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DIVERSE PATHS TO COLLEGE SUCCESS: THE IMPACT OF MASSACHUSETTS' URBAN AND NONURBAN CHARTER SCHOOLS ON COLLEGE TRAJECTORIES

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ABSTRACT

The charter school movement encompasses many school models. In Massachusetts in the 2010's, the site of our study, urban charter schools primarily used "No Excuses" practices, whereas nonurban charters had greater model variety. Using randomized admissions lotteries, we estimate the impact of charter schools by locality on college preparation, enrollment, and graduation. Urban charter schools boost all of these outcomes. Nonurban charter schools raise college enrollment and graduation despite reducing state test scores and AP enrollment. Our results suggest that there is more than one path to a college degree and that test score impacts may not predict college outcomes.

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Despite the recent decline in the college wage premium, individuals with a BA still outearn their peers with only a high-school diploma by 75 percent (Bengali et al., 2023; Autor et al., 2023). With much policy and research in the United States focused on college access, we know less about how K–12 educational experiences contribute to college success (Dynarski et al., 2023). This paper uses application lotteries to show the causal effects of one such K–12 educational intervention—charter schools—on college preparation, enrollment, and graduation.

Charter schools are autonomously operated public schools with oversight, curricular, budgetary, and hiring independence from traditional school districts. They are authorized by a state-empowered entity, undergo periodic review and may be subject to closure. When oversubscribed, charter schools admit students via randomized admissions lotteries.

Charter schools are not monolithic in character. Many urban charter schools feature longer school days and school years, a culture of high expectations, frequent teacher observations and feedback, data-driven instruction, use of tutoring, and strict disciplinary practices, practices which are often referred to as "No Excuses" (Angrist et al., 2013; Dobbie and Fryer, 2013). In recent years, many of these schools have moved away from this label and some of the associated practices (Torres, 2022), though at the time students in this study were enrolled in Massachusetts charter schools, most of the urban charters used these practices, as shown in Table 1. Other charter schools operate on the basis of a greater range of educational models and include project-based learning schools, themed schools (arts, language, culture), Montessori schools, and classical learning schools.

Many lottery-based studies have shown that attending urban charter schools, many of which use these high academic press practices, increases students' test scores (see Cohodes and Roy (2023) for a summary of this research). The more limited lottery-based evidence on nonurban charter schools shows mixed impacts on test scores, with findings of some small positive effects (Dynarski et al., 2018) and, in other cases, null or negative effects (Gleason et al., 2010; Angrist et al., 2013). Observational estimates of charter school impacts appear to confirm the lottery-based evidence that urban charter schools boost test scores while nonurban charters do not (CREDO, 2009; Tuttle et al., 2010; CREDO, 2013; Tuttle et al., 2015; Abdulkadiroğlu et al., 2016; Dobbie and Fryer, 2020; Harris, 2020).

This body of evidence has led some to conclude that charter schools are most successful in urban contexts when they adopt "No Excuses" practices (Chabrier et al., 2016; Epple et al., 2016; Cohodes and Parham, 2021). This conclusion is bolstered by lottery-based evidence showing that urban charters that boost test scores also boost college preparation and enrollment and even shape non–test score outcomes such as voting and risky behavior (Angrist et al., 2016; Dobbie and Fryer, 2015; Wong et al., 2014; Davis and Heller, 2019; Cohodes and Feigenbaum, 2021; Demers et al., 2023). However, there is much less evidence on nonurban charter schools and nontest outcomes. The sole lottery-based evidence on college graduation of which we are aware refers to a broad sample of charter schools in a federally funded national evaluation of charter schools (Gleason et al., 2010)

extended to college outcomes (Place and Gleason, 2019). Place and Gleason (2019) find no impact on college enrollment or graduation and no relationship between test scores and college outcomes. Dobbie and Fryer (2020) use propensity score matching to show that "No Excuses" charter schools improve test scores and four-year college enrollment whereas "other" charter schools decrease both.[1]

This paper builds on Angrist et al. (2013) (APW), which examines the effects of Massachusetts charter schools on test scores across urban and nonurban areas. APW find that urban charter schools generate large test score gains whereas nonurban charters have null or negative effects. In our shared Massachusetts sample, at the time students were enrolled in the 2000's and 2010's, the urban charter schools mostly adhered to "No Excuses" practices and served a primarily minority and economically disadvantaged population. The nonurban schools did not, embracing alternative charter school models and serving primarily white children. APW find that the different practices and student bodies help account for the different test scores trajectories, aligning with the existing literature on charter schools.

With a longer time horizon and more cohorts and schools, we return to APW's diverse sample of charter schools and report several novel findings. First, we replicate their test score results, finding that urban charters boost standardized test scores and nonurban charters driving them downward. Next, we find that urban and nonurban charters also diverge in their college preparation impacts. Urban charters increase Advanced Placement (AP) test-taking and scores and SAT scores while increasing time to high-school graduation, confirming the results for Boston found in Angrist et al. (2016). Nonurban charters decrease AP test-taking. These findings align with APW's test score results.

The nature of the divergences shifts when we turn to college outcomes, however. First, both urban and nonurban charter schools boost four-year college enrollment, by 8 and 11 percentage points, respectively. Next, we turn to college graduation and present some of the first lottery-based estimates of charter school impacts on degree attainment. Here, we find that attending an urban charter school raises attainment of any degree by almost 5 percentage points from the comparison mean of 26 percent and BA completion by 4.1 percentage points from a comparison of 23 percent. Nonurban charter schools increase attainment of any degree by 10 percentage points from a comparison mean of 55 percent and BA attainment by 10 percentage points over a comparison rate of 50 percent. In short, both urban and nonurban charter schools lift degree attainment, but nonurban charter schools—the same schools that negatively impact test scores—induce very large gains.

This paper makes two main contributions. First, we add to the evidence on charter schools by presenting lottery-based estimates of their impacts on college graduation from a diverse sample

[1]Observational work from Florida shows that charter schools decrease scores (Sass, 2006) and college persistence (Sass et al., 2016), but it does not differentiate by location type or model. Hitt et al. (2018) use vote-counting methods to assess the correlation between achievement and attainment impacts in school choice programs, finding little alignment. However, they do not focus on charters alone, nor do they use precise estimates.

of schools. The findings expand our so far limited knowledge of the impact of different charter school models on college outcomes. Second, we demonstrate that the test score gains and declines induced by charter school attendance do not always align with the schools' impacts on students' life trajectories. Standardized test scores provide a measure of student learning that is useful to families and schools and for government accountability ratings, but—for the most part—scores correlate with but are not directly connected to life outcomes such as college graduation and earnings. Researchers often use standardized test scores as a proxy for other outcomes that we care about (Krueger, 2003; Chetty et al., 2011; Hanushek, 2011; Chetty et al., 2014; Ganimian et al., 2021), but had we done so for our sample of Massachusetts charter schools, we would have come to the wrong conclusion about the schools' impacts on attainment. Now that sufficient time has passed for APW's sample of students to have completed their education, we can measure their longer-term outcomes directly and do so in the remainder of this paper.

1 Data and Descriptive Statistics

Below, we describe our data sources and sample criteria. We then describe the population of schools and students in Massachusetts and how it differs by locality.

1.1 Data and Sample

Massachusetts charter school records from randomized admissions lotteries in 2002–2014, corresponding to cohorts projected to graduate high school in 2006–2018, form the basis of our investigation into charter school impacts. We include schools with admission in the middle-school grades or later, as students admitted for elementary school are not yet old enough for us to observe their longer-term outcomes. Our sample, based on APW's but with a few additional schools with students old enough for their college outcomes to be observed, includes 15 urban charter schools and 9 nonurban charter schools. We define schools as urban if they are in towns where the school district participates in the Massachusetts Urban Superintendents Network and as nonurban otherwise. The sample covers all Massachusetts charter schools that offered admission for middle- or high-school grades at the time of the initial lottery record collection (2009–2010) and for which there are extant records of lotteries with more applicants than seats available, with the additions noted above (Appendix Table A.1).

The lottery records include students' names and dates of birth alongside lottery information (application grade, sibling status, town of residence, late application, admissions offers, and waitlist status). We exclude students who are omitted from randomization due to the lottery procedure: namely, guaranteed-admission siblings and late and out-of-area applicants. We use the lotteries for entry grades, as these have the greatest number of open seats and a standard open admission process (some charter schools use waitlists from the previous year for later grades). We create

indicators both for admission on the day of the lottery (initial offers) and offers extended from the randomized waitlist (waitlist offers).

We use name, date of birth, town of residence, and application cohort to match the lottery records to state administrative data from the Massachusetts Department of Elementary and Secondary Education (DESE). These records include student information such as school enrollment, gender, race, special education status, English learner status, subsidized lunch status, days of attendance, and high-school graduation status from the Student Information Management System (SIMS) and achievement scores from the Massachusetts Comprehensive Assessment System (MCAS). We standardize MCAS scores by subject, grade, and year to have mean zero and standard deviation one for the entire state. DESE also provided information on AP and SAT exams from the College Board and college enrollment and graduation records from the National Student Clearinghouse (NSC). All students in the sample are old enough to be observed 5 years after their projected high-school graduation, with one fewer cohort available for observation at 6 years after projected high-school graduation.

We impose two meaningful sample restrictions. First, we limit the sample to students present in the Massachusetts data at baseline, excluding students who applied to charter schools from private schools to ensure that we have baseline demographic information for all students. Second, we restrict the sample to students present in the Massachusetts data in 9th grade. This restriction is more consequential since it conditions on an outcome that charter attendance may affect. Winning a place in an *urban* charter school via lottery does not affect a student's likelihood of appearing in the data in 9th grade, but applicants with initial offers at *nonurban* charters are 5.6 percentage points more likely to appear in the data in this grade (Appendix Table D.2). Thus, this restriction does not jeopardize the causal interpretation of the effects of urban schools but does raise concerns about the estimates for the nonurban schools. We offer three reasons why our approach remains appropriate. First, Foote and Stange (2022), in the context of estimating college effects on earnings, find that conditioning on nonzero earnings does the best job of approximating a sample without attrition. While their context differs from ours, we are not aware of a similar study at the K–12 to college level. Second, we consider our estimates relevant to the Massachusetts public school system, and thus the selected population is the population of policy interest. Finally, as we show in Appendix D, which presents all of our results without conditioning on students' appearing in the data in 9th grade, restricting the sample in this way *reduces* the magnitude of our estimates, implying that the unrestricted model is upwardly biased.

1.2 Schools and Students

1.2.1 Schools

In addition to diverging from their traditional public school counterparts, urban and nonurban charter schools diverge in their characteristics and practices from each other. Table 1 compares

school characteristics for the charter schools in the lottery sample and other public schools. We measure school characteristics in the early 2010's, the point at which most students in our sample matriculated. Urban charter schools have the lowest share of teachers with formal credentials (59 percent licensed in their subject), followed by nonurban charters (71 percent), in contrast to public schools, where almost all teachers are licensed in their subject. All urban charter schools receive federal Title 1 funds for serving a high-poverty student body, as do about two-thirds of nonurban charters. Among traditional schools, 77 percent of urban schools and 41 percent of nonurban schools receive Title 1. The student–teacher ratio is lower in charter schools (12:1 or 11:1 in charters and 14:1 or 13:1 in other public schools). Charter schools are also small schools, with approximately 430 students per school. This compares to 660 students at urban public schools and over 2,000 students per school in nonurban areas, which tend to have large comprehensive high schools. Per-pupil expenditures (in 2014 dollars) are slightly higher in urban charters ($16,250) than in urban traditional schools ($15,660) and lower in nonurban charters ($11,981) than in nonurban traditional schools ($14,410).

For the charter schools only, we have responses to a survey on school practices (Panel B). Urban charters have longer school days and school years, use tutoring, frequent teacher observations, and frequent checks for student understanding, and have a culture of high expectations. Nonurban charters are less likely to deploy these practices, though half of the nonurban charters use frequent checks for student understanding and 75 percent use differentiated instruction (even higher than the 69 percent for urban charters). They also focus less on academic expectations. We can observe disciplinary information via administrative records and see that urban areas have higher disciplinary rates. However, relative to traditional public schools, urban charters use discipline to a greater extent, whereas nonurban charters have fewer disciplinary incidents.

1.2.2 Students

Table 2 presents descriptive statistics for students who attended public schools in Massachusetts in 9th grade and were projected to graduate between 2006 and 2018. We show baseline characteristics and outcomes for students who attended public schools in urban and nonurban areas (Columns 1 and 5), students who applied to charter school lotteries (Columns 2 and 6), students offered a charter seat (Columns 3 and 7) and students not offered a charter seat (Columns 4 and 8).

We see important differences across urban and nonurban areas. In urban areas, Black and Latino/a students comprise 20 and 31 percent of the public school student population (Column 1), respectively, and 54 and 27 percent of lottery applicants (Column 2). Sixty-four percent of urban students in noncharter public schools and 73 percent of lottery applicants receive free or reduced-price lunch. Urban students and lottery applicants also have low average baseline scores: 0.43σ and 0.41σ below the state average in math and 0.44σ and 0.45σ below the average in English language arts (ELA). Regarding test scores, lottery applicants are representative of urban students

overall.

In contrast, most students in nonurban areas are white: 84 percent of nonurban public school students and 90 percent of lottery applicants are white. Students in nonurban locations are of more affluent backgrounds and have better baseline academic outcomes. Nineteen percent of public school students in nonurban areas and 11 percent of charter school applicants receive subsidized lunch. Nonurban students and lottery applicants score 0.16σ and 0.35σ above the state average in math and 0.16σ and 0.43σ above the average in ELA.

Panel B of Table 2 shows that charter enrollment is, as expected, much higher among lottery applicants: 46 percent in urban and 61 percent in nonurban areas, with lottery winners enrolling at a higher rate.[2] In Panel C, we present post-lottery academic outcomes as a benchmark; the rest of this paper explores the lottery win–loss contrast in a causal framework.

2 Empirical Framework

To estimate the impact of urban and nonurban charter schools on educational attainment and other outcomes, we take advantage of the natural experiment created by charter school lotteries. We use randomized lottery offers as instruments for charter school attendance at each type of charter school in a two-stage least squares (2SLS) strategy with multiple endogenous variables. We link charter school attendance to outcomes with an equation of the following form:

$$y_i = \sum_j \delta_j d_{ij} + X_i'\Gamma + \rho^u C_i^u + \rho^n C_i^n + \epsilon_i, \tag{1}$$

where y_i is an educational outcome for student i, such as degree attainment. Charter attendance is represented by type with C_i^u and C_i^n, which are indicator variables for attendance prior to when y_i occurs at an urban (u) or nonurban (n) charter school with a lottery. The effect of attending an urban or nonurban charter is thus captured by ρ^u and ρ^n, respectively. A vector of baseline characteristics, X_i, increases statistical precision and includes indicators for gender, race, special education, English learner status, and subsidized lunch status and a set of year of birth fixed effects. Key to our estimation strategy is the inclusion of "risk sets," indicated by d_{ij}, which are lottery fixed effects that account for the set of charter schools applied to by each student and include the year and grade of application. The risks sets thus account for different probabilities of charter school attendance conditional on the number of schools applied to or a school's popularity. We use robust standard errors.

Charter school lottery offers serve as instruments for charter school attendance, coded as mutually exclusive indicator variables: Z_{i1} represents a random offer for a charter seat on the day of the lottery (initial offer) and Z_{i2} represents an offer for a charter seat from the randomized

[2]Lottery losers who enroll in charter schools typically do so in subsequent grades.

waitlist (waitlist offer). In a few cases, we have only initial or waitlist offer information. Thus, the first stage of our 2SLS framework is:

$$C_i^k = \sum_j \mu_j d_{ij} + X_i'\beta + \pi_1^k Z_{i1}^k + \pi_2^k Z_{i2}^k + \eta_i; k \in u, n, \tag{2}$$

where C_i^k indicates attendance at a charter school of k type, where $k \in u, n$, and is estimated as a function of the risk sets described above, the same vector of student characteristics, and the randomized lottery offers. The effect of lotteries on attendance is captured by π_1^k for the initial offer and π_2^k for the waitlist offer.

