

For Online Publication

1 Data Appendix

This paper utilizes data from several sources. The charter applicant information was collected from the individual charter schools. These data include 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 come from the Student Information Management System (SIMS), which includes all of the public school students in Massachusetts. Student standardized test scores come from the state database for the Massachusetts Comprehensive Assessment System (MCAS). The paper also uses English proficiency exam data, SAT and AP records, the Massachusetts Education Personnel Information Management Systems (EPIMS) data, and National Student Clearinghouse (NSC) data on college enrollment and graduation. This Appendix describes each data source and explains the process used to clean and match them.

1.1 Lottery Data

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

The lottery data typically include 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.

1.2 SIMS Data

This research uses SIMS data from the 2003-2004 school year through the 2014-2015 school year. Each year has a file from October and the end of the school year. The observations are at the individual student level. Each student has only one observation in each data file, except when students switch grades or

schools within year. The dataset includes a unique student identifier known as the SASID. This identifier is used to match the SIMS data to the MCAS, English Proficiency Exam, and SAT and AP data described below.

The SIMS dataset contains grade level, year, name, date of birth, gender, race, special education and limited English proficiency status, level of classroom inclusion and type of disability for special education students, free or reduced price lunch status, school attended, suspensions, attendance rates, native language, and immigrant status. Students appear in the state administrative data if they attend a Massachusetts public school. Those who enroll in private or parochial schools or move out of state do not have outcomes data for the years that 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.

1.3 State Standardized Exam (MCAS) Data

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

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

Qualifying special education and ELL students can receive accommodations on the MCAS exam to meet their specific accessibility needs.¹ Enrolling in a charter school does not affect the likelihood of students with special education or ELL statuses at the time of the lottery receiving testing accommodations. This finding is robust across baseline level of classroom inclusion and level of English proficiency. Therefore, accommodations do not threaten the validity of findings.

¹Accommodations include changing the format of the test (e.g., paper-based vs. computer-based, large print, braille, read aloud), changing the test procedures, supports and devices to facilitate students' test responses (e.g., reference sheets, checklists, transcription).

1.4 English Proficiency Exam (MEPA/ACCESS)

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

1.5 SAT and AP Data

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

1.6 Staff Data

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

1.7 National Student Clearinghouse Data (NSC)

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

1.8 Matching Data Sets

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

uniquely and exactly match the grade, year, name, and date of birth (if available) in the state records are assigned the matched SASID. Then the names in the lottery and SIMS data are stripped of spaces, surnames (i.e., Jr. IV), hyphens, and apostrophes. Students who exactly match after that cleaning process are also assigned the matched SASID. Then `relink`, 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 A21 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.

1.9 Sample Restrictions

Appendix Table A22 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.

2 Threats to Validity

2.1 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.² 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.³ 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 A23. Elementary school lotteries have some differential attrition. Special needs students with charter offers are marginally more likely to take a state math or English exam. These differences are fairly small. Elementary ELL students with charter offers are 2.8 percentage points more likely to contribute to exam data than students without charter offers, 83 percent of whom take the exams. These relatively small differences seem unlikely to explain the elementary school exam results. For classification, 21.2 and 8.1 percent respectively of the non-offered special education and ELL elementary applicants attrit from the data, compared to essentially none of those with offers. These differences are significant and substantial, but they are not large enough to explain the ELL classification effect or to fully explain the special education classification effects.

2.2 School Switching

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

However, excess school switching in charters could potentially inflate my estimates if students who leave would generate negative peer effects (i.e. through disruption). Therefore, Table A24 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

²Students who leave the state or enroll in private or parochial schools do not appear in the data.

³Post-lottery is defined as the October 1 after the lottery occurs.

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.

2.3 Fallback Schools of Charter Applicants

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

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

I find no statistically significant differences between the untreated complier means fallback schools of special education, ELL, and non-special needs students (see Table A25). Therefore, there is no evidence that differences in students' fallback school quality contribute to the findings and charters appear to serve special education, ELL and general education applicants similarly well.

3 Estimation of Mechanisms

3.1 School and Cohort-Level Reclassification and Academic Effects Estimation

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

$$y_{igt} = \sum_t \sum_s \rho_{st} C_{igst} + X_i' \theta + \alpha_t + \beta_g + \sum_j \delta_j d_{ij} + \epsilon_{igt} \quad (1)$$

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

$$r_{igt} = \sum_t \sum_s \vartheta_{st} C_{igst} + X_i' \theta + \alpha_t + \beta_g + \sum_j \delta_j d_{ij} + \epsilon_{igt} \quad (2)$$

where r_{igt} indicates reclassification at enrollment for student i and C_{igst} indicates charter enrollment in the year after the lottery. I estimate equations (1) and (2) separately by baseline special needs status. Two-stage least squares estimates using individual school immediate and waitlist offers and OLS estimates yield similar results. I focus on the OLS estimates for precision. Figure 1 plots the cohort test score effects $\hat{\rho}_{st}$ against the reclassification effects $\hat{\vartheta}_{st}$.

