The Impact of Ohio Charter Schools on Student Outcomes, 2016–19

By Stéphane Lavertu

October 2020

THOMAS B. FORDHAM INSTITUTE
ADVANCING EDUCATIONAL EXCELLENCE

The Impact of Ohio Charter Schools on Student Outcomes, 2016–19

By Stéphane Lavertu

October 2020

About the author

Dr. Stéphane Lavertu is a professor in the John Glenn College of Public Affairs at The Ohio State University. He has conducted studies on school-district governance, state and federal accountability systems, charter schools, and school finance. Lavertu holds a doctorate in political science from the University of Wisconsin–Madison, a master's degree in education-policy analysis and evaluation from Stanford University, and a bachelor's degree in political science from The Ohio State University.

THOMAS B. FORDHAM INSTITUTE
ADVANCING EDUCATIONAL EXCELLENCE

The Thomas B. Fordham Institute promotes educational excellence for every child in America via quality research, analysis, and commentary, as well as advocacy and charter school authorizing in Ohio. It is affiliated with the Thomas B. Fordham Foundation, and this publication is a joint project of the Foundation and the Institute. For further information, please visit our website at www.fordhaminstitute.org or write to the Institute at P.O. Box 82291, Columbus, OH 43202. The Institute is neither connected with nor sponsored by Fordham University.

Contents

Foreword

By Aaron Churchill and Chad L. Aldis

Over the past two decades, public charter schools have become a permanent fixture in Ohio's educational landscape.[1] Their enrollment rose consistently throughout the 2000s, reaching 120,000 students by 2015. Though it has contracted somewhat since then, charters remain a popular public school option in many communities, particularly in large cities. For many low-income families living in those areas, charters are the only accessible alternative to unsatisfactory district offerings in their neighborhoods. Despite this popularity, some have questioned the quality of Ohio's charter schools, questioning that's been stoked by charter critics who make irresponsible apples-to-oranges comparisons of urban charter schools to wealthier school districts or statewide averages.

Fordham has long supported the principle and practice of charter schools, but we also strongly believe that academic performance matters in these schools, as in every other school. Choice for choice's sake is not enough—we also need valid evidence that charters are improving the educational outcomes of students who choose them. To this end, we've committed significant resources over the years to a number of independent evaluations of charter performance that use rigorous methods to make apples-to-apples comparisons of charter and district schools. These studies have yielded a nuanced picture, identifying areas of both strength and weakness. For instance, they've found that children attending online charters lose significant ground, while another evaluation indicated that Black students attending Ohio charters make solid gains.[2]

To update public understanding of charter performance, especially in the wake of significant policy reforms enacted by the legislature five years ago,[3] we asked Ohio State University professor Stéphane Lavertu to conduct an analysis based on the most recent data available. Dr. Lavertu is perfectly suited to lead a skillful evaluation, as he coauthored an early (non-Fordham) analysis of Ohio charters and has produced rigorous Fordham-supported research on school closures and interdistrict open enrollment. We're pleased that he accepted the challenge and has—once again—produced first-rate work.

Lavertu's evaluation relies on anonymous, student-level data provided by the Ohio Department of Education to gauge the impacts of charters from 2015–16 through 2018–19. The study focuses on the performance of the brick-and-mortar charters that educate roughly two-thirds of Ohio charter students (the remainder are enrolled in online or dropout-recovery schools). This is intentionally different from past evaluations that combined the results of general education schools with those of online charters and specialty charters that primarily serve students who have dropped out or have disabilities. That approach made it difficult to know how well or poorly brick-and-mortar charters serving general pupil populations are doing, information that is essential to informed discussions about future policy.

---

1 Ohio law calls them "community schools."

2 For Fordham-sponsored research on Ohio charter schools, see the Center for Research on Education Outcomes (CREDO), *Charter School Performance in Ohio* (2014); June Ahn, *Enrollment and Achievement in Ohio's Virtual Charter Schools* (2016); and CREDO, *Charter School Performance in Ohio* (2019).

3 For more background on these reforms, see Chad L. Aldis and Aaron Churchill, "Charter school reform in Ohio: House Bill 2 at a glance," *Ohio Gadfly Daily* (October 7, 2015).

What have we learned from Dr. Lavertu's analysis of these brick-and-mortar schools?

- In grades 4–8, students make significant gains on state math and ELA exams when compared to district students of similar backgrounds. Consistent with prior research on Ohio charters, Black students make particularly strong progress. Based on gains accumulated over five years, Lavertu estimates that the average Black student who attends a brick-and-mortar charter from grades 4–8 moves from the twenty-fifth to fortieth percentile in statewide achievement. Though their gains are more modest, students of other races/ethnicities also make more progress in brick-and-mortar charters than in district schools, as do both high and low achievers.
- The grade 4–8 analysis also indicates that charters that choose to hire a for-profit or nonprofit management company to run daily operations both produce positive results when compared to districts, but those with nonprofits tend to register stronger performance.
- Though fewer in number than elementary and middle schools—just fifty-nine compared to 232 schools in the grade 4–8 analysis—Ohio's general education charter high schools also deliver notable academic benefits. The analysis shows that students' scores on state English end-of-course exams improve when they attend a brick-and-mortar charter high school, although gains on math end-of-course and ACT exams are not statistically significant.

Lavertu also digs into several valuable nonacademic outcomes, which have not previously been explored in the context of Ohio charters. He finds that, both in grades 4–8 and in high school, brick-and-mortar charters boost attendance and reduce disciplinary incidents. Charter students also receive more hours of instruction, which probably contributes to the achievement gains that we observe. The reduction in disciplinary incidents also suggests that brick-and-mortar charters may improve the social-emotional well-being of their students, an important outcome by itself and another likely mediator of improved achievement.

These positive charter results may come as a surprise to many, yet they are consistent with previous indications of solid performance. In recent years, urban charter schools have outperformed district schools on the state's value-added measure that offers the clearest look at the effectiveness of individual schools. Moreover, CREDO's 2019 evaluation of Ohio charters—which examined data through 2016–17—uncovered evidence of improvement when compared to its earlier analysis from 2014. Lavertu's data in the present study extend two years beyond CREDO's—and he finds that charter performance continues on an upward trajectory. The strong results found in this study likely reflect these recent improvements.

***

We know full well that some charters are more effective than others, as is also the case with district and private schools. Overall, however, the present study offers compelling evidence that, on average, attending a brick-and-mortar charter school in Ohio benefits students whose families make this choice.

What implications does this hold for state policymakers? We offer three recommendations.

1. **Maintain strong accountability for charters (as for all public schools).** In 2015, Ohio lawmakers enacted landmark measures to strengthen accountability in the charter sector. To ensure that the charter sector continues to make progress, the state must stay the course. As this report goes to press, accountability policies applying to both district and charter schools have been put on temporary hold due to the pandemic. That's understandable, even unavoidable. But once the health crisis passes, Ohio should reboot its standard accountability policies, including those designed to hold charters (and their sponsors) to account for results.
2. **Remove geographic restrictions on brick-and-mortar charters.** Under state law, charters may only locate in certain districts. These restrictions have largely confined Ohio brick-and-mortar charters to high-poverty urban communities. They've done much good there, and more quality school options are surely needed in these areas. However, there's no reason to believe that charters couldn't serve families well in other parts of the state. In less-restrictive states, such as Arizona and Colorado, charter schools have offered innovative public school options for suburban and rural communities, too.[4] Ohio's brick-and-mortar charters have proven themselves capable of providing quality options—and it's time to give families across the state similar opportunities.
3. **Support the growth of quality charters.** Because charters receive less funding than district schools, replicating great ones has been an enormous resource struggle. Recognizing the need to deliver support for the expansion of quality schools, Governor DeWine commendably proposed—and the legislature approved—a $30 million per year outlay that provides supplemental funding to quality charter schools.[5] That was adopted during the 2019 budget cycle, and it needs to be repeated. In the coming year, lawmakers should again appropriate funds for the program, while also making it permanent law. Accountability reforms have purged the charter sector of chronically low-performing schools, yet in order to sustain and build on recent quality improvements, the state needs to reenergize new school formation and replication.

For too long, Ohio's charter schools have been viewed by many as second-class education options, temporary competition for school districts that are just so-so for kids. But much as opinions about foreign cars changed over time as they proved to be of good quality, it's high time that outdated perceptions of charter schools evolve, too. We can now say with confidence that the state's brick-and-mortar charters have proven to be equal—if not superior—to their district counterparts. Rather than calling charter schools a "misguided reform," let's follow the evidence and recognize them as a key tool in the ongoing fight to help every Ohio student reach his or her potential.

---

[4] Matthew Ladner, "In Defense of Education's 'Wild West,'" Education Next 18, no. 2 (2018), https://www.educationnext.org/in-defense-educations-wild-west-charter-schools-thrive-four-corners-states.

[5] For more, see the Ohio Department of Education's webpage "Quality Community School Support Fund," http://education.ohio.gov/Topics/Community-Schools/Quality-Community-School-Support-Fund.

Acknowledgments

We offer our deepest thanks to Dr. Stéphane Lavertu for his painstaking work in conducting this analysis. He truly went above and beyond in the depth and quality of the analysis. On the Fordham team, we wish to thank our colleagues Michael J. Petrilli and Chester E. Finn, Jr., for their helpful feedback during the drafting process. Also on the Fordham side, we offer special thanks to Jeff Murray, who assisted with project management and report dissemination. We extend our gratitude to Pamela Tatz for copyediting the manuscript and Andy Kittles for laying out the report. Last, we wish to thank the Ohio Department of Education for providing the necessary data that supported this work.

- *Aaron Churchill and Chad L. Aldis*
Thomas B. Fordham Institute

I thank the staff at the Ohio Department of Education—particularly Eben Dowell and Karlyn Geis—for providing data and sharing their expertise. I also thank Professor Vladimir Kogan for providing valuable advice. The opinions and recommendations presented in this analysis are mine and do not necessarily represent policy positions or views of the John Glenn College of Public Affairs or The Ohio State University.

- *Stéphane Lavertu*

Executive summary

Charter schools (labeled "community schools" in Ohio law) are publicly funded but independently operated schools that may serve students from kindergarten through grade 12. Education reformers have promoted them as a way to create markets in which charter schools and traditional public schools compete for students, thereby incentivizing both to meet the needs of parents and spurring educational innovations that any school might adopt. Advocates consider charter schools particularly important for expanding educational opportunities for disadvantaged children who lack the means to opt out of ineffective district schools. These potential benefits have driven bipartisan support for charter schools' rapid expansion across the United States, including Ohio, which has allowed charters to operate in select districts since 1998.

The extent to which charter schools serve as high-quality educational options varies. Past evaluations of Ohio charter schools—including both site-based and online schools serving a variety of student populations—have indicated a negative average impact on the achievement of students who attend them. These studies also revealed, however, that students of color and those who reside in particular urban districts experience significant achievement gains when attending charter schools. In response to these evaluations, Ohio policymakers took significant steps to address the uneven quality of the state's charter schools.

The purpose of this report is to evaluate Ohio's charter school sector since the General Assembly's 2015 reforms—from the 2015–16 school year (hereafter referred to as 2016) through the 2018–19 school year (hereafter referred to as 2019)—and to examine a wider breadth of outcomes than was possible in previous evaluations. The analysis employs anonymous student-level data and rigorous statistical methods that researchers have validated in a variety of contexts. Essentially, these techniques entail comparing the achievement and behavior trajectories of charter students to those of similar students in traditional public schools. Available data permit the analysis of student achievement, attendance, and discipline in grades 4–12, as well as graduation from high school.

This analysis focuses on site-based—that is, brick-and-mortar as opposed to online—charter schools serving general student populations, as these schools constitute the large majority of the charter sector, are most comparable to traditional public schools, and serve as students' primary alternative to traditional public schools. For brevity, the report often refers to these schools simply as "charter schools" or "charters."

The analysis yields seven major findings:

1) *Students attending Ohio charter schools demonstrate larger achievement gains than students attending traditional public schools.* The primary estimates imply that, on average, attending a charter school for five years (from grade 4 through grade 8) brings the typical charter student from approximately the thirtieth percentile on statewide mathematics and English language arts (ELA) exams to approximately the fortieth percentile. Estimates of the impact of attending a charter school during

high school grades indicate average gains of approximately 1.5 to 2.5 percentile points on end-of-course ELA exams (but not algebra or geometry exams).

2) *Attending charter schools leads to improvements in other outcomes associated with educational success and long-term wellbeing.* Students attending charter schools significantly improve their attendance rates and experience significant declines in the probability that schools will report them for disciplinary incidents. Students attending charter schools in grades 9–12 are also less likely to be chronically absent. These increases in attendance rates also correspond to significantly more instructional time for charter school students—particularly in grades 4–8.

3) *Black and low-achieving students in urban environments benefit most from attending Ohio charter schools.* Black students' achievement gains in grades 4–8 are twice as large as White students' gains, and their achievement gains in high school grades are approximately 30 percent larger. Positive charter impacts on attendance rates, rates of chronic absenteeism, and disciplinary incidents also occur primarily among Black students. For example, for every year a Black student attends a charter school in grades 4–8, their probability of being reported for a disciplinary incident declines an additional three to four percentage points. This effect is nearly large enough to erase the disciplinary gap Black students face (as compared to the average Ohio student) just before enrolling in a charter middle school. Similarly, attending a charter high school on average erases approximately one-third of the difference in eighth-grade attendance rates (or rates of chronic absenteeism) between Black students and the average Ohio student.

4) *Charter schools that contract with nonprofit management organizations have the largest effect on student achievement.* Nonetheless, charter schools that employ for-profit management organizations and those that manage their own operations also post greater achievement gains than traditional public schools.

5) *Attending a charter school during high school grades has no impact on the probability that a student eventually receives a diploma.* Although the estimates are often imprecise, the estimated impact on graduation rates is often close to zero.

6) *Low-achieving students benefit most from attending charter high schools (schools serving grades 9–12 only).* A low-achieving student (one who scores around the sixteenth percentile on state assessments in grade 8) on average will score over 0.5 points higher on the ACT than a similar student who enters a traditional public high school in grade 9. Specifically, these low-achieving charter students score approximately 14.4 out of thirty-six (the sixteenth percentile of the national ACT score distribution) as opposed to 13.9 (the thirteenth percentile). The analysis also cannot rule out substantively significant positive impacts on low-achieving students' probability of graduation.

7) *Charter schools in Columbus are notable for their consistently large positive impacts at all grade levels and across nearly all outcomes—including state achievement tests, college entrance exams, attendance rates, rates of chronic absenteeism, and rates of reported disciplinary incidents.* The positive impacts of Columbus charter schools are often more than double those of the average charter school. Charter

schools in Ohio's largest cities also have notable positive impacts on achievement in grades 4–8 (particularly those in Cleveland, Columbus, and Dayton), on high school end-of-course exams (particularly those in Cincinnati, Columbus, Dayton, and Toledo), and on college entrance exams (particularly those in Columbus and Toledo).

Available data and methods make it difficult to estimate the effects of other charter school types—such as online schools, those serving a large share of students with individualized education plans (IEPs), and those serving students at risk of dropping out. Nevertheless, the report also presents estimates of the average overall impact of all Ohio charter schools. The results indicate that the performance of Ohio's overall charter sector improved significantly between 2016 and 2019. The average charter school student in elementary and middle school grades (the primary focus of past evaluations) now posts significantly greater year-to-year achievement gains on state exams than the average student attending a traditional public school. Results for high school grades do not reveal a clear trajectory since 2016, although that may not be surprising given the special student populations many of these schools enroll.

Overall, the achievement effects of attending Ohio's site-based charter schools are comparable to those of highly effective educational interventions that cost thousands per pupil (for example, intensive individualized tutoring). The cost to taxpayers of expanding charter schools, on the other hand, is minimal. Consequently, promoting the expansion of urban charter schools serving low-achieving students is a promising, cost-effective option for improving educational outcomes. Additionally, given recent studies indicating that increasing spending can yield significant achievement gains among schools with low per-pupil expenditures, increasing charter school funding in Ohio could also yield achievement gains. Research suggests that such improvements could ultimately translate to higher earnings and economic growth for Ohio.

Introduction

Charter schools are publicly funded but independently operated schools that may serve students from kindergarten through grade 12. Education reformers have promoted them as a means of creating education markets in which charters and traditional public schools compete, thereby incentivizing both to meet the needs of children and families. So long as parents select schools based on quality, they argue, highly performing charter schools will attract students and grow, poorly performing charter schools will eventually close, and traditional public schools will improve.[6] Reformers also argue that charter schools' relative freedom from government regulation (for example, regarding the length of the school year and teacher hiring practices) creates an opportunity for efficiency and innovation—generating improvements in educational practice that traditional public schools can also adopt. Notably, advocates consider charter schools particularly important for expanding the educational opportunities of disadvantaged children, who often lack the means to opt out of ineffective district schools (for example, by moving to another neighborhood or district).

These potential benefits led to bipartisan support for charter schools' rapid expansion across the United States. Today, over 7,000 charter schools in forty-three states educate approximately three million kids—6 percent of U.S. public school students (Wang et al., 2019). Since 1997, Ohio lawmakers have authorized the establishment of charter schools (labeled "community schools" in state law) to serve students in poorly performing districts. Today, 320 charter schools serve just over 100,000 pupils—slightly less than 6 percent of Ohio's total public school enrollment. Because state law generally restricts site-based (that is, brick-and-mortar) charter schools to academically underperforming districts, Ohio charters tend to serve students who are far more likely than those in traditional public schools to be Black, economically disadvantaged, have special educational needs, and have limited English proficiency. Accordingly, Ohio's charter students also have far lower academic achievement levels than the typical public school student.

Charter schools perform diverse functions and come in several forms. Two-thirds of Ohio charter schools are site-based, brick-and-mortar schools that serve a general student population. These are the charters that most resemble traditional public schools and serve as their primary alternative. Approximately 10 percent of charter schools primarily serve students with special educational needs (for example, schools for children with autism), and over 20 percent are dropout-prevention and recovery schools that primarily serve students deemed at risk of dropping out or who are behind academically due to personal crises, drug abuse, or extended absences from traditional public schools. Moreover, 4 percent of charters are online virtual schools (which Ohio calls e-schools) that may draw students from across the state. Indeed, although there are few e-schools, they capture approximately 25 percent of Ohio charter school enrollments (see the sidebar "Trends in Ohio's charter sector since 2015 reforms"). Many of these e-schools serve as dropout-prevention and recovery schools, and some primarily serve students with special educational needs (that is, over 50 percent of their enrollments are students with IEPs). Students enrolled in e-schools may also be unusual in that personal experiences led them to leave or avoid traditional public schooling.