The first-stage results are reported in Appendix Table A.5. Among charter school applicants, urban students are 50 percentage points more likely to have ever attended a charter school if they received an initial offer and 35 percentage points more likely to attend if they received a waitlist offer than students not offered a seat. Nonurban applicants are 61 and 42 percentage points more likely to have attended a charter school if they received an initial or waitlist offer to attend. Urban students who received an initial or waitlist offer for a charter seat spent between one and a half to two more years in a charter than students not offered a seat. Nonurban students who received a charter seat or waitlist offer spent between 2 and almost 3 more years in a charter than students who did not receive an offer.

We demonstrate in Appendix Table A.2 that the characteristics of students offered seats in the lottery are very similar in both the urban and nonurban contexts, offering a check on lottery randomization. We also show that we are just as likely to match to the SIMS data students offered seats in the lottery as those not offered seats (Appendix Table A.3).

Even with the sample restricted to students present in 9th grade, there is a small amount of differential attrition. Students offered seats in the initial lottery are slightly more likely to have test score outcomes than those not offered seats in the lottery (by 2 percentage points in urban lotteries and 3 percentage points in nonurban ones) (Appendix Table A.4). This is not surprising, since winning the lottery makes it more likely a student enrolls in a charter school (and thus not a private or out-of-state school). A bounding exercise we detail in Section 3.6 shows little scope for this differential attrition to explain the test score results. However, we note that our analysis is concerned primarily with college outcomes. For these outcomes, and in light of the sample restriction, we have essentially complete data.

The control complier mean (CCM) is our preferred indicator for the counterfactual comparison. The CCM is the average value of the outcome for compliers without charter school offers. These are students who do not attend a charter when they do not receive an initial or waitlist offer in the first charter school lottery they apply to. We estimate the CCM for each charter type k as follows (Katz et al., 2001; Abadie, 2002):

$$y_i * \left(1 - C_i^k\right) = \sum_j \lambda_j d_{ij} + X_i'\alpha + \tau \left(1 - C_i^k\right) + \nu_i \tag{3}$$

where τ is the estimate of the CCM and (1-C_i^k) is instrumented by Z_{i1}^k and Z_{i2}^k, with risk sets and demographics accounted for as in Equation 2.

3 Results

In this section, we report the impacts of charter attendance by location on academic outcomes. We report outcomes within timeframes of expected high-school graduation, where the expected high-school graduation year is based on the year and grade of the charter school lottery. Thus, an outcome such as bachelor's attainment within 6 years indicates that a student obtained a bachelor's within 6 years of her expected high-school graduation based on when she applied to a charter school. In all cases, for college enrollment, graduation and other binary indicators, the outcomes are unconditional, with students without records of college attendance or attainment included in the data as zeroes if they appear in the Massachusetts data in 9th grade.

3.1 Standardized Test Scores

MCAS math and ELA scores serve as our benchmark to compare our findings to those of previous studies. Similarly to APW, we find that attending an urban charter school boosts standardized test scores whereas attending a nonurban charter reduces them. To combine test scores across grade levels, in Table 3, we estimate the impact on MCAS scores two years after the charter school lottery, typically 6th or 7th grade for students entering charter middle schools and 10th grade for those entering charter high schools.

After two years, urban charters increase scores by almost half a standard deviation (σ) in math (0.46σ) and 0.30σ in ELA. These results align with the per-year effects found in APW of 0.33σ for middle-school math, 0.15σ for middle-school ELA, 0.34σ for high-school math, and 0.26σ for high-school ELA, though the comparison is inexact because of the different parameterizations. The urban results are on also par with those reported for Boston (Abdulkadiroğlu et al., 2011; Angrist et al., 2016; Walters, 2018; Cohodes et al., 2021; Setren, 2021; Cohodes and Feigenbaum, 2021). After a student spends two years in a nonurban charter school, test scores drop by -0.11σ in math and -0.14σ in ELA. The corresponding per-year estimates from APW are -0.12σ for middle-school math and -0.14σ for middle-school ELA, with negative but not statistically significant impacts on high-school tests.

Notably, the test score gains and losses occur at very different points in the statewide test score distribution. Comparison (traditional) urban students score approximately a third of standard deviation below the state mean, whereas traditional nonurban students score almost half a

standard deviation above the state mean. Thus, the test score gains in urban charters shift the full distribution of scores rightward from below the state average to at or above the state average in two years, whereas nonurban charter students, despite their performance being lower than that of traditional nonurban students, still perform above the state mean (Appendix Figure B.1 shows the distribution of test scores).

3.2 College Preparation

AP classes and their associated tests allow high-school students to complete college-level work. In Panel B of Table 3, we estimate the impact of charter attendance on the student's likelihood of taking any AP, the number of APs taken, and AP scores. In urban areas, approximately 32 percent of comparison students take at least one AP; charter attendance increases this share to 45 percent, and the number of APs taken from 0.8 to approximately 1.2. There is also a boost in the share of urban charter students scoring 3 or more on any APs (a typical cutoff to receive college credit) from 12 to 17 percent. In nonurban areas, the share of students taking at least one AP is much higher at 49 percent; charter attendance *decreases* this to 22 percent. Nonurban charter attendance decreases the average number of APs from 1.8 to 0.7 and reduces the share of students scoring above every test score threshold. This is driven by nonurban charters' reduced AP offering: students attending a nonurban charter school are 54 percentage points less likely to have had access to an AP class than the comparison group (Appendix Table B.1). We do not observe differences in AP scores for urban and nonurban charter students after we condition the AP score results on their taking at least one AP. This means that the AP score differences are due to test-taking rather than to a change in performance. This shows that urban charters actively boost a college preparatory curriculum via AP classes whereas nonurban charters do not emphasize such classes.

Taking, and scoring well on, the SAT test is another milestone on the path to college, as many colleges require the exam. As shown in Panel C of Table 3, neither urban nor nonurban charter attendance changes the rate of SAT-taking. Approximately 60 percent of urban students and 75 percent of nonurban students in the sample take the SAT. Urban charter attendance boosts the test scores of takers by 41 points (out of 1600), with little difference in nonurban scores.[3] As shown in Panel C of Appendix Figure B.1, urban charter attendance shifts the SAT score distribution rightward, similarly to the MCAS effect.[4] Nonurban charter SAT-takers score close to the nonurban mean.

APs and SATs are helpful for being admitted to and preparing for college; high-school students must also progress through high school and graduate. We display treatment estimates for high-school graduation in Panel D of Table 3 with details on high-school progress in Appendix Table B.2. Here, the findings diverge from those on test scores. Urban students are less likely to graduate

[3]We display SAT reasoning scores (math and verbal, summing to 1600) since all cohorts take these two SAT subsections and only a few take the exam scored out of 2400.

[4]Distributions for each SAT subject are in Appendix Figure B.2.

high-school on time, with a 6-percentage-point decrease in high-school graduation in four years.[5] Urban charter students do catch up, with little difference in graduation rates vis-à-vis their peers' at a 5- or 6-year horizon. Nonurban charter students graduate at the same rates and within the same timeframe as their peers.

Overall, our findings suggest that attending an urban charter school boosts several measures of college preparation: urban charters increase the number of APs that students take and their SAT scores, though there are negative impacts on high-school graduation, which diminish over time. These estimates are similar to those previously reported for Boston charters (Angrist et al., 2016; Setren, 2021; Cohodes and Feigenbaum, 2021). Nonurban charter attendees, for the most part, perform similarly to nonurban comparison peers except that they take fewer APs, given their schools' lower AP course offerings.

3.3 College Enrollment

College preparation in high school is an important precursor to college, but college enrollment, persistence, and graduation show whether students succeed outside secondary education. Within a year of projected high-school graduation, both urban and nonurban charter students enroll in four-year college at greater rates than their peers, as shown in Figure D.1. Additionally, both types divert enrollments from two-year institutions, such that enrollment in any post-secondary institution is slightly higher in urban areas and remains flat in nonurban localities (Appendix Table B.5). Urban charter attendance boosts immediate four-year enrollment to 45 percent from 38 percent; nonurban charter attendance boosts enrollment to 62 percent from 53 percent. The decline in two-year college enrollment due to urban charter attendance is 4 percentage points and that due to nonurban charter attendance 8 percentage points. These college enrollment gains are similar to those found for Boston (Angrist et al., 2016; Setren, 2021; Cohodes and Feigenbaum, 2021). By the second year after projected high-school graduation, an interval that allows for late graduation, there is little difference between the two charter types in enrollment at two-year institutions, and four-year college enrollment increases by 8 and 11 percentage points for urban and nonurban charters, respectively. Since two-year enrollment changes little and four-year enrollment rises, enrollment in any college increases for both charter types in the second year after projected high-school graduation.

As time goes on, into the 3rd and 4th years after expected high-school graduation, urban charters boost four-year college enrollment of 5 to 7 percentage points, with counterfactual attendance decreasing over time as students drop out. In the 5th and 6th years after high-school graduation, urban charters increase enrollment, though the interpretation of this outcome is ambiguous: If it represents progress toward a degree, enrollment could be beneficial; if it represents a delay in joining

[5]Note that high-school graduation rates here will be lower than reported rates because they are based on on-time grade progression since the time of the charter lottery and they are unconditional.

the workforce, it could be detrimental. The decrease in control complier enrollment is now due in part to graduation from college. Nonurban charters boost four-year enrollment in the 3rd and 4th years by 12 percentage points, with lower dropout among the counterfactual students. Nonurban charter students are also more likely to be enrolled in the 5th and 6th years after projected high-school graduation by approximately 4 to 5 percentage points, though only the 6th year difference is statistically significant. Urban and nonurban charters increase both initial college enrollment and persistence through college.

3.4 Degree Attainment

Both urban and nonurban charter school attendance increases the likelihood that a student obtains any degree, in particular a bachelor's from a four-year institution. In the 4th year after projected high-school graduation, which corresponds to on-time high-school progress and on-time college progress, urban charters increase BA receipt by 3 percentage points and nonurban charters by 6.4 percentage points. Urban charters boost two-year attainment by a small amount, whereas nonurban schools decrease it, meaning that both school types increase receipt of a degree of any type by 4 to 5 percentage points (Figure D.1 and Appendix Table B.6).

As time goes on, urban charter attendance increases the BA boost to 4.1 percentage points by the 6th year after projected high-school graduation and the gains in attainment of any degree to 4.8 percentage points. The nonurban edge increases to an even greater extent over time, with a bump of 10.4 percentage points for BA attainment (9.7 percentage points for any degree) in the 6th year after projected high-school graduation. By the 6th year, 23 percent of urban control compliers graduate with a BA, with urban charter attendance increasing this to 27 percent, an increase of 18 percent of the comparison mean. By the 6th year, 50 percent of the nonurban control compliers graduate college, with the charter effect boosting this outcome for treated compliers to 61 percent, a 21 percent increase over the mean.

Charter attendees are more likely to enroll and graduate from four-year institutions in both urban and nonurban areas. However, 6 years after graduating from high school, the college edge is from nonurban charter attendance is more than twice as large as that from urban charter attendance. Notably, the nonurban charter effect is even larger for college graduation outcomes than for college enrollment outcomes.

3.5 College Quality

College quality can increase college graduation and earnings (Hoekstra, 2009; DeAngelo et al., 2011; Cohodes and Goodman, 2014; Zimmerman, 2014; Goodman et al., 2017; Ge et al., 2022; Black et al., 2023). Thus, we investigate both the impact of charter attendance on college quality and the extent to which college quality accounts for the observed boost in college graduation. As shown in Appendix Table B.7, urban charter attendance increases both four-year college enrollment

and BA attainment in fairly equal measure at highly competitive institutions and competitive institutions. Nonurban charter attendance boosts college enrollment and graduation primarily at highly competitive institutions. Thus, we consider whether nonurban charters' high rates of placement of their students at elite colleges explains the large degree attainment gains. We investigate this possibility in Panel C of Table B.7, which shows BA receipt conditional on college enrollment. The graduation effects of urban charters are fully explained by enrollment—that is, conditional on students' having entered college, there is no additional impact on graduation—whereas nonurban charters boost graduation even conditional on students' having enrolled. This implies that even at highly competitive colleges, nonurban charters impact both where students attend and how they experience and complete college.

3.6 Robustness

We examine threats to validity and confirm that our findings are robust. In Appendix Table C.2, we show for three key outcomes (MCAS math scores, four-year college enrollment, and four-year college graduation (6 years)) that similar results emerge under alternative specifications. Excluding covariates or adding baseline scores does not meaningfully affect the magnitudes or statistical significance of the results. Using initial offers as the only instrument slightly reduces the magnitude of our estimates and decreases their statistical precision, but our conclusions hold.

We also address differential attrition (Appendix Table A.4). Slightly more students with charter offers have test score outcomes than those who do not receive an offer. To assess the extent to which differential attrition affects test score results, we estimate Lee (2009) bounds (Appendix Table C.1). By locality, we calculate the lower bound by dropping the fraction of the highest-scoring lottery winners until the response rates among lottery winners and losers are equal. To estimate the upper bound, we drop instead the fraction of lowest-scoring lottery winners. The findings from this exercise suggest that, even in the presence of nonrandom attrition, the overarching test score patterns remain consistent with our main results. Urban charter impacts remain large, statistically significant, and positive. The nonurban effect remains negative under both scenarios, though the upper bound for math is not statistically significant. There is no attrition for college outcomes since virtually all students in the sample are sent to the NSC for matching.

In Appendix D, we also present our complete findings without restricting the sample to students in Massachusetts in 9th grade, filling in zeroes for missing data on binary outcomes. As shown in Appendix Table D.2, students with urban charter offers are no more likely to be present in 9th grade, but in nonurban areas, those with initial offers are 5 percentage points more likely to be present in the data. The unconditional results tend to enlarge the estimates on the college outcomes by a small amount for urban charters and by several percentage points for nonurban charters. They also make it appear as if nonurban charters boost SAT-taking, on-time progress through high school, and high-school graduation, but this is an artifact of the greater presence in the data of students

with nonurban charter offers. This exercise shows empirically that our decision to restrict the sample to 9th graders present in Massachusetts is a conservative one.

4 Conclusion

This paper presents estimates of the impact of different charter school models on college preparation, enrollment, and graduation. We confirm previous evidence from Massachusetts that urban charters boost test scores, with nonurban schools driving scores downward, a pattern that aligns with results in the broader charter school literature. However, when we turn to college enrollment and graduation, we have several novel findings. First, we show that the bump in college enrollment found previously for Boston charter attendance translates into degree completion in a wider sample of urban schools, with urban charters boosting BA attainment rates by 4.1 percentage points and attainment of any degree by 5.1 percentage points within 6 years of projected high-school graduation. Second, we show that nonurban charter schools—the same schools that *decrease* test scores—increase four-year college enrollment and BA attainment by 9 and 11 percentage points, respectively. Even conditional on college enrollment, nonurban charters still boost college graduation.

We draw two main conclusions from these findings. First, multiple charter school models can induce college gains. While many have focused on the "No Excuses" practices as the path forward for charter school success (Chabrier et al., 2016; Epple et al., 2016; Cohodes and Parham, 2021) (though there is a recent move away from that model (Torres, 2022)), the nonurban schools in this sample operating on alternative models deliver a large boost to BA attainment. Second, although test scores and longer-term outcomes are typically positively correlated (Krueger, 2003; Chetty et al., 2011; Hanushek, 2011; Dynarski et al., 2013; Chetty et al., 2014), we show that the relationship between test scores and college outcomes does not hold in all contexts, concluding that researchers and policymakers should be wary of evaluating programs solely on standardized test results, especially when participants are relatively high achieving. In future work, we will investigate the mechanisms behind this pattern of results, including differences in school practices and contexts.

