate than traditional public schools. Column (2) of Table 7 shows that relative to their counterparts who attend traditional public schools, elementary and middle school special education charter students are 18.9 and 15.7 percentage points more likely to have their special education classification removed.[17] Middle school charters even remove special education status from students with more severe disabilities: students from substantially separate classrooms are 13.9 percentage points less likely to keep their special education status in a charter compared to a traditional public school. Charter high schools change classifications of incoming special education students at a similar rate to traditional public high schools.[18]

Charters move elementary and middle school special education applicants to more inclusive classrooms over 28 percentage points more often than traditional publics, a pattern documented in Column (10) of Table 7. This means that students spend more time in a general education classroom and less time receiving services outside of the mainstream classroom. Middle school charters move students across all ranges of need to more inclusive settings. For elementary schools, charters move students with the most severe needs to full inclusion classrooms (see Column (4) and (8) of Table 7). Overall, high school charters do not move special education students to more inclusive settings at significantly higher rates, but they are 48.2 percentage points more likely to move partial inclusion classroom students to a full inclusion or general education classroom.

In all school levels, charters remove ELL status at the time of enrollment at a substantially higher rate than traditional public schools. Ninety percent of elementary ELL applicants who enroll in traditional public schools remain ELL by the following fall, but as shown in Table 8, 20.5 percentage points fewer elementary school ELL applicants maintain their ELL classification in charters. Compared

[16] 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.

[17] 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. Students who have their classification removed and then reinstated are coded as keeping their classification. I follow the same practice for changes in classroom inclusion.

[18] Applicants from substantially separate classrooms are substantially less likely to remain classified as special education in a charter high school. It is surprising that students receiving special education services for more than 60% of the time prior to the lottery would transition to receiving no services.

to traditional public schools, applicants to charter middle and high schools are respectively 32.4 and 37.4 percentage points less likely to keep their ELL classifications. Students with intermediate and advanced English proficiency drive the differences in classification. In both types of schools, those with beginning English proficiency rarely have their ELL classification removed at the time of enrollment.

Furthermore, charters classify new enrollees to Massachusetts public schools as special needs less often than traditional public schools. New students in pre-k and kindergarten do not have pre-lottery special needs classifications. Only 1.4 percent of applicants who attend a traditional public school become classified as special education at the time of enrollment.[19] Attending a charter leads to an even lower special education classification rate close to zero (see Column (2), Panel A of Table 7). The difference comes largely from fewer students receiving full inclusion status in charters. Similar rates of students have partial or substantially separate inclusion in charters and traditional public schools.[20] 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 Panel A of Table 8). These classification and inclusion effects appear to persist for two years, as shown in Tables A11 and A12, though with less precision.[21]

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. The differential special needs classification for new pre-k and kindergarten students implies that charters have a lower preference for classification compared to 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 remove ELL classification 3.1 times more often than traditional public schools. This supports the idea that charters have lower preference for classification.

Unlike English language proficiency, Massachusetts does not require schools to assess all new enrolled students for special education needs. Because schools do not evaluate each student, factors other than schools' classification preferences could contribute to different classification practices. Different

[19]This is likely due to the state's active recruitment of students with special needs to 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.

[20]Analogous analysis of initial classification for new students could not be conducted on middle and high school applicants because few students have no special education classification at application and then become classified after the lottery.

[21]The time of enrollment and two years after the lottery sample sizes are different because data from the most recent lottery is included in the former, but not the latter, and some students attrit from the sample if they move out of state or to private school. The estimates for the Fall after the lottery are similar in magnitude and significance if the sample is restricted to those who appear in the data after two years.

classification practices are likely due to differences in parental reporting and in student record transfers from the pre-lottery school to charters compared to traditional public schools. The transfer of student records, which include special education status and level of inclusion, occurs in a smoother and timelier manner between BPS district schools compared to between BPS district schools and charter schools.

As a result, charters learn of special needs classifications from voluntary parental reporting before they receive school records.[22] The initial reliance on parental reporting could contribute to fewer students maintaining their special education classifications in charters. Due to concerns over stigmas or because of their individual preferences, parents in charters can choose to not disclose their child's previous special education status or level of inclusion. 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.

Along with data transfer issues, parental reporting and preferences likely contribute to the increased use of inclusion in charter schools. Charters commonly cite special education inclusion policies in their annual reports. Since charters are relatively smaller schools, they are less likely to have the economies of scale to provide substantially separate and partial inclusion services to students compared to traditional public schools.

5.2 Relationship Between Classification and Academic Effects

To test the relationship between classification practices and school effectiveness, I calculate the partial correlation between the estimated test score effects and the estimated classification effects of each application cohort for each school. The test score effects and classification effects for each cohort and school combination are estimated using a 2SLS model with multiple endogenous variables. The second stage is:

$$y_{igt} = \alpha_t + \beta_g + X_i'\theta + \sum_{st} \tau_{st} C_{ist} + \sum_{js} \delta_{js} d_{ijs} + \epsilon_{igst} \tag{3}$$

where α_t denotes a set of year dummies, β_g is a set of testing grade dummies, and X_i denotes the standard set of demographics. The multiple endogenous variables for years spent in each charter school s in year t are denoted as $\sum_{st} \tau_{st} C_{ist}$ and instrumented for by the set of lottery and waitlist offers

[22]Starting in late Fall 2012, the Massachusetts Department of Elementary and Secondary Education began using a new data reporting system called Edwin Analytics. This system aims to make student data accessible to their schools in a more efficient and timely manner. The charter schools began using this system at varying times. Even with the new system, charter schools still did not always have the special education classification information of their students before the school year started.

for each charter and application cohort. The model also controls for the lotteries students applied for using $\sum_{sj} \delta_{sj} d_{isj}$, where d_{isj} is the experimental strata interacted with the charter school indicators. Standard errors are clustered on unique student identifier and the school, grade, and year of the test.

Figure 1 plots the $\hat{\tau_{st}}$ for test scores on the y axis against the $\hat{\tau_{st}}$ for changing classification to show the partial correlation between the estimate effects schools have on test scores and their effect on changing classification. The fitted line between the partial correlations weights by the inverse of the variance of $\hat{\tau_{st}}$. The relationship between test score gains and classification effects is weakly positive and very imprecise. From this, there is no evidence suggesting that classification practices are related to positive test score gains because the schools that change classifications and move students to more inclusive settings more often are not significantly correlated with the schools with the largest test score gains.

Therefore, classification practices cannot fully explain the variation in charter effectiveness. This suggests that general charter characteristics, not aspects specific to the special needs experience, play a significant role in generating special needs gains.

6 Threats to Validity

6.1 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.[23] 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.[24] 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 A4. 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

[23] Students who leave the state or enroll in private or parochial schools do not appear in the data.
[24] Post-lottery is defined as the October 1 after the lottery occurs.

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

6.2 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 2SLS 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 A13 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.

7 Conclusion

Using randomized admission lotteries, this paper finds strong positive effects of Boston's elementary, middle, and high schools for special education and ELL students. Charters generate substantial gains for special needs students in math and English standardized exam scores, English proficiency, and college preparation outcomes. Even the most disadvantaged special needs students perform better in charter schools compared to traditional public schools.

Lower enrollment rates of special needs students in charters compared to district schools have led to the common perception that charters underserve special education and ELL students. For example, the Boston Globe Editorial Board writes that charters "fall short" with "special education students and those who speak only limited English" (2015). The Massachusetts Teachers Association circulates materials "about how charters exclude English language learners [and] special needs students...", citing overall enrollment statistics (2015).

This paper debunks these perceptions. It documents that special needs students are now proportionally represented in charter lotteries. Even those with the highest need are close to proportional representation in charter lotteries. Furthermore, charters remove special needs classifications at a higher rate than traditional public schools and move special education students to more inclusive classrooms. These differences in classification practices make the proportion of special needs students in charters appear smaller.

Also, 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 0.266 standard deviations for special education students, one year in a charter reduces the special education achievement gaps by 30.5 percent. ELL students score 0.345 standard deviations higher in charters, narrowing the ELL achievement gap by 88.0 percent.