[6] The competitive pressures could lead the performance of charter and traditional public schools to increase in tandem—without any discernable difference in the achievement of charter and traditional public schools.

It is difficult to evaluate the impact of charter schools that serve unusual student populations. These students are different by definition, and their learning trajectories are unlikely to be comparable to those of traditional public school students. That is why researchers evaluating charters' impact often exclude schools that primarily serve such distinct student populations. Accordingly, this analysis of Ohio's charter sector focuses on estimating the impact of site-based charter schools serving general student populations. Nevertheless, for completeness, it also includes estimates of the impact of all Ohio charter schools, including e-schools, dropout-prevention and recovery schools, and charters that primarily serve students with IEPs. Doing so provides a means of comparing the results of this evaluation to those of prior studies that emphasize the performance of Ohio's charter sector as a whole. Still, readers should interpret with caution any results that include all types of charter schools.

Several studies have estimated the impact of Ohio's charter schools—taken as a whole—on student achievement. Most notably, the Center for Research on Education Outcomes (CREDO) determined in 2009 that, on average, Ohio charter schools had a negative impact on student achievement in mathematics and ELA (CREDO, 2009). A RAND Corporation report that same year found a similar overall effect, but it also revealed that online schools (that is, e-schools) brought down the overall average. Once the researchers focused on site-based charter schools, they found no statistically significant differences in student learning between charter and traditional public schools (Zimmer et al., 2009). Follow-up reports by CREDO in 2014 and 2019 came to similar overall conclusions as the earlier evaluations, but they also revealed that some students benefited significantly from attending charter schools—particularly minority and economically disadvantaged students in urban areas. Nevertheless, CREDO's most recent assessment concluded that Ohio charter schools—taking online and site-based charters together—had a negative overall impact on the achievement of students who attended them between 2014 and 2017.

These prior evaluations leave open a number of questions:

1) What is the impact of attending site-based charter schools serving general student populations?
2) What is the impact of attending these site-based charter schools on metrics other than academic achievement, such as student attendance, disciplinary incidents, and graduation?
3) What is the impact of site-based charter high schools on student achievement on Ohio's end-of-course exams and college entrance exams?
4) Do these effects vary by student characteristics, school location, and the for-profit or nonprofit status of the organizations that schools contract with to help them run their day-to-day operations?
5) Has the performance of Ohio charter schools as a whole—including both e-schools and site-based schools primarily serving potential dropouts and students with IEPs—improved since the General Assembly put in place several rigorous charter accountability measures in 2015?
6) Could the expansion of Ohio's best site-based charter schools improve educational and economic outcomes in Ohio?

This report answers these questions using the most rigorous empirical methods available and drawing on the latest research. It compares otherwise-similar charter and traditional public school students to estimate the cognitive and behavioral impact of charter attendance. It also tests the validity and sensitivity of the primary estimates in a variety of ways, including using empirical approaches that respected econometricians have used to estimate the impact of charter schools in cities across the U.S.

The report proceeds as follows. First, it describes the analysis's primary methodological approach. Second, it provides estimates of site-based charter schools' achievement impacts for students in grades 4–8, exploring differences by student characteristic, school location, and school management structure. Third, because of the methodological advantages of focusing on charter school entry during natural grade transitions, the report focuses on site-based charter "middle schools" (defined as the subset of schools with entry grades 4, 5, 6, or 7) to follow students' achievement, attendance, and disciplinary outcomes from the time they enter middle school through up to four years later. Fourth, it presents estimates of the impact of attending a charter school in grades 9–12, much like the analysis for grades 4–8 but examining outcomes such as end-of-course exams and college entrance exams. Fifth, the analysis examines standalone charter high schools (those for which grade 9 is the entry grade)—once again because of the methodological advantages of following students through normal grade transitions (in this case, transitioning from attending a middle school in grade 8 to attending a high school in grade 9). Sixth, drawing on charter school research, the report concludes with a discussion of policy implications.

The appendixes provide a thorough explanation of the data, methods, and results. Due to space constraints, the figures in the main report present only a subset of the results. For example, the report includes figures summarizing impacts on attendance and discipline only for the middle school and high school analyses, as those analyses lend themselves to following students over time across grades. The figures and text provide a fair characterization of the entire set of results, but interested readers should review the appendixes to get the results across all statistical models. Finally, it is important to emphasize that all of the results in the main body of the report are for site-based charter schools serving general student populations and that they provide an average of charter school effects across all years (2016–19). The sidebar "Trends in Ohio's charter sector since 2015 reforms" (see page 22) examining trends in overall charter school performance from 2016 to 2019 is the only place with estimates for all charter school types—including e-schools, dropout-prevention and recovery schools, and charter schools that primarily serve students with IEPs. The sidebar is also the only place where estimates are for individual years (2016, 2017, 2018, and 2019). The rest of the report presents estimates of the average impact of charter schools across all four years (2016–19).

Analytic approach

Characterizing the quality of charter schools by comparing the achievement of their students to the achievement of students in traditional public schools is challenging. Students in these two sectors differ in important ways. For example, charter students in elementary and middle school grades—the grades charter school evaluations most often study—are far more likely than students in traditional public schools across Ohio to be Black (53 percent as opposed to 12 percent), economically disadvantaged (89 percent as opposed to 45 percent), have IEPs (18 percent as opposed to 13 percent), and have limited English proficiency (3 percent as opposed to 1 percent).[7] Indeed, charter students have average test scores that place them 0.5 standard deviations below the state average, which is equivalent to the thirty-first percentile on the statewide achievement distribution. To address this problem, evaluators often employ research designs that entail comparing year-to-year achievement gains between students who are nearly identical according to these observable characteristics but who attended different types of schools.

Research indicates that such comparisons of observationally similar students are generally appropriate for general-education students who reside in the same district but are likely to be flawed when done across district boundaries or based on students in unusual circumstances.[8] In these cases, controlling for observable student characteristics may not be sufficient, as there would likely remain important unmeasured differences between students who attend charter schools as opposed to traditional public schools. Indeed, most charter schools that focus on student populations with special needs have no natural comparison groups among traditional public schools. For example, *all* Ohio schools focused on dropout prevention and recovery are charter schools. The students they serve are different by definition. Similarly, the unmeasured factors that lead students to select into e-schools are also likely to make them significantly different from traditional public school students.

Another important issue is whether available data allow one to paint a relatively complete picture of school performance. Charter school evaluations typically focus exclusively on student achievement in the elementary and middle school grades. Research has documented the importance of student achievement in mathematics and ELA in these grades, both for students' own long-term economic and social wellbeing as well as for a state's economic growth. Additionally, state test data instill confidence because of these tests' rigorous design and the state's strict procedures for administration and reporting. Thus, if one must focus on a single metric, student achievement is arguably the best. But research also indicates that behavioral measures such as attendance are associated with better lifetime outcomes and that students' experiences in high school can have lasting consequences.

To provide the most accurate assessment possible of Ohio charter schools, this report focuses on site-based charter schools serving a general student population, examines achievement outcomes at

---

[7] These descriptive statistics come from Table G1 in Appendix G. As Table G2 in Appendix G indicates, the differences are similar in charter schools that include high school grades.

[8] The appendixes review these methodological challenges in greater depth.

both the elementary and secondary levels, and explores how these achievement outcomes correspond to behavioral outcomes such as attendance, disciplinary incidents, and graduation. Importantly, all estimates are derived from research designs that econometricians have validated for these types of schools and pupil populations. Specifically, the primary estimates are based on statistical models that compare similar charter and traditional public school students who attended schools in the same district. The specific details of the primary statistical models and a thorough presentation of the results appear in Appendix B for grades 4–8 and Appendix E for grades 9–12.[9] Details and results from alternative designs appear in appendixes C, D, F, and G.[10] The analysis that follows reviews these alternative designs and results when relevant.

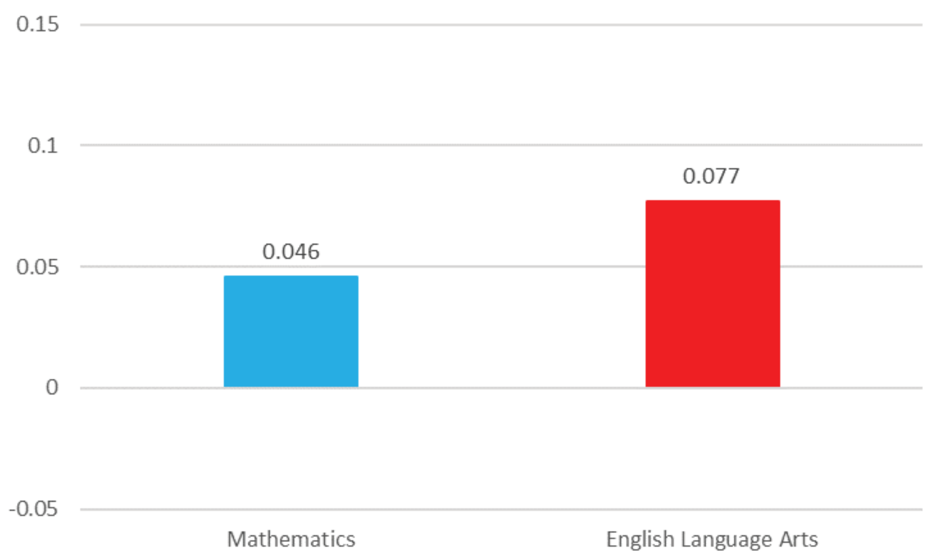
[9] A description of the data and data-cleaning procedures appears in Appendix A.

[10] Appendix D presents results based on a matching procedure similar to CREDO's. It generally yields estimates that are greater in magnitude than the results below. Appendix C and Appendix E focus on charters with middle school and high school entry grades, respectively, as that allows one to follow students who attended the same school prior to a natural grade transition. Appendix G makes statewide school comparisons so that statewide online charter schools can be included in the analysis. In order to minimize bias associated with comparing students from different districts, the models control for multiple prior years of student achievement.

Annual achievement impact of charter school attendance in grades 4–8

The analysis begins by examining achievement effects in grades 4–8, averaged across years 2016–19. Throughout, I present estimates of the annual achievement effects of attending site-based charter schools serving general student populations in Ohio, which I simply refer to as charter schools from this point forward. The bar charts below indicate the average impact of attending a charter school (as opposed to a traditional public school) in standard deviation units.[11] Positive numbers indicate a positive impact (a charter school advantage), whereas negative numbers indicate a negative impact (a charter school disadvantage). Solid bars indicate that the results attain statistical significance at the conventional 5 percent threshold, whereas empty bars indicate that the estimate is not statistically significant.

Figure 1. Annual impact of charter schools on achievement (2016–19)



Note. The table illustrates the annual impact of attending a site-based charter school (as opposed to a traditional public school) on student achievement in grades 4–8 averaged across the 2016–19 school years. Estimates listed above the bars are in standard deviations and are statistically significant if the bars are solid. Model specifications and tabular results appear in Appendix B.

Figure 1 reveals that, on average, students attending Ohio charter schools between 2016 and 2019 demonstrated greater annual achievement gains in both mathematics (0.046 standard deviations) and ELA (0.077 standard deviations)—an average of 0.062 standard deviations across both subjects.[12]

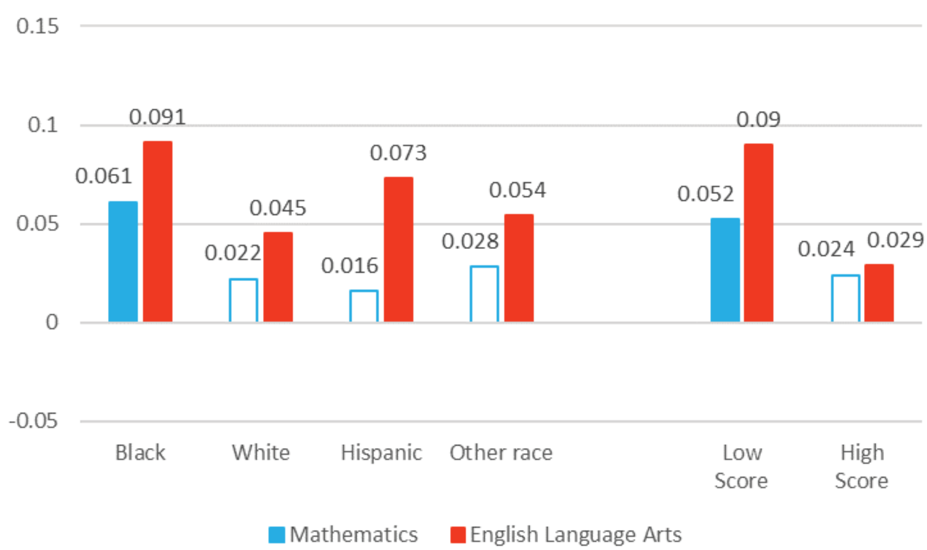
[11] The purpose of using standard deviation units as the scale is so that one can directly compare test scores across different subjects, grades, and years. Specifically, test scores are standardized such that they are centered around the average score for a given subject, grade, and year. After this conversion, the average test score for a subject, grade, and year is zero and a unit change in the standardized score is one standard deviation. Consequently, calculating differences (between students in charter and traditional public schools) yields differences in student achievement in terms of standard deviations. Appendix A provides more detail on score standardization.

[12] The estimates are generally larger when employing a matching approach similar to CREDO's. See Appendix D for results using this approach.

The results imply that if a student attended a charter school for all grades 4–8, their average achievement in mathematics and English would be approximately 0.3 standard deviations greater (0.06 x five years) than it would have been had they attended a traditional public school. These results imply that, on average, attending a charter school for five years (from grade 4 through grade 8) brings the typical charter student from approximately the thirtieth percentile on statewide mathematics and ELA exams to approximately the fortieth percentile. The final section of this report provides benchmarks for assessing the size of estimated effects. For now, consider that educational interventions that are the subject of randomized controlled trials typically yield effects of approximately 0.05–0.2 standard deviations (Kraft, 2020). Thus, researchers might characterize the implied effects of 0.3 standard deviations as large—roughly comparable to providing individual tutoring for high-needs students (see Kraft, 2020).

Prior evaluations showed that minority students benefit most from Ohio charter schools. Figure 2 reveals that this remains the case. Black students experience average annual achievement gains of approximately 0.075 standard deviations in mathematics and ELA combined. These estimates imply that a Black student who attends a charter school for all five years (grades 4–8) would realize cumulative achievement gains of 0.375 standard deviations by the end of grade 8. That is roughly equivalent to moving from the twenty-fifth percentile just prior to grade 4 to the fortieth percentile by the end of grade 8. The benefits of charter school attendance decline in magnitude—but remain statistically and substantively significant—as one moves from Black to Hispanic to White students, respectively. Figure 2 also reveals that the overall results are driven by low-achieving students—those who score below the statewide average on mathematics and ELA exams. These results are consistent with evaluations of high-performing charter sectors around the country, which tend to find that minority, low-achieving, and low-income students benefit most from charter school attendance.

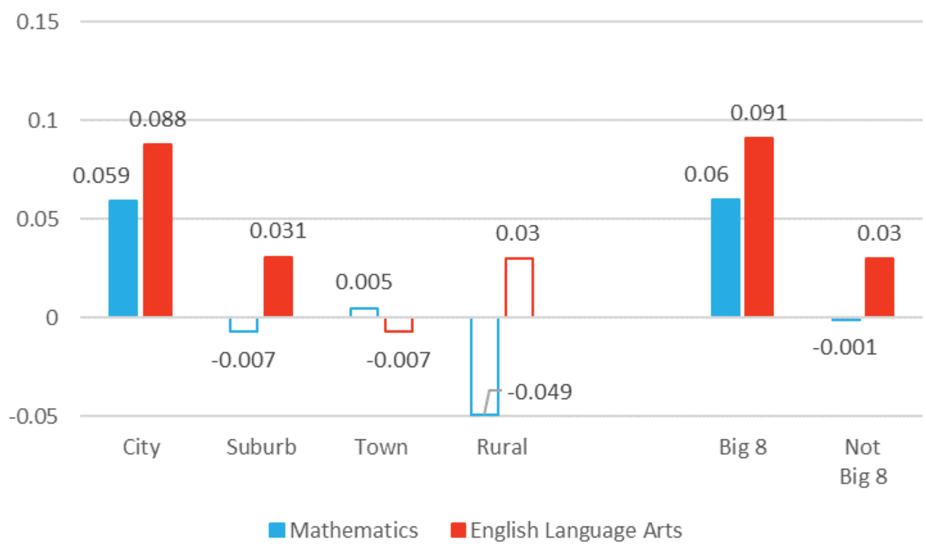
Figure 2. Annual impact of charter schools on achievement by race/ethnicity and prior achievement (2016–19)



Note. The table illustrates the annual impact of attending a site-based charter school (as opposed to a traditional public school) on student achievement in grades 4–8. Students with a “low score” or “high score” are those with test scores below or above the statewide mean, respectively. Model specifications and tabular results appear in Appendix B.

Figure 3 reveals that the overall positive effects of charter schools are driven by students who reside in cities—mostly the "Big 8."[13] This finding is also consistent with research that indicates that urban charter schools are more beneficial than those in other locales. The estimates for charters in towns and rural locales are not statistically different from zero. In the case of rural schools, there are too few students to rule out substantively significant positive and negative effects, as Ohio charter schools are largely limited to urban areas. Nevertheless, the results are consistent with the common belief that as population density declines, so do the benefits of charter schools.