3.2 Multiple Endogenous Variable Empirical Strategy

The individual charter lottery offers randomize not only whether students can enroll in charters, but also student exposure to different reclassification rates. The interaction of individual charter offers with students' reclassification likelihood captures variation in classification removal for similar students. I use individual charter lottery offers and the interaction of these offers with students' pre-lottery classification removal likelihood as instruments for charter enrollment, classification removal, and the interaction of charter enrollment and classification removal. In a constant effects framework, these instruments identify causal effects for charter compliers. Heterogeneous effects across the interacted characteristics make the estimates difficult to interpret (Kline and Walters, 2016; Hull, 2018; Kirkeboen, Leuven and Mogstad, 2016), but test score effects are not statistically significantly different across baseline level of classroom inclusion, English proficiency, or test score terciles (see Tables 6 and 7).

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

$$L_i = \lambda T_i + \alpha_t + \beta_g + \epsilon_{itg}. \quad (3)$$

First, I estimate the model for Boston 5th, 6th, and 9th grade students who do not apply for charter schools.⁴ I use the full range of available baseline student characteristics from the prior grade, including gender, race, free or reduced price lunch, suspensions, days truant, and test scores. I estimate the model separately for the different types of reclassification (special education classification removal, special education increased inclusion, and ELL classification removal). The estimation for special education students includes baseline level of classroom inclusion and the estimation for ELLs includes an indicator for native Spanish speakers and the baseline English proficiency exam. The model also controls for year and grade effects using α_t and β_g .

I use the estimates from equation (3) which show how each student characteristic relates to likelihood of classification removal in charter application grades in Boston to predict the likelihood that charter applicants will have their special needs classification changed. Then, I center this pre-lottery reclassification likelihood variable around the BPS mean for L_i within a grade-year.⁵

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

$$y_{igt} = \tau_1 C_{igt} + \tau_2 R_{igt} + \tau_3 C_{igt} R_{igt} + \gamma L_i + \alpha_t + \beta_g + \sum_j \delta_j d_{ij} + X_i' \theta + \epsilon_{igt} \quad (4)$$

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

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

$$C_{igt} = \sum_k \rho_k Z_{ki} + \sum_k \psi_k Z_{ki} L_i + \varphi L_i + \lambda_t + \kappa_g + \sum_j \mu_j d_{ij} + X_i' \Gamma + \eta_{igt}, \quad (5)$$

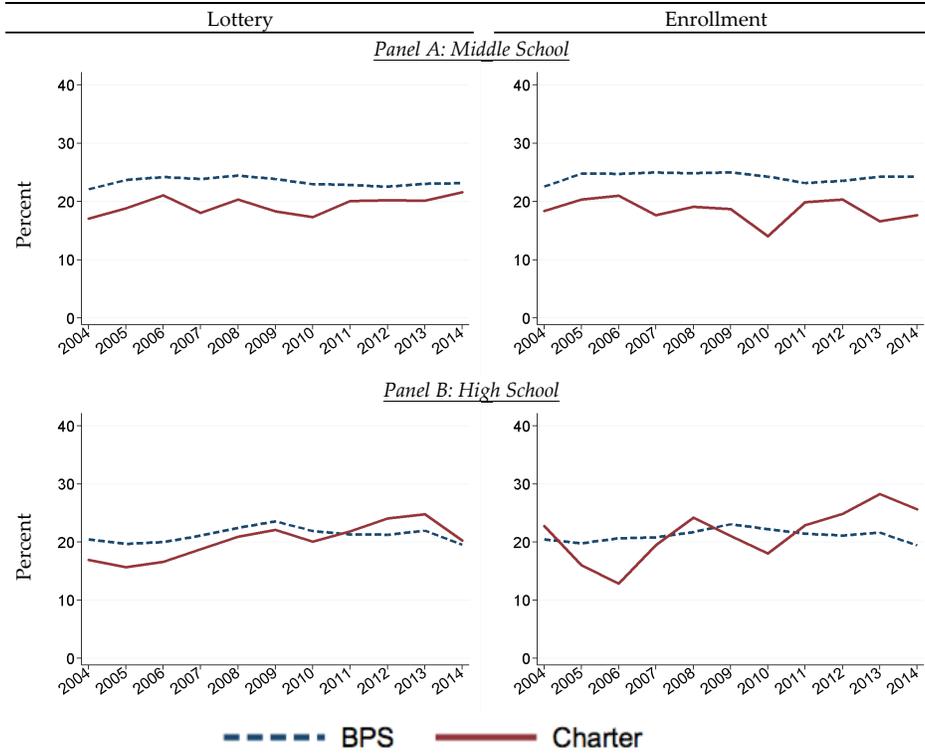
⁴I focus on middle and high school applicants for this analysis so that I can include baseline test scores in equation (3).

⁵Figure A7 plots the proportion of students with classification changes by pre-lottery reclassification likelihood for treated compliers, untreated compliers, and the full lottery applicant sample. It shows the positive relationship between the predicted reclassification likelihood index and the proportion of students reclassified.

where ρ_k represents the effect of receiving an offer, Z_{ki} , from charter school k on charter attendance and ψ_k captures the effect of a one standard deviation increase in pre-lottery reclassification likelihood, L_i , on charter attendance for students with offers at charter school k .⁶ The first stages for R_{igt} and $C_{igt}R_{igt}$ have analogous specifications. The new set of instruments yield charter effect estimates similar to the main estimates.