The weak positive relationship between charter effectiveness and classification practices suggests

that the latter cannot fully explain the academic gains in charters. This implies 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. Without further evidence, I cannot definitively state which school characteristics better support special needs students, but several factors are likely important. For schools in the study, charters have a higher staff-to-student ratio than traditional public schools. They often use longer school days and years, offer intensive tutoring, and set high expectations. Charters also utilize data-driven methods, which enables them to identify and provide support to struggling students, regardless of special needs status.

It is worth noting that the results apply to charter lottery applicants. Boston charters could have different effects for the special education and ELL students and families who do not apply for charter schools. 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. In future work, I hope to provide additional evidence on the relative effectiveness of different special needs charter school practices.

References

Abdulkadiroğlu, Atila, Joshua Angrist, Susan Dynarski, Thomas J. Kane, and Parag Pathak. 2011. "Accountability and flexibility in public schools: Evidence from Boston's charters and pilots." *The Quarterly Journal of Economics* 126 (2):699–748.

Angrist, Joshua D, Sarah R Cohodes, Susan M Dynarski, Parag a Pathak, and Christopher R Walters. forthcoming 2016. "Stand and deliver: Effects of Boston's charter high schools on college preparation, entry, and choice." *Journal of Labor Economics* :.URL `http://www.nber.org/papers/w19275`.

Angrist, Joshua D., Parag a. Pathak, and Christopher R. Walters. 2013. "Explaining Charter School Effectiveness." *American Economic Journal: Applied Economics* 5 (4):1–27.

Boston Globe Editorial Board. 2015. "Charter Schools Take a Commendable Step." *The Boston Globe* April 20.

Carter, Samuel Casey. 2000. *No Excuses: Lessons from 21 High-Performing, High-Poverty Schools.* Washington, DC: Heritage Foundation.

Chin, Aimee, N. Meltem Daysal, and Scott Imberman. 2013. "Impact of Bilingual Education Programs on Limited English Proficient Students and Their Peers: Regression Discontinuity Evidence from Texas." *Journal of Public Economics* 107:63–78.

Dobbie, Will and Roland Fryer. 2011. "Getting Beneath the Veil of Effective Schools: Evidence from New York City." *American Economic Journal: Applied Economics* 5 (4):28–60.

Farver, JoAnn, Christopher. Lonigan, and Stefanie Eppe. 2009. "Effective early literacy skill development for young Spanishspeaking English Language Learners: An experimental study of two methods." *Child Development* (80(3)):703–719.

Francis, David, Nonie Lesaux, and Diane August. 2006. "Language of instruction." *In D. August, & T. Shanahan (Eds.), Developing literacy in second language learners: Report of the National Literacy Panel on Language Minority Children and Youth* Mahwah, NJ: Erlbaum:365–414.

Hanushek, Eric, John Kain, and Steven Rivkin. 2002. "Inferring Program Effects for Special Populations: Does Special Education Raise Achievement for Students with Disabilities?" *The Review of Economics and Statistics* 4 (84):584–599.

Hoxby, Caroline and Jonah Rockoff. 2004. "The Impact of Charter Schools on Student Achievement." *NBER Converence Paper* .

Hoxby, Caroline M., Jenny L. Kang, and Sonali Murarka. 2009. "Technical Report : How New York City Charter Schools Affect Achievement." *National Bureau of Economic Research (NBER)* .

Jepsen, Christopher. 2010. "Bilingual education and English proficiency." *Education Finance and Policy* (52(2)):200–227.

Massachusetts Department of Elementary and Secondary Education. 2014. "Massachusetts Charter Schools Fact Sheet." .

Massachusetts Teachers Association. 2015. "Week of Action on Charter Schools." URL `http://massteacher.org/issues_and_action/charter_schoolsweek_of_action.aspx`.

Thernstrom, Abigail and Stephen Thernstrom. 2003. *No Excuses: Closing the Racial Gap in Learning.* New York: Simon and Schuster.

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, and the Massachusetts Education Personnel Information Management Systems (EPIMS) data. This Appendix describes each data source and explains the process used to clean and match them.

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 instrument, 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.

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, date of birth, 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.

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.

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.

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 2014. For students who took the SAT more than once, their data includes only the most recent exam score.

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.

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 A3 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.

Sample Restrictions

Appendix Table A2 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 School Staff

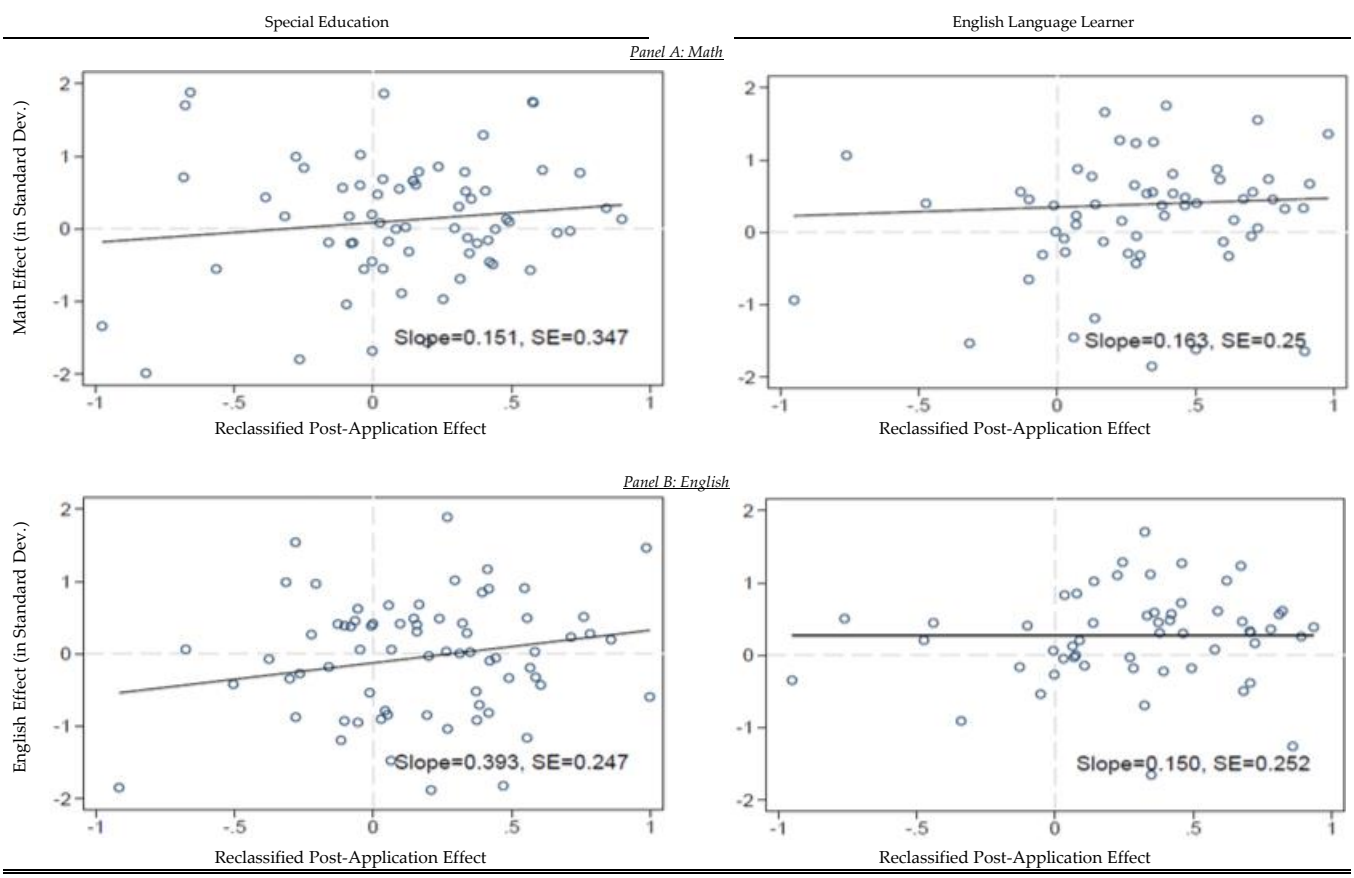
Schools are only legally obligated to provide special education or ELL services to students with special needs classifications. Therefore, the higher rate of classification removal in charter schools likely results in baseline special needs students receiving fewer special education and ELL services. Additionally, students who are moved to more inclusive classrooms spend less time receiving services.