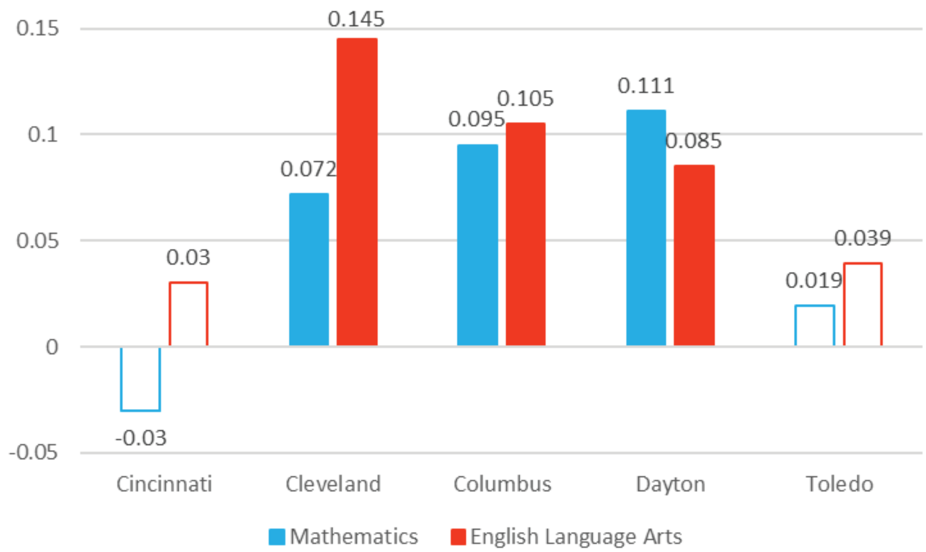
Figure 3. Annual impact of charter schools on achievement by locale (2016–19)



Note. The table illustrates the annual impact of attending a site-based charter school (as opposed to a traditional public school) on student achievement in grades 4–8. Estimates are in standard deviations and are statistically significant if bars are solid. "Big 8" districts include Akron, Canton, Cincinnati, Cleveland, Columbus, Dayton, Toledo, and Youngstown. Model specifications and tabular results appear in Appendix B.

[13] "Big 8" districts include Akron, Canton, Cincinnati, Cleveland, Columbus, Dayton, Toledo, and Youngstown. These results are available in Table B5 in Appendix B.

Figure 4. Annual impact of charter schools on achievement by major city (2016–2019)



Note. The table illustrates the annual impact of attending a site-based charter school (as opposed to a traditional public school) on student achievement in grades 4–8. Estimates are in standard deviations and are statistically significant if bars are solid. Model specifications and tabular results appear in Appendix B.

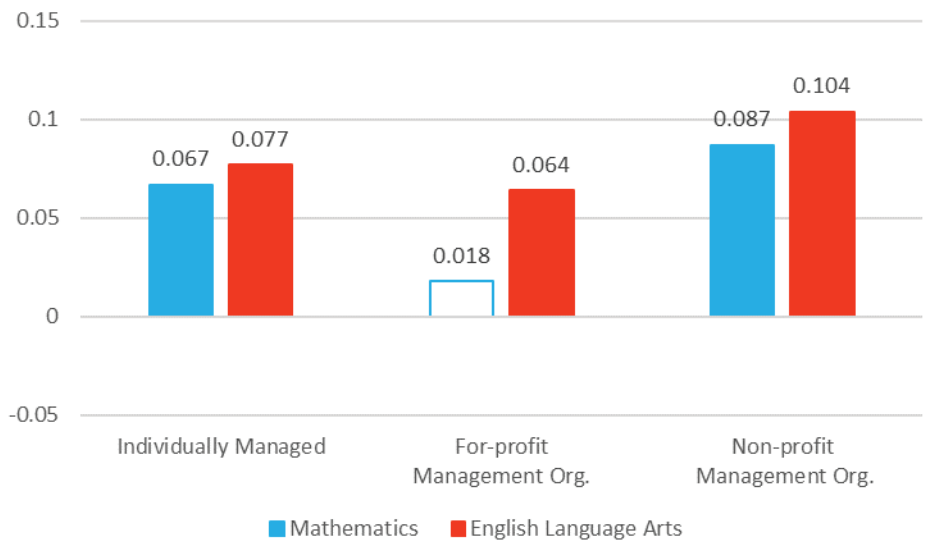
Figure 4 disaggregates the results further, focusing on the five city school districts that have the largest number of charter schools: Cincinnati, Cleveland, Columbus, Dayton, and Toledo. The results indicate that students in Cleveland, Columbus, and Dayton on average experience annual gains in achievement of approximately 0.1 standard deviations (averaged across both mathematics and ELA) if they attend charter schools instead of traditional public schools. These effects are approximately 50 percent larger than the overall average achievement gains associated with charter school attendance. The more modest gains in Toledo approach but do not quite reach conventional levels of statistical significance for ELA.[14]

Finally, one source of public controversy revolves around the performance of charter schools operated by for-profit organizations. Charter schools themselves are all nonprofit organizations in Ohio, but some contract with for-profit firms to help manage their operations. There is a concern that such operators have strong incentives to minimize educational investments in order to maximize profits from a fixed amount of state per-pupil funding. On the other hand, some have argued that for-profit organizations have incentives to provide a quality education that attracts more students and, in turn, boosts revenue. To explore such a possibility, Figure 5 disaggregates the above estimates according to whether a charter school manages itself (that is, it does not contract with a management organization), contracts with a for-profit management organization, or contracts with a nonprofit management organization.[15]

[14] The estimates for charters in Columbus and Dayton remain relatively large if one compares them to all traditional public schools in Ohio. However, the estimate for Cincinnati charters becomes negative (−0.04 standard deviations) and the positive estimates for Cleveland charters significantly decrease in magnitude (from over 0.1 standard deviations to 0.04 standard deviations). Estimates based on statewide comparisons appear in Table G5 of Appendix G. As the appendix notes, however, these estimates should be interpreted with some caution.

[15] There has been some debate regarding the classification of charter management organizations. This analysis is based on 2019 classifications that the Ohio Department of Education provided. Organizations labeled as "other" in prior years are not included in these estimates.

Figure 5. Annual impact by charter school management structure (2016–19)



Note. The table illustrates the annual impact of attending a site-based charter school (as opposed to a traditional public school) on student achievement in grades 4–8 by the type of charter school operator. Estimates are in standard deviations and are statistically significant if bars are solid. Model specifications and tabular results appear in Appendix B.

The results are merely suggestive—they do not indicate whether estimated performance is in fact because of an organization's for-profit or nonprofit status. Nevertheless, the results indicate that charters run by nonprofit management organizations yield superior achievement outcomes as compared to individually managed charters schools and, especially, charter schools managed by for-profit management organizations. Charter schools managed by for-profit management organizations nonetheless have positive achievement effects in ELA when compared to traditional public schools.

Estimating charter school effects by focusing on middle school transitions

The above analysis presents estimates that apply to all students attending site-based charter schools in grades 4–8, which includes schools that serve various grade spans such as K–12, K–8, 6–8, and 7–12. An advantage of this approach is that the estimates of average effects apply to all charter school students in grades 4–8, providing the most complete picture possible. Another way to estimate charter school impacts in grades 4–8 is to follow students as they transition to schools with entry grades of 4, 5, 6, or 7. Specifically, one can identify students who are identical in terms of observable measures (race, sex, economic disadvantage, limited English proficiency, and special education status) and who attended the same elementary school (at the same time and in the school's terminal grade) before some transitioned to a charter with middle school entry grades while others transitioned to traditional public schools.[16] Although middle schools typically serve grades 6–8, for brevity this section refers to schools with entry grades 4–7 as middle schools.

This approach limits the analysis to thirty-three of the 232 charter schools included in the previous section. Because not every charter school is included, the results may not be representative of all site-based charter schools serving grades 4–8. However, a major benefit of this methodology is that students are more likely to be alike on characteristics we cannot observe (for example, parental motivation). Indeed, studies that employ such a design have found that estimates of charter schools' impact are very similar to those one gets from designs that involve randomly assigning students to charter and traditional public schools—the gold standard in evaluation research. Moreover, this design allows one to examine directly the cumulative effects of charter school attendance, as one can track students as they enter and progress across grades. This approach is more straightforward and requires fewer assumptions than projecting the cumulative effects of charter school attendance, by multiplying annual estimates by the number of years students might spend in a charter school (as does the analysis in the previous section). Consequently, one has more confidence that the results in this section capture the cumulative impacts of attending a charter school, although this advantage comes at a cost of smaller sample sizes and the inability to generalize performance across the entire sector.

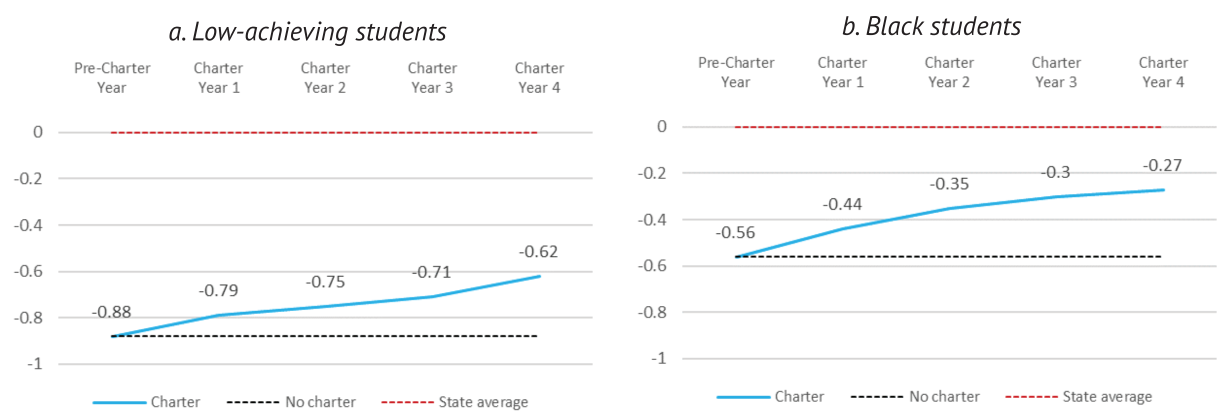
This approach yields overall estimates of annual charter school impacts that are somewhat smaller than those in the previous section (approximately 0.036 standard deviations as opposed to 0.062 standard deviations), but the estimates for low-achieving and Black students (who constitute the majority of the analytic sample) are similar (approximately 0.06 standard deviations). These comparable results provide additional confidence that the primary estimates of charter school effects are valid. Additionally, because the impacts on student attendance and disciplinary incidents are similar to those based on the analytic approach used in the previous section, one can limit the presentation of these results to this

[16] Appendix C contains a more detailed description of the research design and presents the results in tabular form. Unfortunately, the data file did not contain historical attendance data that would have allowed tracking years spent in charter schools if achievement data are not available in those years. The estimates are qualitatively similar but less precise if one limits the sample to students who attended the same charter elementary school before transitioning to middle school.

section in order to conserve space. Thus, examining how achievement, attendance, and disciplinary incidents change from the time low-achieving and Black students enter a charter school in grades 4–7 provides an opportunity to illustrate the cumulative impact of charter school attendance on both achievement and behavior.

Figure 6 begins by illustrating the cumulative achievement impact of charter school attendance for low-achieving students (panel a) and Black students (panel b) who attended their respective middle schools for at least three years. Specifically, it presents the cumulative impact of attending a charter middle school and provides a projection of how students would have performed had they not transitioned to a charter middle school. This projection (the black dashed line in the figure) captures the average achievement of low-achieving or Black students who did not transition to a charter school in grades 4–7.

Figure 6. Cumulative achievement impact of charter middle schools (average of ELA/math)

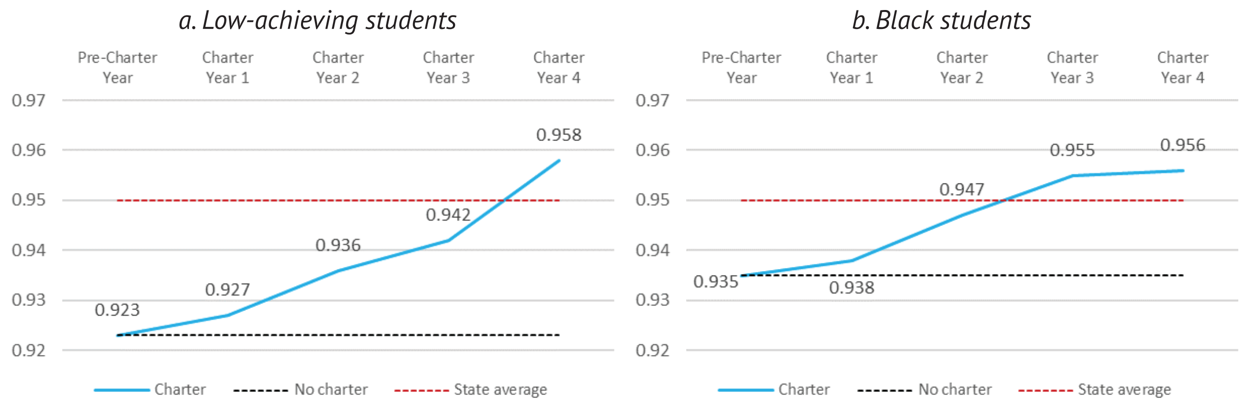


Note. The figure illustrates the cumulative impact of site-based charter schools on the achievement of low-achieving and Black students. The vertical axis captures the number of standard deviations below the statewide average a charter student's achievement is in mathematics and ELA. The *x*-axis captures the year of charter enrollment. The blue line captures the cumulative gains in average achievement that students experience when enrolled in charter schools. The red dashed line is the average achievement statewide, and the black dashed line is the average achievement for low-achieving or Black students not in charter schools. "Low-achieving" students are those who score below the fiftieth percentile in this sample. Estimates are based on models from Appendix C.

Figure 6a shows that the average low-achieving student in this subset of schools had test scores that placed them almost 0.9 of a standard deviation below the statewide average (about the nineteenth percentile) before transitioning to middle school. Setting this as the baseline, the figure plots the cumulative achievement advantage of attending a charter school for up to four years. It indicates that among students who attended a charter school for four years, achievement levels were 0.62 of a standard deviation below the statewide mean (approximately the twenty-seventh percentile) after four years. Figure 6b reveals similar results for Black students. They increase their achievement from 0.56 of a standard deviation below the statewide average to 0.27 standard deviations below the average four years later—roughly from the twenty-ninth percentile to the thirty-ninth percentile. In other words, Black students are able to close the racial achievement gap (roughly, the difference between their baseline achievement and the statewide average) by half when they attend charter middle schools for three to four years. Again, as compared to the typical effects of educational interventions, these are large effects.

This analysis also presents an opportunity to examine the cumulative impact of charter schools on student attendance rates and reported disciplinary incidents. As the appendixes reveal, the results for these outcomes are consistent across samples and estimation methods. (I present the results here only—not in the prior section above—to avoid redundancy.) Such an analysis is important for a number of reasons. First, research indicates that schools' impacts on student behavior can yield long-term economic and social benefits for students. Second, examining attendance and disciplinary outcomes can provide some insights as to what makes charter schools successful at improving achievement. For example, research in other contexts has shown that schools that focus on improving student behavior yield bigger achievement effects than those that do not. There are also concerns that the manner in which public schools discipline students (for example, the disproportionate suspension of Black students) undermines their educational achievement and attainment.

Figure 7. Impact of charter middle schools on attendance rates



Note. The figure illustrates the impact of site-based charter schools on attendance rates for low-achieving and Black students. The vertical axis captures the attendance rate. The *x*-axis captures the year of charter enrollment. The blue line captures student attendance rates for each year students are enrolled in charter schools. The red dashed line is the average attendance rate statewide, and the black dashed line is the average attendance rate for low-achieving or Black students not in a charter school. "Low-achieving" students are those who score below the fiftieth percentile in this sample. Estimates are based on models from Appendix C.

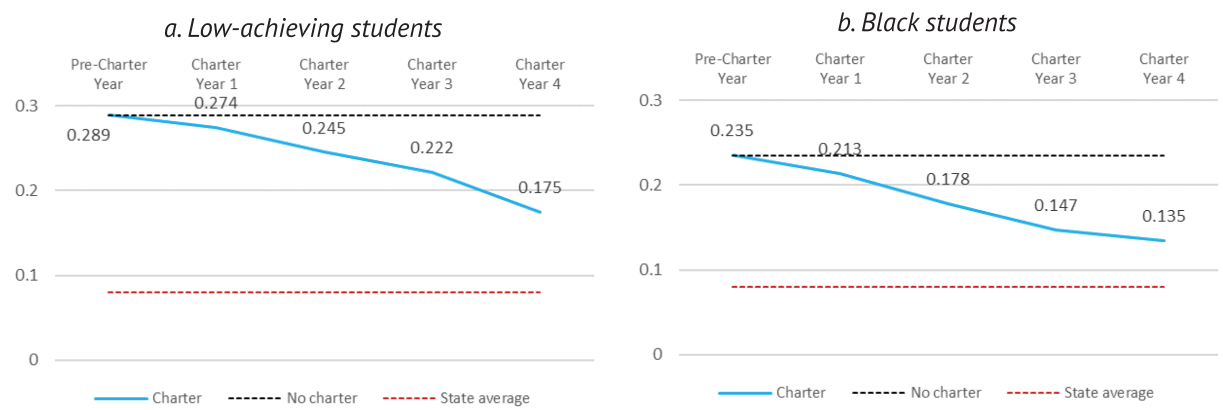
Figure 7 shows that attending a charter middle school eventually leads to an average student attendance rate of almost 0.96 for both low-achieving and Black students. This means that students were present for almost 96 percent of a school's total instructional hours in their fourth year attending a charter school. This attendance rate is significantly greater than the average attendance rate of 0.92-0.94 for students who attended traditional public schools.[17] This estimate is comparable to the

[17] Tables C3 and C4 in Appendix C report the results of models on which these projections are based. The tables report an average annual impact on attendance rates of 0.007, which is very similar to the 0.005 effect for the larger sample (see Table B3 in Appendix B). However, the results in Figure 9 imply an annual impact over 0.01. That is partly because the results in Appendix C include many more students who spent one to two years in charter schools than students who spent three to four years. This is due to later entry grades at these schools.

estimated effects across all charter schools serving grades 4–8 (see Appendix B).[18] It also is important to note that all models indicate that charter students are getting significantly more instructional time than traditional public school students (see Appendix B and Appendix C).