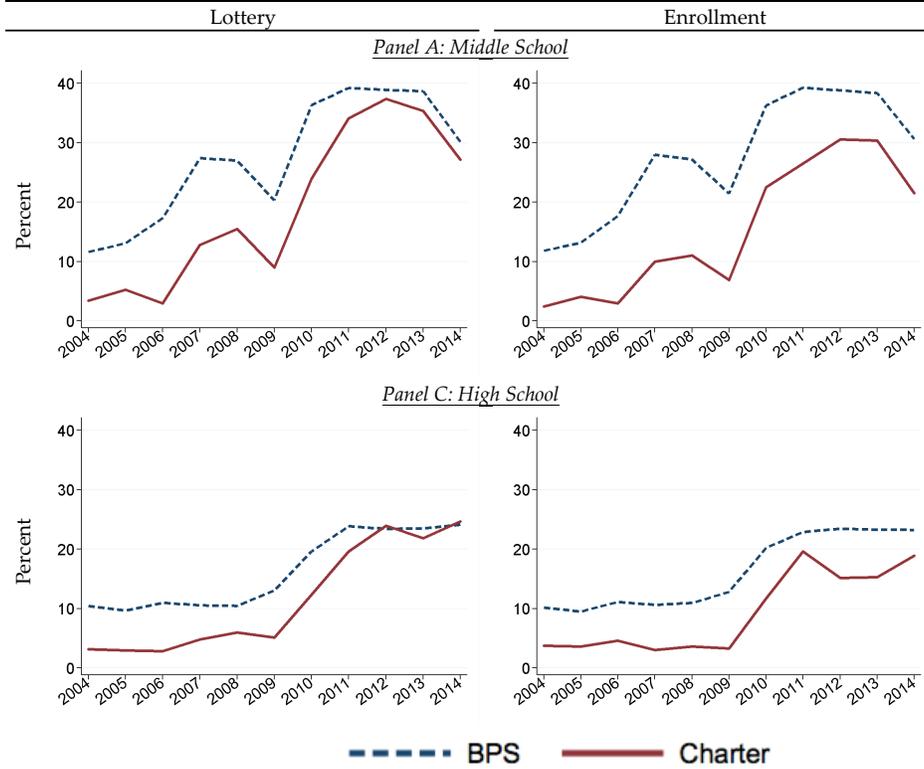
⁶Student sorting into charter schools based on classification removal rates poses a potential threat to the use of school interactions as instruments. There is no clear evidence of this: the average predicted reclassification index of applicants is not correlated with charter special education increased inclusion effects or the charter ELL classification removal effects.

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



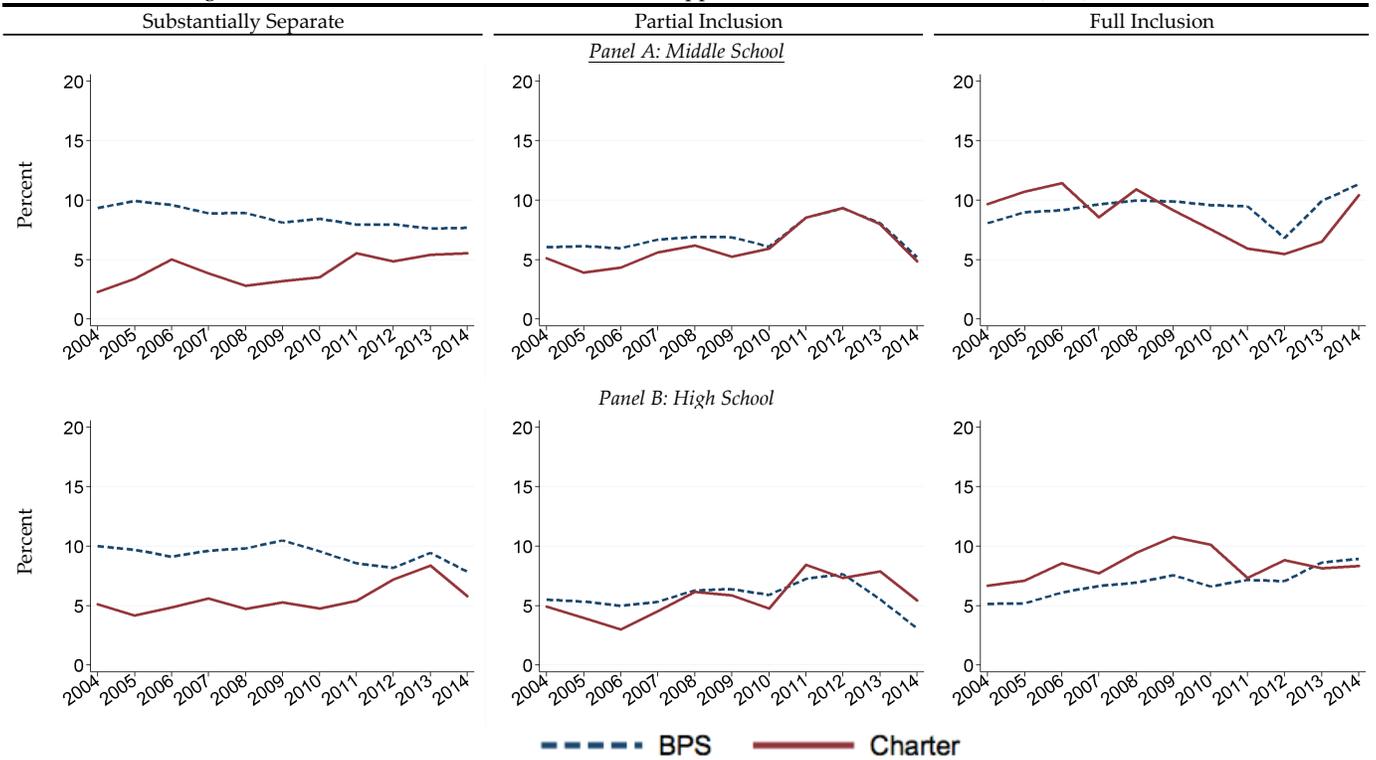
Notes: The graphs on the left plot the percent of students with a special education status at the time of the lottery for charter applicants and Boston Public School (BPS) students in charter application grades (4, 5, and 8). The graphs on the right plot the percent of students with special education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