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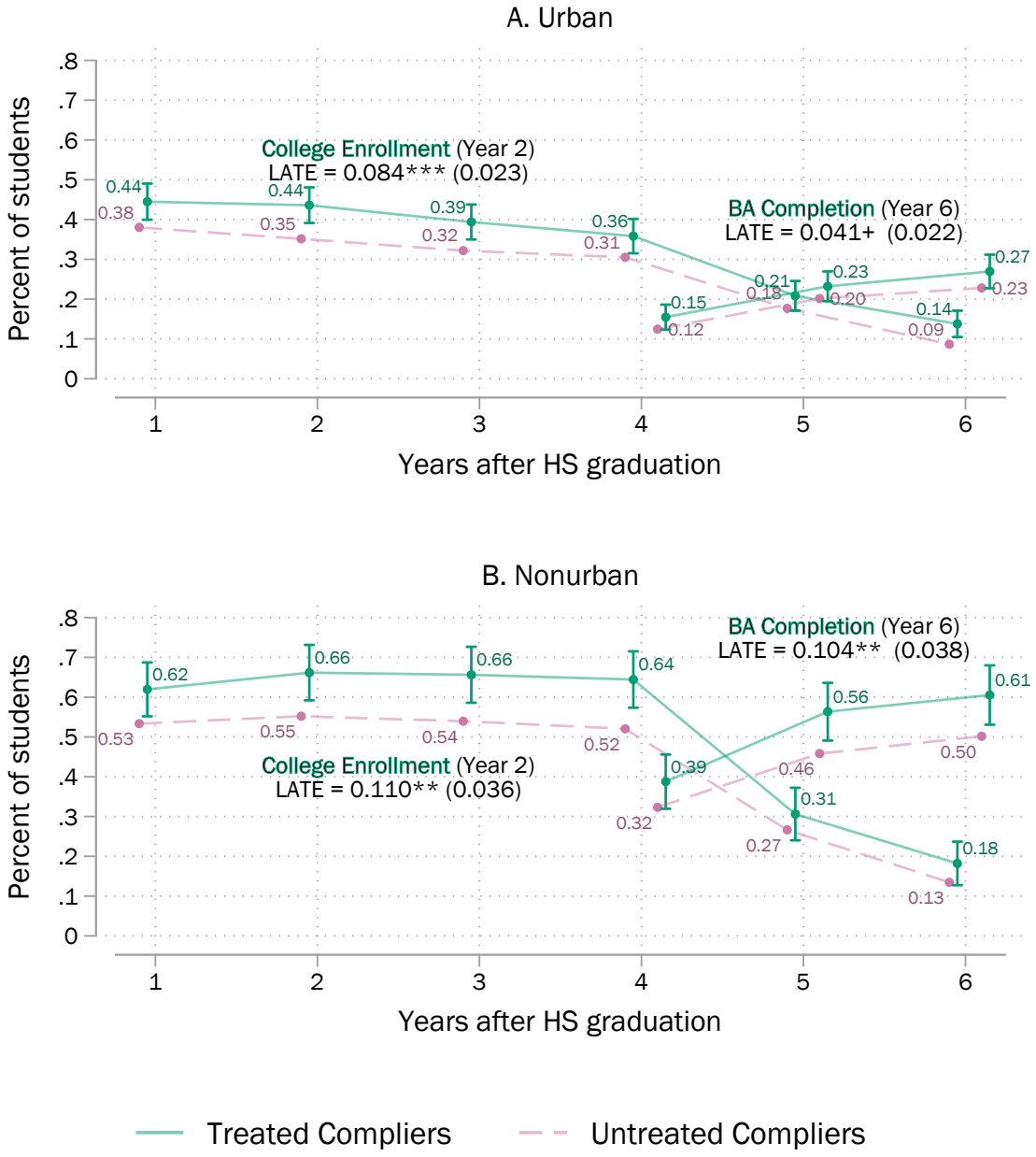
Figure 1: Four-Year College Progression for Treated and Untreated Compliers



Notes: This figure shows the treatment and control complier means for four-year college enrollment and graduation for treated and untreated compliers. Treatment effects on college enrollment two years after projected high-school graduation and graduation rates six years after projected high-school graduation are reported under the labels.

Table 1: School Characteristics

	Charter Schools		Other Public Schools	
	Urban (1)	Nonurban (2)	Urban (3)	Nonurban (4)
(A) Administrative Records				
% of teachers licensed in subject	58.867	70.611	96.608	96.855
% of core classes taught by highly qualified teachers	86.227	94.089	89.876	97.378
Title I school	1.000	0.667	0.767	0.409
Student–teacher ratio	11.721	10.511	13.955	13.165
Per-pupil expenditure	16,250	11,982	15,661	14,411
School size	433	435	663	2,271
Counselors per 1000 students	5.204	2.150	2.793	3.043
Disciplined students per 1000 students	191.923	33.963	122.090	45.412
(B) Survey Responses				
Days per school year	191.833	182.000	-	-
Hours per school day	7.935	6.974	-	-
High-quality tutoring	0.615	0.111	-	-
Frequent teacher observations	0.538	0.375	-	-
Frequent checks for student understanding	0.846	0.500	-	-
Differentiated instruction	0.692	0.750	-	-
Culture of high expectations (No Excuses)	0.733	0.111	-	-
N(Schools)	15	9	266	599

Notes: This table shows characteristics for urban and nonurban charter schools in the lottery analysis sample in Columns 1 and 2. Information on traditional public schools that serve 6th and/or 9th grades in urban and nonurban areas appears in Columns 3 and 4 for comparative purposes. Data sources for Panel A are Massachusetts Department of Elementary and Secondary Education School District Profiles for the 2013–2014 school year. Title I eligibility is reported for the 2013–2014 school year and comes from the U.S. Department of Education Common Core of Data (CCD). The data for Panel B come from a survey of charter school leaders fielded in 2011 and 2012.

Table 2: Sample Characteristics and Outcomes

	Urban				Nonurban			
	Noncharter Public Schools (1)	Lottery Applicants (2)	Offered Charter (3)	Not Offered Charter (4)	Noncharter Public Schools (5)	Lottery Applicants (6)	Offered Charter (7)	Not Offered Charter (8)
(A) Baseline characteristics								
Female	0.482	0.519	0.519	0.518	0.491	0.522	0.521	0.526
Asian	0.076	0.031	0.030	0.031	0.039	0.029	0.031	0.025
Black	0.199	0.526	0.535	0.507	0.046	0.024	0.023	0.027
Latinx	0.316	0.280	0.284	0.274	0.062	0.022	0.022	0.024
Other race	0.028	0.042	0.039	0.049	0.017	0.023	0.018	0.034
White	0.381	0.121	0.112	0.138	0.837	0.901	0.906	0.890
Special education	0.188	0.205	0.208	0.200	0.177	0.160	0.156	0.170
English learner	0.179	0.115	0.117	0.112	0.028	0.006	0.005	0.007
Free/reduced price lunch	0.644	0.744	0.752	0.730	0.198	0.112	0.115	0.105
Baseline MCAS ELA	-0.432	-0.457	-0.476	-0.421	0.155	0.426	0.422	0.435
Baseline MCAS Math	-0.426	-0.405	-0.413	-0.389	0.153	0.341	0.349	0.326
(B) Charter school enrollment								
Attend any charter in grades 5-12	0.058	0.449	0.539	0.278	0.052	0.613	0.749	0.322
(C) Academic outcomes								
MCAS Math	-0.360	-0.219	-0.162	-0.320	0.174	0.298	0.290	0.315
MCAS ELA	-0.392	-0.305	-0.274	-0.359	0.189	0.371	0.352	0.412
Took any AP	0.240	0.339	0.346	0.327	0.333	0.287	0.241	0.384
Score 3+ on any AP	0.132	0.122	0.121	0.124	0.253	0.232	0.198	0.305
Took SAT	0.455	0.580	0.574	0.593	0.634	0.740	0.739	0.743
SAT score (1600) (for takers)	94.865	900.442	898.933	903.162	107.148	1128.522	1132.211	1120.670
Graduate high school (4 years)	0.609	0.626	0.610	0.656	0.827	0.820	0.825	0.808
Graduate high school (5 years)	0.656	0.714	0.704	0.733	0.850	0.881	0.878	0.888
Enroll in any college	0.501	0.597	0.599	0.593	0.699	0.801	0.805	0.793
Enroll in 4-year college	0.315	0.436	0.440	0.427	0.563	0.668	0.676	0.651
Enroll in 2-year college	0.219	0.206	0.205	0.207	0.177	0.188	0.181	0.202
Complete any degree	0.256	0.266	0.267	0.265	0.492	0.584	0.588	0.577
Complete BA	0.214	0.230	0.229	0.232	0.449	0.537	0.545	0.520
Complete AA	0.059	0.053	0.055	0.049	0.066	0.073	0.065	0.089
N	275,568	12,394	8,143	4,251	642,847	3,026	2,062	964

Notes: This table shows demographic characteristics and outcome means, for various samples. The sample in Column 1 is restricted to students who attended schools in the state of Massachusetts in 9th grade in the projected high-school classes of 2006–2018. The sample in Column 2 is restricted to charter school applicants enrolled in schools in the state of Massachusets at the time of application in the projected high-school classes of 2006–2018. The samples in Columns 3 and 4 are further restricted to those offered and not offered a seat at a charter in the lottery, respectively.

Table 3: The Impact of Charter School Attendance on Tests

	Urban			Nonurban		
	2SLS (1)	CCM (2)	N (3)	2SLS (4)	CCM (5)	N (6)
(A) MCAS (2 years after lottery)						
Math	0.464***	-0.318	10,206	-0.109+	0.356	2,889
	(0.042)			(0.060)		
ELA	0.298***	-0.342	10,310	-0.136**	0.466	2,856
	(0.040)			(0.052)		
(B) Advanced Placement (AP)						
Took any AP	0.132***	0.317	11,570	-0.284***	0.493	3,026
	(0.022)			(0.033)		
Number of APs	0.374***	0.811	11,570	-1.115***	1.807	3,026
	(0.070)			(0.153)		
Score 2+ on any AP	0.098***	0.198	11,570	-0.286***	0.465	3,026
	(0.019)			(0.032)		
Score 3+ on any AP	0.044**	0.124	11,570	-0.224***	0.375	3,026
	(0.016)			(0.031)		
Score 4+ on any AP	0.004	0.075	11,570	-0.158***	0.265	3,026
	(0.012)			(0.029)		
Score 5 on any AP	-0.002	0.031	11,570	-0.114***	0.173	3,026
	(0.007)			(0.023)		
(C) SAT						
Took SAT	0.007	0.595	11,570	0.010	0.747	3,026
	(0.024)			(0.032)		
SAT score (1600) (for takers)	40.639***	891.669	6,914	11.026	1123.677	2,240
	(9.512)			(15.273)		
(D) High school graduation						
Graduate high school (4 years)	-0.067**	0.655	12,185	-0.016	0.814	3,026
	(0.023)			(0.026)		
Graduate high school (5 years)	-0.019	0.734	12,185	-0.007	0.899	3,026
	(0.022)			(0.024)		
Graduate high school (6 years)	-0.011	0.786	12,185	-0.012	0.911	3,026
	(0.021)			(0.023)		

Notes: Each coefficient labeled 2SLS is the instrumental variables estimate of attending an urban or nonurban charter at any period of time before the outcome listed in the row heading occurred. Indicator variables for a lottery offer on the day of the lottery (initial offer) and lottery offer off of the waitlist (waitlist offer), separately for urban and nonurban charters, are the instruments for charter attendance. The control complier mean is listed in the column labeled CCM. All regressions control for lottery risk sets and a vector of demographic characteristics including indicators for race, gender, birth year, calendar year, and baseline special education, English learner, and free or reduced price lunch status. The sample is restricted to students enrolled in Massachusetts schools at the time of application in the projected high school classes of 2006 to 2018, who attend a Massachusetts public school in 9th grade. Robust standard errors in parentheses (+ p<0.10 * p<0.05 ** p<0.01 ***p<0.001). MCAS scores exclude middle school scores from 2015 and 2016 when districts could select the MCAS or PARCC exam. AP and SAT outcomes are available for the class of 2007 and later.

Appendix

Diverse Paths to College Success: The Impact of Massachusetts' Urban and Nonurban Charter Schools on College Trajectories

Sarah R. Cohodes and Astrid Pineda

Appendix A: Lottery Details

Table A.1: Massachusetts Charter Schools Eligible for Lottery Study

School (1)	Town (2)	Urban (3)	Grades Served (4)	Entry Grade (5)	Available Years (6)
Academy of the Pacific Rim Charter School	Boston	Yes	5-12	5,6	2005-2010
Advanced Math and Science Academy Charter School	Marlborough	No	6-12		
Berkshire Arts and Technology Charter Public School	Adams	No	6-12		
Boston Collegiate Charter School	Boston	Yes	5-12	5	2002-2010
Boston Green Academy	Boston	Yes	6-12	9	2011-2014
Boston Preparatory Charter Public School	Boston	Yes	6-12	6	2005-2011, 2014
Cape Cod Lighthouse Charter School	Orleans	No	6-8	6	2007-2010
Christa McAuliffe Regional Charter Public School	Framingham	Yes	6-8		
City on a Hill Charter Public School (Circuit Street)	Boston	Yes	9-12	9	2002, 2004-2014
City on a Hill Charter Public School (Dudley Square)	Boston	Yes	9-12	9	2013-2014
Codman Academy Charter Public School	Boston	Yes	K-12	9	2004, 2008-2014
Community Charter School of Cambridge	Cambridge	Yes	7-12		
Edward Brooke Charter School	Boston	Yes	K-8	5	2006-2009
Excel Academy Charter School	Boston	Yes	5-8	5	2008-2010
Four Rivers Charter Public School	Greenfield	No	7-12	7	2003-2012
Francis W Parker Charter Essential School	Devins	No	7-12	7	2006-2011
Global Learning Charter Public School	New Bedford	Yes	5-12	5	2006-2007, 2009
Hampden Charter School of Science	Chicopee	Yes	6-12		
Health Careers Academy Charter School	Boston	Yes	9-12		
Helen Davis Leadership Academy (formerly Smith)	Boston	Yes	6-8		
Innovation Academy Charter School	Tyngsboro	No	5-12	5	2007-2010
KIPP Academy Lynn	Lynn	Yes	K-12	5	2005-2009
Marblehead Community Charter Public School	Marblehead	No	4-8	4	2005-2007, 2009
MATCH Charter Public School	Boston	Yes	K-12	6,9	2002-2011
New Leadership Charter School	Springfield	Yes	6-12		
Phoenix Charter Academy	Chelsea	Yes	9-12		
Pioneer Charter School of Science	Everett	Yes	7-12		
Pioneer Valley Performing Arts Charter Public School	South Hadley	No	7-12	7	2006-2010
Rising Tide Charter Public School	Plymouth	No	5-8	5	2009-2010
Roxbury Preparatory Charter School	Boston	Yes	6-8	6	2002-2011
Salem Academy Charter School	Salem	No	6-12	6	2010-2011
Sizer School, A North Central Charter Essential School	Fitchburg	Yes	7-12		
Sturgis Charter Public School	Hyannis	No	9-12	9	2004, 2006, 2008-2011
UP Academy Boston	Boston	Yes	6-8	6	2011

Notes: This table includes charter schools that meet the following criteria: 1) admitted students for middle or high-school grades (4-7, 9); 2) has students in the projected high-school classes of 2006-2018; 3) does not serve special populations (such as students a risk of dropping out), and 4) are not closed charter schools. Schools that indicate grade ranges that do not begin at the lottery entry grade expanded grades served after lottery data was collected. Schools that are eligible for the lottery study that do not have lottery grades and years indicated either had fewer applicants than seats available, or did not retain usable lottery records. Urban towns include those which participate in the Massachusetts Urban Superintendents Network: Boston, Brockton, Cambridge, Chelsea, Chicopee, Everett, Fall River, Fitchburg, Framingham, Haverhill, Holyoke, Lawrence, Leominster, Lowell, Lynn, Malden, New Bedford, Pittsfield, Quincy, Revere, Somerville, Springfield, Taunton, and Worcester (Salem joined the network at a later date and thus is categorized as nonurban in this study). MATCH is included in the study as both a middle and a high school.