Figure 8 illustrates the impact of charter school attendance on reported disciplinary incidents among low-achieving and Black students. Specifically, it presents estimates of the probability that a school will report a student for a serious disciplinary incident (such as fighting or drug possession but not truancy). Such an analysis should capture changes in student behavior, although it might also reveal that a school is more or less punitive or more or less inclined to report students for disciplinary infractions. Figure 8 reveals that the incident rate declines by about eleven percentage points for low-achieving students who attended charter middle schools (those with entry in grade 4 or 5) for four years—from approximately 29 percent of students reported for a disciplinary incident prior to enrolling to approximately 18 percent of students reported for such an incident four years later. The rate declines by approximately ten percentage points for Black students—from 24 percent to 14 percent. These declines eliminate about two-thirds of the gap in reported disciplinary incidents between Black students and the average Ohio student prior to these students enrolling in charter middle schools.

Figure 8. Impact of charter middle schools on the rate of disciplinary incidents



Note. The figure illustrates the impact of site-based charter schools on the rate of disciplinary incidents for low-achieving and Black students. The vertical axis captures the rate of disciplinary incidents. The *x*-axis captures the year of charter enrollment. The blue line captures the incident rate for each year students are enrolled in charter schools. The red dashed line is the average incident rate statewide, and the black dashed line is the average incident rate for low-achieving or Black students not in a charter school. "Low-achieving" students are those who score below the fiftieth percentile in this sample. Estimates are based on models from Appendix C.

[18] I do not report results on chronic absenteeism for middle school students because the estimates diverge from those in the main analysis. One reason might be that I am able to control for baseline absenteeism in the larger analysis of annual impacts, whereas I am unable to do so for analyses of cumulative impacts because attendance data go back only to 2015. Nonetheless, the estimates appear in appendixes B and C.

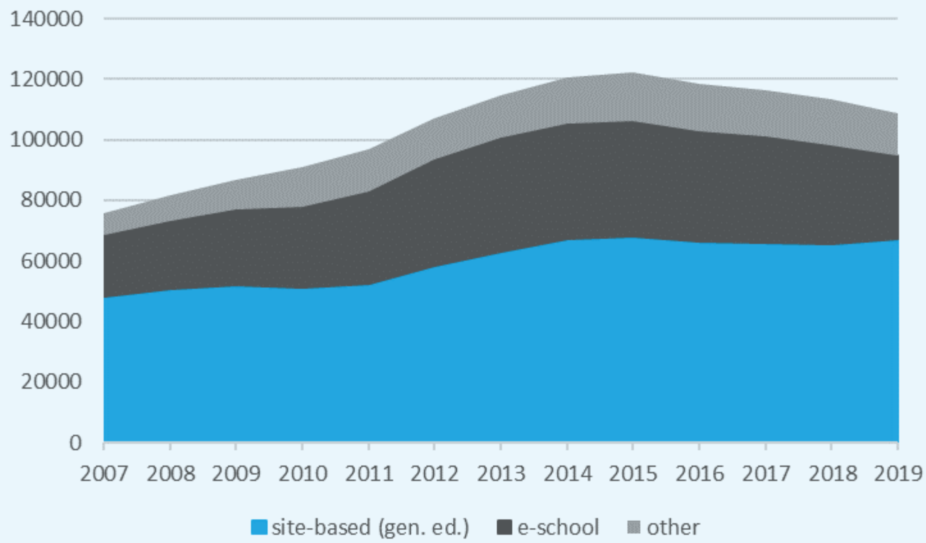
Overall, the analysis of this subset of charter schools with middle school entry grades yields results comparable to the larger analysis that includes all charter school students in grades 4–8—particularly for low-achieving and Black students. For these students, the annual achievement impacts of charter school attendance accumulate such that they wipe out between one-quarter and one-half of the baseline achievement gap between these charter students and the statewide average. A parallel increase in attendance rates and a decline in reported disciplinary incidents accompany these positive achievement effects associated with charter school attendance. The analysis does not allow one to determine whether changes in these behavioral outcomes explain or merely accompany achievement effects. They suggest, however, that the benefits of charter schools extend beyond achievement.

Trends in Ohio's charter sector since 2015 reforms

Since Ohio passed its original charter school law in 1997, the General Assembly has enacted a number of significant reforms to improve the sector. Most significant was a package of reforms passed in 2015 that instituted a more rigorous accountability system for charter school sponsors—nonprofit and government organizations that authorize and oversee Ohio charter schools. The reforms include a number of regulations that sought to improve the services that e-schools (online or virtual schools) provide, as well as the financial management of all charter schools. The legislation also requires more transparency around the practices of charter school operators—the organizations that many Ohio charter school boards contract with to run their schools. Consequently, Ohio arguably went from having one of the least-regulated charter school sectors in the nation to having one of the most strictly regulated sectors.

Given the tighter regulatory environment, it is perhaps unsurprising to see a contraction in the size of the charter sector, which went from a peak of 392 schools in 2014 to 320 in 2019. As Figure A illustrates, the 2015 reforms (and subsequent state actions) appear to have had a similar impact on charter enrollments.

Figure A. Number of students in Ohio charter schools

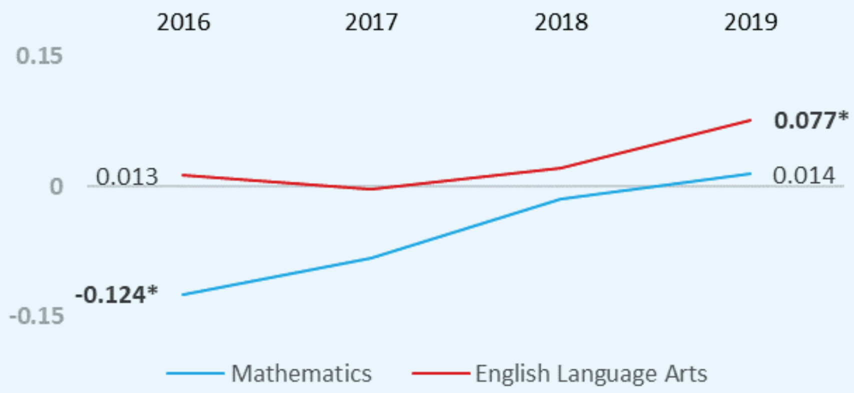


Note. The table illustrates trends in enrollments in Ohio charter schools. The area in blue captures enrollments in site-based charter schools serving a general student population—those that most resemble traditional public schools and that are the primary focus of this report. The dark grey area captures enrollment in online e-schools, which serve a variety of student populations. The "other" category, in light grey, captures enrollments in site-based schools serving primarily special student populations and those at risk of dropping out. Calculations are based on the National Center for Education Statistics's annual school-building files and the Ohio Department of Education's Charter School Annual Report tables.

Figure A reveals that Ohio charter schools went from enrolling over 120,000 students in 2015 to under 110,000 students in 2019—the latest year included in this study. But it also reveals that the enrollment losses occurred among e-schools. Enrollments for site-based charters serving general student populations (the focus of this report) held steady near the all-time high of 67,000 students, and these schools' share of total charter school enrollment rose from 56 percent in 2015 to 62 percent in 2019. Conversely, whereas 31 percent of charter school enrollments were in e-schools in 2015, that figure had fallen to 25 percent by 2019. The closure of the state's largest e-school, the Electronic Classroom of Tomorrow (ECOT), in early 2018 contributed to the decline in e-school enrollments.

Prior evaluations focused on the quality of Ohio's charter sector as a whole—combining the results for site-based schools serving general education students, e-schools, dropout-recovery schools, and those that educate special student populations (schools in which more than 50 percent of students have IEPs). The last such evaluation indicated that between 2016 and 2017—immediately after the enactment of Ohio's 2015 law—the impact of Ohio charter schools was negative in mathematics and statistically insignificant in ELA (see CREDO, 2019, page 12). As the present report discusses, there are methodological challenges with estimating the impacts of e-schools and other schools serving special student populations. Nevertheless, in an attempt to characterize the postreform performance of the overall charter sector in a way similar to previous evaluations, I used a variation of this report's primary methodology to estimate the overall impact of Ohio charter schools by year. Briefly, the method entails controlling for all observable student characteristics, including two prior years of student-level test scores to allow comparisons across districts (which allows the inclusion of e-schools that draw students statewide). Appendix G provides a detailed description and the results in tabular form.

Figure B. Estimated annual impact of attending any Ohio charter school



Note. The table illustrates improvement in the estimated annual impact of charter school attendance (including e-schools and schools serving students with special needs) on student achievement in grades 5–8. Values displayed in bold and with asterisks are statistically significant at a 5 percent level. Model specifications and tabular results appear in Appendix G.

Figure B presents estimates for each year since the 2015 reforms. It reveals that attending a charter school had a negative effect on students' achievement in mathematics in the years immediately after the reforms. These negative effects were −0.12 standard deviations in 2016 and −0.08 standard deviations in 2017, and both are statistically significant. There is no statistically significant impact for ELA in 2016 and 2017. That is, students who attended charter schools posted achievement gains that were no different than those of similar students in traditional public schools. These 2016–17 results are nearly identical to CREDO's most recent estimates.

Figure B also reveals a significant improvement in both subjects since CREDO's evaluation. In 2019, students attending charter schools had annual test score gains in ELA that were significantly greater than that of their district counterparts (by 0.077 standard deviations). Although the result in math was not statistically significant, it represents an improvement against the sector's performance in 2016. Overall, although one cannot attribute the improvements directly to the 2015 policy reforms, the evidence indicates that sector performance is on the upswing in grades 5–8.

This is good news for students and charter supporters alike, but some significant concerns remain. As the results in Table G4 of Appendix G reveal, there is no comparable trend for the impact of attending charter schools in high school grades. Learning gains in geometry and algebra remain low for students in charter high schools. Additionally, as Table G3 in the appendix reveals, overall charter school estimates are brought down by students in e-schools, who continue to post year-to-year achievement losses in ELA and very large losses in mathematics across all grades. As this report emphasizes, it is difficult to disentangle how much of the learning loss is due to the schools and how much is due to these students' special circumstances, which likely led them to e-schools in the first place. It is clear, however, that although disenrollment from e-schools led to significant average improvements in the overall charter sector (Figure B above), students in e-schools continue to fall behind rapidly.

Impact of charter school attendance in grades 9–12

Analyzing outcomes in grades 9–12 presents fresh challenges, as students become more mobile and there is greater variability in the curricula to which they are exposed. For example, end-of-course exams do not necessarily test knowledge and skills based on standards that are clearly articulated across consecutive grades. Students take those exams in different grades, depending on when they take the relevant coursework. Mobility further complicates attempts to capture accumulating effects, as students may change schools over time or leave school altogether. Thus, in contrast to the analysis for grades 4–8, it is less clear how much of the achievement gains to attribute to the year in which a student took the exam as opposed to prior years. This issue is even more pronounced for outcomes such as graduation and scores on college entrance exams, as these outcomes may have little to do with the school that students attended in the year they graduated or took the exam.[19]

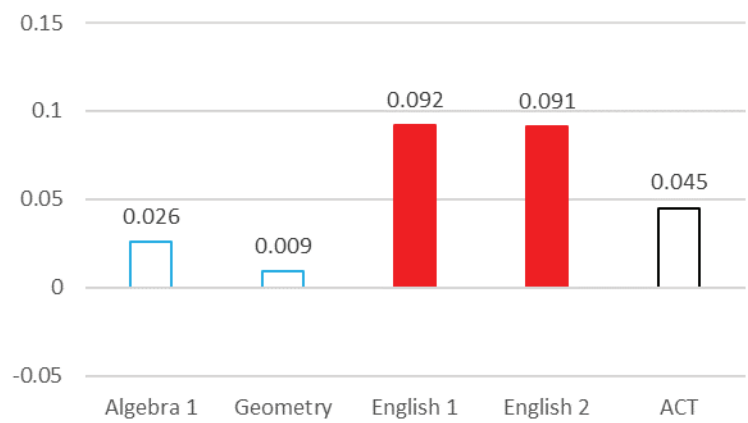
To address these problems, the analysis of outcomes observed in grades 9–12 estimates the impact of attending a site-based charter school (as opposed to a traditional public school) in grade 9. Thus, a student's ninth-grade school is held responsible for all subsequent educational outcomes. This common approach allows one to avoid the problems of mobility and the timing of testing and course-taking, but it introduces some noise into the estimates as it may not precisely capture how much a given school contributed to a mobile student's longer-term outcomes. The impact estimates are based on comparisons of students who are similar in terms of observable characteristics as of grade 8—including test scores, race, sex, economic disadvantage, special education status, and limited English proficiency—as well as test scores in grade 7.

Figure 9 presents the results for end-of-course exams and the ACT, which nearly all Ohio students took beginning in 2017. (Students who took the SAT are included by converting their composite scores to the ACT scale.) Once again, the primary estimates capture differences in test-score gains between observationally similar students attending charter and traditional public schools within the same geographic school district.[20] The bars indicate the average impact of attending a charter school (as opposed to a traditional public school) in standard deviation units. Positive numbers indicate a positive impact (a charter school advantage), whereas negative numbers indicate a negative impact (a charter school disadvantage). Solid bars indicate that the results attain conventional levels of statistical significance at the 5 percent threshold.

[19] Mobility is particularly problematic for students who end up in virtual or dropout-prevention and recovery schools (which are charter schools in Ohio), as students often spend significant time in other schools before taking an exam in a school that focuses on dropout-prevention and recovery. Indeed, one might consider enrollment in dropout-focused charter schools a negative outcome for which a student's prior school is partly responsible. That is one reason the focus of this report is on site-based schools with general student populations.

[20] Appendix E provides a thorough description of the research design and reports the results in tabular form.

Figure 9. Impact of charter schools on achievement (2016–19)



Note. The table illustrates the impact of attending a site-based charter school in grade 9 (as opposed to a traditional public school) on student achievement on end-of-course exams (primarily grades 9–10) and the ACT (primarily grade 11). Estimates are in standard deviations and are statistically significant if bars are solid. Model specifications and tabular results appear in Appendix E.

Figure 9 reveals that charter attendance leads to larger gains on English end-of-course exams by approximately 0.09 standard deviations (equivalent to moving from approximately the thirty-third percentile to the thirty-sixth percentile for the average charter school student in the sample), but there are no statistically significant impacts on end-of-course exams in algebra and geometry. Similarly, the estimated impact on the ACT (0.045 standard deviations) does not quite reach conventional levels of statistical significance.[21] A relatively small sample size may be partly responsible for the statistically insignificant result for the ACT, as this measure is available for fewer years.[22] That the estimates for the ACT (which includes both mathematics and English content) yield a similar average effect size as the end-of-course exams suggests that learning gains in high school persist and are not simply the result of teaching to state tests. The magnitudes of estimated impacts across the various models reported in appendixes E, F, and G (approximately 0.04–0.05 standard deviations across both mathematics and English exams) might seem modest—equivalent to moving from approximately the thirty-third to the thirty-fifth percentile on the national ACT distribution—but it is important to keep in mind that typical achievement gains in high school are small compared to the gains students make in early grades.

Because there are only fifty-nine site-based charter schools in Ohio that serve grades 9–12 (as compared to the 232 schools serving grades 4–8), providing breakdowns by locale and operator type is problematic. Additionally, although there is some evidence that minority and low-achieving students may benefit a bit more from charters serving grades 9–12—particularly when it comes to mathematics—the differences are too small and the estimates too imprecise to make that determination conclusively.[23]

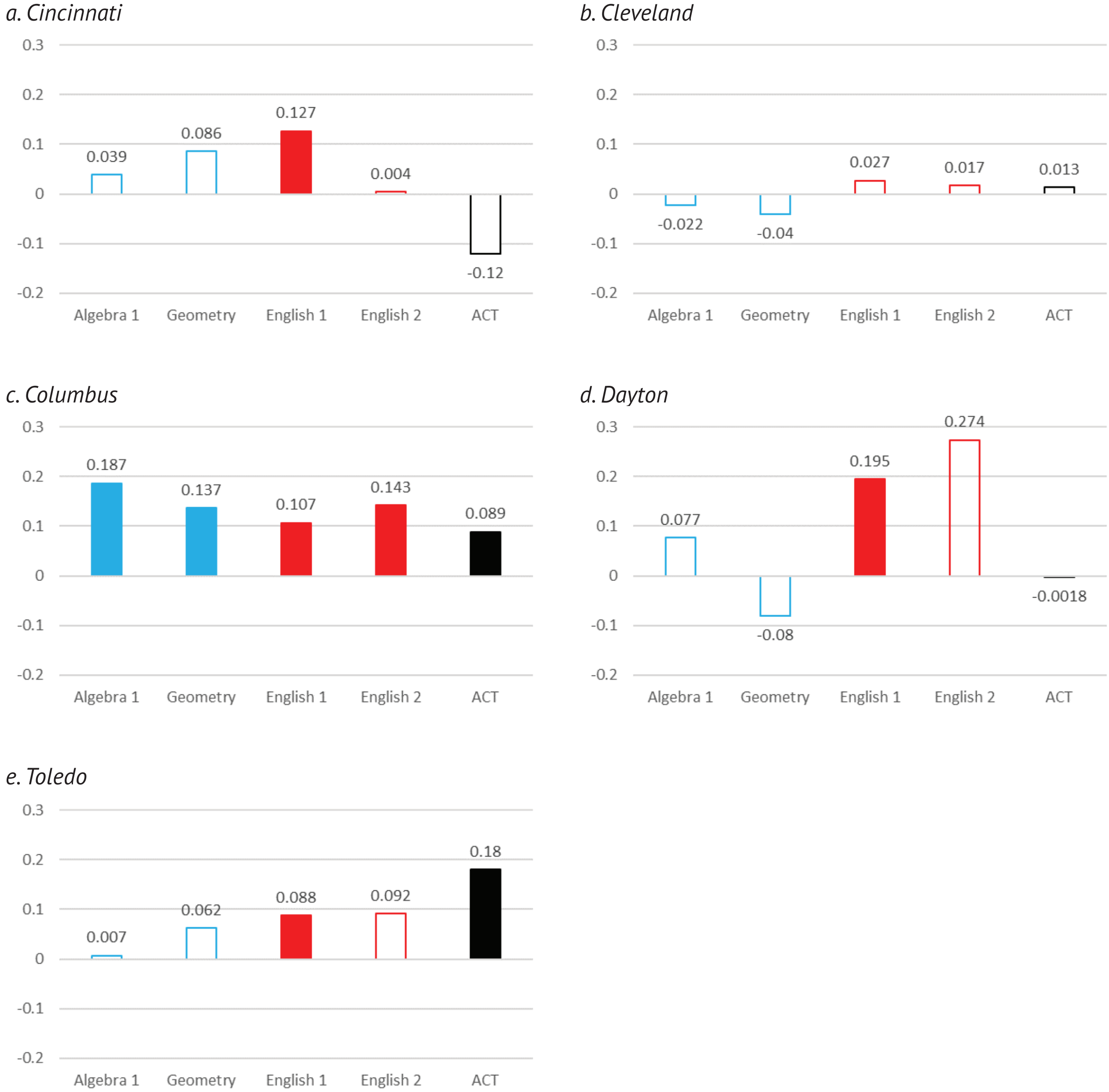
[21] The results in Appendix E are in the ACT scale that ranges from one to thirty-six. I converted the estimates to standard deviation units so that they are comparable to the units used for the state achievement tests. Specifically, I converted the estimates by dividing them by the national standard deviation for the ACT in 2018, which was 5.6.