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



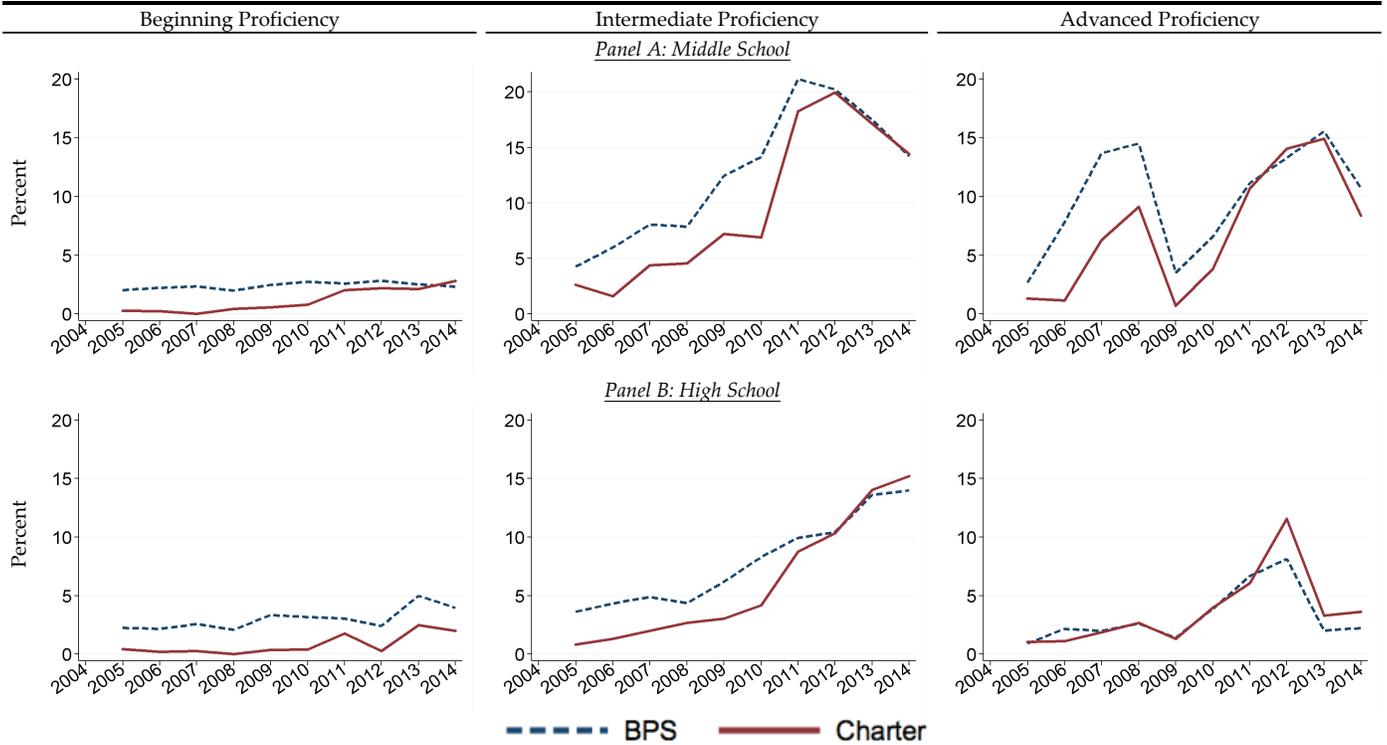
Notes: The graphs on the left plot the percent of students with English Language Learner (ELL) status at the time of the lottery for charter applicants and Boston Public School (BPS) students in charter application grades (4, 5, and 8). The graphs on the right plot the percent of students with ELL status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