Table A.2: Covariate Balance

	Urban			Nonurban		
	Fraction of Non-Offered With Outcome (1)	Initial Offer Differential (2)	Waitlist Offer Differential (3)	Fraction of Non-Offered With Outcome (4)	Initial Offer Differential (5)	Waitlist Offer Differential (6)
Female	0.515	0.004	0.008	0.526	0.003	0.022
		(0.011)	(0.011)		(0.021)	(0.023)
Asian	0.028	0.001	0.001	0.025	-0.005	0.013
		(0.004)	(0.004)		(0.007)	(0.009)
Black	0.512	-0.001	-0.002	0.027	-0.000	0.003
		(0.011)	(0.011)		(0.006)	(0.007)
Latinx	0.279	-0.003	0.009	0.024	0.013*	-0.016*
		(0.010)	(0.010)		(0.006)	(0.006)
Other race	0.045	0.000	-0.008+	0.034	-0.002	-0.008
		(0.004)	(0.004)		(0.006)	(0.006)
White	0.136	0.002	-0.000	0.890	-0.006	0.007
		(0.007)	(0.007)		(0.012)	(0.014)
Special education	0.202	0.002	-0.010	0.170	-0.010	-0.004
		(0.009)	(0.009)		(0.015)	(0.017)
English learner	0.109	-0.004	0.010	0.007	0.000	-0.002
		(0.007)	(0.007)		(0.003)	(0.003)
Subsidized lunch	0.728	0.006	-0.004	0.105	0.000	0.017
		(0.010)	(0.010)		(0.013)	(0.015)
Baseline MCAS ELA	-0.431	-0.016	0.019	0.435	0.034	-0.046
		(0.023)	(0.023)		(0.034)	(0.039)
Baseline MCAS Math	-0.400	-0.018	0.004	0.326	0.044	-0.041
		(0.021)	(0.022)		(0.038)	(0.043)
p-value		0.962	0.892		0.529	0.326

Notes: This table shows student characteristics and test scores, and differentials between offered and nonoffered charter applicants. The sample is restricted to students enrolled in Massachusetts schools at the time of application in the projected high school classes of 2006 to 2018, who attend a Massachusetts public school in 9th grade. Columns 1 and 4 show the proportion of non-offered students with a given characteristic. Columns 2, 3, 5, and 6 report coefficients from regressions of the student characteristic on initial and waitlist offer dummies, including controls for risk sets (+ $p<0.10$ * $p<0.05$). N (urban) = 13281, N (nonurban) = 3285.

Table A.3: Match Rate to SIMS

Projected HS Class	Non-offered Mean (1)	Initial Offer Differential (2)	Waitlist Offer Differential (3)	Number of Applications (4)
2006	0.986	-0.008	0.008	515
		(0.012)	(0.009)	
2007	0.997	-0.011	-0.033	422
		(0.017)	(0.038)	
2008	0.996	-0.014	0.007	939
		(0.011)	(0.009)	
2009	0.992	0.003	-0.007	1,010
		(0.009)	(0.009)	
2010	0.994	0.000	-0.003	1,332
		(0.009)	(0.010)	
2011	0.996	-0.000	-0.002	1,595
		(0.006)	(0.008)	
2012	0.989	-0.005	0.002	2,159
		(0.006)	(0.004)	
2013	0.992	-0.004	0.000	2,472
		(0.006)	(0.005)	
2014	0.993	-0.000	0.000	2,972
		(0.004)	(0.004)	
2015	0.994	-0.001	-0.000	3,791
		(0.004)	(0.003)	
2016	0.993	-0.000	0.000	3,724
		(0.004)	(0.004)	
2017	0.993	-0.001	0.000	5,273
		(0.003)	(0.003)	
2018	0.995	-0.003	0.001	5,611
		(0.003)	(0.003)	
All cohorts	0.994	-0.003*	0.000	31,815
		(0.001)	(0.001)	

Notes: This table shows the match between lottery records and the SIMS data by projected high school class. The sample excludes disqualified, late, out-of-area, and sibling applications. Individuals can be in the sample multiple times if they apply to multiple schools. Columns 2 and 3 report coefficients from regressions of the student characteristic on initial and waitlist offer dummies, including controls for risk sets (+ $p<0.10$ * $p<0.05$ ** $p<0.01$ ***$p<0.001$).

Table A.4: Attrition

	Urban			Nonurban		
	Fraction of Non-Offered With Outcome (1)	Initial Offer Differential (2)	Waitlist Offer Differential (3)	Fraction of Non-Offered With Outcome (4)	Initial Offer Differential (5)	Waitlist Offer Differential (6)
Has ELA score	0.896	0.006	0.005	0.935	0.020*	-0.003
		(0.007)	(0.007)		(0.009)	(0.010)
Has math score	0.881	0.007	0.004	0.945	0.017+	-0.002
		(0.007)	(0.007)		(0.009)	(0.009)
Present in 12th grade in MA	0.850	-0.004	-0.000	0.908	-0.003	-0.003
		(0.008)	(0.008)		(0.012)	(0.013)
Sent to NSC	0.999	0.000	-0.000	1.000	0.000	0.000
		(0.001)	(0.001)		(0.000)	(0.000)

Notes: This table shows follow-up rates for MCAS scores two years after charter application, presence in the data in 12th grade, and an indicator for being sent to the NSC to be matched to college outcome data for Boston charter school applicants. The sample is restricted to students enrolled in Massachusetts schools at the time of application in the projected high-school classes of 2006–2018, who attend a Massachusetts public school in 9th grade. Columns 1 and 4 show the proportion of non-offered students with a given outcome. Columns 2, 3, 5, and 6 report coefficients from regressions of indicators for follow-up data on initial and waitlist offer dummies, including controls for risk sets (+ $p<0.10$ * $p<0.05$ ** $p<0.01$ ***$p<0.001$). N (urban) = 12185, N (nonurban) = 3026.

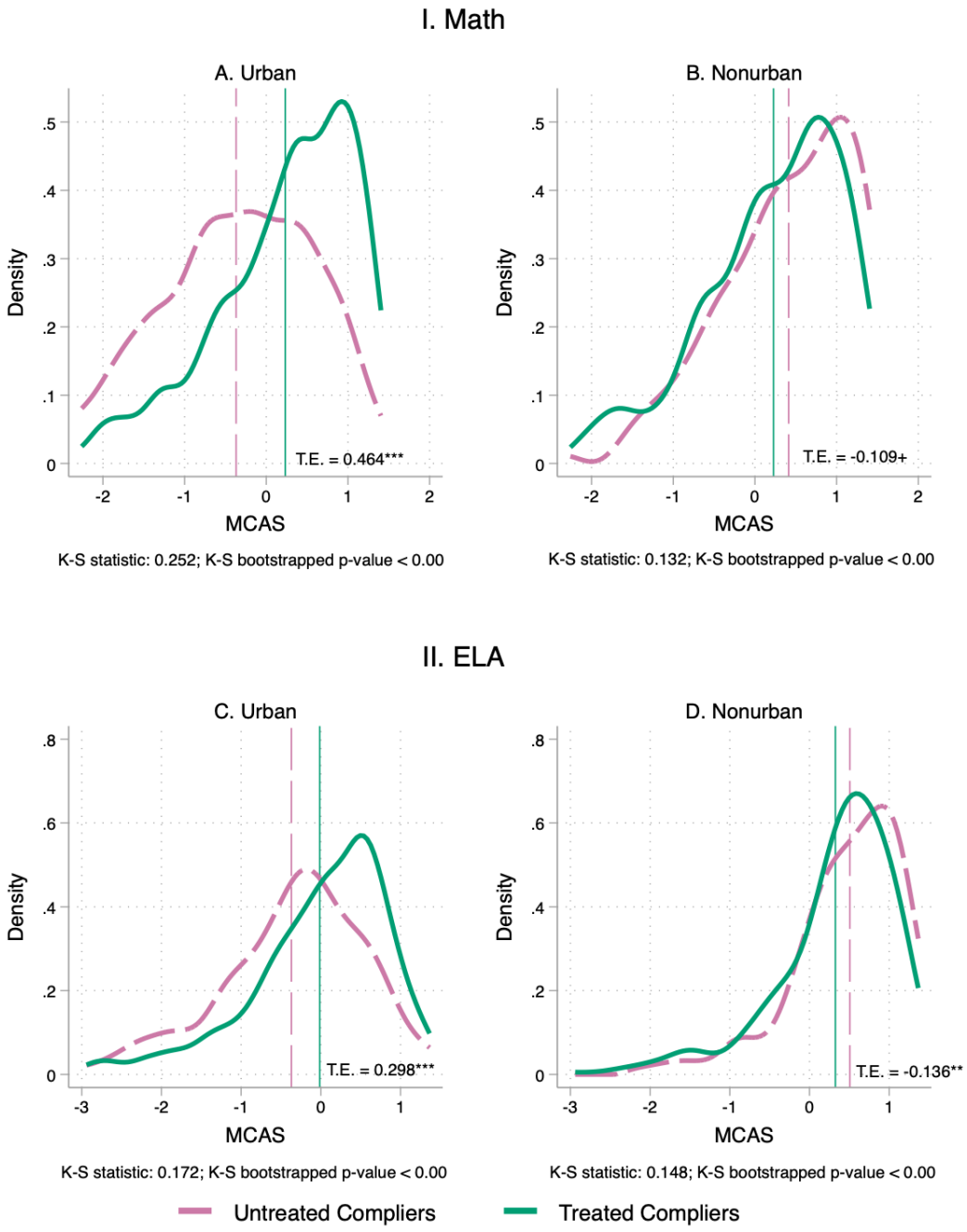
Table A.5: The Impact of Charter School Offers on Charter Attendance

	Non-offered Mean (1)	Initial Offer (2)	Waitlist Offer (3)
(A) Ever attended charter			
Urban	0.130	0.500***	0.350***
		(0.011)	(0.010)
Nonurban	0.268	0.608***	0.421***
		(0.020)	(0.025)
(B) Years attended charter			
Urban	0.911	1.845***	1.414***
		(0.056)	(0.054)
Nonurban	1.104	2.835***	2.103***
		(0.102)	(0.128)

Notes: This table shows the impact of a charter school offer on charter school attendance for the urban and nonurban samples. The sample is restricted to students enrolled in Massachusetts schools at the time of application in the projected high school classes of 2006 to 2018, who attend a Massachusetts public school in 9th grade. Column 1 shows the proportion of non-offered students attending a charter school. Columns 2 and 3 report coefficients from regressions of charter attendance on initial and waitlist offer dummies, including controls for demographic characteristics and risk sets. Robust standard errors in parentheses (+ p<0.10 * p<0.05 ** p<0.01 ***p<0.001). N = 16,780.

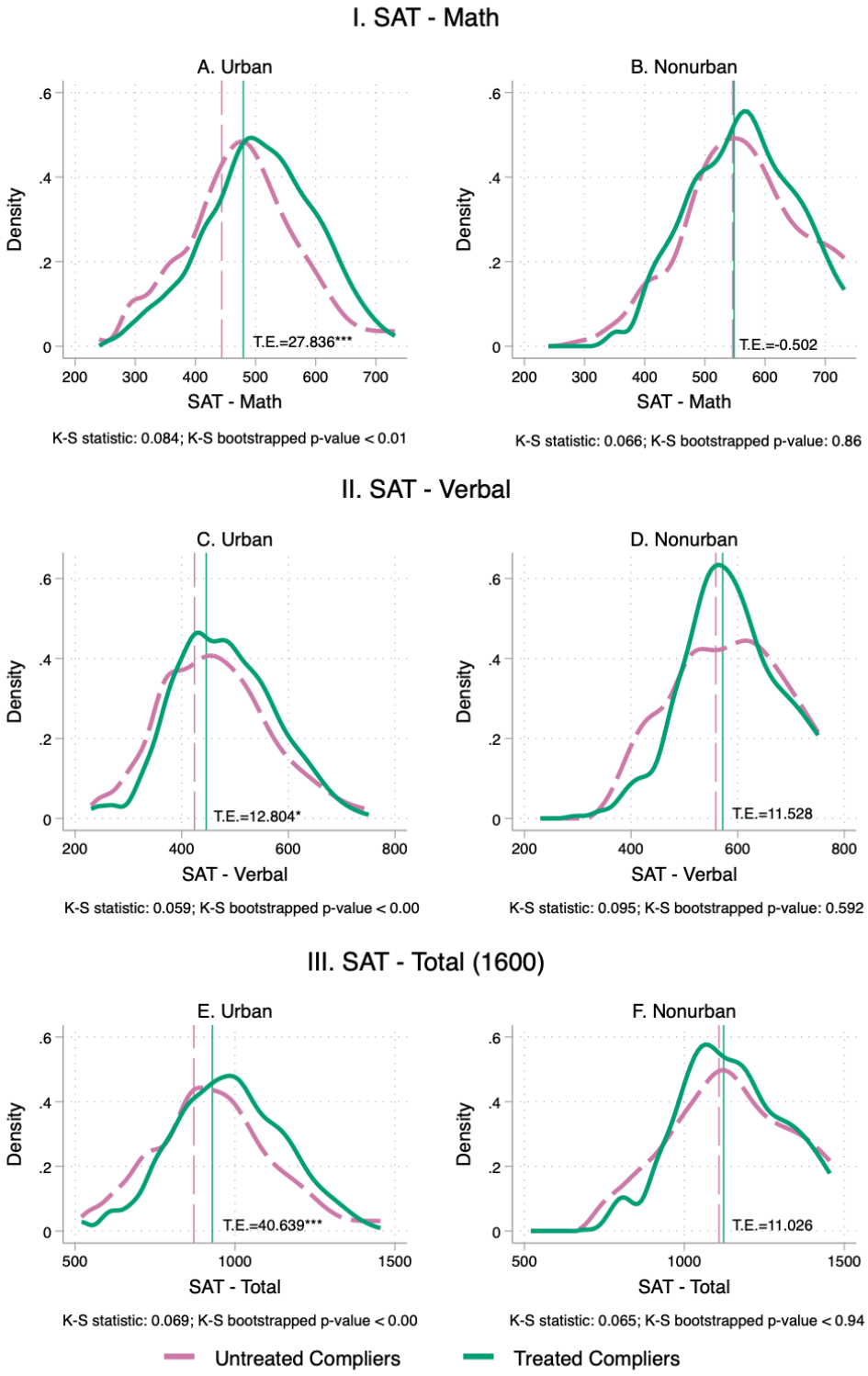
Appendix B: Additional Results

Figure B.1: Test Score Distributions for Treated and Untreated Compliers



Notes: This figure shows the distribution of test scores for treated and untreated compliers, for MCAS Math and ELA two years after the lottery.

Figure B.2: SAT Score Distributions for Treated and Untreated Compliers



Notes: This figure shows the distribution of SAT scores among takers in math and verbal (each out of 800) and the total score (out of 1600). Vertical dashed lines indicate control complier means and solid lines indicate treated complier means. Kolmogorov-Smirnov statistics are maximum differences in complier CDFs and p-values are bootstrapped.