[22] The ACT data start in 2017 (as opposed to 2016) and the data for 2019 are incomplete, as districts are still reporting ACT scores to the Ohio Department of Education through August 2020.

[23] See Tables E3 and E4 in Appendix E.

Thus, here I do not report the disaggregated effects as I did in the section for grades 4–8. However, because there is significant interest in knowing how the impact of charter schools varies across cities, Figure 10 presents the results disaggregated for the five cities with the largest charter school markets. It is important to emphasize, however, that the estimates are often too imprecise to detect substantively significant impacts.

Figure 10. Impact of charter schools on achievement (2016–19)



Note. The table illustrates the impact of attending a site-based charter school in grade 9 (as opposed to a traditional public school) on student achievement on end-of-course exams (primarily grades 9–10) and the ACT (primarily grade 11). Estimates are in standard deviations and are statistically significant if bars are solid. Model specifications and tabular results appear in Appendix E.

Figure 10 reveals that charter schools in Columbus provide significant value-added for high school grades, as measured by all four end-of-course exams and college entrance exams.[24] Although students attending charter schools in Cincinnati, Dayton, and Toledo also experience significant gains as measured by at least one exam, only Columbus charter schools yield such gains across the board. Some estimates for Dayton and Toledo just miss conventional levels of statistical significance, which is likely a product of the smaller sample sizes for these districts. The analysis clearly indicates, however, that there is no achievement advantage of attending a Cleveland charter school in grades 9–12.

The overall estimates for graduation rates are too imprecise to rule out substantively significant effects, and the problem is predictably worse if one disaggregates these effects by district (due to smaller sample sizes). For example, as Table E8 in Appendix E reveals, the estimated impact of Dayton charter schools on the probability of graduation may be quite large (around seven percentage points), but the results do not reach conventional levels of statistical significance. Because the analysis of graduation rates is inconclusive, I do not report the estimates here. Overall, however, the estimates suggest that there is no average difference in the probability of graduation if a student enrolls in a charter school in grade 9 instead of a traditional public school.[25]

Finally, because the estimated impacts of charter school attendance on attendance rates and disciplinary incidents are again similar regardless of the design, in the interest of space I present those results as part of the analysis of high school transitions (next section below).

[24] Recall that students who took the SAT are included, but their scores are on the ACT scale.

[25] Future evaluations probably should estimate the impact of middle school attendance on graduation or simply estimate this impact using more years of high school data.

Estimating charter school effects by focusing on high school transitions

Much like the middle school transition analysis in the section above, a potentially superior research design for grades 9–12 entails limiting the analysis to students who attended the same charter middle school in grade 8, with some of them transitioning to traditional public high schools and others transitioning to site-based charter high schools. Because the families of both sets of high school students previously exercised choice, such a design effectively controls for family characteristics that might affect both charter enrollment and education outcomes.[26] As with the analysis of middle schools, this approach yields average estimates similar to but somewhat more modest in size as compared to those based on the larger sample. For example, the overall estimated effect of attending a charter school in grade 9 is 0.077 standard deviations for English II, and the estimate for English I does not reach conventional levels of statistical significance. Once again, because this analysis is for a small subset of schools (there are only fourteen site-based charter schools in Ohio with grade 9 entry), the more modest results could be due to a change in the sample.

The estimates disaggregated by student characteristic (race and baseline achievement) are not the same, however, as those for the larger sample of charters serving grades 9–12. Whereas the analysis of all charter schools serving grades 9–12 revealed negligible differences across student groups, the results of this high school analysis reveal that minority and low-achieving students drive the overall achievement effects—which is more in line with the analysis of grades 4–8. In particular, the positive achievement effects for low-achieving students are quite pronounced: approximately 0.1 standard deviations on the ACT (an extra 0.54 points on the scale of one through thirty-six), 0.06 standard deviations for English I, and 0.1 standard deviations for English II. The estimates are also substantively significant for algebra and geometry exams (approximately 0.06 standard deviations) and for the probability of graduation (a 2.8 percentage-point increase), although these results do not attain conventional levels of statistical significance.[27]

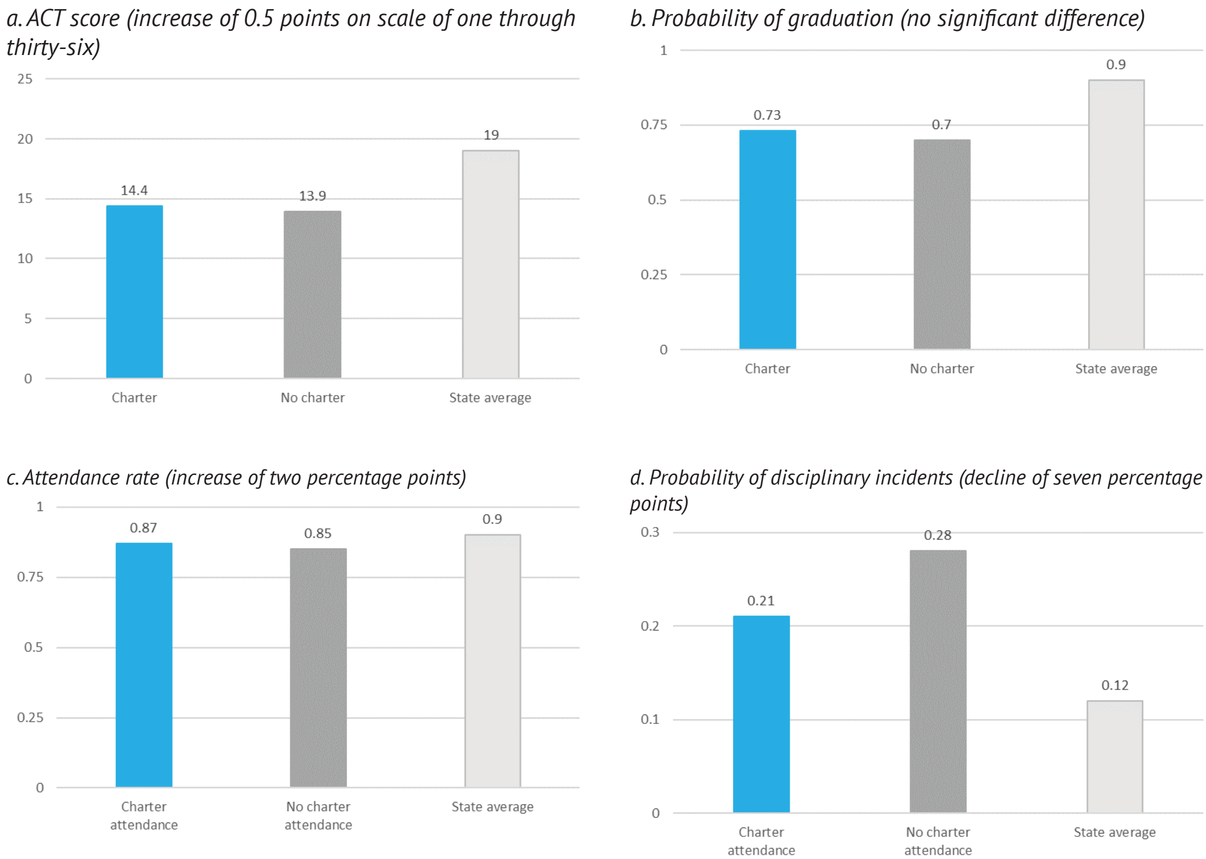
In order to illustrate how these achievement effects correspond to behavioral outcomes for low-achieving students, Figure 11 presents the effects of charter high schools on ACT scores, the probability of graduation, attendance rates, and the rate of disciplinary incidents.

---

[26] Indeed, such a matching design passes a validity test that entails comparing the seventh-grade test scores of matched students. The results are similar if I include students who attended traditional public schools in eighth grade. The biggest difference in results is that the achievement effects (on both the ACT and end-of-course exams) increase in size and become statistically significant for Black students when I use this larger sample of students. Whereas the loss of observations is significant if one limits the middle school analysis to students who attended the same elementary charter school, the reduction in sample size is relatively minimal for the high school analysis.

[27] These results appear in Table F3 of Appendix F.

Figure 11. Impact of attending a charter high school (low-achieving students only)



Note. The figure illustrates the impact of a low-achieving student attending a charter high school instead of a traditional high school on their ACT scores, probability of receiving a diploma, attendance rate, and probability of being reported for a disciplinary incident. The blue bars indicate the outcome for students who enter a charter high school, and the dark gray bars indicate the outcome for students who enter a traditional high school. The light gray bars indicate the state average for that outcome across all Ohio students. Values are based on models presented in Appendix F.

The increase of 0.5 points on the ACT makes up about 10 percent of the gap between the average score for the sample's low-achieving students (13.9 points) and the statewide average (19 points). There are no statistically significant ACT effects for Black students, but the behavioral effects of charter school attendance are similar across low-achieving and minority groups.[28] As Figure 11 reveals, those effects are substantial. Attendance rates increase by roughly two percentage points for low-achieving students attending charter schools, which closes about 40 percent of the eighth-grade attendance gap between low-achieving students in our sample and the statewide average. Similarly, as the results in the appendix reveal, the probability of chronic absenteeism (the fraction of students who miss 10 percent or more of total instructional hours) drops by six percentage points (about one-third of the eighth-grade gap between low-achieving students and the statewide average). Finally, the probability of disciplinary incidents drops by seven percentage points (almost half of the gap in eighth grade).

[28] If one replicates the analysis such that it includes students who attended traditional public schools prior to high school, then the ACT estimates are nearly identical and statistically significant for both Black and low-achieving students.

Unfortunately, the estimates of the impact of charter school attendance are too imprecise to know whether there is a true difference in the probability of graduation. The estimated three-percentage-point increase in the graduation rate for low-achieving students closes about 15 percent of the gap between the sample's low-achieving students (0.7 probability of graduation) and the statewide average (0.9 probability of graduation).[29] However, this estimated effect does not reach conventional levels of statistical significance and may merely be a statistical artifact.

***

Overall, the analysis of this subset of fourteen charter high schools yields results comparable to the larger analysis that includes all charter school students in grades 9–12. But it also reveals substantively significant impacts for low-achieving students on college entrance exams—an estimate that did not quite reach conventional levels of statistical significance in the larger sample. There is also a substantial increase in attendance rates and a decline in reported disciplinary incidents—particularly for low-achieving and Black students—regardless of the sample or analytic method used.

[29] The statewide four-year graduation rate is 0.85, but the overall probability that students eventually receive a diploma is around 0.9.

Benchmarking the effect sizes

The analysis above indicates that there are cognitive and behavioral benefits to attending Ohio's site-based charter schools in grades 4–12. How large these benefits are is a matter of perspective. One way to gauge the magnitude of the annual achievement effects is to compare them to how much students typically learn in a given school year. That is effectively what CREDO (2019) does when it converts its estimates to "days of learning" equivalents. According to Hill et al. (2008), average annual achievement in grades 4–8 increases by about 0.3025 standard deviations. Assuming that student achievement increases linearly and additively across 180 school days, the average achievement estimate of 0.062 standard deviations for the grade 4–8 analysis (Figure 1) implies that charter school students achieved as if they had received thirty-seven additional days of instruction each year during those grades.[30] In other words, if students attended charter schools for all five years (grades 4–8), the magnitude of the cumulative achievement effect is comparable to an extra year of schooling by eighth grade (5 x 37 = 185 days).

Another way to benchmark effect sizes is by examining the extent to which they reduce gaps in education outcomes. Figures 6–8 and Figure 11 do this by comparing predicted outcomes for low-achieving and Black students to statewide averages. For example, the conservative achievement estimates in Figures 6–8 reveal that charter middle schools reduce achievement gaps by approximately one-half for Black students and by one-quarter for low-achieving students. The figures also illustrate how charter middle schools nearly eliminate differences in attendance and disciplinary incidents between the average Ohio student and Black or low-achieving students in our sample. Similarly, Figure 11 reveals that attending a charter high school leads to a 10 percent reduction in the ACT-score gap between low-achieving students and the average Ohio student, as well as reductions of 30 to 50 percent in the disparities in attendance rates and disciplinary incidents. The results are comparable for Black students.

These two benchmarking exercises provide some intuition, but they do not provide comparisons to other education interventions that policymakers might pursue. Kraft (2020) conducted a meta-analysis of interventions that were evaluated using randomized control trials. His analysis indicates that educational interventions typically have achievement effects of 0.1 standard deviations (for example, programs that provide breakfast to disadvantaged students), and he argues that total effect sizes above 0.2 standard deviations (for example, those associated with intensive one-on-one tutoring for high-needs students) are large because that puts them in the seventy-fifth percentile of effectiveness. This evaluation's achievement analysis of grades 4–8 implies that students attending charter schools for all five of those grades experience improvements in achievement of approximately 0.3 standard deviations, whereas the results of the more restricted middle school analysis suggest cumulative effects of around 0.2 standard deviations. Effect sizes in high school (across math and ELA) are closer to 0.05 standard deviations. Thus, one might characterize as "medium to large" the average achievement effects of charter schools for grades 4–8 and characterize as "small to medium" the effect sizes in high school grades.

---

[30] Although there are problems with this conversion (Baird and Pane, 2019), it provides some useful intuition.

Such characterizations of effect sizes are informative, but they omit what appear to be positive behavioral effects of charter schools across all grades. Research has shown that such measures capture dimensions of school quality not captured by test scores and that they can be predictive of superior life outcomes—even beyond the long-term effects associated with improved student achievement. There are questions about what these measures capture. For example, it is unclear whether fewer disciplinary incidents indicate that there were actually fewer such incidents (suggesting behavioral improvements) or that a school is less inclined to report such incidents among its pupils. At the very least, however, the results suggest some positive behavioral outcomes that may help explain charter schools' impacts on student achievement.

Finally, one might characterize the effect sizes in Ohio by comparing them with the effect sizes of charter schools in other states. In particular, studies in cities such as Boston, Chicago, Washington, D.C., and New York City indicate that urban charter schools serving poor and minority students can have very large achievements effects of 0.2–0.4 standard deviations annually (for example, see Angrist et al., 2013). In terms of charters serving high school grades, Angrist et al. (2016) find that Boston high schools have large positive impacts of approximately 0.3 standard deviations on graduation exams and the SAT.

Perhaps the most appropriate comparison to make is with the charter sector in Columbus. Like Boston, it is the highest-performing charter sector in the state (relative to nearby schools and relative to schools statewide) and has a positive impact across all achievement outcomes: tests in grades 3–8 (0.1 standard deviations annually), end-of-course exams (0.1–0.2 standard deviations), and the ACT (0.1 standard deviations).[31] Thus, achievement effects of Columbus charter schools are approximately 25 to 50 percent as large as Boston's, arguably one of the nation's highest-performing charter sectors.

In terms of high school effects on attainment and behavioral outcomes, rigorous research is sparse. In the most rigorous study of charter high school impacts, Angrist et al. (2016) find that Boston high schools have no impact on graduation rates. Like Boston's, Ohio's charter high schools have no discernable effect on graduation rates. That might be due in part to imprecision in this study's estimates. For example, the estimates for low-achieving students would be substantively significant if the high school models were more precisely estimated (for example, see Dobbie and Fryer, 2020). It also is important to note that Angrist et al. (2016) found positive postsecondary outcomes in spite of the lack of graduation effects. In other words, the achievement effects seem to yield long-term benefits even in the absence of graduation effects. Finally, average reductions in chronic absenteeism attributable to Ohio charter high schools are similar in magnitude to those found in North Carolina (McEachin et al., 2020).

[31] Note that Toledo's charter sector provides students with an even larger advantage on the ACT (0.2 standard deviations) and the charter schools in Cleveland and Dayton do just as well in elementary grades (approximately 0.1 standard deviations annually). These estimates by city appear in Table B5 of Appendix B and Table E9 of Appendix E. However, one should exercise caution when comparing charter schools between cities, as the analysis compares charters to students' local educational options. As Table G5 in Appendix G reveals, comparing charters to the average traditional public school in Ohio leads to smaller estimated effects. In particular, the large achievement impacts of Cleveland's charters may be due in large part to the relatively poor performance of its traditional public schools.

Charter school expansion in Ohio

This study indicates that Ohio charter schools generally have positive educational effects on the students who attend them—particularly Black and low-achieving students in urban areas. Research indicates that such effects translate to tangible benefits for students and for society at large. An increase in student achievement of 0.2 standard deviations can increase that student's future earnings by 2 percent—for a present value of over $10,000 at age twelve (Chetty et al., 2014).[32] Such improvements in achievement could also have significant impacts on economic growth (Hanushek et al., 2017). For the state of Ohio, Hanushek (2018) projects that increasing student achievement at graduation by 0.25 standard deviations would yield future economic growth with a present discounted value of over $1.5 trillion.

Whether such potential benefits are sufficiently great to warrant expanding enrollments in Ohio charter schools depends on the costs involved. Educational interventions that yield achievement effects of around 0.2 standard deviations typically cost over $1,000 per pupil (for example, see Abott et al., 2020; Kraft 2020). By comparison, the direct cost of charter schools is minimal. The state provides charter schools and traditional public schools with comparable funding per pupil, even as charter schools provide substantial savings to local taxpayers. Local taxpayers are responsible for funding a substantial share of district per-pupil costs, but charter schools typically do not share in this revenue (save for a few charters in Cleveland). Districts are required to provide some services to charter students (for example, transportation), but the direct costs of charter schools to local taxpayers is generally far lower than that of traditional public schools. Thus, charter schools arguably provide a significant cost savings to taxpayers while delivering significant educational benefits.