Massachusetts staffing data provides additional evidence of how the special needs services vary between charter and traditional public schools. Charter schools make different special education and ELL staffing choices. Students who enroll in charters experience higher staff-to-student ratios, as shown in Column (2) of Table A14. Students in charter schools also have lower special education and ELL staff-to-student ratios (Columns (4) and (6)). For example, traditional public middle school students have roughly 1.9 special education staff per 100 students, but charter middle school students have 0.8 special education staff per 100 students.

The lower special needs staff-to-student ratio in charters is driven by charters using fewer special needs teachers. Despite charters having fewer classified special needs students, they employ mostly similar proportions of staff to total students for special needs specialists and content support teachers. Special needs specialists include special education and ELL directors who oversee service provision, special education diagnosticians, therapists, and counselors. 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. The annual reports of several charter schools describe that they provide early intervention for non-special education students in early elementary school grades to avoid the need for special education classification in later years.

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.

Figure 1: Correlations of Effect Sizes by School x Cohort



Notes: This figure plots the school-specific math and English effects against the school-specific post-application special needs reclassification effects. For special education students, reclassification is defined as losing special education status or moving to a more inclusive classroom setting. For English Language Learners, reclassification is defined as losing English Language Learner status. 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 reclassification effect on the test score effect, weighted by the inverse of the standard errors of the effects.

Table 1: Descriptive Statistics and Covariate Balance

	Boston Public School Students	All Lottery Applicants			Special Education at Baseline			ELL at Baseline		
			Immediate			Immediate			Immediate	
	Mean	Mean	Offer	Any Offer	Mean	Offer	Any Offer	Mean	Offer	Any Offer
Baseline Charateristics	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Female	0.483	0.503	0.010	0.001	0.342	0.012	0.013	0.482	0.006	-0.012
			(0.013)	(0.013)		(0.030)	(0.030)		(0.028)	(0.028)
Black	0.385	0.461	-0.023*	-0.017	0.477	0.005	-0.006	0.269	0.009	-0.002
			(0.013)	(0.013)		(0.031)	(0.031)		(0.025)	(0.024)
Latino/a	0.369	0.369	0.013	0.005	0.360	-0.015	-0.016	0.624	-0.035	-0.004
			(0.012)	(0.012)		(0.029)	(0.029)		(0.027)	(0.027)
Subsidized Lunch	0.752	0.749	0.002	-0.007	0.757	0.031	0.012	0.844	-0.003	0.001
			(0.011)	(0.011)		(0.024)	(0.025)		(0.020)	(0.018)
Baseline Math Test Score	-0.452	-0.407	0.016	-0.012	-1.002	-0.012	0.018	-0.736	0.017	-0.047
			(0.027)	(0.027)		(0.066)	(0.066)		(0.057)	(0.055)
Baseline English Test Score	-0.551	-0.455	-0.028	0.004	-1.214	-0.036	0.062	-0.980	-0.028	-0.003
			(0.028)	(0.028)		(0.069)	(0.068)		(0.062)	(0.060)
Special Education	0.217	0.192	0.007	-0.002	-	-	-	0.190	-0.008	0.001
			(0.011)	(0.011)		-	-		(0.022)	(0.022)
Substantially Separate Classroom	0.074	0.050	0.005	-0.004	0.260	0.016	-0.017	0.067	-0.021*	-0.008
			(0.005)	(0.006)		(0.025)	(0.026)		(0.011)	(0.012)
Partial Inclusion	0.055	0.057	0.008	0.002	0.296	0.021	0.014	0.059	0.015	0.011
			(0.007)	(0.007)		(0.030)	(0.030)		(0.016)	(0.015)
Full Inclusion	0.092	0.082	-0.005	-0.001	0.425	-0.035	-0.004	0.061	0.000	-0.001
			(0.007)	(0.007)		(0.030)	(0.030)		(0.014)	(0.013)
English Language Learner	0.252	0.258	-0.008	-0.003	0.254	-0.023	-0.010	-	-	-
			(0.011)	(0.011)		(0.026)	(0.026)		-	-
Beginning Proficiency	0.019	0.025	-0.006**	-0.007**	0.024	-0.007	-0.006	0.098	-0.019	-0.028**
			(0.003)	(0.003)		(0.006)	(0.005)		(0.012)	(0.013)
Intermediate Proficiency	0.077	0.121	0.002	0.005	0.144	0.008	-0.002	0.465	0.033	0.035
			(0.009)	(0.008)		(0.022)	(0.022)		(0.028)	(0.027)
Advanced Proficiency	0.053	0.058	0.001	0.004	0.029	-0.009	0.001	0.216	0.010	0.018
			(0.008)	(0.007)		(0.015)	(0.013)		(0.027)	(0.027)
Observations with School/Offer Type	169648	7591	5085	10408	1458	1007	2076	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 for the same grades and years. Columns (3) and (4) report coefficients from regressions of observed characteristics on immediate offers and any offers, controlling for experimental strata dummies. P-values are from tests of the hypothesis that all non-test score coefficients are zero. The sample includes students with pre-lottery demographics. Baseline test scores are only available applicants to the 4th grade or higher. Columns (5) through (10) report analogous results for the subsample with special education classification and ELL classification in the lottery application year.

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

Table 2: Test Score Effects by Baseline Special Needs Status

		Special Education		English Language Learner		Non-Special Needs		P-value of Difference Between Non-Special Needs and	
		Trad. Public mean	Charter effect	Trad. Public mean	Charter effect	Trad. Public mean	Charter effect	Special Education	English Language Learner
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
					Panel A: Elementary School				
Math		-0.730	0.309**	-0.323	0.386***	-0.087	0.184***	0.341	0.064
			(0.123)		(0.101)		(0.045)		
	N		170		540		591		
English		-1.172	0.478***	-0.516	0.360***	-0.128	0.199***	0.068	0.131
			(0.148)		(0.100)		(0.046)		
	N		168		538		590		
					Panel B: Middle School				
Math		-1.025	0.243***	-0.549	0.307***	-0.126	0.255***	0.860	0.355
			(0.060)		(0.052)		(0.026)		
	N		3602		4364		12000		
English		-1.176	0.172***	-0.763	0.200***	-0.100	0.142***	0.641	0.283
			(0.062)		(0.050)		(0.025)		
	N		3589		4368		11933		
					Panel C: High School				
Math		-0.918	0.223**	-0.423	0.414***	-0.083	0.342***	0.272	0.603
			(0.096)		(0.139)		(0.053)		
	N		1023		490		3887		
English		-1.068	0.148	-0.763	0.423**	-0.135	0.215***	0.553	0.223
			(0.104)		(0.171)		(0.042)		
	N		1043		500		3933		

Notes: This table reports the 2SLS estimates of the effects of time spent in charter schools on test scores. The endogenous variable is years spent in charter schools and the instruments are lottery and waitlist offer dummies. 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. Column (7) reports the p-values for tests of the hypothesis that the coefficients for special education and other students are equal. Column (8) shows this for English Language Learners. 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 and cluster by student identifier and school-grade-year. Estimates for the high school sample include only scores for tenth grade and cluster by school-grade-year.
*significant at 10%; **significant at 5%; ***significant at 1%

Table 3: Charter Effects on English Proficiency Scores for Baseline English Language Learners

		English Proficiency Exam Takers		Exam Takers and Imputed Scores for Non-takers	
		Trad. Public mean	Charter effect	Trad. Public mean	Charter effect
School Level		(1)	(2)	(3)	(4)
Elementary School		0.002	-0.069	-	-
			(0.110)		-
	N		455		-
Middle School		0.594	-0.074	0.350	0.135***
			(0.105)		(0.052)
	N		1052		1863
High School		0.484	0.841*	-	-
			(0.468)		-
	N		339		-

Notes: This table reports the 2SLS estimates of charter enrollment on an English Proficiency exam administered in the spring after the charter lottery. The endogenous variable is an indicator for charter enrollment in the year following the lottery and instruments are immediate and waitlist offer dummies. Students who remain classified as English Language Learners take the English Proficiency exam. Columns (1) and (2) show estimates for this selected group. Columns (3) and (4) show estimates for all baseline English Language Learners by imputing English proficiency exam scores for non-takers using the state English Language Arts (ELA) exam scores. Scores are imputed by mapping each ELA score to the median English proficiency exam score for each year and grade in Massachusetts. All 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.