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



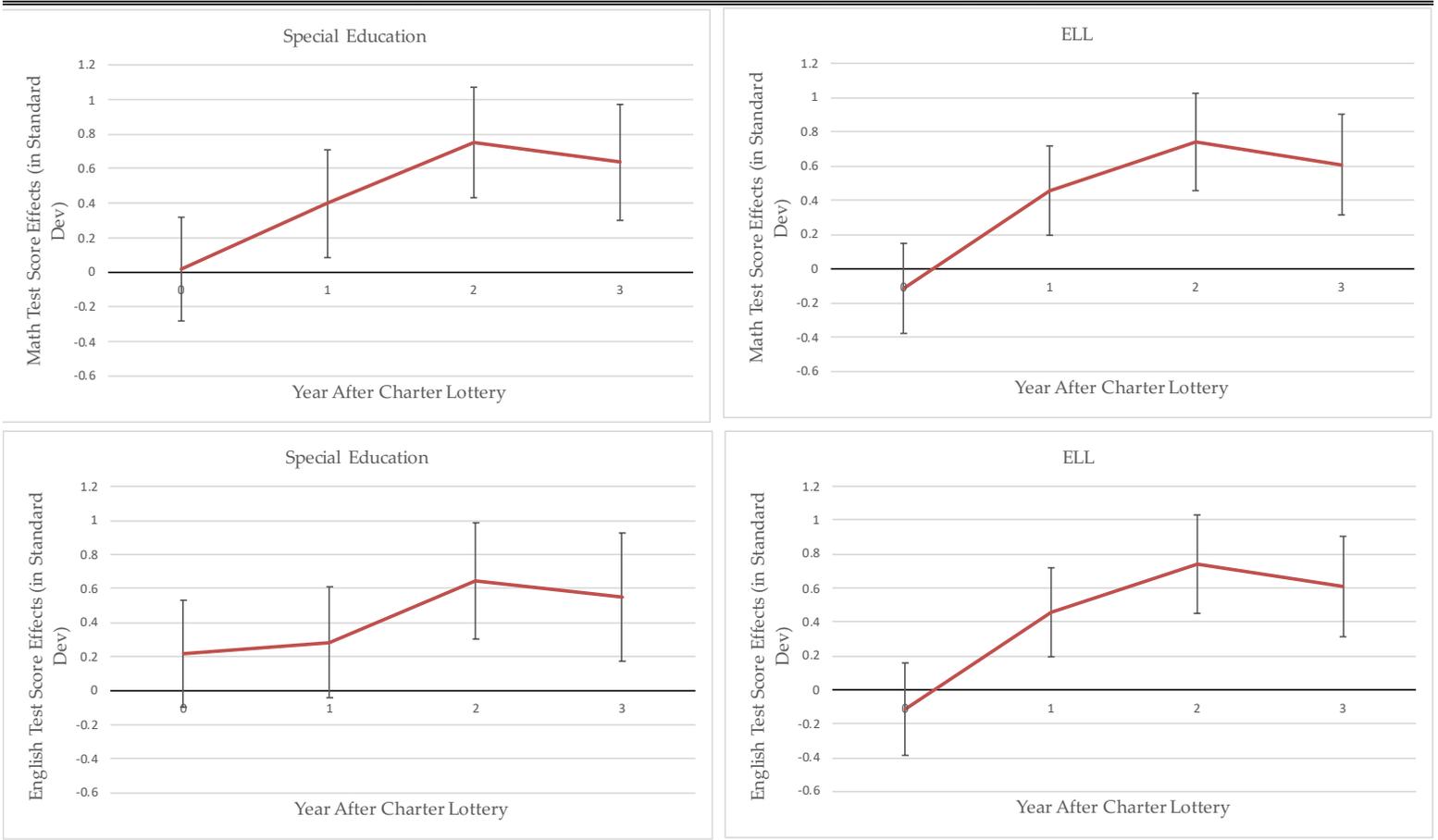
Notes: This figure plots the percent of students with special education substantially separate, partial, and full classroom inclusion at the time of the lottery for charter applicants and Boston Public School students in charter application grades (4, 5, and 8).