One important factor to consider, however, is that there may be both costs and benefits that this evaluation does not capture. In particular, critics of charter schools worry about the impacts on traditional public schools and the students "left behind." Research indicates that the impact of charter school competition on student achievement in traditional public schools is either nonexistent or positive (for example, see Epple et al., 2015), but some studies find that charter schools have a negative impact on district finances. For example, Cook (2019) concludes that competition from Ohio charter schools in the early 2000s led to a decline in district revenue and spending by depressing housing values. It is important to note, however, that Ohio's charter schools were likely far less effective in the early 2000s than they are today. Indeed, this study finds a significant improvement in charter school performance since 2016 and as compared to evaluations using data prior to 2016. Because housing prices are responsive to school quality, the expansion of high-performing charter schools could now have a very different impact on the local tax base from which school districts draw.

Another concern is that charter schools might negatively affect U.S. democracy by promoting individualism, lowering citizen engagement with public institutions, and emphasizing student

[32] Thus, if providing students with charter elementary and middle schools were to cost an extra $1,000 per student annually for grades 4–8 (for a total cost of $5,000 per student), the net benefit based on student earnings is $5,000 ($10,000 minus $5,000).

achievement on tested subjects. The limited research on these topics does not indicate that charter schools produce inferior citizens. For example, McEachin et al. (2020) find that attending a North Carolina charter high school leads to lower rates of criminal behavior and higher rates of political participation. Cook et al. (2020) did find that charter school competition led to reductions in citizen participation in Ohio school board elections, but they found no such effect on other Ohio elections. Thus, although charter schools may limit engagement with school district politics, there is no evidence that they undermine other democratic institutions.

There is also a longstanding concern that school choice will lead to racial segregation, as families sort their children into schools with similar peers. Indeed, there is some solid evidence that charter schools lead to some increase in segregation within U.S. public school districts. Monarrez et al. (2019) estimate that eliminating charter schools nationwide would lead to a 5 percent decrease in racial or ethnic segregation within districts (although they find that eliminating charters would increase segregation between districts in the same metro areas). Their estimates for Ohio are about the same as they are for the U.S. at large, but the Ohio-specific estimates do not reach conventional levels of statistical significance. Whether the impact on within-district segregation is sufficiently large to cause concern depends on how much value one assigns to racial integration relative to charters' achievement effects and the value of providing parents with educational options.

Finally, another important factor to consider is scalability—whether the achievement effects would hold if charter enrollments were to expand. At least two conditions must hold. First, charter school practices must be replicable. That means in part that there must be a ready supply of teachers and school leaders willing and able to run new schools as effective as existing ones. Second, students who stand to benefit most—low-achieving and minority kids in urban areas—need to select into these schools at sufficiently high rates. This evaluation makes clear that one cannot expand charter schools to the point that Ohio as a whole can experience student achievement gains of 0.25 standard deviations (to generate the $1.5 trillion in growth that Hanushek's analysis predicts). Charter schools' positive impacts are primarily in urban areas serving disadvantaged students. On the other hand, the results of the analysis also make clear that the returns to charter schooling could increase if policymakers found a way to enroll a larger share of low-achieving students, many of whom are not taking full advantage of their current charter school options. That is because students who stand to benefit most are least likely to exercise school choice (Walters, 2018; Singleton, 2020). Thus, to maintain (or enhance) the quality of Ohio's charter sector while expanding it, policymakers would need to focus on expanding charter school models that are scalable, and they would need to take steps to make sure that disadvantaged students enroll. For example, one option is to provide more per-pupil funding to charters when they serve disadvantaged students (see Singleton, 2020).

With these caveats in mind, there is reason to believe that charter school expansion could be beneficial. For example, Boston's program for replicating high-quality charter schools led to an overall increase in the quality of the charter sector while also increasing the charter market share from 15 percent to 31 percent in just a few years (see Cohodes et al., 2019). Ohio's charter sectors in Cleveland, Columbus, and Dayton already enroll 25 to 30 percent of all public school students. But cities like Cincinnati and Toledo have charter market shares of 10 to 20 percent. They could experience expansions roughly on par with Boston and significantly improve their charter and traditional public schools. For example, if they can replicate the types of charter school models that have proven successful in Columbus, the achievement impact of charter expansion in Cincinnati could be quite large. Smaller cities with small charter market shares—such as Akron and Canton—might also see significant gains in student achievement with the replication and expansion of successful charter schools. Indeed, there remain significant opportunities across all of the Big 8 districts if policy incentivizes charter schools to educate the lowest-achieving students, as Ohio report cards indicate that these districts do a poor job of educating students in the bottom twentieth percentile.

Overall, if policymakers are interested in increasing student achievement at relatively low cost—particularly among low-income and minority students in urban areas—the available evidence suggests that a promising approach is to expand site-based charter schools serving general student populations. The results of this analysis, combined with the best available prior research, suggest that an expansion policy should focus on scalable charter schools that yield significant year-to-year achievement gains and that it should incentivize schools to enroll low-achieving students. Additionally, given recent studies indicating that increasing spending can yield significant achievement gains among schools with low per-pupil expenditures (for example, Abott et al., 2020), increasing charter school funding in Ohio could also yield achievement gains.

Appendixes

Appendix A: Data

The Ohio Department of Education (ODE) provided student-level data for the analysis. These data include scale scores for mathematics and English language arts (ELA) exams in grades 3–8 (available for years 2006–19) and scale scores for end-of-course exams (Algebra I, Geometry, English I, and English II) that students primarily take in grades 9–11 (available for years 2015–19). Setting aside scores for students who took alternative assessments, I standardized the grade 3–8 exams by grade, subject, and year using the statewide file. I standardized the end-of-course exam scores by subject and year, as students take these exams across different grades. Finally, I removed all scores that were more than three standard deviations beyond the mean, which led to a normal distribution of scores for each subject, year, and grade. The distribution of scores is not quite normal otherwise, as there is a bunching of extremely low scores on the left end of the score distribution (for example, as if students sat for the exams but did not make a serious attempt at answering the questions). The cutoff of three standard deviations is common in statistical research.

The test data also include scores on ACT and SAT exams, which all students across the state took beginning in 2017. Students primarily take these exams in eleventh grade. For each student, I calculated the total score across subjects and kept the scores on their last recorded attempt. The analysis focuses on ACT scores. For the minority of students who took the SAT but not the ACT, I translated their SAT score to the ACT scale. Because of a lag in district reporting of ACT scores, there are some missing data for students who took the ACT in 2019.

ODE also provided data on student attendance (measured in hours), disciplinary incidents, and graduation. The analysis focuses on overall student attendance (total hours a student is in school in a given year), attendance rates (total attendance hours as a proportion of all possible attendance hours for that school), whether or not a student was chronically absent (missed 10 percent or more of the possible school hours in a given year), whether or not a school reported at least one disciplinary incident for a student (any incident besides truancy), and whether or not a student received a diploma. Like the end-of-course exam scores, these data are available for 2015–19.

In addition to these outcome data, ODE provided the standard battery of student-level covariates for years 2006–19. These include student race, sex, special education status, limited English proficiency (LEP) status, and an economic-disadvantage status based in part on free- and reduced-price lunch eligibility. As I note below, because economic disadvantage is sometimes a school- or district-wide status, it may not accurately capture the status of individual students in some schools. Finally, ODE provided charter school data, including the school district in which a charter school is physically located (2015–19), the type of charter school (for example, whether it is site based or virtual), and whether the school contracts with a management organization. Tables in the following appendixes provide descriptive statistics for these student- and school-level variables.

Appendix B: Primary analysis of site-based charters serving grades 4–8

The data for grades 3–8 enable one to estimate the impact of attending a charter school on year-to-year changes (or gains) in student achievement, attendance, and disciplinary incidents. The primary empirical strategy in this report entails comparing year-to-year changes in these outcomes between students attending charter schools and those attending traditional public schools in the same school district, while accounting for observed differences between those students. To maximize sample size and to include all charter school students for whom we have data, the primary results in this report are based on statistical models estimated using all grade 3–8 student data for the sixty-six districts in which charter schools with the relevant grades are located during our period of study. Table B1 presents descriptive statistics for the analytic sample.

I estimated the annual impact of attending a charter school—as opposed to attending a traditional public school—using the following Ordinary Least Squares (OLS) model:

$$y_{igdt} = \alpha_t + \beta_g + \mu_d + X'_{it}\vartheta + Charter'_{it}\tau + \varepsilon_{igdt} \qquad \text{(B1)}$$

where y_{igdt} is an outcome for student *i* in grade *g* and district *d* during school year *t*. α_t, β_g, and μ_d are year, grade, and district fixed effects, respectively. The vector X_{it} includes a series of indicator variables capturing student demographic characteristics (race, sex, special education status, LEP status, and economic-disadvantage status) in a given year *t* a variable indicating whether a student received test-taking accommodations in the year *t* cubic polynomials of standardized math and reading scores during the prior school year *(t-1)*, a student's attendance rate in the prior school year *(t-1)*, and variables indicating whether a student had a disciplinary incident or was chronically absent during the prior school year *(t-1)*. The vector $Charter_{it}$ contains variables indicating whether student *i* attended each type of charter school (for example, a site-based charter school serving a general student population) during school year *t*. Many of the results below are for regressions estimating heterogeneity in charter school effects by student and district characteristics. I generated these estimates by interacting $Charter_{it}$ with the relevant characteristics. Standard errors are clustered by school.

The parameter τ captures the causal impact of charter school attendance on student achievement and behavior if charter attendance is as good as randomly assigned, conditional on the covariates included in the model. In other words, the estimates are valid if statistical controls account for all observed and unobserved student characteristics that explain both charter school attendance and year-to-year changes in the outcomes. This conditional-independence assumption is not testable, but there is good reason to believe that the estimates in this study are a close approximation of the true causal effect of attending a charter school. First, research has shown that within-district comparisons of student achievement gains using the above regression approach capture the causal impact of schools quite well (for example, see Bifulco, 2012, and Deming, 2014). Indeed, as in these other studies, removing student covariates other than math and reading scores does not significantly affect the results. Second, as I show below, the results are similar when using methods scholars have validated (for example, Abdulkadiroglu et al., 2011; Angrist et al., 2013; and Dobbie and Fryer, 2013) but that apply to a more limited sample.

It is also important to note that these well-regarded studies generally omit from their analyses schools that serve populations with special educational needs, as including these schools makes apples-to-apples comparisons difficult (for example, one would need specific information about students' IEPs). Moreover, because statewide virtual schools do not allow for within-district comparisons and tend to serve students in unusual circumstances, using standard education data to estimate their impact is likely to yield biased results (for example, see Bifulco, 2012). Thus, although I report some estimates of the impact of attending any Ohio charter school in Appendix G (including virtual, dropout prevention and recovery, and special education), this report focuses on estimating the impact of site-based charter schools serving general student populations.

Tables B2–B7 (below) report the estimated effects. Recall that these estimates capture the impact of attending a charter school for one year. For example, consider the results in Table B3. The table indicates that attending a charter school (instead of a traditional public school) for one year leads to achievement gains of 0.062 of a standard deviation on math and reading exams. Thus, if a student attended a charter school for grades 4–8, this result implies that the student's achievement would increase by approximately 0.3 standard deviations (that is, 0.06 x 5 years). The results also indicate that students received seventy-five more hours of instruction annually in charter schools than they did in traditional public schools. This is partly due to charter schools' impact on student attendance rates, which went up by 0.004—that is, by 0.4 percentage points per year for a total of two percentage points after five years. Note, however, that there is no discernable impact of charter school attendance on the probability that a student is chronically absent. The estimated effect is close to zero and not statistically significant, which is why the coefficient it not in bold.

Finally, Table B3 reveals that students attending charter schools are less likely to be reported for a disciplinary incident other than truancy. Specifically, the results indicate that for every year a student is in a charter school, the probability that a student is reported for such an incident declines by three percentage points. That implies a reduction of fifteen percentage points after five years.

Table B1. Descriptive statistics for analytic sample (grades 4–8)

	Charter school students	Site-based / gen. ed. charter school students	Traditional public school students
Overall counts			
Unique districts	62	42	66
Unique schools	297	232	734
Unique students	62,722	47,603	234,202
Student-year observations	114,827	90,229	500,139
Student race			
Black (percent of students)	53.48	64.13	33.76
Hispanic (percent of students)	8.57	9.61	8.98
White (percent of students)	30.59	19.29	48.58
Other (percent of students)	7.06	6.97	8.68
Student designations			
Special education (percent of students)	17.49	14.72	15.95
Economically disadvantaged (percent of students)	83.85*	89.21*	77.93*
LEP (percent of students)	3.64	4.56	3.25
School location			
Big 8 (percent of students)	71.89	79.44	43.44
City (percent of students)	74.94	82.73	52.49
Suburb (percent of students)	22.15	16.08	35.39
Town (percent of students)	2.46	0.72	7.00
Rural (percent of students)	0.46	0.47	5.13
Student outcomes			
ELA (average in standard deviations)	−0.45	−0.47	−0.34
Mathematics (average in standard deviations)	−0.56	−0.55	−0.32
Attendance (average annual rate)	0.94	0.94	0.94
Attendance (average annual hours of schooling)	1,023	1,040	983
Chronically absent (average annual rate)	0.19	0.19	0.16
Disciplinary incidents (average annual rate)	0.17	0.19	0.16

Note. The table presents descriptive statistics for the data used in the analysis of charter school effects for grades 4–8. The "student outcomes" variables are one-year lags of the outcomes used in the analysis (for example, grade 3 values for students in grade 4). The ELA and mathematics scores capture the number of standard deviations from the statewide mean by grade, subject, and school year. The statistics for economic disadvantage are starred because they should be interpreted with caution. They incorrectly identify students who attended schools in which all students participate in free- or reduced-price lunch programs regardless of a given student's economic status.

Table B2. Annual impact of site-based charter schools serving a general student population (2016–19)

	Average math/ELA (SDs)	Math (SDs)	ELA (SDs)	Attendance hours	Attendance rate	Chronic absenteeism (0,1)	Disciplinary incidents (0,1)
SB charters	**0.062**	**0.046**	**0.077**	**75.525**	**0.004**	−0.000	**−0.029**
	(0.009)	(0.012)	(0.009)	(6.677)	(0.002)	(0.006)	(0.009)

Note. The table reports the results of models estimated using the specification in equation B1. Each coefficient is from a separate regression. Standard errors clustered by school appear in parentheses below coefficient estimates. Coefficients in bold are significant at the p<0.05 level.

Table B3. Annual impact of site-based charter schools serving a general student population (by student race)

	Average math/ ELA (SDs)	Math (SDs)	ELA (SDs)	Attendance hours	Attendance rate	Chronic absenteeism (0,1)	Disciplinary incidents (0,1)
Black	**0.077**	**0.061**	**0.091**	**87.916**	**0.005**	−0.002	**−0.040**
	(0.011)	**(0.014)**	**(0.010)**	(7.614)	**(0.002)**	(0.008)	**(0.012)**
White	**0.034**	0.022	**0.045**	**45.355**	0.000	0.009	−0.011
	(0.011)	(0.015)	**(0.010)**	**(8.092)**	(0.001)	(0.006)	(0.008)
Hispanic	**0.044**	0.016	**0.073**	**68.360**	0.002	−0.004	−0.016
	(0.013)	0.018	**(0.012)**	**(10.309)**	(0.002)	(0.009)	(0.008)
Other	**0.042**	0.028	**0.054**	**68.015**	0.003	0.000	−0.004
	(0.012)	0.015	**(0.012)**	**(8.784)**	(0.002)	(0.007)	(0.009)

Note. The table reports the results of models estimated using the specification in equation B1. Each column of estimates is from a single regression and captures charter school impacts disaggregated by student race. Standard errors clustered by school appear in parentheses below coefficient estimates. Coefficients in bold are significant at the p<0.05 level.

Table B4. Annual impact of site-based charter schools serving a general student population (by achievement)

	Average math/ ELA (SDs)	Math (SDs)	ELA (SDs)	Attendance hours	Attendance rate	Chronic absenteeism (0,1)	Disciplinary incidents (0,1)
Low	**0.072**	**0.052**	**0.090**	**75.879**	**0.004**	−0.000	**-0.032**
	(0.009)	(0.012)	(0.009)	(6.589)	(0.002)	(0.007)	(0.010)
High	**0.028**	0.024	**0.029**	**74.282**	0.003	0.001	**−0.017**
	(0.012)	(0.016)	(0.011)	(8.770)	0.002	0.006	(0.007)

Note. The table reports the results of models estimated using the specification in equation B1. Each column of estimates is from a single regression and captures charter school impacts disaggregated by student achievement levels in the prior year—either below the statewide median of 0.0568 ("low") or above it ("high"). Standard errors clustered by school appear in parentheses below coefficient estimates. Coefficients in bold are significant at the $p<0.05$ level.

Table B5. Annual impact of site-based charter schools serving a general student population (by NCES "locale")

	Average math/ ELA (SDs)	Math (SDs)	ELA (SDs)	Attendance hours	Attendance rate	Chronic absenteeism (0,1)	Disciplinary incidents (0,1)
City	**0.074**	**0.059**	**0.088**	**79.944**	**0.004**	0.001	**−0.023**
	(0.011)	(0.014)	(0.010)	(7.688)	(0.002)	(0.007)	(0.010)
Suburb	0.012	−0.007	**0.031**	**66.538**	0.001	−0.006	**−0.056**
	(0.016)	(0.021)	(0.015)	(12.510)	(0.002)	(0.009)	(0.017)
Town	−0.005	0.005	−0.007	**−68.496**	−0.002	0.040	0.017
	(0.074)	(0.093)	(0.063)	(26.737)	(0.003)	(0.023)	(0.028)
Rural	0.002	−0.049	0.030	**−58.774**	0.003	−0.005	**−0.075**
	(0.083)	(0.154)	(0.025)	(26.782)	(0.006)	(0.037)	(0.012)

Note. The table reports the results of models estimated using the specification in equation B1. Each column of estimates is from a single regression and captures charter school impacts disaggregated by the National Center for Education Statistics's "locale" designations. Standard errors clustered by school appear in parentheses below coefficient estimates. Coefficients in bold are significant at the $p<0.05$ level.