Table B.1: The Impact of Charter School Attendance on Advanced Placement (AP)

	Urban			Nonurban		
	2SLS (1)	CCM (2)	N (3)	2SLS (4)	CCM (5)	N (6)
(A) Advanced Placement (AP)						
Offered AP	0.017	0.750	4,584	-0.542***	0.885	1,028
	(0.022)			(0.058)		
Number of APs offered	-0.713*	4.361	4,584	-3.759***	5.390	1,028
	(0.331)			(0.649)		
(B) AP by subject						
Offered AP Calculus	0.145***	0.494	4,584	-0.426***	0.650	1,028
	(0.031)			(0.071)		
Offered AP English	-0.149***	0.569	4,584	-0.469***	0.720	1,028
	(0.030)			(0.067)		
Offered AP History	0.033	0.402	4,584	-0.364***	0.565	1,028
	(0.031)			(0.068)		
Offered AP Science	-0.014	0.400	4,584	-0.392***	0.452	1,028
	(0.032)			(0.068)		
(C) Conditional AP scores						
Score 2+ on any AP	0.052	0.610	3,917	-0.065	0.938	867
	(0.034)			(0.045)		
Score 3+ on any AP	0.012	0.376	3,917	0.019	0.724	867
	(0.034)			(0.065)		
Score 4+ on any AP	-0.039	0.223	3,917	0.018	0.519	867
	(0.028)			(0.078)		
Score 5 on any AP	-0.019	0.088	3,917	-0.072	0.362	867
	(0.018)			(0.075)		

Notes: Each coefficient labeled 2SLS is the instrumental variables estimate of attending an urban or nonurban charter at any period of time before the outcome listed in the row heading occurred. Indicator variables for a lottery offer on the day of the lottery (initial offer) and lottery offer off of the waitlist (waitlist offer), separately for urban and nonurban charters, are the instruments for charter attendance. The control complier mean is listed in the column labeled CCM. All regressions control for lottery risk sets and a vector of demographic characteristics including indicators for race, gender, birth year, calendar year, and baseline special education, English learner, and free or reduced price lunch status. The sample is restricted to students enrolled in Massachusetts schools at the time of application in the projected high school classes of 2006 to 2018, who attend a Massachusetts public school in 9th grade. Robust standard errors in parentheses (+ p<0.10 * p<0.05 ** p<0.01 ***p<0.001). AP outcomes are available for the class of 2007 and later. In the second panel, AP offers are defined based on whether students' 9th grade school offered an AP class. In the third panel, AP scores are conditional on having taken at least one AP.

Table B.2: The Impact of Charter School Attendance on High School Progression

	Urban			Nonurban		
	2SLS (1)	CCM (2)	N (3)	2SLS (4)	CCM (5)	N (6)
(A) On-time grade progression						
10th grade	-0.027	0.851	12,185	0.007	0.957	3,026
	(0.018)			(0.016)		
11th grade	-0.061**	0.808	12,185	0.012	0.927	3,026
	(0.020)			(0.021)		
12th grade	-0.037+	0.784	12,185	-0.021	0.918	3,026
	(0.021)			(0.023)		
Repeat any grade	-0.002	0.057	8,658	0.009	0.003	2,610
	(0.014)			(0.007)		
(B) High school graduation						
Graduate high school (4 years)	-0.067**	0.655	12,185	-0.016	0.814	3,026
	(0.023)			(0.026)		
Graduate high school (5 years)	-0.019	0.734	12,185	-0.007	0.899	3,026
	(0.022)			(0.024)		
Graduate high school (6 years)	-0.011	0.786	12,185	-0.012	0.911	3,026
	(0.021)			(0.023)		
(C) Days attended						
9th grade	0.794	162.633	12,185	1.136	169.728	3,026
	(1.794)			(1.810)		
10th grade	0.513	163.095	11,169	2.477	167.513	2,898
	(1.560)			(1.631)		
11th grade	1.695	157.636	10,311	0.844	167.672	2,802
	(1.736)			(1.671)		
12th grade	2.452	154.675	10,302	-2.329	160.916	2,762
	(1.635)			(1.634)		

Notes: Each coefficient labeled 2SLS is the instrumental variables estimate of attending an urban or nonurban charter at any period of time before the outcome listed in the row heading occurred. Indicator variables for a lottery offer on the day of the lottery (initial offer) and lottery offer off of the waitlist (waitlist offer), separately for urban and nonurban charters, are the instruments for charter attendance. The control complier mean is listed in the column labeled CCM. All regressions control for lottery risk sets and a vector of demographic characteristics including indicators for race, gender, birth year, calendar year, and baseline special education, English learner, and free or reduced price lunch status. The sample is restricted to students enrolled in Massachusetts schools at the time of application in the projected high school classes of 2006 to 2018, who attend a Massachusetts public school in 9th grade. Robust standard errors in parentheses (+ $p<0.10$ * $p<0.05$ ** $p<0.01$ ***$p<0.001$).

Table B.3: The Impact of Charter School Attendance on High School Attendance

	9th Grade (1)	10th Grade (2)	11th Grade (3)	12th Grade (4)	All High School (5)
(A) Days Attended					
Urban	0.794	0.513	1.695	2.452	11.344**
	(1.794)	(1.560)	(1.736)	(1.635)	(3.718)
CCM	162.633	163.095	157.636	154.675	659.002
N	12,185	11,169	10,311	10,302	9,494
Nonurban	1.136	2.477	0.844	-2.329	-1.586
	(1.810)	(1.631)	(1.671)	(1.634)	(3.024)
CCM	169.728	167.513	167.672	160.916	675.763
N	3,026	2,898	2,802	2,762	2,655
(B) Attendance Rate					
Urban	-0.035***	-0.026**	-0.010	-0.002	-0.012*
	(0.010)	(0.008)	(0.009)	(0.009)	(0.005)
CCM	0.895	0.898	0.870	0.854	0.908
N	12,185	11,169	10,311	10,302	9,494
Nonurban	-0.008	0.001	-0.003	-0.017+	-0.012**
	(1.810)	(1.631)	(1.671)	(1.634)	(0.004)
CCM	0.942	0.931	0.932	0.894	0.939
N	3,026	2,898	2,802	2,762	2,655
(C) Present in Data					
Urban	-	-0.010	-0.028	-0.011	-0.015
	-	(0.014)	(0.018)	(0.018)	(0.020)
CCM	-	0.934	0.882	0.866	0.809
N	-	12,185	12,185	12,185	12,185
Nonurban	-	0.010	0.008	-0.009	-0.004
	-	(0.015)	(0.020)	(0.021)	(0.024)
CCM	-	0.960	0.933	0.928	0.906
N	-	3,026	3,026	3,026	3,026

Notes: Each coefficient labeled Urban/Nonurban is the instrumental variables estimate of attending an urban or nonurban charter at any period of time before the outcome listed in the column heading occurred. Indicator variables for a lottery offer on the day of the lottery (initial offer) and lottery offer off of the waitlist (waitlist offer), separately for urban and nonurban charters, are the instruments for charter attendance. The control complier mean is listed in the row labeled CCM. All regressions control for lottery risk sets and a vector of demographic characteristics including indicators for race, gender, birth year, calendar year, and baseline special education, English learner, and free or reduced price lunch status. The sample is restricted to students enrolled in Massachusetts schools at the time of application in the projected high school classes of 2006 to 2018, who attend a Massachusetts public school in 9th grade. Robust standard errors in parentheses (+ p<0.10 * p<0.05 ** p<0.01 ***p<0.001).

Table B.4: The Impact of Charter School Attendance on School Suspensions

	Urban			Nonurban		
	2SLS (1)	CCM (2)	N (3)	2SLS (4)	CCM (5)	N (6)
(A) Total suspensions						
Suspension days	1.264***	2.643	12,185	0.072	0.645	3,026
	(0.354)			(0.257)		
Number of in-school suspensions	0.312***	0.282	12,185	0.073	0.130	3,026
	(0.069)			(0.064)		
Number of out-of-school suspensions	1.280***	1.332	12,185	-0.045	0.308	3,026
	(0.171)			(0.106)		
(B) Ever suspended						
Any suspension	0.151***	0.381	12,185	-0.028	0.182	3,026
	(0.022)			(0.028)		
In-school suspension	0.075***	0.115	12,185	-0.003	0.093	3,026
	(0.015)			(0.021)		
Out-of-school suspension	0.137***	0.347	12,185	-0.020	0.138	3,026
	(0.022)			(0.025)		

Notes: Each coefficient labeled 2SLS is the instrumental variables estimate of the effect of attending an urban or nonurban charter at any period of time before the outcome listed in the row heading occurred. Indicator variables for a lottery offer on the day of the lottery (initial offer) and lottery offer from the waitlist (waitlist offer), separately for urban and nonurban charters, are the instruments for charter attendance. The control complier mean is listed in the column labeled CCM. All regressions control for lottery risk sets and a vector of demographic characteristics including indicators for race, gender, birth year, calendar year, and baseline special education, English learner, and free or reduced price lunch status. The sample is restricted to students enrolled in Massachusetts schools at the time of application in the projected high-school classes of 2006–2018, who attend a Massachusetts public school in 9th grade. Robust standard errors in parentheses (+ $p<0.10$ * $p<0.05$ ** $p<0.01$ ***$p<0.001$). Students are marked as having no suspensions if they are missing from the data.

Table B.5: The Impact of Charter School Attendance on College Enrollment

	Any College		4 Year College		2 Year College		
Year after Projected High School Graduation	2SLS (1)	CCM (2)	2SLS (3)	CCM (4)	2SLS (5)	CCM (6)	N (7)
(A) 1st year							
Urban	0.028	0.509	0.065**	0.380	-0.036*	0.127	12,185
	(0.024)		(0.023)		(0.016)		
Nonurban	0.010	0.672	0.086*	0.533	-0.076**	0.138	3,026
	(0.032)		(0.035)		(0.023)		
(B) 2nd year							
Urban	0.078**	0.487	0.084***	0.352	-0.007	0.134	12,185
	(0.024)		(0.023)		(0.017)		
Nonurban	0.068*	0.685	0.110**	0.552	-0.042+	0.133	3,026
	(0.033)		(0.036)		(0.024)		
(C) 3rd year							
Urban	0.081***	0.428	0.072**	0.322	0.011	0.104	12,185
	(0.024)		(0.022)		(0.015)		
Nonurban	0.101**	0.634	0.117**	0.540	-0.016	0.095	3,026
	(0.035)		(0.036)		(0.021)		
(D) 4th year							
Urban	0.073**	0.392	0.053*	0.305	0.020	0.085	12,185
	(0.023)		(0.022)		(0.014)		
Nonurban	0.113**	0.588	0.124***	0.520	-0.011	0.068	3,026
	(0.036)		(0.036)		(0.018)		
(E) 5th year							
Urban	0.027	0.243	0.031+	0.177	-0.007	0.066	12,185
	(0.021)		(0.019)		(0.012)		
Nonurban	0.023	0.313	0.040	0.266	-0.018	0.047	3,026
	(0.035)		(0.034)		(0.014)		
(F) 6th year							
Urban	0.061**	0.130	0.051**	0.087	0.010	0.043	10,579
	(0.020)		(0.017)		(0.012)		
Nonurban	0.036	0.160	0.047+	0.135	-0.011	0.025	2,863
	(0.030)		(0.028)		(0.011)		

Notes: Each coefficient labeled 2SLS is the instrumental variables estimate of the effect of attending an urban or nonurban charter at any period of time before the outcome listed in the row heading occurred. Indicator variables for a lottery offer on the day of the lottery (initial offer) and lottery offer from the waitlist (waitlist offer), separately for urban and nonurban charters, are the instruments for charter attendance. The control complier mean is listed in the column labeled CCM. All regressions control for lottery risk sets and a vector of demographic characteristics including indicators for race, gender, birth year, calendar year, and baseline special education, English learner, and free or reduced price lunch status. The sample is restricted to students enrolled in Massachusetts schools at the time of application in the projected high-school classes of 2006–2018, who attend a Massachusetts public school in 9th grade. Robust standard errors in parentheses (+ p<0.10 * p<0.05 ** p<0.01 ***p<0.001).

Table B.6: The Impact of Charter School Attendance on College Degrees

	Any Degree		B.A.		A.A.		
Year after Projected High School Graduation	2SLS (1)	CCM (2)	2SLS (3)	CCM (4)	2SLS (5)	CCM (6)	N (7)
(A) 4th year							
Urban	0.036*	0.143	0.030+	0.124	0.009	0.023	12,185
	(0.017)		(0.016)		(0.008)		
Nonurban	0.052	0.380	0.064+	0.323	-0.025	0.075	3,026
	(0.036)		(0.035)		(0.018)		
(B) 5th year							
Urban	0.037+	0.226	0.031	0.202	0.006	0.038	12,185
	(0.020)		(0.019)		(0.010)		
Nonurban	0.092*	0.513	0.105**	0.458	-0.032+	0.087	3,026
	(0.037)		(0.037)		(0.019)		
(C) 6th year							
Urban	0.048*	0.255	0.041+	0.228	0.014	0.042	10,579
	(0.023)		(0.022)		(0.011)		
Nonurban	0.097*	0.548	0.104**	0.502	-0.031	0.094	2,863
	(0.038)		(0.038)		(0.021)		

Notes: Each coefficient labeled 2SLS is the instrumental variables estimate of the effect of attending an urban or nonurban charter at any period of time before the outcome listed in the row heading occurred. Indicator variables for a lottery offer on the day of the lottery (initial offer) and lottery offer from the waitlist (waitlist offer), separately for urban and nonurban charters, are the instruments for charter attendance. The control complier mean is listed in the column labeled CCM. All regressions control for lottery risk sets and a vector of demographic characteristics including indicators for race, gender, birth year, calendar year, and baseline special education, English learner, and free or reduced price lunch status. The sample is restricted to students enrolled in Massachusetts schools at the time of application in the projected high-school classes of 2006–2018, who attend a Massachusetts public school in 9th grade. Robust standard errors in parentheses (+ $p<0.10$ * $p<0.05$ ** $p<0.01$ ***$p<0.001$). Students can obtain both a BA and an AA, so the coefficient for any degree will not be the sum of the BA and AA coefficients.

Table B.7: The Impact of Charter School Attendance on 4-Year College Attendance and Graduation, by Barron's Categories

	Urban			Nonurban		
	2SLS (1)	CCM (2)	N (3)	2SLS (4)	CCM (5)	N (6)
(A) College Enrollment (by Year 2)						
All	0.084***	0.352	12,185	0.110**	0.552	3,026
	(0.023)			(0.036)		
Highly Competitive	0.036*	0.115	12,185	0.103**	0.289	3,026
	(0.016)			(0.035)		
Competitive	0.050**	0.175	12,185	0.015	0.218	3,026
	(0.019)			(0.032)		
Noncompetitive	-0.001	0.061	12,185	-0.008	0.044	3,026
	(0.011)			(0.016)		
(B) BA Receipt (by Year 6)						
All	0.041+	0.228	10,579	0.104**	0.502	2,863
	(0.022)			(0.038)		
Highly Competitive	0.022	0.089	12,185	0.075*	0.271	3,026
	(0.014)			(0.034)		
Competitive	0.029+	0.098	12,185	0.038	0.166	3,026
	(0.015)			(0.030)		
Noncompetitive	-0.005	0.039	12,185	-0.007	0.051	3,026
	(0.009)			(0.016)		
(C) Conditional BA Receipt (by Year 6)						
All	-0.029	0.496	5,237	0.099*	0.711	2,065
	(0.034)			(0.041)		
Highly Competitive	0.008	0.168	6,843	0.083+	0.372	2,228
	(0.023)			(0.042)		
Competitive	0.010	0.194	6,843	0.031	0.235	2,228
	(0.025)			(0.038)		
Noncompetitive	-0.023	0.078	6,843	-0.011	0.068	2,228
	(0.016)			(0.022)		

Notes: Each coefficient labeled 2SLS is the instrumental variables estimate of the effect of attending an urban or nonurban charter at any period of time before the outcome listed in the row heading occurred. Indicator variables for a lottery offer on the day of the lottery (initial offer) and lottery offer from the waitlist (waitlist offer), separately for urban and nonurban charters, are the instruments for charter attendance. The control complier mean is listed in the column labeled CCM. All regressions control for lottery risk sets and a vector of demographic characteristics including indicators for race, gender, birth year, calendar year, and baseline special education, English learner, and free or reduced price lunch status. The sample is restricted to students enrolled in Massachusetts schools at the time of application in the projected high-school classes of 2006–2018, who attend a Massachusetts public school in 9th grade. Robust standard errors in parentheses (+ $p<0.10$ * $p<0.05$ ** $p<0.01$ ***$p<0.001$). includes Barron's categories *highly competitive*, *most competitive*, and *very competitive*; includes the categories *competitive* and *special*; and includes *noncompetitive*, *unranked*, and *less competitive* tconds.