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



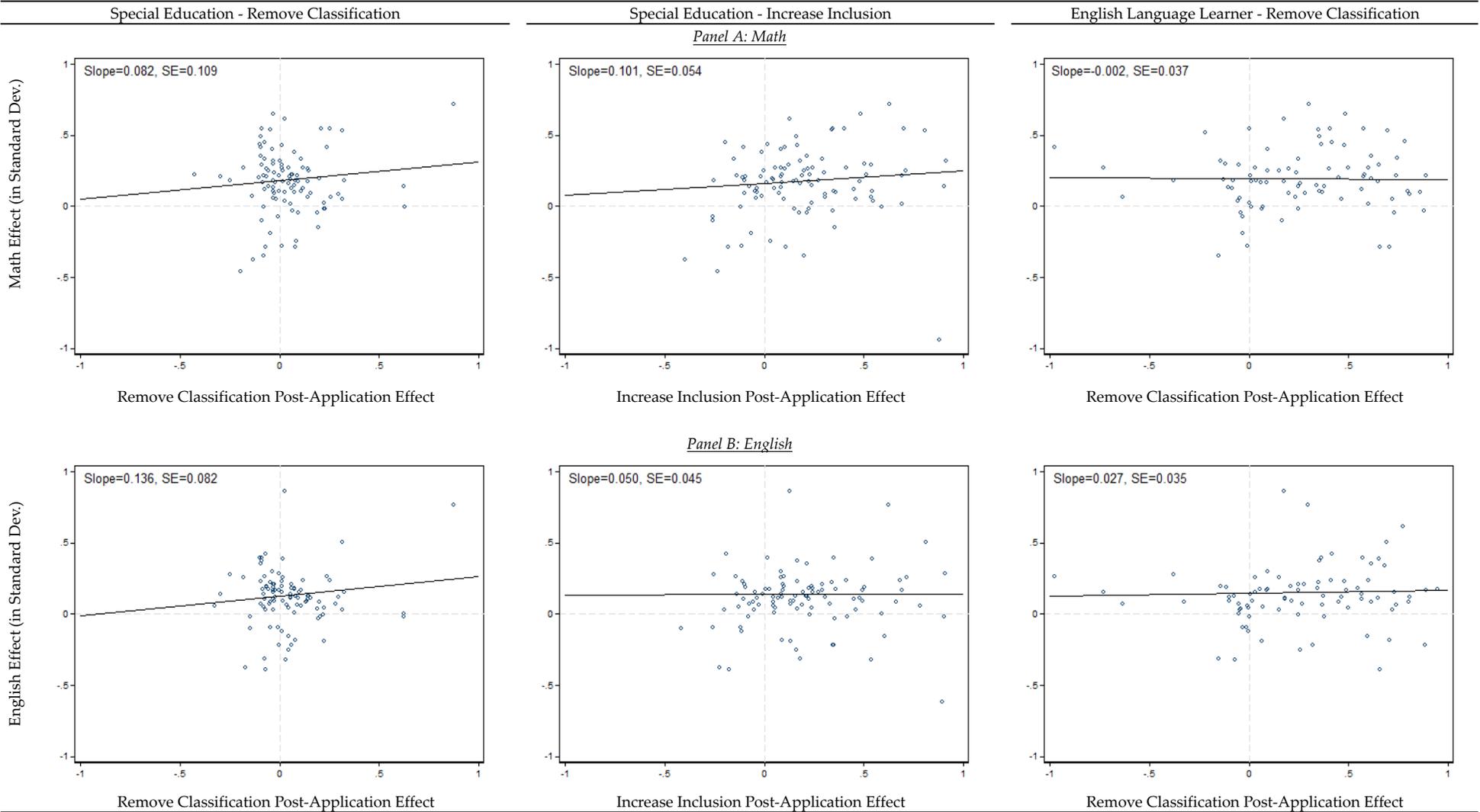
Notes: This figure plots the percent of students with beginning, intermediate, and advanced English proficiency at the time of the lottery for charter applicants and Boston Public School students in charter application grades (4, 5, and 8). English proficiency is measured by the required annual state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

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



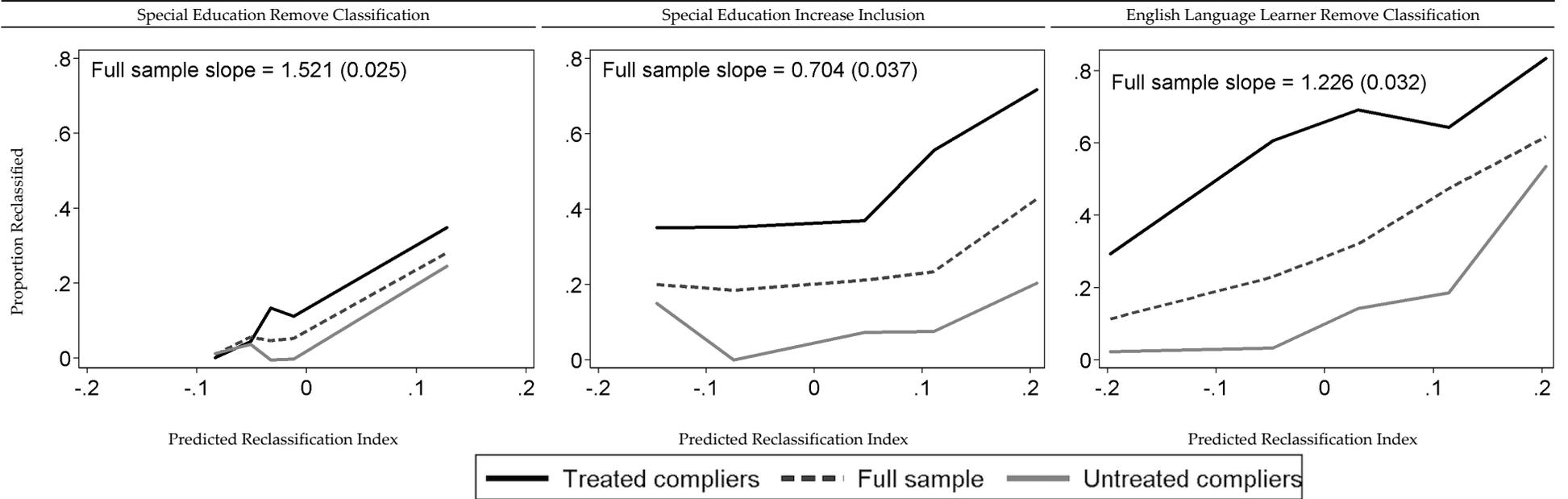
Notes: This figure shows the two-stage least squares estimates of charter enrollment on math test scores for pre-lottery special education and ELL middle school applicants. Each data point reflects a separate estimation for 0, 1, 2, and 3 years after the lottery. The baseline year is represented by year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