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

Table 4: Effects on Longer-Term Outcomes by Special Needs Status

	Special Education		English Language Learner		Non-Special Needs		P-value of Difference Between Non-Special Needs and	
	Trad. Public mean	Charter effect	Trad. Public mean	Charter effect	Trad. Public mean	Charter effect	Special Education	English Language Learner
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: High School Performance								
Meets High School Proficiency Graduation Requirement	0.376	0.242**	0.558	0.383**	0.763	0.146***	0.394	0.129
		(0.117)		(0.164)		(0.055)		
Eligible for Adams Scholarship	0.041	0.127**	0.128	0.296**	0.255	0.350***	0.050	0.756
		(0.054)		(0.131)		(0.057)		
N		1000		481		3854		
Panel B: SAT and AP Exams								
Took SAT	0.463	0.087	0.615	-0.102	0.640	0.146***	0.625	0.228
		(0.113)		(0.222)		(0.054)		
Took AP	0.071	0.369***	0.173	0.476**	0.244	0.289***	0.511	0.399
		(0.092)		(0.200)		(0.063)		
Number of AP Exams	0.138	0.698***	0.400	0.244	0.529	1.034***	0.339	0.229
		(0.210)		(0.748)		(0.243)		
N		952		361		3535		
SAT Score (For takers)	1071.373	115.748**	1163.851	78.274	1319.649	78.394**	0.577	0.999
		(55.303)		(118.634)		(33.585)		
N		500		244		2507		
AP Score 3 or Higher (For takers)	0.031	0.084	0.089	0.137	0.117	0.105*	0.820	0.849
		(0.055)		(0.222)		(0.057)		
N		952		361		3535		
Panel C: High School Graduation								
Four-year Graduation	0.297	-0.442***	0.164	-0.367	0.367	-0.069	0.008	0.426
		(0.130)		(0.375)		(0.057)		
N		760		193		2941		
Five-year Graduation	0.655	-0.183	0.660	-0.649	0.768	-0.046	0.298	0.095
		(0.133)		(0.460)		(0.065)		
N		604		125		2452		

Notes: This table reports the 2SLS estimates of the effects of charter enrollment on longer-term outcomes. The high school proficiency graduation requirement is the Massachusetts Competency Determination which is based off of scores on the 10th-grade state standardized exam. Adams Scholarship eligibility requires higher performance on this same exam. The sample for Panel A includes students projected to graduate in Spring 2008 – 2016. Panel B includes students projected to graduate in Spring 2008 - 2015. All other outcomes are restricted to students projected to graduate in 2008 – 2014, except for five-year graduation, which is limited to students projected to graduate by 2013. 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 cluster by school-grade-year.
*significant at 10%; **significant at 5%; ***significant at 1%

Table 5: Test Score Effects 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	0.306***	-0.606	0.270***
			(0.114)		(0.094)		(0.072)
	N		1004		1647		2088
English		-1.614	0.204	-1.244	0.152	-0.791	0.214***
			(0.135)		(0.103)		(0.065)
	N		1004		1649		2090

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)		(0.073)
	N		289		2710		1799
English		-1.961	0.498***	-0.904	0.315***	-0.251	0.162**
			(0.145)		(0.056)		(0.063)
	N		292		2719		1801

Notes: This table reports 2SLS estimates of the effects of charter enrollment on 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. See Table 2 notes for detailed regression specifications. *significant at 10%; **significant at 5%; ***significant at 1%

Table 6: Test Score Effects by Baseline Performance and Special Needs Status

Baseline Performance within 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: Math				
Bottom third		-1.699	0.226**	-1.337	0.248***	-0.905	0.357***
			(0.088)		(0.089)		(0.040)
	N		1352		1491		5074
Middle third		-1.067	0.220***	-0.539	0.334***	-0.100	0.284***
			(0.074)		(0.065)		(0.032)
	N		1544		1613		5285
Top third		-0.304	0.318***	0.254	0.328***	0.592	0.185***
			(0.068)		(0.061)		(0.026)
	N		1599		1706		5123
			Panel B: English				
Bottom third		-1.812	0.189*	-1.474	0.400***	-0.789	0.175***
			(0.110)		(0.073)		(0.039)
	N		1418		1486		5021
Middle third		-1.187	0.114	-0.722	0.305***	-0.080	0.173***
			(0.077)		(0.075)		(0.028)
	N		1487		1580		5222
Top third		-0.443	0.126*	0.009	0.140**	0.451	0.106***
			(0.064)		(0.056)		(0.025)
	N		1589		1617		5213

Notes: This table reports the 2SLS estimates of the effects of time spent in charter schools on test scores by baseline 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. See Table 2 notes for detailed regression specifications.
*significant at 10%; **significant at 5%; ***significant at 1%

Table 7: Post-Application Changes in 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	0.908	-0.189***							0.164	0.284**
		(0.068)								(0.126)
N		256								256
Substantially Separate	0.905	-0.018	0.619	-0.411**	0.016	0.073	0.190	0.561***	0.238	0.555***
Classroom		(0.105)		(0.167)		(0.092)		(0.124)		(0.169)
N		73								73
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	0.911	-0.144					0.693	0.034	0.059	0.141
		(0.136)						(0.171)		(0.131)
N		127								127
No Baseline	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	-0.157***							0.124	0.299***
		(0.044)								(0.049)
N		1737								1737
Substantially Separate	0.976	-0.139**	0.898	-0.682***	0.035	0.017	0.028	0.259***	0.071	0.286***
Classroom		(0.064)		(0.097)		(0.066)		(0.077)		(0.093)
N		405								405
Partial Inclusion	0.935	-0.140**			0.666	-0.649***	0.154	0.429***	0.191	0.472***
		(0.066)				(0.087)		(0.079)		(0.083)
N		614								614
Full Inclusion	0.888	-0.222***					0.693	-0.101	0.096	0.114*
		(0.076)						(0.089)		(0.059)
N		687								687
Panel C: High School										
All Special Education	0.842	0.063							0.179	0.093
		(0.109)								(0.095)
N		1168								1168
Substantially Separate	0.975	-0.442***	0.820	-0.468***	0.071	-0.171*	0.042	0.065	0.130	0.101
Classroom		(0.077)		(0.123)		(0.095)		(0.077)		(0.126)
N		334								334
Partial Inclusion	0.887	0.244			0.590	-0.458**	0.180	0.615***	0.252	0.482***
		(0.180)				(0.191)		(0.171)		(0.177)
N		342								342
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 2SLS estimates of the effects of Boston charter enrollment on special education classification and level of classroom inclusion by baseline level of inclusion. Columns (1) and (2) display the estimates of the effect of charter enrollment on the student being classified as special education on the October 1 following the charter application. Columns (3) through (8) show analagous estimates with special education level of inclusion on October 1 as dependent variables. Effects persist for up to two years following the charter application. "No baseline" includes only Pre-K and Kindergarten applicants. See Table 4 notes for detailed regression specifications.
*significant at 10%; **significant at 5%; ***significant at 1%