Appendix C: Robustness Checks

Table C.1: The Impact of Charter School Attendance on Tests (Lee Bounds)

	Lower Bound		Upper Bound	
	MCAS Math (1)	MCAS ELA (2)	MCAS Math (3)	MCAS ELA (4)
Urban	0.447***	0.300***	0.495***	0.300***
	(0.042)	(0.041)	(0.042)	(0.041)
CCM	-0.307	-0.341	-0.329	-0.341
N	10,182	10,310	10,177	10,310
Nonurban	-0.205***	-0.187***	-0.087	-0.110*
	(0.061)	(0.053)	(0.060)	(0.051)
CCM	0.425	0.508	0.395	0.495
N	2,854	2,836	2,854	2,835

Notes: The notes to this table are the same as those in Table 3 except as follows. To estimate the lower bound, we progressively exclude the top-scoring lottery winners (initial offer recipients) until an equal response rate is achieved among lottery winners and lottery losers. To estimate the upper bound, we follow the same procedure but drop instead the fraction of lowest-scoring lottery winners. We do this for urban and nonurban applicants, separately. Robust standard errors in parentheses (+ p<0.10 * p<0.05 ** p<0.01 ***p<0.001).

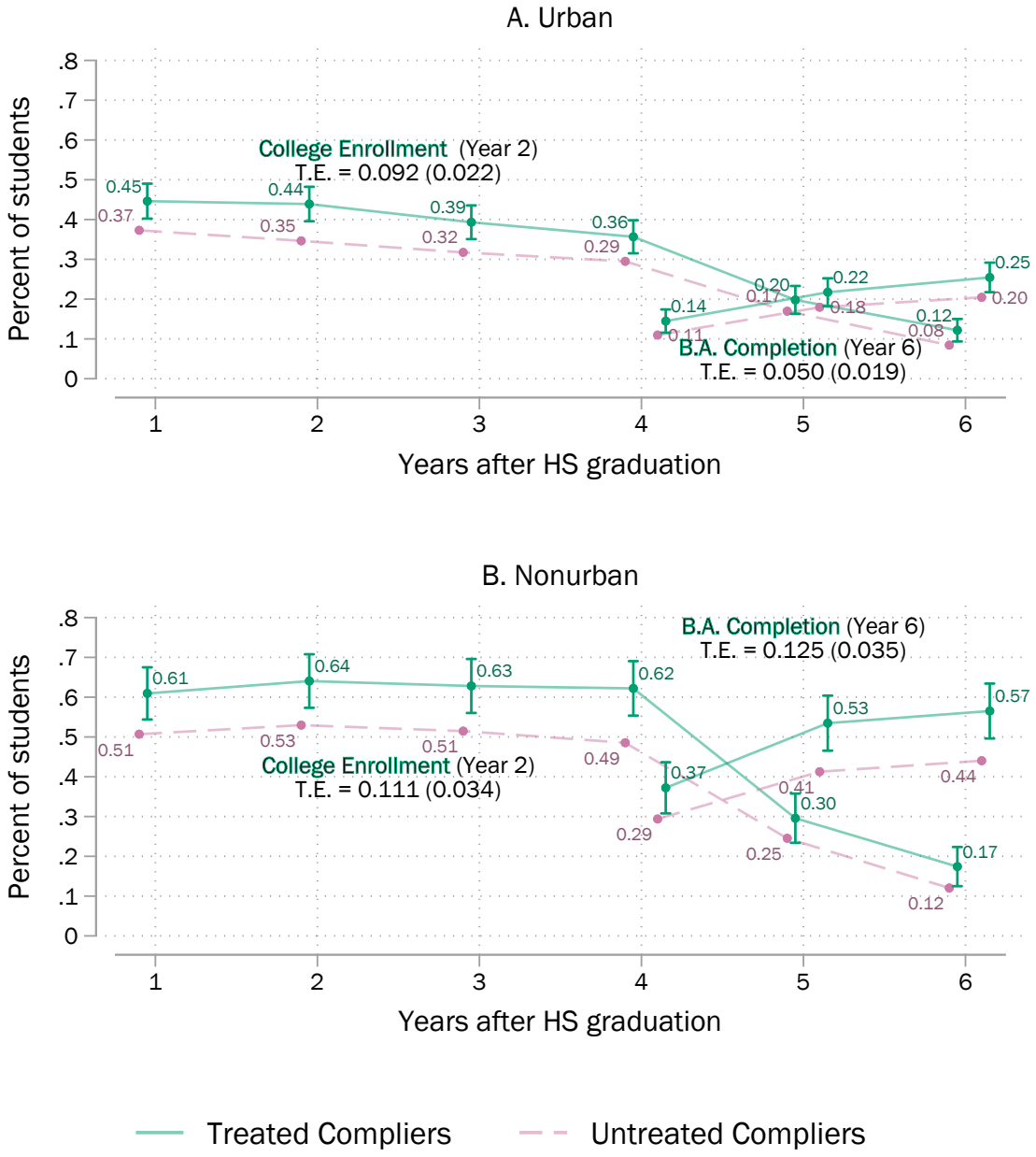
Table C.2: The Impact of Charter School Attendance on Test Scores, College Enrollment and Graduation

	Urban			Nonurban		
	Math MCAS (1)	4-Year College Enrollment (2)	4-Year College Graduation (3)	Math MCAS (4)	4-year College Enrollment (5)	4-year College Graduation (6)
Main Specification	0.464***	0.084***	0.041+	-0.109+	0.110**	0.104**
	(0.042)	(0.023)	(0.022)	(0.060)	(0.036)	(0.038)
N	10,206	12,185	10,579	2,889	3,026	2,863
Initial offer only	0.413***	0.082**	0.033	-0.081	0.117**	0.101*
	(0.054)	(0.031)	(0.030)	(0.077)	(0.045)	(0.048)
N	10,206	12,185	10,579	2,889	3,026	2,863
Baseline test scores	0.464***	0.088***	0.040+	-0.080	0.120**	0.116**
	(0.043)	(0.024)	(0.023)	(0.064)	(0.037)	(0.040)
N	9,493	11,078	9,599	2,458	2,548	2,429
No covariates	0.482***	0.088***	0.043+	-0.083	0.114**	0.110**
	(0.046)	(0.024)	(0.022)	(0.066)	(0.037)	(0.039)
N	10,206	12,185	10,579	2,889	3,026	2,863

Notes: The first row of the table repeats the main specification reported in the other tables, see Tables 3, B.5, and B.6 for details. Four-year college enrollment is enrollment within 2 years of projected high school graduation. Each subsequent panel shows an alternative specification. The panel labeled "Initial offer only" uses only admissions offers on the day of the charter school lottery as an instrument for charter attendance (excluding the waitlist offer). The panel labeled "Baseline test scores" uses only students for which baseline math MCAS scores are available. The panel labeled "No covariates" excludes all demographic variables from the regression.Robust standard errors in parentheses (+ p<0.10 * p<0.05 ** p<0.01 ***p<0.001).

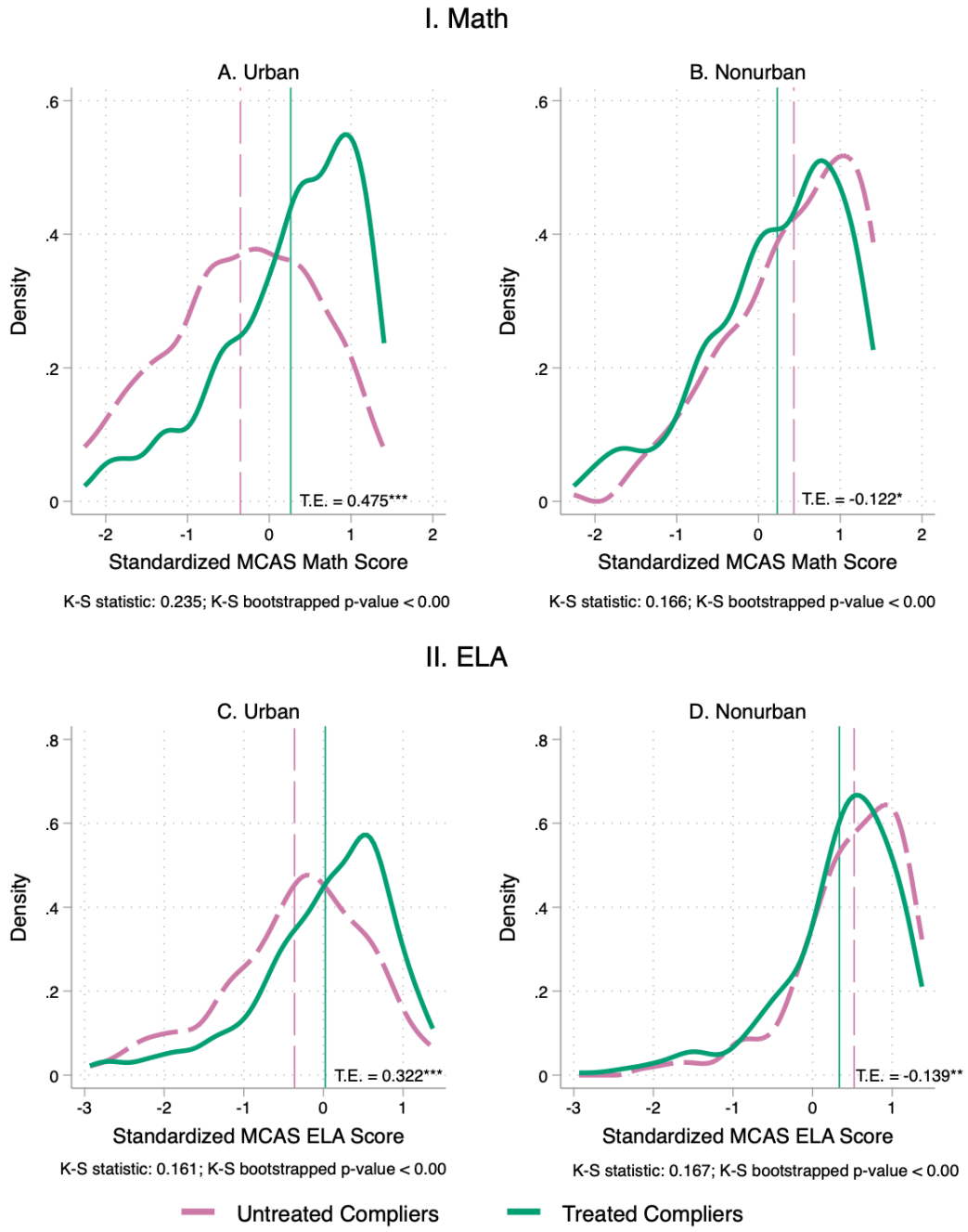
Appendix D: Unconditional Results

Figure D.1: Four-Year College Progression for Treated and Untreated Compliers



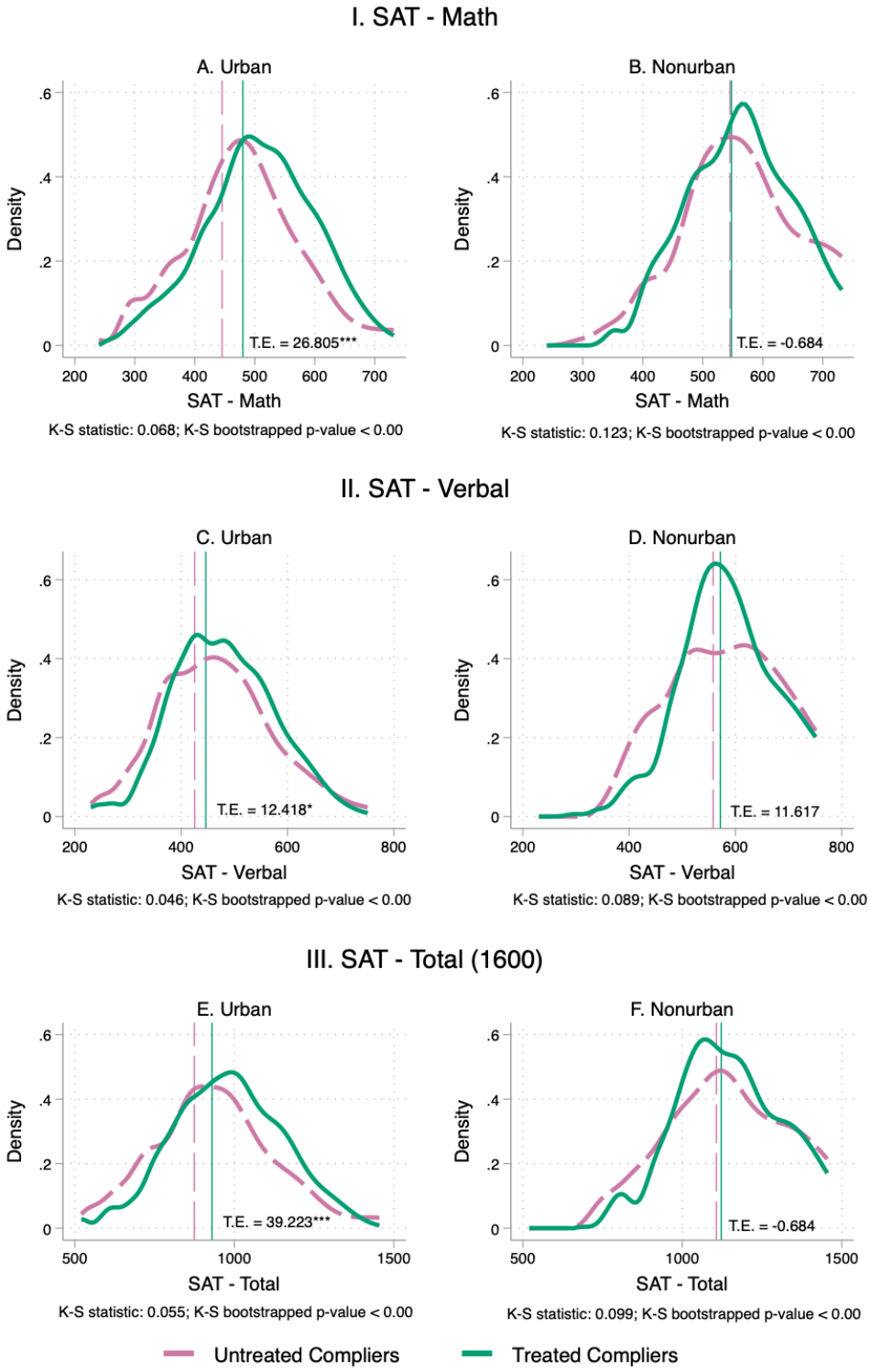
Notes: This figure shows the treatment and control complier means for four-year college enrollment and graduation for treated and untreated compliers. Treatment effects on college enrollment two years after projected high-school graduation and graduation rates six years after projected high-school graduation are reported under the labels.

Figure D.2: Test Score Distributions for Treated and Untreated Compliers



Notes: This figure shows the distribution of test scores for treated and untreated compliers, for MCAS Math and ELA two years after the lottery. Vertical dashed lines indicate control complier means and solid lines indicate treated complier means. Kolmogorov-Smirnov statistics are maximum differences in complier CDFs and p-values are bootstrapped.

Figure D.3: SAT Score Distributions for Treated and Untreated Compliers



Notes: This figure shows the distribution of SAT scores among takers in math and verbal (each out of 800) and the total score (out of 1600). Vertical dashed lines indicate control complier means and solid lines indicate treated complier means. Kolmogorov-Smirnov statistics are maximum differences in complier CDFs and p-values are bootstrapped.