Table B6. Annual impact of site-based charter schools serving a general student population (by major city)

	Average math/ELA (SDs)	Math (SDs)	ELA (SDs)	Attendance hours	Attendance rate	Chronic absenteeism (0,1)	Disciplinary incidents (0,1)
Big 8	**0.076**	**0.060**	**0.091**	**81.762**	**0.004**	0.001	−0.023
	(0.011)	(0.014)	(0.010)	(7.891)	(0.002)	(0.008)	(0.010)
Not Big 8	0.015	−0.001	**0.030**	**54.483**	0.001	−0.004	**−0.049**
	(0.014)	(0.019)	(0.013)	(11.817)	(0.001)	(0.007)	(0.014)
Cincinnati	0.008	−0.030	0.030	**184.418**	**0.025**	0.032	**−0.088**
	(0.029)	(0.034)	(0.027)	(18.384)	(0.008)	(0.021)	(0.042)
Cleveland	**0.109**	**0.072**	**0.145**	**59.917**	−0.005	0.024	0.020
	(0.021)	(0.027)	(0.020)	(13.916)	(0.003)	(0.014)	(0.018)
Columbus	**0.100**	**0.095**	**0.105**	**89.023**	**0.017**	**−0.078**	**−0.061**
	(0.022)	(0.028)	(0.019)	(16.709)	(0.003)	(0.013)	(0.018)
Dayton	**0.099**	**0.111**	**0.085**	**59.685**	0.002	−0.010	0.019
	(0.033)	(0.045)	(0.029)	(14.113)	(0.003)	(0.017)	(0.017)
Toledo	0.029	0.019	0.039	**64.379**	**−0.011**	**0.065**	−0.006
	(0.024)	(0.031)	(0.021)	(16.616)	(0.003)	(0.018)	(0.021)

Note. The table reports the results of models estimated using the specification in equation B1. Each column of estimates in the top panel is from a single regression and captures charter school impacts disaggregated by whether or not a district is one of the “Big 8” school districts (Akron, Cincinnati, Cleveland, Columbus, Canton, Dayton, Toledo, and Youngstown). Each column of estimates in the bottom panel is from a separate regression estimate and disaggregates impacts from the five districts with the greatest charter school enrollments. Standard errors clustered by school appear in parentheses below coefficient estimates. Coefficients in bold are significant at the $p<0.05$ level.

Table B7. Annual impact of site-based charter schools serving a general student population (by operator type)

	Average math/ ELA (SDs)	Math (SDs)	ELA (SDs)	Attendance hours	Attendance rate	Chronic absenteeism (0,1)	Disciplinary incidents (0,1)
No management	**0.073**	**0.067**	**0.077**	**51.537**	**0.009**	−0.021	**−0.091**
organization	(0.023)	(0.028)	(0.020)	(17.501)	(0.003)	(0.011)	(0.020)
For-profit management	**0.042**	0.018	**0.064**	**86.600**	−0.000	**0.019**	**−0.023**
organization	(0.010)	(0.014)	(0.010)	(8.352)	(0.002)	(0.007)	(0.009)
Nonprofit management	**0.096**	**0.087**	**0.104**	**70.360**	**0.007**	**−0.022**	0.014
organization	(0.015)	(0.021)	(0.014)	(10.789)	(0.002)	(0.011)	(0.012)

Note. The table reports the results of models estimated using the specification in equation B1. Each column of estimates is from a single regression and captures charter school impacts disaggregated by the type of operator—whether a school runs itself ("no management organization"), contracts with a for-profit management organization, or contracts with a nonprofit management organization. Standard errors clustered by school appear in parentheses below coefficient estimates. Coefficients in bold are significant at the $p<0.05$ level.

Appendix C: Alternative design for charter middle schools

Focusing on charter middle schools allows for a potentially more rigorous design than one that includes all elementary grades. That is because one can identify students who attended the same elementary school at the same time—and who had identical demographic characteristics—in the year before a natural grade transition. Students who attended the same pre-transition elementary school are likely to be similar on a number of dimensions (for example, parental motivation and income) that demographic characteristics and test scores may not capture, and natural grade transitions enable one to set aside unusual circumstances that might lead students to move between sectors. Indeed, in their analysis of Boston charter schools, Angrist et al. (2013) found that a research design that matched traditional public and charter middle school students based elementary school attendance and student demographics yielded estimates comparable to a research design that features random assignment to charter and traditional public schools—the gold standard in evaluation research. Other studies of charter schools also have found that such designs yield minimal bias in other contexts (see Dobbie and Fryer, 2019).

Specifically, the design entails creating matched "cells" of students who attended the same elementary school in the same year and in the same terminal grade for that school and who share demographic characteristics (sex, race, LEP status, economic-disadvantage status, and special education status). I included a student cell in the analysis if at least one student in that cell transitioned to a charter middle school (with entry grades 4, 5, 6, or 7) and at least one student in that cell did not transition to a charter middle school in that entry grade. I then estimated the following OLS model:

$$Y_{igtc} = \alpha_t + \beta_g + \mu_c + X'_i\vartheta + S'_{it}\tau + \varepsilon_{igdt} \qquad \text{(C1)}$$

where y_{igtc} is an outcome for student i in grade g during school year t who is part of cell c. α_t, β_g, and μ_c are year, grade, and cell fixed effects, respectively. The vector X_{it} includes cubic polynomials of standardized math and reading scores in the year prior to transitioning to middle school. The vector S_{it} is a running sum of time spent in site-based charter middle schools serving a general student population and a running sum of time spent in other charter schools (including those no longer in operation in 2016–19). Standard errors are clustered by school.

Although Table C1 (below) suggests imbalances between the characteristics of those who did and did not transition to charter middle schools, what is important is covariate balance within cells. Student demographics are perfectly balanced within cells (because of the matching). There are only minor differences in student achievement within cells—even though the procedure does not entail matching on those test scores. Tables C2–C4 (below) provide overall estimated effects, estimates by student race, and estimates by baseline achievement levels. Once again, the estimates capture the annual impact of charter school attendance. Thus, if a student attends a charter middle school for three years, one should multiply the estimated effect by three.

Table C1. Descriptive statistics for middle school analytic sample

	Site-based / gen. ed. charter school students	Traditional public school students
Overall counts		
Unique districts	12	158
Unique schools	33	500
Unique students	1,883	5,373
Student-year observations	8,337	23,322
Years in charter		
Years in site-based charter (average)	1.6	0.0
Years in other charter (average)	0.01	0.17
Years in traditional public (average)	0.23	1.97
Student race		
Black (percent of students)	60.22	58.42
Hispanic (percent of students)	10.20	2.07
White (percent of students)	23.79	38.30
Student designations (baseline)		
Special education (percent of students)	12.21	5.16
Economically disadvantaged (percent of students)	87.15*	74.37*
LEP (percent of students)	7.22	1.54
Student test scores (baseline)		
ELA (average in standard deviations)	−0.35	−0.29
Mathematics (average in standard deviations)	−0.41	−0.38
Student outcomes (available years)		
ELA (average in standard deviations)	−0.33	−0.31
Mathematics (average in standard deviations)	−0.34	−0.35
Attendance (average annual rate)	0.94	0.93
Attendance (average annual hours of schooling)	1,061	1,010
Chronically absent (average annual rate)	0.17	0.21
Disciplinary incidents (average annual rate)	0.22	0.24

Note. The table presents descriptive statistics for the data used in the analysis of charter school effects for middle schools. The ELA and mathematics scores capture the number of standard deviations from the statewide mean by grade, subject, and school year. The statistics for economic disadvantage are starred because they should be interpreted with caution. They incorrectly identify students who attended schools in which all students participate in free- or reduced-price lunch programs regardless of a given student's economic status.

Table C2. Annual impact of site-based charter middle schools serving a general student population (2016–19)

	Average math/ELA (SDs)	Math (SDs)	ELA (SDs)	Attendance hours	Attendance rate	Chronic absenteeism (0,1)	Disciplinary incidents (0,1)
SB charters	**0.036**	0.027	**0.043**	**22.541**	**0.006**	**−0.024**	**−0.027**
	(0.014)	(0.016)	(0.012)	(4.528)	(0.001)	(0.006)	(0.007)

Note. The table reports the results of models estimated using the specification in equation C1. Each coefficient is from a separate regression. Standard errors clustered by school appear in parentheses below coefficient estimates. Coefficients in bold are significant at the p<0.05 level.

Table C3. Annual impact of site-based charter middle schools serving a general student population (by student race)

	Average math/ ELA (SDs)	Math (SDs)	ELA (SDs)	Attendance hours	Attendance rate	Chronic absenteeism (0,1)	Disciplinary incidents (0,1)
Black	**0.060**	**0.046**	**0.068**	**29.919**	**0.008**	**−0.034**	**−0.039**
	(0.013)	(0.017)	(0.011)	(5.130)	(0.002)	(0.008)	(0.010)
Hispanic	**0.033**	**0.036**	0.028	**16.314**	**0.004**	**−0.024**	−0.010
	(0.016)	(0.018)	(0.016)	(4.047)	(0.001)	(0.011)	(0.009)
White	−0.002	−0.009	0.005	10.148	0.002	−0.007	**−0.013**
	(0.021)	(0.023)	(0.019)	(6.379)	(0.002)	(0.007)	(0.006)
Other	0.023	0.020	0.028	**30.197**	**0.008**	**−0.036**	−0.012
	(0.033)	(0.035)	(0.034)	(7.192)	(0.003)	(0.014)	(0.018)

Note. The table reports the results of models estimated using the specification in equation C1. Each column of estimates is from a single regression and captures charter school impacts disaggregated by student race. Standard errors clustered by school appear in parentheses below coefficient estimates. Coefficients in bold are significant at the p<0.05 level.

Table C4. Annual impact of site-based charter middle schools serving a general student population (by achievement)

	Average math/ ELA (SDs)	Math (SDs)	ELA (SDs)	Attendance hours	Attendance rate	Chronic absenteeism (0,1)	Disciplinary incidents (0,1)
Low	**0.061**	**0.050**	**0.070**	**26.986**	**0.008**	**−0.036**	**−0.034**
	(0.014)	(0.018)	(0.012)	(4.790)	(0.002)	(0.009)	(0.009)
High	0.010	0.002	0.013	**17.770**	**0.003**	**−0.012**	**−0.020**
	(0.015)	(0.017)	(0.014)	(4.224)	(0.001)	(0.005)	(0.006)

Note. The table reports the results of models estimated using the specification in equation C1. Each column of estimates is from a single regression and captures charter school impacts disaggregated by student achievement levels in the prior year—either below the sample median of −0.34 ("low") or above it ("high"). Standard errors clustered by school appear in parentheses below coefficient estimates. Coefficients in bold are significant at the $p<0.05$ level.

Appendix D: Matching on prior-year characteristics (grades 4–8)

The primary research design entails comparing all charter and noncharter students attending school in the same districts in grades 4–8 (see Appendix B). A somewhat different approach is to limit the analysis to charter and traditional public school students who are nearly identical in terms of observable student characteristics such as test scores and demographics. As CREDO (2019) puts it, the strategy entails comparing the one-year changes in outcomes between students who attend different schools but who are otherwise "virtual twins" at the start of a given school year. This design allows one to make fewer modeling assumptions regarding how student characteristics (for example, baseline test scores) relate to future outcomes. It limits the sample to students for whom one can obtain matches and, thus, includes fewer charter students than the primary analysis in Appendix B (and Appendix G). On the other hand, it includes more charter school students than the middle school analysis because it does not entail limiting the sample to schools with entry grades 4–7 and does not require that students attended the same elementary school in the prior year.

To implement this design, I first defined student "cells" based on student characteristics (race, sex, LEP status, special education status, economic-disadvantage status, grade, district of attendance, and test-score decile) during the previous school year. I kept only those cells with at least one charter school student and one student attending a traditional public school. After limiting the sample to these matched cells of students, I estimated the following OLS model:

$$y_{igtc} = \alpha_t + \beta_g + \mu_c + X'_i\vartheta + Charter'_{it}\tau + \varepsilon_{igdt} \qquad \text{(D1)}$$

where y_{igtc} is an outcome for student i in grade g during school year t who is part of cell c. α_t, β_g, and μ_c are year, grade, and cell fixed effects, respectively. The vector X_{it} includes prior-year standardized test scores in math and reading. The vector $Charter_i$ contains variables indicating the type of charter school a student attended. Standard errors are clustered by school.

Table D1 (below) appears to reveal sample imbalance. However, estimating differences within cells reveals no statistically significant imbalances in math and a substantively insignificant imbalance of 0.01 standard deviations for ELA. Indeed, using this approach, the estimates are similar if we include no baseline achievement controls in the models. The results in Tables D2–D5 are similar to those we report using the complete sample of charter and traditional public school students (Tables B2–B5).

Table D1. Descriptive statistics for grades 4–8 analytic sample

	Site-based / gen. ed. charter school students	Traditional public school students
Overall counts		
Unique districts	41	53
Unique schools	230	615
Unique students	35,696	68,855
Student-year observations	64,004	120,962
Student race		
Black (percent of students)	62.51	70.96
Hispanic (percent of students)	9.39	7.04
White (percent of students)	21.36	18.67
Student designations		
Special education (percent of students)	15.55	16.12
Economically disadvantaged (percent of students)	88.02*	95.63*
LEP (percent of students)	3.83	2.18
Student outcomes		
ELA (average in standard deviations)	−0.49	−0.71
Mathematics (average in standard deviations)	−0.58	−0.77
Attendance (average annual rate)	0.93	0.92
Attendance (average annual hours of schooling)	1,039	951
Chronically absent (average annual rate)	0.21	0.27
Disciplinary incidents (average annual rate)	0.22	0.32

Note. The table presents descriptive statistics for the data used in the analysis of charter school effects for grades 4–8. The "student outcomes" variables are one-year lags of the outcomes used in the analysis (for example, grade 3 values for students in grade 4). The ELA and mathematics scores capture the number of standard deviations from the statewide mean by grade, subject, and school year. The statistics for economic disadvantage are starred because they should be interpreted with caution. They incorrectly identify students who attended schools in which all students participate in free- or reduced-price lunch programs regardless of a given student's economic status.

Table D2. Annual impact of site-based charter schools serving a general student population (2016–19)

	Average math/ELA (SDs)	Math (SDs)	ELA (SDs)	Attendance hours	Attendance rate	Chronic absenteeism (0,1)	Disciplinary incidents (0,1)
SB charters	**0.081**	**0.063**	**0.098**	**63.355**	**0.004**	−0.007	**−0.044**
	(0.009)	(0.012)	(0.009)	(6.210)	(0.002)	(0.007)	(0.011)

Note. The table reports the results of models estimated using the specification in equation D1. Each coefficient is from a separate regression. Standard errors clustered by school appear in parentheses below coefficient estimates. Coefficients in bold are significant at the p<0.05 level.

Table D3. Annual impact of site-based charter schools serving a general student population (by student race)

	Average math/ ELA (SDs)	Math (SDs)	ELA (SDs)	Attendance hours	Attendance rate	Chronic absenteeism (0,1)	Disciplinary incidents (0,1)
Black	**0.087**	**0.070**	**0.105**	**70.348**	**0.006**	−0.007	**−0.052**
	(0.011)	(0.014)	(0.011)	(7.125)	(0.002)	(0.008)	(0.014)
Hispanic	**0.080**	**0.037**	**0.122**	**56.517**	0.002	−0.009	**−0.021**
	(0.014)	(0.019)	(0.016)	(7.835)	(0.002)	(0.011)	(0.010)
White	**0.052**	**0.044**	**0.059**	**36.984**	0.000	−0.004	**−0.026**
	(0.010)	(0.013)	(0.012)	(5.725)	(0.002)	(0.008)	(0.010)
Other	**0.087**	**0.069**	**0.098**	**57.153**	**0.005**	−0.008	−0.023
	(0.015)	(0.020)	(0.016)	(7.673)	(0.002)	(0.013)	(0.015)

Note. The table reports the results of models estimated using the specification in equation D1. Each column of estimates is from a single regression and captures charter school impacts disaggregated by student race. Standard errors clustered by school appear in parentheses below coefficient estimates. Coefficients in bold are significant at the p<0.05 level.

Table D4. Annual impact of site-based charter schools serving a general student population (by achievement)

	Average math/ ELA (SDs)	Math (SDs)	ELA (SDs)	Attendance hours	Attendance rate	Chronic absenteeism (0,1)	Disciplinary incidents (0,1)
Low	**0.093**	**0.070**	**0.116**	**60.806**	**0.004**	−0.008	**−0.053**
	(0.010)	(0.012)	(0.010)	(5.609)	(0.002)	(0.009)	(0.013)
High	**0.069**	**0.056**	**0.082**	**65.807**	**0.004**	−0.005	**−0.035**
	(0.010)	(0.013)	(0.010)	(7.346)	(0.002)	(0.006)	(0.011)

Note. The table reports the results of models estimated using the specification in equation D1. Each column of estimates is from a single regression and captures charter school impacts disaggregated by student achievement levels in the prior year—either below the sample median of −0.73 (“low”) or above it (“high”). Standard errors clustered by school appear in parentheses below coefficient estimates. Coefficients in bold are significant at the $p<0.05$ level.

Appendix E: Grade 9–12 analysis

Analyzing outcomes in grades 9–12 presents some challenges because there is more student mobility and more variability in the curriculum to which students are exposed. For example, end-of-course exams do not test knowledge and skills based on standards clearly articulated across consecutive grades. Students take them in different grades, depending on when they take the relevant coursework. It is unclear how much of the gains to attribute to the year in which a student took the exam as opposed to prior years. Student mobility further complicates attempts to capture accumulating effects—particularly for students who end up in virtual or dropout-prevention and recovery schools (which are charter schools in Ohio) in later grades. Attributing test outcomes to these schools is suspect, as these students' unusual circumstances make apples-to-apples comparisons difficult. The challenges are even greater for high school grades, as students often spend significant time in other high schools before taking an exam in a school that focuses on dropout prevention and recovery. Indeed, one might consider enrollment in dropout-focused charter schools a negative outcome for which a student's prior schools are partly responsible.