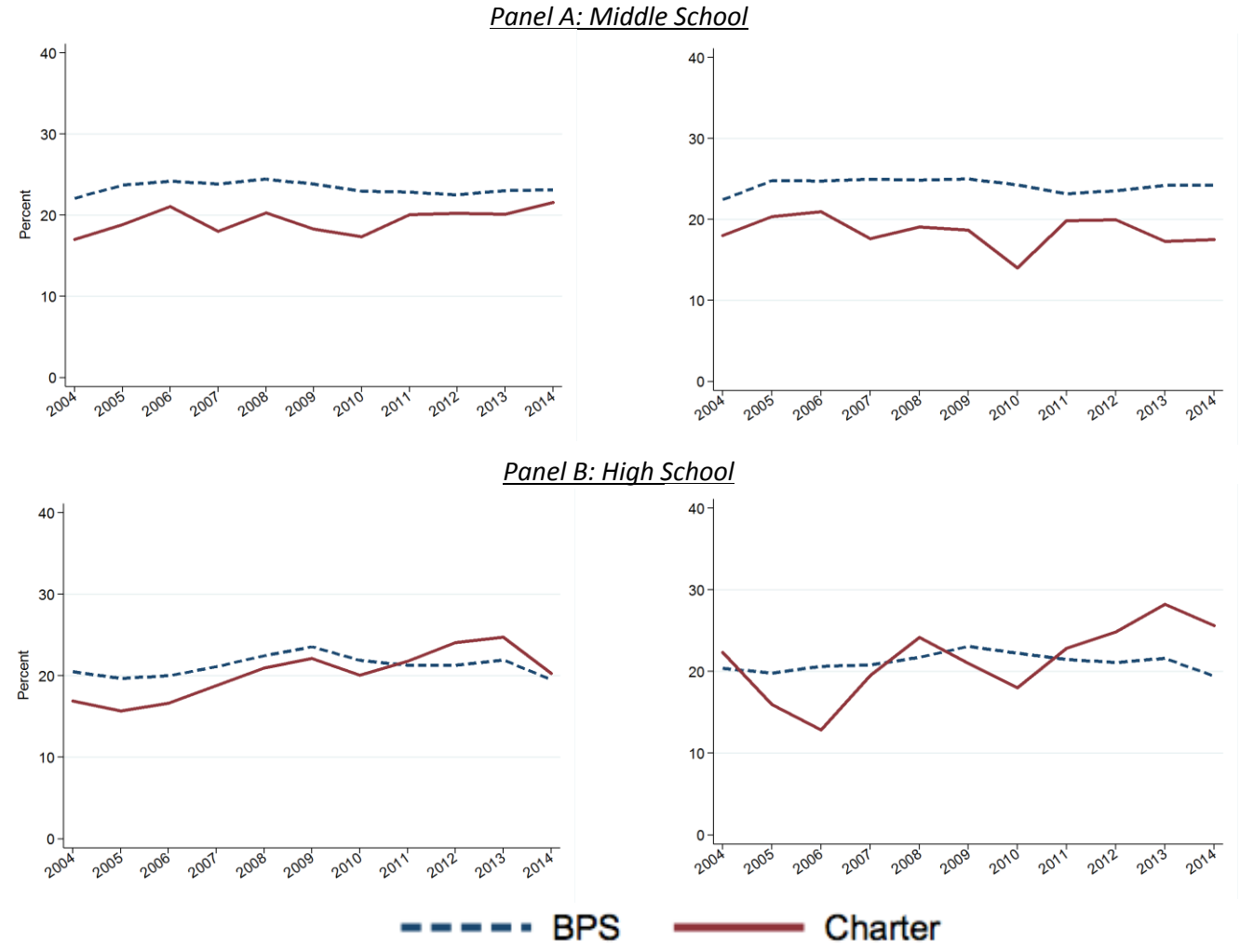
Table 8: Post-Application Changes in English Language Learner Classification

	English Language Learner	
	Trad. Public mean	Charter effect
Baseline Status	(1)	(2)
Panel A: Elementary School		
All English Language Learners	0.901	-0.205***
		(0.075)
N		823
Beginning Proficiency	0.989	-0.033
		(0.029)
N		110
Intermediate Proficiency	0.986	-0.135*
		(0.077)
N		351
Advanced Proficiency	0.739	-0.604**
		(0.297)
N		25
No Baseline, Non-native English Speakers	0.637	-0.261***
		(0.061)
N		856
Panel B: Middle School		
All English Language Learners	0.795	-0.324***
		(0.059)
N		2235
Beginning Proficiency	1.000	0.000
		(0.000)
N		130
Intermediate Proficiency	0.953	-0.410***
		(0.073)
N		1110
Advanced Proficiency	0.570	-0.199**
		(0.086)
N		774
Panel C: High School		
All English Language Learners	0.802	-0.374***
		(0.142)
N		713
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 2SLS estimates of the effects of Boston charter enrollment on English Language Learner classification by baseline English proficiency level. Columns (1) and (2) display the estimates of the effect of charter enrollment on the student being classified as an English Language Learner on the October 1 following the charter application. Effects persist for up to two years following the charter application. "No baseline" includes only Pre-K and Kindergarten applicants. See Table 4 notes for detailed regression specifications.

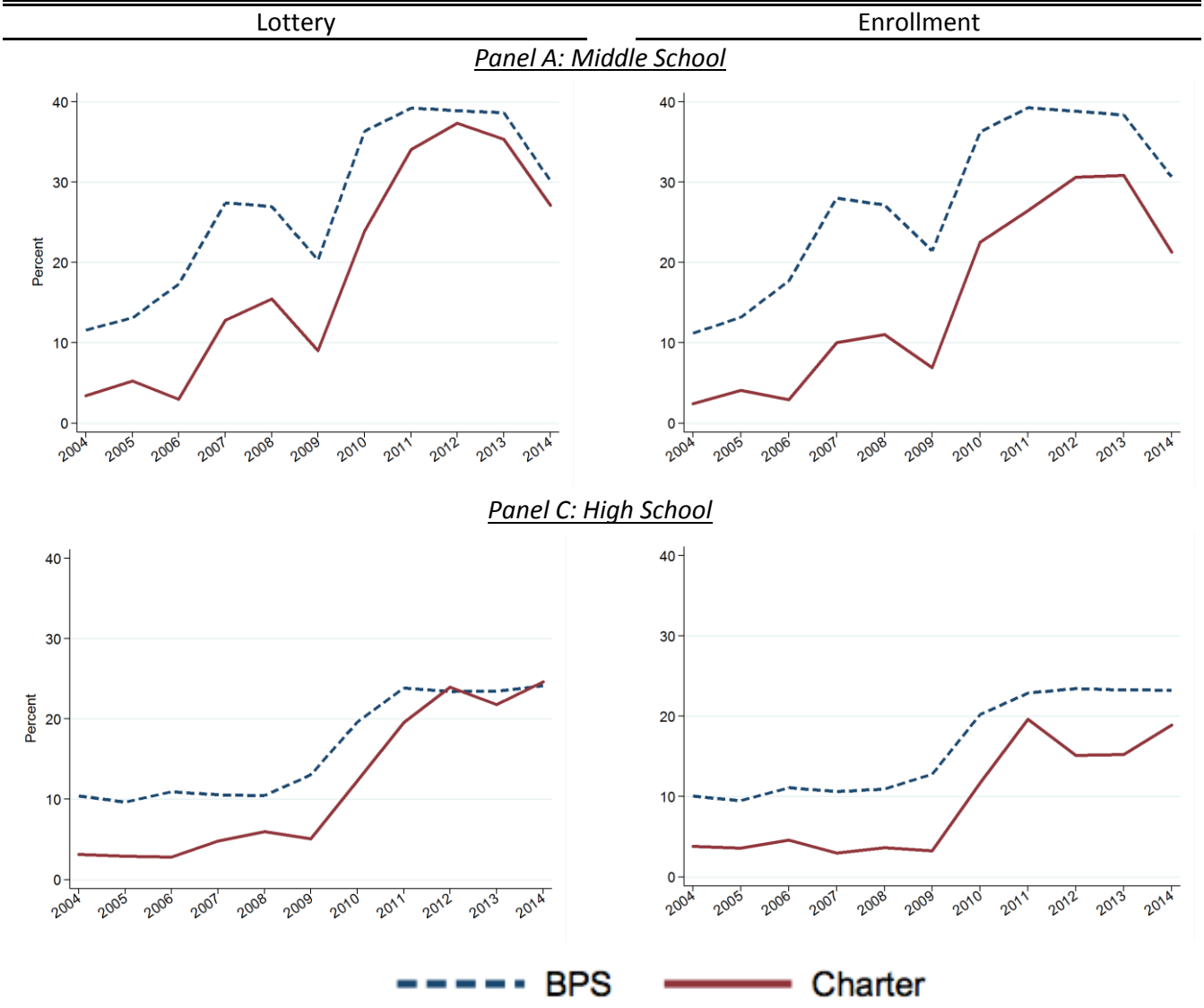
*significant at 10%; **significant at 5%; ***significant at 1%