Table D.1: Covariate Balance

	Urban			Nonurban		
	Fraction of Non-Offered With Outcome (1)	Initial Offer Differential (2)	Waitlist Offer Differential (3)	Fraction of Non-Offered With Outcome (4)	Initial Offer Differential (5)	Waitlist Offer Differential (6)
Female	0.516	-0.003	0.008	0.520	-0.002	0.023
		(0.010)	(0.011)		(0.019)	(0.022)
Asian	0.028	0.003	-0.001	0.025	-0.006	0.014+
		(0.003)	(0.003)		(0.007)	(0.008)
Black	0.506	0.002	-0.000	0.025	0.002	0.001
		(0.010)	(0.010)		(0.006)	(0.006)
Latinx	0.280	-0.006	0.010	0.023	0.012*	-0.013*
		(0.009)	(0.009)		(0.006)	(0.006)
Other race	0.044	0.002	-0.007+	0.032	-0.001	-0.008
		(0.004)	(0.004)		(0.006)	(0.006)
White	0.142	-0.001	-0.001	0.896	-0.008	0.006
		(0.006)	(0.006)		(0.011)	(0.013)
Special education	0.196	-0.001	-0.011	0.163	0.001	-0.010
		(0.008)	(0.008)		(0.014)	(0.015)
English learner	0.107	-0.001	0.008	0.007	0.001	-0.004
		(0.006)	(0.007)		(0.003)	(0.003)
Subsidized lunch	0.716	0.008	0.001	0.098	0.001	0.017
		(0.009)	(0.009)		(0.012)	(0.014)
Baseline MCAS ELA	-0.398	-0.012	0.022	0.466	0.005	-0.046
		(0.021)	(0.022)		(0.033)	(0.038)
Baseline MCAS Math	-0.368	-0.010	0.011	0.361	0.008	-0.025
		(0.020)	(0.021)		(0.037)	(0.041)
p-value		0.966	0.778		0.701	0.525

Notes: This table shows student characteristics and test scores, and differentials between offered and nonoffered charter applicants. The sample is restricted to students enrolled in Massachusetts schools at the time of application in the projected high school classes of 2006 to 2018. Columns 1 and 4 show the proportion of non-offered students with a given characteristic. Columns 2, 3, 5, and 6 report coefficients from regressions of the student characteristic on initial and waitlist offer dummies, including controls for risk sets (+ p<0.10 * p<0.05). N (urban) = 15572, N (nonurban) = 4047.

Table D.2: Attrition

	Urban			Nonurban		
	Fraction of Non-Offered With Outcome (1)	Initial Offer Differential (2)	Waitlist Offer Differential (3)	Fraction of Non-Offered With Outcome (4)	Initial Offer Differential (5)	Waitlist Offer Differential (6)
Has ELA score	0.815	0.014+	0.018*	0.852	0.040***	0.001
		(0.008)	(0.008)		(0.012)	(0.014)
Has math score	0.802	0.015+	0.014+	0.864	0.040***	-0.001
		(0.008)	(0.008)		(0.012)	(0.013)
Present in 9th grade in MA	0.862	0.009	-0.001	0.852	0.047***	0.003
		(0.007)	(0.007)		(0.012)	(0.014)
Present in 12th grade in MA	0.755	-0.003	-0.000	0.801	0.026+	0.002
		(0.009)	(0.009)		(0.015)	(0.017)
Sent to NSC	0.945	0.006	0.006	0.939	0.007	0.012
		(0.004)	(0.004)		(0.008)	(0.009)

Notes: This table shows follow-up rates for MCAS scores two years after charter application, presence in the data in 9th or 12th grade, and an indicator for being sent to the NSC to be matched to college outcome data for Boston charter school applicants. The sample is restricted to students enrolled in Massachusetts schools at the time of application in the projected high-school classes of 2006–2018. Columns 1 and 4 show the proportion of non-offered students with a given outcome. Columns 2, 3, 5, and 6 report coefficients from regressions of indicators for follow-up data on initial and waitlist offer dummies, including controls for risk sets (+ p<0.10 * p<0.05 ** p<0.01 ***p<0.001). N (urban) = 14165, N (nonurban) = 3425.

Table D.3: The Impact of Charter School Offers on Charter Attendance

	Non-offered Mean (1)	Initial Offer (2)	Waitlist Offer (3)
(A) Ever attended charter			
Urban	0.118	0.483***	0.342***
		(0.010)	(0.009)
Nonurban	0.212	0.597***	0.407***
		(0.019)	(0.024)
(B) Years attended charter			
Urban	0.816	1.737***	1.331***
		(0.051)	(0.049)
Nonurban	0.857	2.730***	2.003***
		(0.097)	(0.120)

Notes: This table shows the impact of a charter school offer on charter school attendance for the urban and nonurban samples. The sample is restricted to students enrolled in Massachusetts schools at the time of application in the projected high school classes of 2006 to 2018. Column 1 shows the proportion of non-offered students attending a charter school. Columns 2 and 3 report coefficients from regressions of charter attendance on initial and waitlist offer dummies, including controls for demographic characteristics and risk sets. Robust standard errors in parentheses (+ p<0.10 * p<0.05 ** p<0.01 ***p<0.001). N = 19,871.

Table D.4: Sample Characteristics and Outcomes

	Urban				Nonurban			
	Noncharter Public Schools (1)	Lottery Applicants (2)	Offered Charter (3)	Not Offered Charter (4)	Noncharter Public Schools (5)	Lottery Applicants (6)	Offered Charter (7)	Not Offered Charter (8)
(A) Baseline characteristics								
Female	0.482	0.519	0.519	0.518	0.491	0.516	0.513	0.520
Asian	0.076	0.029	0.029	0.030	0.039	0.030	0.033	0.025
Black	0.199	0.521	0.532	0.500	0.046	0.023	0.022	0.025
Latinx	0.316	0.284	0.288	0.277	0.062	0.022	0.022	0.023
Other race	0.028	0.042	0.038	0.048	0.017	0.024	0.020	0.032
White	0.381	0.124	0.113	0.145	0.837	0.901	0.904	0.896
Special education	0.188	0.195	0.195	0.194	0.177	0.156	0.152	0.163
English learner	0.179	0.114	0.116	0.110	0.028	0.006	0.006	0.007
Free/reduced price lunch	0.644	0.737	0.748	0.715	0.198	0.109	0.114	0.098
Baseline MCAS ELA	-0.432	-0.414	-0.428	-0.388	0.155	0.444	0.433	0.466
Baseline MCAS Math	-0.426	-0.363	-0.366	-0.356	0.153	0.363	0.364	0.361
(B) Charter school enrollment								
Attend any charter in grades 5-12	0.058	0.428	0.516	0.260	0.052	0.568	0.706	0.291
(C) Academic outcomes								
MCAS Math	-0.360	-0.199	-0.137	-0.313	0.174	0.314	0.303	0.337
MCAS ELA	-0.392	-0.285	-0.245	-0.355	0.189	0.382	0.362	0.426
Took any AP	0.240	0.296	0.302	0.283	0.333	0.259	0.222	0.334
Score 3+ on any AP	0.132	0.106	0.105	0.108	0.253	0.211	0.183	0.267
Took SAT	0.455	0.510	0.506	0.517	0.634	0.666	0.674	0.651
SAT score (1600) (for takers)	94.865	900.001	898.068	903.506	107.148	1129.566	1133.172	1122.008
Graduate high school (4 years)	0.609	0.553	0.540	0.576	0.827	0.740	0.753	0.712
Graduate high school (5 years)	0.656	0.631	0.623	0.645	0.850	0.795	0.802	0.782
Enroll in any college	0.501	0.574	0.580	0.562	0.699	0.764	0.771	0.747
Enroll in 4-year college	0.315	0.427	0.435	0.411	0.563	0.640	0.651	0.619
Enroll in 2-year college	0.219	0.190	0.190	0.190	0.177	0.174	0.170	0.181
Complete any degree	0.256	0.239	0.240	0.238	0.492	0.536	0.546	0.518
Complete BA	0.214	0.206	0.205	0.208	0.449	0.492	0.505	0.467
Complete AA	0.059	0.048	0.050	0.044	0.066	0.068	0.061	0.081
N	275,568	14,409	9,447	4,962	642,847	3,425	2,293	1,132

Notes: This table shows demographic characteristics and outcome means, for various samples. The sample in Column 1 is restricted to students who attended schools in the state of Massachusetts in 9th grade in the projected high-school classes of 2006–2018. The sample in Column 2 is restricted to charter school applicants enrolled in schools in the state of Massachusets at the time of application in the projected high-school classes of 2006–2018. The samples in Columns 3 and 4 are further restricted to those offered and not offered a seat at a charter in the lottery, respectively.

Table D.5: Impact of Charter School Attendance on Tests

	Urban			Nonurban		
	2SLS (1)	CCM (2)	N (3)	2SLS (4)	CCM (5)	N (6)
(A) MCAS (2 years after lottery)						
Math	0.475***	-0.299	10,891	-0.122*	0.371	3,054
	(0.040)			(0.059)		
ELA	0.322***	-0.333	11,011	-0.139**	0.476	3,018
	(0.038)			(0.051)		
(B) Advanced Placement						
Took any AP	0.126***	0.282	13,499	-0.232***	0.430	3,425
	(0.021)			(0.032)		
Number of APs	0.352***	0.723	13,499	-0.943***	1.592	3,425
	(0.065)			(0.142)		
Score 2+ on any AP	0.091***	0.179	13,499	-0.238***	0.408	3,425
	(0.018)			(0.031)		
Score 3+ on any AP	0.042**	0.112	13,499	-0.187***	0.330	3,425
	(0.014)			(0.029)		
Score 4+ on any AP	0.007	0.066	13,499	-0.133***	0.236	3,425
	(0.011)			(0.027)		
Score 5 on any AP	-0.000	0.027	13,499	-0.099***	0.155	3,425
	(0.007)			(0.021)		
(C) SAT						
Took SAT	0.018	0.531	13,499	0.066*	0.658	3,425
	(0.023)			(0.033)		
SAT score (1600) (for takers)	39.223***	893.198	7,083	10.933	1122.451	2,282
	(9.473)			(15.326)		
(D) High-school graduation						
Graduate high school (4 years)	-0.053*	0.594	14,165	0.047	0.721	3,425
	(0.023)			(0.030)		
Graduate high school (5 years)	-0.011	0.668	14,165	0.056+	0.798	3,425
	(0.023)			(0.029)		
Graduate high school (6 years)	-0.005	0.717	14,165	0.051+	0.809	3,425
	(0.022)			(0.028)		

Notes: Each coefficient labeled "2SLS" is the instrumental variables estimate of the effect of attending an urban or nonurban charter at any period of time before the outcome listed in the row heading occurred. Indicator variables for a lottery offer on the day of the lottery (initial offer) and lottery offer from the waitlist (waitlist offer), separately for urban and nonurban charters, are the instruments for charter attendance. The control complier mean is listed in the column labeled "CCM". All regressions control for lottery risk sets and a vector of demographic characteristics including indicators for race, gender, birth year, calendar year, and baseline special education, English learner, and free or reduced price lunch status. The sample is restricted to students enrolled in Massachusetts schools at the time of application in the projected high school classes of 2006–2018. Robust standard errors in parentheses (+ p<0.10 * p<0.05 ** p<0.01 ***p<0.001). MCAS scores exclude middle-school scores from 2015 and 2016, when districts could select the MCAS or PARCC exam. AP and SAT outcomes are available for the class of 2007 and later.

Table D.6: The Impact of Charter School Attendance on Advanced Placement (AP)

	Urban			Nonurban		
	2SLS (1)	CCM (2)	N (3)	2SLS (4)	CCM (5)	N (6)
(A) Advanced Placement (AP)						
Offered AP	0.037	0.582	6,564	-0.411***	0.672	1,427
	(0.025)			(0.066)		
Number of APs offered	-0.517+	3.419	6,564	-2.753***	3.964	1,427
	(0.294)			(0.599)		
(B) AP by subject						
Offered AP Calculus	0.133***	0.386	6,564	-0.309***	0.481	1,427
	(0.028)			(0.068)		
Offered AP English	-0.105***	0.441	6,564	-0.346***	0.536	1,427
	(0.028)			(0.067)		
Offered AP History	0.031	0.316	6,564	-0.277***	0.427	1,427
	(0.027)			(0.065)		
Offered AP Science	-0.005	0.314	6,564	-0.277***	0.325	1,427
	(0.028)			(0.063)		
(C) Conditional AP scores						
Score 2+ on any AP	0.042	0.622	3,984	-0.073	0.944	888
	(0.034)			(0.045)		
Score 3+ on any AP	0.003	0.385	3,984	0.010	0.736	888
	(0.034)			(0.065)		
Score 4+ on any AP	-0.038	0.224	3,984	0.010	0.534	888
	(0.028)			(0.078)		
Score 5 on any AP	-0.020	0.088	3,984	-0.074	0.368	888
	(0.018)			(0.075)		

Notes: Each coefficient labeled 2SLS is the instrumental variables estimate of attending an urban or nonurban charter at any period of time before the outcome listed in the row heading occurred. Indicator variables for a lottery offer on the day of the lottery (initial offer) and lottery offer off of the waitlist (waitlist offer), separately for urban and nonurban charters, are the instruments for charter attendance. The control complier mean is listed in the column labeled CCM. All regressions control for lottery risk sets and a vector of demographic characteristics including indicators for race, gender, birth year, calendar year, and baseline special education, English learner, and free or reduced price lunch status. The sample is restricted to students enrolled in Massachusetts schools at the time of application in the projected high school classes of 2006 to 2018. Robust standard errors in parentheses (+ $p<0.10$ * $p<0.05$ ** $p<0.01$ ***$p<0.001$). AP outcomes are available for the class of 2007 and later. In the second panel, AP offers are defined based on whether students' 9th grade school offered an AP class. In the third panel, AP scores are conditional on having taken at least one AP.

Table D.7: The Impact of Charter School Attendance on High School Progression

	Urban			Nonurban		
	2SLS (1)	CCM (2)	N (3)	2SLS (4)	CCM (5)	N (6)
(A) On-time grade progression						
10th grade	-0.014	0.767	14,165	0.080**	0.842	3,425
	(0.021)			(0.025)		
11th grade	-0.051*	0.737	14,165	0.078**	0.820	3,425
	(0.022)			(0.027)		
12th grade	-0.033	0.721	14,165	0.044	0.817	3,425
	(0.022)			(0.028)		
Repeat any grade	-0.002	0.057	8,658	0.009	0.003	2,610
	(0.014)			(0.007)		
(B) High school graduation						
Graduate high school (4 years)	-0.053*	0.594	14,165	0.047	0.721	3,425
	(0.023)			(0.030)		
Graduate high school (5 years)	-0.011	0.668	14,165	0.056+	0.798	3,425
	(0.023)			(0.029)		
Graduate high school (6 years)	-0.005	0.717	14,165	0.051+	0.809	3,425
	(0.022)			(0.028)		
(C) Days attended						
9th grade	0.794	162.633	12,185	1.136	169.728	3,026
	(1.794)			(1.810)		
10th grade	1.075	162.078	11,407	2.809+	167.257	2,950
	(1.600)			(1.639)		
11th grade	1.891	156.881	10,604	0.986	167.432	2,866
	(1.774)			(1.701)		
12th grade	3.712*	153.187	10,615	-2.056	160.640	2,825
	(1.660)			(1.624)		

Notes: Each coefficient labeled 2SLS is the instrumental variables estimate of attending an urban or nonurban charter at any period of time before the outcome listed in the row heading occurred. Indicator variables for a lottery offer on the day of the lottery (initial offer) and lottery offer off of the waitlist (waitlist offer), separately for urban and nonurban charters, are the instruments for charter attendance. The control complier mean is listed in the column labeled CCM. All regressions control for lottery risk sets and a vector of demographic characteristics including indicators for race, gender, birth year, calendar year, and baseline special education, English learner, and free or reduced price lunch status. The sample is restricted to students enrolled in Massachusetts schools at the time of application in the projected high school classes of 2006 to 2018. Robust standard errors in parentheses (+ p<0.10 * p<0.05 ** p<0.01 ***p<0.001).