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



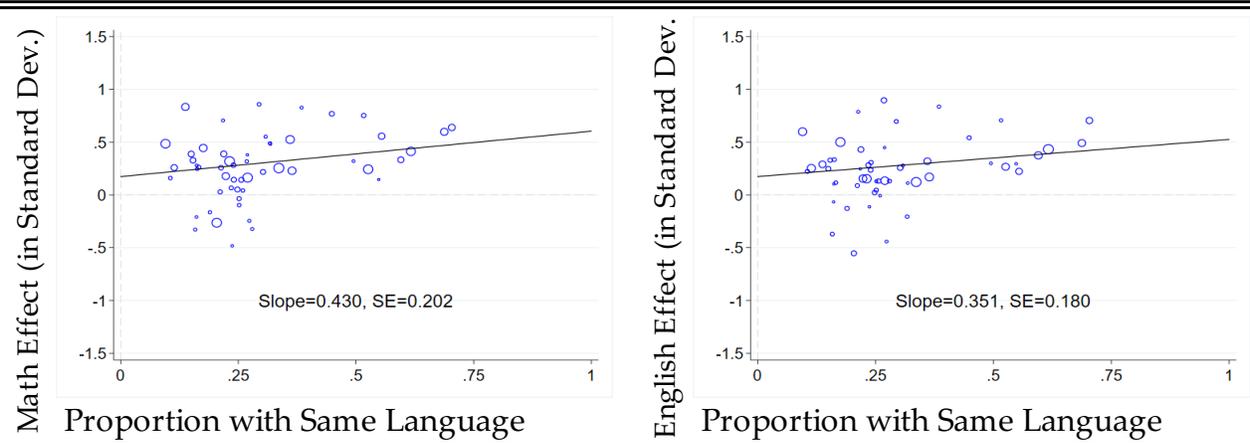
Notes: This figure plots the school-specific math and English Ordinary Least Squares (OLS) effects of years in charter schools for non-special needs students against the school-specific post-application special needs reclassification OLS effects of charter enrollment by the fall following the lottery.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

Figure A7: Relationship between Proportion Reclassified and Predicted Reclassification Index



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

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



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

A1: Lottery Participation by Schools and Cohorts

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

<i>Panel B: Middle School</i>										
Application Year/School	Dorchester Prep (UCS)	Brooke Roslindale	Brooke Mattapan	Brooke East Boston	Excel East Boston	Excel Orient Heights	Lucy Stone (UCS)	Mission Hill (UCS)	KIPP Boston	UP Academy Boston
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Entry Grade	5	5	5	5	5	5	5	5/6	5	6
2003								Y*		
2004		No records						Y*		
2005					No records			Y*		
2006		Y**	Not open	Not open			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			Y		Y		Y	Y		Y
2012	Y	Not entry grade	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

<i>Panel C: Combined Middle and High Schools (5th-6th - 12th Grades)</i>					
Application Year/School	Academy of the Pacific Rim	Boston Collegiate	Boston Prep	Codman Academy	Match MS
	(1)	(2)	(3)	(4)	(5)
Entry Grade	5/6	5	6	5/6	6
2003		Y	Not open		
2004	No records		Incomplete records		
2005	Y	Y	Y**		Not open
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	1852	3025	1636	69	2137

<i>Panel D: High School</i>					
Application Year/School	Boston Green Academy	City on a Hill	City on a Hill II	Codman Academy	Match HS
	(1)	(2)	(3)	(4)	(5)
Entry Grade	9	9	9	9	9
2003		No records		Incomplete records	Y
2004			Y*	Y**	Y
2005	Y		Y		Y
2006	Y		Y	Incomplete records	Y
2007	Y		Y	Not open	No record
2008	Y		Y*		Y
2009	Y		Y		Y
2010	Y		Y		Y
2011	Y		Y		Y
2012	Y		Y		Y
2013	Y		Y	Y**	Y
2014	No records	Y	Y	Y	Y
N	1852	4624	1102	1737	2766

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

* Only ever offer information is available.