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



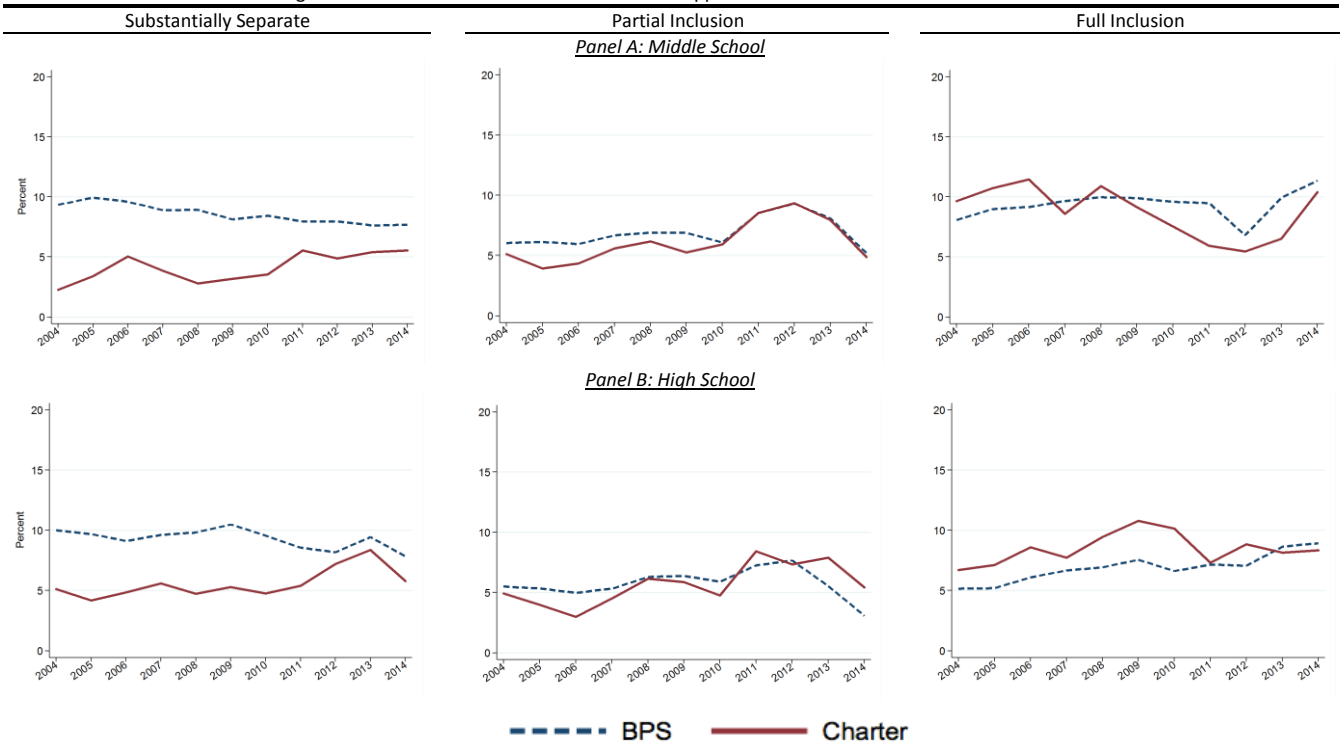
Notes: The graphs on the left plot the percent of students with special education status at the time of the lottery for Charter applicants and Boston Public School (BPS) students in Charter application grades (4, 5, and 8). The graphs on the right plot the percent of students with special education status 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



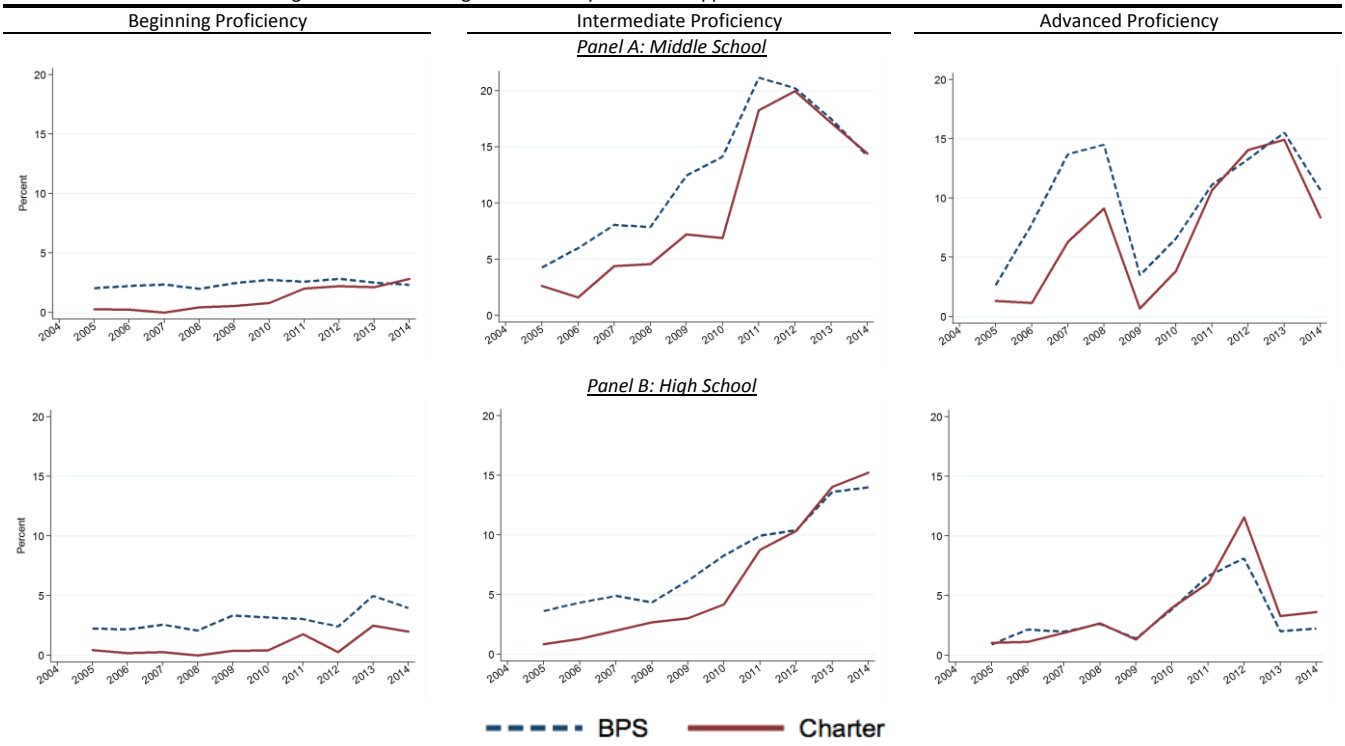
Notes: The graphs on the left plot the percent of students with English Language Learner (ELL) status at the time of the lottery for Charter applicants and Boston Public School (BPS) students in Charter application grades (4, 5, and 8). The graphs on the right plot the percent of students with ELL status 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 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 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 state annual exam for English Language Learners.