Table D.8: The Impact of Charter School Attendance on High School Attendance

	9th Grade (1)	10th Grade (2)	11th Grade (3)	12th Grade (4)	All High School (5)
(A) Days Attended					
Urban	0.794	1.075	1.891	3.712*	11.344**
	(1.794)	(1.600)	(1.774)	(1.660)	(3.718)
CCM	162.633	162.078	156.881	153.187	659.002
N	12,185	11,407	10,604	10,615	9,494
Nonurban	1.136	2.809+	0.986	-2.056	-1.586
	(1.810)	(1.639)	(1.701)	(1.624)	(3.024)
CCM	169.728	167.257	167.432	160.640	675.763
N	3,026	2,950	2,866	2,825	2,655
(B) Attendance Rate					
Urban	-0.035***	-0.022**	-0.009	0.005	-0.012*
	(0.010)	(0.009)	(0.010)	(0.009)	(0.005)
CCM	0.895	0.892	0.866	0.846	0.908
N	12,185	11,407	10,604	10,615	9,494
Nonurban	-0.008	0.003	-0.002	-0.015+	-0.012**
	(1.810)	(1.639)	(1.701)	(1.624)	(0.004)
CCM	0.942	0.929	0.930	0.893	0.939
N	3,026	2,950	2,866	2,825	2,655
(C) Present in Data					
Urban	0.022	0.002	-0.020	-0.008	0.003
	(0.016)	(0.019)	(0.020)	(0.020)	(0.022)
CCM	0.877	0.840	0.803	0.794	0.712
N	14,165	14,165	14,165	14,165	14,165
Nonurban	0.092***	0.083***	0.075**	0.055*	0.086**
	(0.021)	(0.024)	(0.026)	(0.027)	(0.029)
CCM	0.863	0.846	0.826	0.826	0.781
N	3,425	3,425	3,425	3,425	3,425

Notes: Each coefficient labeled Urban/Nonurban is the instrumental variables estimate of attending an urban or nonurban charter at any period of time before the outcome listed in the column heading occurred. Indicator variables for a lottery offer on the day of the lottery (initial offer) and lottery offer off of the waitlist (waitlist offer), separately for urban and nonurban charters, are the instruments for charter attendance. The control complier mean is listed in the row labeled CCM. All regressions control for lottery risk sets and a vector of demographic characteristics including indicators for race, gender, birth year, calendar year, and baseline special education, English learner, and free or reduced price lunch status. The sample is restricted to students enrolled in Massachusetts schools at the time of application in the projected high school classes of 2006 to 2018. Robust standard errors in parentheses (+ p<0.10 * p<0.05 ** p<0.01 ***p<0.001).

Table D.9: The Impact of Charter School Attendance on School Suspensions

	Urban			Nonurban		
	2SLS (1)	CCM (2)	N (3)	2SLS (4)	CCM (5)	N (6)
(A) Total suspensions						
Suspension days	1.194***	2.525	14,165	0.115	0.579	3,425
	(0.324)			(0.239)		
Number of in-school suspensions	0.297***	0.270	14,165	0.079	0.109	3,425
	(0.063)			(0.058)		
Number of out-of-school suspensions	1.202***	1.311	14,165	-0.029	0.283	3,425
	(0.160)			(0.096)		
(B) Ever suspended						
Any suspension	0.156***	0.368	14,165	-0.014	0.164	3,425
	(0.021)			(0.026)		
In-school suspension	0.073***	0.110	14,165	0.004	0.081	3,425
	(0.014)			(0.020)		
Out-of-school suspension	0.140***	0.337	14,165	-0.010	0.126	3,425
	(0.021)			(0.023)		

Notes: Each coefficient labeled 2SLS is the instrumental variables estimate of the effect of attending an urban or nonurban charter at any period of time before the outcome listed in the row heading occurred. Indicator variables for a lottery offer on the day of the lottery (initial offer) and lottery offer from the waitlist (waitlist offer), separately for urban and nonurban charters, are the instruments for charter attendance. The control complier mean is listed in the column labeled CCM. All regressions control for lottery risk sets and a vector of demographic characteristics including indicators for race, gender, birth year, calendar year, and baseline special education, English learner, and free or reduced price lunch status. The sample is restricted to students enrolled in Massachusetts schools at the time of application in the projected high-school classes of 2006–2018. Robust standard errors in parentheses (+ $p<0.10$ * $p<0.05$ ** $p<0.01$ ***$p<0.001$). Students are marked as having no suspensions if they are missing from the data.

Table D.10: The Impact of Charter School Attendance on College Enrollment

	Any College		4 Year College		2 Year College		
Year after Projected High School Graduation	2SLS (1)	CCM (2)	2SLS (3)	CCM (4)	2SLS (5)	CCM (6)	N (7)
(A) 1st year							
Urban	0.039+	0.495	0.073**	0.373	-0.034*	0.121	14,165
	(0.023)		(0.022)		(0.015)		
Nonurban	0.036	0.634	0.102**	0.507	-0.066**	0.127	3,425
	(0.032)		(0.033)		(0.021)		
(B) 2nd year							
Urban	0.093***	0.470	0.092***	0.346	0.001	0.123	14,165
	(0.023)		(0.022)		(0.016)		
Nonurban	0.080*	0.652	0.111**	0.530	-0.030	0.122	3,425
	(0.033)		(0.034)		(0.022)		
(C) 3rd year							
Urban	0.088***	0.415	0.076***	0.317	0.014	0.096	14,165
	(0.023)		(0.022)		(0.015)		
Nonurban	0.110**	0.598	0.113**	0.515	-0.003	0.083	3,425
	(0.034)		(0.035)		(0.019)		
(D) 4th year							
Urban	0.079***	0.377	0.062**	0.295	0.017	0.081	14,165
	(0.023)		(0.021)		(0.013)		
Nonurban	0.135***	0.544	0.137***	0.485	-0.002	0.058	3,425
	(0.035)		(0.035)		(0.016)		
(E) 5th year							
Urban	0.023	0.231	0.028	0.170	-0.007	0.062	14,165
	(0.020)		(0.018)		(0.011)		
Nonurban	0.040	0.285	0.051	0.245	-0.011	0.041	3,425
	(0.033)		(0.032)		(0.013)		
(F) 6th year							
Urban	0.053**	0.124	0.045**	0.083	0.008	0.041	12,291
	(0.018)		(0.016)		(0.011)		
Nonurban	0.054+	0.139	0.061*	0.117	-0.009	0.023	3,232
	(0.028)		(0.026)		(0.010)		

Notes: Each coefficient labeled 2SLS is the instrumental variables estimate of the effect of attending an urban or nonurban charter at any period of time before the outcome listed in the row heading occurred. Indicator variables for a lottery offer on the day of the lottery (initial offer) and lottery offer from the waitlist (waitlist offer), separately for urban and nonurban charters, are the instruments for charter attendance. The control complier mean is listed in the column labeled CCM. All regressions control for lottery risk sets and a vector of demographic characteristics including indicators for race, gender, birth year, calendar year, and baseline special education, English learner, and free or reduced price lunch status. The sample is restricted to students enrolled in Massachusetts schools at the time of application in the projected high-school classes of 2006–2018. Robust standard errors in parentheses (+ $p<0.10$ * $p<0.05$ ** $p<0.01$ ***$p<0.001$).

Table D.11: The Impact of Charter School Attendance on College Degrees

	Any Degree		B.A.		A.A.		
Year after Projected High School Graduation	2SLS (1)	CCM (2)	2SLS (3)	CCM (4)	2SLS (5)	CCM (6)	N (7)
(A) 4th year							
Urban	0.041*	0.126	0.035*	0.110	0.009	0.021	14,165
	(0.016)		(0.015)		(0.008)		
Nonurban	0.067*	0.347	0.078*	0.294	-0.023	0.071	3,425
	(0.034)		(0.033)		(0.016)		
(B) 5th year							
Urban	0.044*	0.201	0.038*	0.180	0.004	0.035	14,165
	(0.019)		(0.018)		(0.009)		
Nonurban	0.113**	0.462	0.122***	0.413	-0.027	0.081	3,425
	(0.036)		(0.035)		(0.018)		
(C) 6th year							
Urban	0.052*	0.230	0.046*	0.206	0.010	0.039	12,291
	(0.021)		(0.020)		(0.011)		
Nonurban	0.127***	0.493	0.129***	0.451	-0.025	0.087	3,232
	(0.037)		(0.037)		(0.019)		

Notes: Each coefficient labeled 2SLS is the instrumental variables estimate of the effect of attending an urban or nonurban charter at any period of time before the outcome listed in the row heading occurred. Indicator variables for a lottery offer on the day of the lottery (initial offer) and lottery offer from the waitlist (waitlist offer), separately for urban and nonurban charters, are the instruments for charter attendance. The control complier mean is listed in the column labeled CCM. All regressions control for lottery risk sets and a vector of demographic characteristics including indicators for race, gender, birth year, calendar year, and baseline special education, English learner, and free or reduced price lunch status. The sample is restricted to students enrolled in Massachusetts schools at the time of application in the projected high-school classes of 2006–2018. Robust standard errors in parentheses (+ $p<0.10$ * $p<0.05$ ** $p<0.01$ ***$p<0.001$). Students can obtain both a BA and an AA, so the coefficient for any degree will not be the sum of the BA and AA coefficients.

Table D.12: The Impact of Charter School Attendance on 4-Year College Attendance and Graduation, by Barron's Categories

	Urban			Nonurban		
	2SLS (1)	CCM (2)	N (3)	2SLS (4)	CCM (5)	N (6)
(A) College Enrollment (by Year 2)						
All	0.092***	0.346	14,165	0.111**	0.530	3,425
	(0.022)			(0.034)		
Highly Competitive	0.041**	0.112	14,165	0.073*	0.300	3,425
	(0.015)			(0.033)		
Competitive	0.049**	0.175	14,165	0.036	0.194	3,425
	(0.018)			(0.030)		
Noncompetitive	0.003	0.059	14,165	0.002	0.035	3,425
	(0.011)			(0.015)		
(B) BA Receipt (by Year 6)						
All	0.046*	0.206	12,291	0.129***	0.451	3,232
	(0.020)			(0.037)		
Highly Competitive	0.024+	0.080	14,165	0.071*	0.250	3,425
	(0.013)			(0.032)		
Competitive	0.029*	0.087	14,165	0.057*	0.142	3,425
	(0.014)			(0.027)		
Noncompetitive	-0.002	0.037	14,165	-0.004	0.047	3,425
	(0.009)			(0.015)		
(C) Conditional BA Receipt (by Year 6)						
All	-0.015	0.456	5,926	0.123**	0.667	2,238
	(0.033)			(0.041)		
Highly Competitive	0.012	0.153	7,800	0.074+	0.357	2,431
	(0.021)			(0.041)		
Competitive	0.012	0.175	7,800	0.053	0.211	2,431
	(0.023)			(0.036)		
Noncompetitive	-0.020	0.075	7,800	-0.010	0.065	2,431
	(0.014)			(0.020)		

Notes: Each coefficient labeled 2SLS is the instrumental variables estimate of the effect of attending an urban or nonurban charter at any period of time before the outcome listed in the row heading occurred. Indicator variables for a lottery offer on the day of the lottery (initial offer) and lottery offer from the waitlist (waitlist offer), separately for urban and nonurban charters, are the instruments for charter attendance. The control complier mean is listed in the column labeled CCM. All regressions control for lottery risk sets and a vector of demographic characteristics including indicators for race, gender, birth year, calendar year, and baseline special education, English learner, and free or reduced price lunch status. The sample is restricted to students enrolled in Massachusetts schools at the time of application in the projected high-school classes of 2006–2018. Robust standard errors in parentheses (+ p<0.10 * p<0.05 ** p<0.01 ***p<0.001). includes Barron's categories *highly competitive*, *most competitive*, and *very competitive*; includes the categories *competitive* and *special*; and includes *noncompetitive*, *unranked*, and *less competitive* tunconds.

Table D.13: The Impact of Charter School Attendance on Tests (Lee Bounds)

	Lower Bound		Upper Bound	
	MCAS Math (1)	MCAS ELA (2)	MCAS Math (3)	MCAS ELA (4)
Urban	0.427***	0.307***	0.556***	0.355***
	(0.039)	(0.039)	(0.039)	(0.038)
CCM	-0.285	-0.331	-0.331	-0.350
N	10,806	10,987	10,793	10,990
Nonurban	-0.335***	-0.291***	0.072	0.035
	(0.059)	(0.052)	(0.057)	(0.046)
CCM	0.469	0.538	0.399	0.506
N	2,924	2,908	2,929	2,907

Notes: The notes to this table are the same as those in Table D.5 except as follows. To estimate the lower bound, we progressively exclude the top-scoring lottery winners (initial offer recipients) until an equal response rate is achieved among lottery winners and lottery losers. To estimate the upper bound, we follow the same procedure but drop instead the fraction of lowest-scoring lottery winners. We do this for urban and nonurban applicants, separately. Robust standard errors in parentheses (+ p<0.10 * p<0.05 ** p<0.01 ***p<0.001).

Table D.14: The Impact of Charter School Attendance on College Attendance and Graduation (Lee Bounds)

	Lower Bound		Upper Bound	
	College Attendance (1)	College Graduation (2)	College Attendance (3)	College Graduation (4)
Urban	0.038	0.041*	0.083***	0.044*
	(0.023)	(0.021)	(0.023)	(0.021)
CCM	0.515	0.217	0.493	0.215
N	13,287	11,731	13,461	11,702
Nonurban	0.037	0.109**	0.070*	0.118**
	(0.034)	(0.037)	(0.033)	(0.038)
CCM	0.700	0.481	0.697	0.479
N	3,191	3,086	3,249	3,073

Notes: The notes to this table are the same as those in Table D.11 except as follows. To estimate the lower bound, we progressively exclude the top-scoring lottery winners (initial offer recipients) until an equal response rate is achieved among lottery winners and lottery losers. To estimate the upper bound, we follow the same procedure but drop instead the fraction of lowest-scoring lottery winners. We do this for urban and nonurban applicants, separately. Robust standard errors in parentheses (+ p<0.10 * p<0.05 ** p<0.01 ***p<0.001).

Table D.15: The Impact of Charter School Attendance on Test Scores, College Enrollment and Graduation

	Urban			Nonurban		
	Math MCAS (1)	4-Year College Enrollment (2)	4-Year College Graduation (3)	Math MCAS (4)	4-year College Enrollment (5)	4-year College Graduation (6)
Main Specification	0.475***	0.092***	0.046*	-0.122*	0.111**	0.129***
	(0.040)	(0.022)	(0.020)	(0.059)	(0.034)	(0.037)
N	10,891	14,165	12,291	3,054	3,425	3,232
Initial offer only	0.428***	0.074*	0.039	-0.095	0.105*	0.113*
	(0.052)	(0.030)	(0.028)	(0.075)	(0.043)	(0.046)
N	10,891	14,165	12,291	3,054	3,425	3,232
Baseline test scores	0.482***	0.088***	0.043*	-0.096	0.120***	0.140***
	(0.040)	(0.023)	(0.021)	(0.062)	(0.036)	(0.038)
N	10,104	12,604	10,914	2,568	2,798	2,662
No covariates	0.499***	0.096***	0.048*	-0.102	0.111**	0.132***
	(0.043)	(0.023)	(0.021)	(0.065)	(0.035)	(0.037)
N	10,891	14,165	12,291	3,054	3,425	3,232

Notes: The first row of the table repeats the main specification reported in the other tables, see Tables D.5, D.10, and D.11 for details. Four-year college enrollment is enrollment within 2 years of projected high school graduation. Each subsequent panel shows an alternative specification. The panel labeled "Initial offer only" uses only admissions offers on the day of the charter school lottery as an instrument for charter attendance (excluding the waitlist offer). The panel labeled "Baseline test scores" uses only students for which baseline math MCAS scores are available. The panel labeled "No covariates" excludes all demographic variables from the regression.Robust standard errors in parentheses (+ p<0.10 * p<0.05 ** p<0.01 ***p<0.001).