** There is no variation in waitlist offers.

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

Table A2: Special Education and English Language Learner Descriptive Statistics

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

A8: Post-Application Special Education Classification

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

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

A9: Post-Application English Language Learner Classification

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

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

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

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

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

A11: School Finances

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

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

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

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

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

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

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

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

A14: Test Score Effects by Baseline Special Needs Status

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

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

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

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

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

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

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

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

A17: 2SLS Multiple Endogenous Variable Test Score Estimates

Endogenous Variables	Special Education Test Scores		English Language Learner Test Scores	
	Endogenous Variables Include:			
	Classification		Classification	
	Removal	School Quality	Removal	School Quality
	(1)	(2)	(3)	(4)
<i>Panel A: Math</i>				
Charter Enrollment	0.204 (0.040)	0.164 (0.039)	0.344 (0.049)	0.212 (0.040)
First-stage F	9.213	8.786	4.330	5.477
Remove Classification	0.275 (0.339)	0.334 (0.360)	0.537 (0.233)	0.130 (0.115)
First-stage F	8.567	10.178	1.040	26.639
Charter X Remove Classification	0.014 (0.100)		-0.222 (0.119)	
First-stage F	13.623		3.026	
School Quality Index		0.201 (0.070)		0.325 (0.079)
First-stage F		9.662		13.826
Overid. p-value	0.210	0.346	0.046	0.157
N		3693		3830
<i>Panel B: English</i>				
Charter Enrollment	0.167 (0.043)	0.154 (0.042)	0.279 (0.051)	0.195 (0.046)
First-stage F	9.472	8.920	4.296	5.371
Remove Classification	0.315 (0.341)	0.324 (0.356)	0.467 (0.255)	0.228 (0.122)
First-stage F	8.434	10.152	1.104	27.272
Charter X Remove Classification	-0.004 (0.115)		-0.128 (0.129)	
First-stage F	13.358		3.037	
School Quality Index		0.062 (0.075)		0.222 (0.080)
First-stage F		9.689		14.057
Overid. p-value	0.398	0.409	0.025	0.036
N		3705		3844

Notes: This table displays multiple endogenous variable two-stage least squares (2SLS) estimates of two separate models which investigate mechanisms behind the charter test score effects. Columns (1) and (3) display the 2SLS estimates of a model with three endogenous variables: years in charter, classification removal by the fall following the lottery, and the interaction of the two. Columns (2) and (4) display the 2SLS estimates of a model with the following endogenous variables: years in charter, classification removal by the fall following the lottery, and a school quality index. The school quality index is the sum of the non-special needs math and English individual school 2SLS effects relative to Boston Public Schools. Instruments for both models include individual charter offers and individual charter offers interacted with a predicted reclassification index. See the online appendix for details about the predicted reclassification index. The sample includes middle, and high school lottery applicants with baseline test scores and special education or ELL classifications at the time of the charter application. All models control for gender, ethnicity, female x minority interaction, baseline special education, baseline ELL, baseline subsidized lunch, experimental strata, year-applied dummies, and grade-applied dummies. Estimates pool post-lottery outcomes for test-taking grades. Standard errors are clustered by student identifier and school-grade-year.

A18: Ordinary Least Squares Estimates of Charter Enrollment on Special Education Classification

	Any Special Education		Substantially Separate Classroom		Partial Inclusion		Full Inclusion		Move to More Inclusive Classroom	
	Trad. Public	Charter	Trad. Public	Charter	Trad. Public	Charter	Trad. Public	Charter	Trad. Public	Charter
	mean	effect	mean	effect	mean	effect	mean	effect	mean	effect
Baseline Status	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
All Special Education	0.890	-0.117 (0.020)							0.151	0.224 (0.022)
N		3153								3153
Substantially Separate Classroom	0.967	-0.126 (0.028)	0.834	-0.536 (0.047)	0.049	0.046 (0.024)	0.051	0.250 (0.035)	0.114	0.344 (0.044)
N		808								808
Partial Inclusion	0.914	-0.120 (0.028)			0.627	-0.410 (0.044)	0.173	0.283 (0.037)	0.225	0.333 (0.039)
N		1004								1004
Full Inclusion	0.823	-0.097 (0.027)					0.617	0.004 (0.031)	0.117	0.081 (0.022)
N		1278								1278
New Students (No Prior Special Ed. Evaluation)	0.014	-0.005 (0.005)	0.001	-0.002 (0.001)	0.003	0.001 (0.003)	0.008	-0.002 (0.004)		
N		2665								

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

A19: Ordinary Least Squares Estimates of Charter Enrollment on English
Language Learner Classification

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

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

A20: Test Score Effects of Years in Charters for Lotteries with High and Low
Proportions of Special Needs Applicants

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

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

A21: Match from Lottery Data to Administrative Data

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

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

A22: Sample Selection

Year of application	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	All
<u>Panel A: Elementary School</u>												
Total number of records	160	166	194	364	396	602	702	2899	2963	2537	2298	13281
Excluding disqualified 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
<u>Panel B: Middle School</u>												
Total number of records	341	739	913	1143	1422	1595	1467	4283	4312	4766	3189	24170
Excluding disqualified 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
<u>Panel C: High School</u>												
Total number of records	940	884	942	1330	1211	1300	1500	1835	2049	3280	3417	18688
Excluding disqualified 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.

A23: Attrition

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

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

A24: Effect of Charter Enrollment on School Switching by Baseline Special Needs Status

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

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

A25: Value-Added of Fallback Schools for Charter Applicants

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

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

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