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
2002										
2003										Not open
2004				No records						Y
2005						No records	Not open			Y*
2006	Not open	Not open	Not open						Not open	Y*
2007				Y	Not open			Not open		Y
2008				Y						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
	(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
2002		Y			
2003	No records	Y	Not open Incomplete records		
2004		Y			Not open
2005	Y	Y	Y**		
2006	Y	Y	Y		
2007	Y	Y	Y	Not entry grade	
2008	Y	Y	Y		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	0	0	0	0	0

Panel D: High School

Boston Green Academy	City on a Hill	City on a Hill II	Codman Academy	Match HS
(1)	(2)	(3)	(4)	(5)
9	9	9	9	9
	**			Y
	No records		Incomplete records	Y
	Y*		Y**	Y
	Y			Y
Not open	Y		Incomplete records	Y
	Y	Not open		Y
	Y		No record	Y
	Y*		Y	Y
	Y		Y	Y
	Y		Y	Y
	Y		Y	
	Y		Y	Not entry grade
Y	Y	Y**	Y	
Y**	Y	Y	Y	
901	4624	1102	1737	2766

Notes: This table shows study charters and their application cohorts. These counts contain the number of students applying to each school in the study sample. Siblings, out of area applicants, duplicates, and disqualified applicants have been removed as have students who were not matched to the state dataset. In 2012, Uncommon Schools (Roxbury Prep, Dorchester Prep, and Grove Hall) had a common 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.

* There is only ever offer information.

** There is no variation in waitlist offers.

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

A2: 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.

A3: 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 SIMS 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 SIMS 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.

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

A4: 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)
			Panel A: Elementary School			
Math Exam	0.266	-0.059*	0.168	-0.027*	0.196	-0.026*
		(0.035)		(0.015)		(0.014)
		217		625		695
English Exam	0.260	-0.071**	0.168	-0.028*	0.198	-0.027*
		(0.035)		(0.015)		(0.015)
		217		625		695
Classification Status	0.212	-0.219**	0.081	-0.114***	0.105	-0.059
		(0.101)		(0.040)		(0.038)
		240		726		716
			Panel B: Middle School			
Math Exam	0.201	0.002	0.164	-0.005	0.200	-0.030***
		(0.022)		(0.019)		(0.011)
		4304		4966		13878
English Exam	0.204	0.003	0.164	-0.008	0.203	-0.032***
		(0.021)		(0.018)		(0.011)
		4304		4966		13878
Classification Status	0.114	-0.025	0.120	-0.023	0.148	-0.076***
		(0.031)		(0.027)		(0.018)
		1658		2164		5036
			Panel C: High School			
Math Exam	0.287	0.052	0.308	0.125	0.274	-0.022
		(0.041)		(0.104)		(0.021)
		1340		643		4869
English Exam	0.268	0.023	0.291	0.051	0.263	-0.014
		(0.042)		(0.099)		(0.023)
		1340		643		4869
Classification Status	0.080	-0.060	0.027	0.106	0.056	-0.176***
		(0.089)		(0.096)		(0.062)
		1347		819		4596

Notes: This table reports the 2SLS estimates of the effect time spent in charter schools on attriting from the sample for the test score and reclassification outcomes. See Table 2 notes for detailed regression specifications.

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

A5: 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)
			Panel A: Elementary School			
Years in Charter	1.626***	1.125***	1.463***	0.831***	2.234***	0.924***
	(0.153)	(0.265)	(0.096)	(0.156)	(0.162)	(0.277)
N	171		542		591	
Enroll in Charter	0.589***	0.364***	0.620***	0.347***	0.709***	0.384***
	(0.060)	(0.086)	(0.030)	(0.042)	(0.031)	(0.049)
N	236		715		682	
			Panel B: Middle School			
Years in Charter	1.035***	0.676***	1.100***	0.661***	1.221***	0.809***
	(0.041)	(0.041)	(0.033)	(0.033)	(0.022)	(0.023)
N	3632		4380		12046	
Enroll in Charter	0.581***	0.387***	0.640***	0.422***	0.629***	0.410***
	(0.030)	(0.030)	(0.025)	(0.026)	(0.017)	(0.017)
N	1607		2052		4696	
			Panel C: High School			
Years in Charter	0.717***	0.490***	0.662***	0.726***	0.714***	0.424***
	(0.084)	(0.079)	(0.116)	(0.105)	(0.038)	(0.037)
N	1055		504		3955	
Enroll in Charter	0.720***	0.470***	0.680***	0.722***	0.717***	0.452***
	(0.082)	(0.079)	(0.109)	(0.105)	(0.039)	(0.038)
N	1160		621		3752	

Notes: This table reports the first stage estimates for the two main 2SLS specifications. It displays the effect of lottery offers on years spent in charter schools and an indicator for charter enrollment.

A6: OLS Estimates 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	0.250***	-0.326	0.200***	-0.087	0.089**
			(0.071)		(0.059)		(0.040)
	N		171		541		591
English		-1.186	0.337***	-0.519	0.194***	-0.128	0.108***
			(0.074)		(0.066)		(0.038)
	N		169		539		590
			Panel B: Middle School				
Math		-1.025	0.231***	-0.550	0.276***	-0.127	0.197***
			(0.019)		(0.021)		(0.012)
	N		3603		4366		12005
English		-1.176	0.186***	-0.763	0.220***	-0.101	0.137***
			(0.019)		(0.018)		(0.010)
	N		3590		4370		11938
			Panel C: High School				
Math		-0.918	0.229***	-0.423	0.105	-0.083	0.168***
			(0.034)		(0.067)		(0.029)
	N		1023		490		3887
English		-1.068	0.194***	-0.763	0.140**	-0.135	0.128***
			(0.028)		(0.070)		(0.021)
	N		1043		500		3933

Notes: This table reports the OLS estimates of time spent in charter school on state standardized test scores. See Table 2 notes for detailed regression specifications.

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

A7: Reduced Form (Intent To Treat) Estimates by Baseline Special Needs Status

		Special Education		English Language Learner		Non-Special Needs	
		No charter offer mean	Charter offer effect	No charter offer mean	Charter offer effect	No charter offer mean	Charter offer effect
		(1)	(2)	(3)	(4)	(5)	(6)
			Panel A: Elementary School				
Math		-0.618	0.444**	-0.351	0.587***	-0.100	0.461***
			(0.187)		(0.114)		(0.104)
	N		171		541		591
English		-1.047	0.694***	-0.544	0.528***	-0.154	0.498***
			(0.199)		(0.133)		(0.111)
	N		169		539		590
			Panel B: Middle School				
Math		-0.910	0.202***	-0.449	0.231***	-0.031	0.248***
			(0.055)		(0.055)		(0.032)
	N		3603		4366		12005
English		-1.090	0.159***	-0.687	0.147***	-0.034	0.130***
			(0.058)		(0.049)		(0.028)
	N		3590		4370		11938
			Panel C: High School				
Math		-0.766	0.154**	-0.410	0.260**	-0.073	0.199***
			(0.066)		(0.110)		(0.037)
	N		1023		490		3887
English		-0.960	0.108*	-0.756	0.272**	-0.124	0.129***
			(0.065)		(0.125)		(0.030)
	N		1043		500		3933

Notes: This table reports the Reduced Form estimates of the effect of getting any charter offer on state standardized test scores. See Table 2 notes for detailed regression specifications.

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

A8: Test Score Effects for Elementary Applicants with No Baseline

		All Students		Non-native English Speakers	
		Trad. Public mean	Charter effect	Trad. Public mean	Charter effect
		(1)	(2)	(3)	(4)
Math		-0.165	0.158***	-0.213	0.246***
			(0.025)		(0.048)
	N		4402		1318
English		-0.171	0.154***	-0.336	0.248***
			(0.025)		(0.046)
	N		4396		1315

Notes: This table reports the 2SLS estimates of the effects of time spent in charter schools on the state standardized exams for elementary school applicants with no baseline characteristics. All models control for gender, ethnicity, female x minority interaction, age, immigrant status, a native English speaker dummy, experimental strata, year-applied dummies, and grade-applied dummies. Estimates pool post-lottery outcomes for grades 3-5 and cluster by student identifier and school-grade-year. *significant at 10%; **significant at 5%; ***significant at 1%

A9: Test Score Effects by Baseline Special Education of Disability

		Intellectual		Communication		Emotional		Learning	
		Trad. Public mean	Charter effect	Trad. Public mean	Charter effect	Trad. Public mean	Charter effect	Trad. Public mean	Charter effect
Exam		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Math		-1.834	0.635	-0.721	0.183	-1.028	-0.329	-1.055	0.337***
			(0.578)		(0.121)		(0.252)		(0.068)
	N		263		1179		361		2783
English		-2.051	0.363	-0.913	0.130	-1.240	-0.584	-1.199	0.236***
			(0.458)		(0.119)		(0.372)		(0.069)
	N		264		1177		365		2785

Notes: This table reports the 2SLS estimates of the effects of time spent in charter schools on test scores for students by their baseline disability type for elementary, middle, and high school applicants. Disabilities with fewer than 200 observations for math are not shown. These include autism, physical disabilities, multiple disabilities, developmental disabilities, and health disabilities. See Table 2 notes for detailed regression specifications. *significant at 10%; **significant at 5%; ***significant at 1%

A10: Test Score Effects by First Language of Baseline English Language Learners

		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		-0.568	0.273***	-0.731	0.587***	-0.236	0.257***
			(0.058)		(0.123)		(0.096)
	N		3115		931		1330
English		-0.787	0.210***	-0.816	0.451***	-0.564	0.087
			(0.057)		(0.121)		(0.108)
	N		3129		931		1328

Notes: This table reports the 2SLS estimates of the effects of time 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. See Table 2 notes for detailed regression specifications.
*significant at 10%; **significant at 5%; ***significant at 1%

A11: Changes in 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)
						Panel A: Elementary School					
All Special Education		0.897	-0.049							0.299	0.359***
			(0.093)								(0.139)
	N		137								
Substantially Separate Classroom		0.941	0.058	0.529	-0.620***	0.059	0.144	0.324	0.678***	0.441	0.764***
			(0.071)		(0.167)		(0.120)		(0.127)		(0.168)
	N		38								
Partial Inclusion		0.909	0.111			0.182	-0.160	0.364	0.173	0.455	0.062
			(0.093)				(0.120)		(0.208)		(0.182)
	N		29								
Full Inclusion		0.848	-0.110					0.565	0.162	0.152	0.110
			(0.157)						(0.235)		(0.157)
	N		63								
No Baseline		0.090	-0.027	0.011	-0.014**	0.011	-0.018**	0.067	0.002		
			(0.023)		(0.005)		(0.007)		(0.021)		
	N		1138								
						Panel B: Middle School					
All Special Education		0.889	-0.117**							0.326	0.229***
			(0.055)								(0.077)
	N		1189								
Substantially Separate Classroom		1.000	0.034	0.789	-0.266	0.037	0.051	0.137	0.393**	0.174	0.410**
			(0.056)		(0.163)		(0.076)		(0.165)		(0.168)
	N		271								
Partial Inclusion		0.948	-0.116			0.354	-0.087	0.441	0.064	0.493	0.180
			(0.075)				(0.112)		(0.128)		(0.119)
	N		429								
Full Inclusion		0.743	-0.096					0.466	0.119	0.257	0.096
			(0.101)						(0.110)		(0.101)
	N		471								
						Panel C: High School					
All Special Education		0.840	0.005							0.303	0.013
			(0.093)								(0.135)
	N		842								
Substantially Separate Classroom		0.967	-0.109	0.663	-0.044	0.120	-0.240	0.120	0.076	0.272	-0.056
			(0.088)		(0.189)		(0.148)		(0.141)		(0.203)
	N		240								
Partial Inclusion		0.862	-0.349**			0.516	-0.378*	0.277	0.178	0.415	0.527**
			(0.171)				(0.212)		(0.213)		(0.226)
	N		239								
Full Inclusion		0.750	0.264					0.465	0.468**	0.250	-0.264
			(0.174)						(0.208)		(0.174)
	N		349								

Notes: This table reports 2SLS estimates of the effects of Boston charter enrollment on special education classification and level of classroom inclusion by baseline level of inclusion. Columns (1) and (2) display the estimates of the effect of charter enrollment on the student being classified as special education two years following lottery application. Columns (3) through (8) show analagous estimates with special education level of inclusion as dependent variables. "No baseline" includes only Pre-K and Kindergarten applicants. See Table 4 notes for detailed regression specifications.

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

A12: Changes in English Language Learner Classification Two Years After Application

	English Language Learner	
	Trad. Public mean	Charter effect
Baseline Status	(1)	(2)
Panel A: Elementary School		
All English Language Learners	0.781	-0.210
		(0.198)
N		496
Beginning Proficiency	1.000	-0.145
		(0.118)
N		65
Intermediate Proficiency	0.763	-0.152
		(0.220)
N		274
Advanced Proficiency	0.286	-
		-
N		15
No Baseline, Non-native English Speakers	0.565	-0.336***
		(0.093)
N		308
Panel B: Middle School		
All English Language Learners	0.553	-0.352***
		(0.065)
N		1423
Beginning Proficiency	0.980	-0.309
		(0.231)
N		65
Intermediate Proficiency	0.734	-0.576***
		(0.118)
N		688
Advanced Proficiency	0.283	-0.262***
		(0.069)
N		476
Panel C: High School		
All English Language Learners	0.552	-0.280
		(0.190)
N		392
Beginning Proficiency	0.900	-
		-
N		16
Intermediate Proficiency	0.822	-0.181
		(0.253)
N		166
Advanced Proficiency	0.244	0.188
		(0.461)
N		151

Notes: This table reports 2SLS estimates of the effects of Boston charter enrollment on English Language Learner classification by baseline English proficiency level. Columns (1) and (2) display the estimates of the effect of charter enrollment on the student being classified as English Language Learners two years following lottery application. "No baseline" includes only Pre-K and Kindergarten applicants. See Table 4 notes for detailed regression specifications. *significant at 10%; **significant at 5%; ***significant at 1%

A13: Effects 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 2SLS 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. See Table 4 notes for detailed regression specifications.

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

A14: Staff-to-Student Ratios

	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)
			Panel A: Elementary School			
Total Staff	0.125	0.087***	0.021	-0.014***	0.018	-0.014***
		(0.030)		(0.003)		(0.003)
Teachers	0.075	0.005	0.010	-0.012***	0.003	-0.003***
		(0.003)		(0.001)		(0.001)
Specialists	-	-	0.003	0.000	0.000	0.002***
				(0.001)		(0.001)
Content Support	-	-	0.005	0.001	0.001	-0.001***
				(0.001)		(0.000)
N (students)			4264			
			Panel B: Middle School			
Total Staff	0.117	0.051***	0.019	-0.011***	0.017	-0.014***
		(0.013)		(0.001)		(0.001)
Teachers	0.079	0.009***	0.010	-0.009***	0.003	-0.003***
		(0.003)		(0.001)		(0.001)
Specialists	-	-	0.003	-0.001**	0.000	0.000
				(0.000)		(0.000)
Content Support	-	-	0.004	0.001	0.001	0.001
				(0.001)		(0.000)
N (students)			6984			
			Panel C: High School			
Total Staff	0.119	0.097***	0.015	-0.006***	0.008	-0.005***
		(0.016)		(0.002)		(0.002)
Teachers	0.082	-0.009***	0.008	-0.008***	0.002	-0.001***
		(0.003)		(0.001)		(0.000)
Specialists	-	-	0.002	-0.001	0.000	0.000**
				(0.001)		(0.000)
Content Support	-	-	0.002	0.006***	0.000	0.000
				(0.001)		(0.000)
N (students)			3348			

Notes: This table shows 2SLS estimates of the effect of charter enrollment on the staff to student ratio. The dependent variable is the staff to student ratio for the staff type. The endogenous variable is an indicator for charter enrollment in the year following the lottery and instruments are immediate and waitlist offer dummies. The sample is restricted to all lottery applicants applying for the 2007-08 through 2013-14 school years. Staffing and student counts data are captured in October of each year. See Table 4 notes for detailed regression specifications.
*significant at 10%; **significant at 5%; ***significant at 1%