To minimize these problems, I estimate the impact of attending a charter school (as opposed to a traditional public school) in grade 9 on student performance on all end-of-course exams and, eventually, the ACT and graduation. Thus, a student's ninth-grade school is effectively held responsible for all subsequent achievement and attainment. In order to account for potential differences between students who select into charter schools in grade 9, I control for student variables observed in grade 8 and test scores for both grade 8 and grade 7. Specifically, I estimated the overall impact of attending a charter school—as opposed to attending a traditional public school—using the following Ordinary Least Squares (OLS) model:

$$Y_{igdt} = \alpha_t + \beta_g + \mu_d + X'_i\vartheta + Charter'_i\tau + \varepsilon_{igdt} \qquad \text{(E1)}$$

where y_{igdt} is a test score or diploma indicator for student i in grade g in district d during school year t. α_t, β_g, and μ_d are year, grade, and district fixed effects, respectively (note that I exclude grade fixed effects for models estimating graduation). The vector X_i includes a series of indicator variables capturing student characteristics in grade 8, including demographic indicators (race, sex, special education status, limited English proficiency, and economic disadvantage) and cubic polynomials of standardized math and reading scores in grades 7 and 8. The vector $Charter_i$ contains a variable indicating whether student i attended a site-based charter school serving a general student population in grade 9, as well as a variable indicating whether the student attended a different type of charter high school (including schools no longer in operation in 2016–19). Standard errors are clustered by school.

To estimate the impact of attending a charter school in grades 9–12 on annual attendance and disciplinary outcomes, I employ a running sum of the years spent in charter schools. Specifically, using the same sample of students observed in both grade 8 and grade 9, I estimated the following OLS model:

$$y_{igdt} = \alpha_i + \beta_g + \mu_d + X'_i\vartheta + \tau S_{it} + \varepsilon_{igdt} \qquad \text{(E2)}$$

The vector S_{it} is a running sum of time spent in site-based charter high schools serving a general student population and a running sum of time spent in other charter schools (including those no longer in operation in 2016–19). Standard errors are clustered by school. Tables E1–E8 present the results.

Table E1. Descriptive statistics for grades 9–12 analytic sample (2016–19)

	Charter school students	Site-based / gen. ed. charter school students	Traditional public school students
Overall counts			
Unique districts	69	28	69
Unique schools	175	59	212
Unique students	23,903	8,004	111,943
Student-year observations	51,583	18,279	266,714
Student race (grade 8)			
Black (percent of students)	30.86	56.90	37.53
Hispanic (percent of students)	5.73	8.30	7.56
White (percent of students)	57.04	28.72	47.16
Student designations (grade 8)			
Special education (percent of students)	21.99	16.33	17.91
Economically disadvantaged (percent of students)	73.04*	82.12*	75.11*
LEP (percent of students)	1.79	3.73	2.93
Student test scores (grade 8)			
ELA (average in standard deviations)	−0.45	−0.42	−0.44
Mathematics (average in standard deviations)	−0.47	−0.36	−0.34
Student outcomes (grades 9–12)			
ELA 1 (average in standard deviations)	−0.42	−0.34	−0.43
ELA 2 (average in standard deviations)	−0.38	−0.32	−0.37
Algebra I (average in standard deviations)	−0.64	−0.55	−0.54
Geometry (average in standard deviations)	−0.60	−0.54	−0.54
ACT (average score)	16.83	16.82	17.07
Diploma (graduation rate)	0.68	0.81	0.81
Attendance (average annual rate)	0.90	0.90	0.89
Attendance (average annual hours of schooling)	909	945	943
Chronically absent (average annual rate)	0.31	0.32	0.32
Disciplinary incidents (average annual rate)	0.11	0.16	0.23

Note. The table presents descriptive statistics for the data used in the analysis of charter school effects for grades 9–12. The "student outcomes" variables are observed in grades 9–12, whereas baseline student characteristics and test scores are from grade 8. Test scores for grade 8 math and ELA and for end-of-course exams (ELA 1, ELA 2, geometry, and algebra) capture the number of standard deviations from the statewide mean by subject and school year. The statistics for economic disadvantage are starred because they should be interpreted with caution. They incorrectly identify students who attended schools in which all students participate in free- or reduced-price lunch programs regardless of a given student's economic status.

Table E2. Total impact of site-based charters serving a general student population in grades 9–12 (2016–19)

	ACT (1–36)	ELA1 (SDs)	ELA2 (SDs)	ALG1 (SDs)	GEOM (SDs)	Diploma (0,1)
Site based (gen pop.)	0.254	**0.085**	**0.089**	0.026	0.011	0.002
	(0.160)	(0.020)	(0.024)	(0.027)	(0.026)	(0.016)

Note. The table reports the results of models estimated using the specification in equation E1. Each coefficient is from a separate regression. Standard errors clustered by school appear in parentheses below coefficient estimates. Coefficients in bold are significant at the p<0.05 level.

Table E3. Total impact of site-based charters serving a general student population in grades 9–12 (by race)

	ACT (1-36)	ELA1 (SDs)	ELA2 (SDs)	ALG1 (SDs)	GEOM (SDs)	Diploma (0,1)
Black	0.195	**0.098**	**0.101**	0.063	0.032	0.017
	(0.184)	(0.027)	(0.029)	(0.036)	(0.033)	(0.019)
Hispanic	0.129	**0.096**	**0.076**	0.065	0.014	0.007
	(0.283)	(0.027)	(0.035)	(0.036)	(0.035)	(0.026)
White	0.340	**0.061**	**0.089**	−0.038	−0.020	−0.020
	(0.212)	(0.025)	(0.033)	(0.030)	(0.038)	(0.019)
Other	0.496	**0.067**	0.010	−0.021	−0.011	−0.026
	(0.239)	(0.031)	(0.031)	(0.029)	(0.030)	(0.029)

Note. The table reports the results of models estimated using the specification in equation E1. Each column of co-efficients is from a separate regression. Standard errors clustered by school appear in parentheses below coefficient estimates. Coefficients in bold are significant at the p<0.05 level.

Table E4. Total impact of site-based charters serving a general student population in grades 9–12 (by achievement)

	ACT (1–36)	ELA1 (SDs)	ELA2 (SDs)	ALG1 (SDs)	GEOM (SDs)	Diploma (0,1)
Low achievement	0.247	**0.104**	**0.088**	0.036	0.019	0.004
	(0.138)	(0.023)	(0.023)	(0.027)	(0.028)	(0.021)
High achievement	0.259	**0.067**	**0.090**	0.016	0.003	0.00
	(0.218)	(0.021)	(0.030)	(0.031)	(0.032)	(0.016)

Note. The table reports the results of models estimated using the specification in equation E1. Each column of coefficients is from a separate regression. Standard errors clustered by school appear in parentheses below coefficient estimates. Coefficients in bold are significant at the p<0.05 level.

Table E5. Annual impact of site-based charters serving a general student population in grades 9–12 (2016–19)

	Attend. hours	Attend. rate	Chronic abs. (0,1)	Discipline (0,1)
Site based (gen pop.)	11.454	0.004	**−0.014**	**−0.034**
	(6.996)	(0.003)	(0.009)	(0.005)

Note. The table reports the results of models estimated using the specification in equation E2. Each coefficient is from a separate regression. Standard errors clustered by school appear in parentheses below coefficient estimates. Coefficients in bold are significant at the p<0.05 level.

Table E6. Annual impact of site-based charters serving a general student population in grades 9–12 (by race)

	Attend. hours	Attend. rate	Chronic abs. (0,1)	Discipline (0,1)
Black	**21.351**	**0.008**	**−0.027**	**−0.040**
	(10.893)	(0.003)	(0.013)	(0.007)
Hispanic	6.719	0.003	−0.013	**−0.027**
	(5.725)	(0.003)	(0.011)	(0.007)
White	−3.200	−0.003	0.011	**−0.026**
	(4.568)	(0.002)	(0.008)	(0.007)
Other	2.827	0.005	**−0.024**	**−0.031**
	(4.668)	(0.003)	(0.009)	(0.007)

Note. The table reports the results of models estimated using the specification in equation E2. Each column of coefficients is from a separate regression. Standard errors clustered by school appear in parentheses below coefficient estimates. Coefficients in bold are significant at the p<0.05 level.

Table E7. Annual impact of site-based charters serving a general student population in grades 9–12 (by achievement)

	Attend. hours	Attend. rate	Chronic abs. (0,1)	Discipline (0,1)
Low achievement	17.156	0.005	−0.016	**−0.043**
	(9.312)	(0.003)	(0.011)	(0.007)
High achievement	6.970	0.003	−0.012	**−0.026**
	(5.468)	(0.002)	(0.008	(0.005)

Note. The table reports the results of models estimated using the specification in equation E2. Each column of coefficients is from a separate regression. Standard errors clustered by school appear in parentheses below coefficient estimates. Coefficients in bold are significant at the p<0.05 level.

Table E8. Total impact of site-based charters serving a general student population in grades 9–12 (by district)

	ACT (1–36)	ELA1 (SDs)	ELA2 (SDs)	ALG1 (SDs)	GEOM (SDs)	Diploma (0,1)
Cincinnati	−0.659	**0.127**	0.004	0.039	0.086	0.031
	(0.510)	(0.040)	(0.048)	(0.041)	(0.051)	(0.025)
Cleveland	0.072	0.027	0.017	−0.022	−0.040	0.036
	(0.282)	(0.027)	(0.027)	(0.048)	(0.032)	(0.051)
Columbus	**0.496**	**0.107**	**0.143**	**0.187**	**0.137**	0.013
	(0.205)	(0.043)	(0.037)	(0.069)	(0.042)	(0.037)
Dayton	−0.010	**0.195**	0.274	0.077	−0.080	0.067
	(0.456)	(0.061)	(0.156)	(0.099)	(0.095)	(0.039)
Toledo	**0.989**	**0.088**	0.092	0.007	0.062	−0.018
	(0.345)	(0.036)	(0.049)	(0.040)	(0.037)	(0.046)

Note. The table reports the results of models estimated using the specification in equation E1. Each column of coefficients is from a separate regression. Standard errors clustered by school appear in parentheses below coefficient estimates. Coefficients in bold are significant at the p<0.05 level.

Appendix F: Alternative design for charter high schools

Like the analysis of middle schools, focusing on charter high schools might allow for a more rigorous design because one can identify students who attended the same middle school—and who had identical demographic characteristics—in the year before a natural transition to high school. Students who attended the same pre-transition middle school are likely to be similar on a number of dimensions (for example, parental motivation and income) that demographic characteristics and test scores may not capture. Indeed, as Sass et al. (2016) point out in their analysis of charter high schools, focusing on students who attended charter schools in grade 8 is probably ideal. These students and their families exercised school choice prior to high school, which accounts for important unmeasured factors that might otherwise make those who select charter high schools different from those who do not.

I implemented the design by creating matched "cells" of students who attended the same charter middle school in grade 8 and who share demographic characteristics (sex, race, LEP status, economic-disadvantage status, and special education status). I included students in the analysis if at least one student in their cell transitioned to a charter high school in grade 9 and at least one student did not transition to a charter high school in that grade. I then estimated the following OLS model:

$$y_{igtc} = \alpha_t + \beta_g + \mu_c + X'_i\vartheta + Charter'_i\tau + \varepsilon_{igdt} \qquad \text{(F1)}$$

where y_{igtc} is a test score or diploma indicator for student *i* in grade *g* during school year *t* who is part of cell *c*. α_t, β_g, and μ_c are year, grade, and cell fixed effects, respectively (I do not include grade fixed effects if graduation is the outcome of interest). The vector X_{it} includes cubic polynomials of standardized math and reading scores in grade 8. The vector $Charter_i$ contains a variable indicating whether student *i* attended a site-based charter school serving a general student population in grade 9, as well as a variable indicating whether the student attended a different type of charter high school (including schools no longer in operation in 2016–19). Standard errors are clustered by school.

To estimate the impact of attending a charter school in grades 9–12 on annual attendance and disciplinary outcomes, I employ a running sum of the years spent in charter schools. Specifically, I estimated the following OLS model:

$$y_{igtc} = \alpha_t + \beta_g + \mu_c + X'_i\vartheta + S'_{it}\tau + \varepsilon_{igdt} \qquad \text{(F2)}$$

where y_{igtc} is an attendance or disciplinary outcome and the vector S_{it} is a running sum of time spent in site-based charter high schools serving a general student population and a running sum of time spent in other charter schools serving high school grades (including those no longer in operation in 2016–19). Standard errors are clustered by school.

The parameter τ captures the causal impact of charter school attendance on student achievement and behavior if charter attendance is as good as randomly assigned, conditional on the covariates included in the model. As a partial test of this assumption, I estimated the models above using test scores from grade 7 (which are not part of the matching procedure) as the outcome of interest. Doing so serves as a placebo test, as there should be no differences in charter and traditional public school students' test scores prior to entering high school. Indeed, estimates reveal no differences in grade 7 test scores (*p* values between 0.5 and 0.6). Similarly, omitting grade 8 test scores from the regressions has no substantively significant impact on the estimated effects of charter school attendance.

Table F1. Descriptive statistics for the high school analytic sample (2016–19)

	Site-based / gen. ed. charter school students	Traditional public school students
Overall counts		
Unique districts	7	399
Unique schools	14	594
Unique students	2,602	7,069
Student-year observations	5,739	15,535
Years in charter		
Years in site-based charter	2.06	0.03
Years in other charter	0.18	0.18
Years in traditional public (average)		
Student race (grade 8)		
Black (percent of students)	75.19	63.13
Hispanic (percent of students)	4.25	2.99
White (percent of students)	16.12	31.01
Student designations (grade 8)		
Special education (percent of students)	12.75	9.77
Economically disadvantaged (percent of students)	89.11	84.38
LEP (percent of students)	3.71	2.26
Student test scores (grade 8)		
ELA (average in standard deviations)	−0.31	−0.33
Mathematics (average in standard deviations)	−0.26	−0.35

Student outcomes (grades 9–12)

ELA 1 (average in standard deviations)	−0.28	−0.32
ELA 2 (average in standard deviations)	−0.27	−0.33
Algebra I (average in standard deviations)	−0.46	−0.50
Geometry (average in standard deviations)	−0.41	−0.49
ACT (average score)	16.92	17.17
Diploma (graduation rate)	0.83	0.80
Attendance (average annual rate)	0.89	0.88
Attendance (average annual hours of schooling)	928	947
Chronically absent (average annual rate)	0.31	0.37
Disciplinary incidents (average annual rate)	0.16	0.21

Note. The table presents descriptive statistics for the data used in the analysis of charter school effects for grades 4–8. The ELA and mathematics scores capture the number of standard deviations from the statewide mean by grade, subject, and school year. The statistics for economic disadvantage are starred because they should be interpreted with caution. They incorrectly identify students who attended schools in which all students participate in free- or reduced-price lunch programs regardless of a given student's economic status.

Table F2. Total impact of charter high schools serving a general student population (2016–19)

	ACT (1–36)	ELA1 (SDs)	ELA2 (SDs)	ALG1 (SDs)	GEOM (SDs)	Diploma (0,1)
Site based (gen pop.)	0.206	0.034	**0.077**	0.038	0.033	−0.007
	(0.171)	(0.032)	(0.032)	(0.040)	(0.031)	(0.029)

Note. The table reports the results of models estimated using the specification in equation F1. Each coefficient is from a separate regression. Standard errors clustered by school appear in parentheses below coefficient estimates. Coefficients in bold are significant at the p<0.05 level.

Table F3. Total impact of charter high schools serving a general student population (by race)

	ACT (1–36)	ELA1 (SDs)	ELA2 (SDs)	ALG1 (SDs)	GEOM (SDs)	Diploma (0,1)
Black	0.263	0.038	**0.078**	0.029	0.033	−0.004
	(0.192)	(0.033)	(0.040)	(0.046)	(0.034)	(0.031)
Hispanic	−0.392	0.001	0.051	**0.155**	−0.037	0.049
	(0.518)	(0.108)	(0.081)	(0.078)	(0.082)	(0.072)
White	0.429	0.020	0.017	0.039	0.014	−0.032
	(0.320)	(0.045)	(0.055)	(0.071)	(0.061)	(0.038)
Other	0.817	0.038	0.074	0.022	−0.076	−0.014
	(0.681)	(0.076)	(0.085)	(0.137)	(0.117)	(0.078)

Note. The table reports the results of models estimated using the specification in equation F1. Each column of coefficients is from a separate regression. Standard errors clustered by school appear in parentheses below coefficient estimates. Coefficients in bold are significant at the p<0.05 level.

Table F4. Total impact of charter high schools serving a general student population (by achievement)

	ACT (1–36)	ELA1 (SDs)	ELA2 (SDs)	ALG1 (SDs)	GEOM (SDs)	Diploma (0,1)
Low achievement	**0.544**	**0.057**	**0.101**	0.058	0.061	0.028
	(0.184)	(0.029)	(0.033)	(0.039)	(0.038)	(0.036)
High achievement	0.139	0.016	0.046	0.012	−0.002	−0.032
	(0.204)	(0.035)	(0.043)	(0.041)	(0.044)	(0.027)

Note. The table reports the results of models estimated using the specification in equation F1. Each column of coefficients is from a separate regression. Standard errors clustered by school appear in parentheses below coefficient estimates. Coefficients in bold are significant at the p<0.05 level.

Table F5. Annual impact of charter high schools serving a general student population (2016–19)

	Attend. hours	Attend. rate	Chronic abs. (0,1)	Discipline (0,1)
Site based (gen pop.)	−10.854	0.005	**−0.025**	**−0.028**
	6.189	0.003	(0.009)	(0.006)

Note. The table reports the results of models estimated using the specification in equation F2. Each coefficient is from a separate regression. Standard errors clustered by school appear in parentheses below coefficient estimates. Coefficients in bold are significant at the p<0.05 level.

Table F6. Annual impact of charter high schools serving a general student population (by race)

	Attend. hours	Attend. rate	Chronic abs. (0,1)	Discipline (0,1)
Black	−10.206	**0.006**	**−0.030**	**−0.031**
	(7.072)	(0.003)	(0.009)	(0.008)
Hispanic	**−19.717**	−0.002	−0.009	−0.020
	(7.557)	(0.006)	(0.024)	(0.012)
White	−10.090	0.002	−0.011	**−0.015**
	(5.159)	(0.003)	(0.015)	(0.005)
Other	−15.811	−0.003	−0.003	−0.033
	(9.056)	(0.008)	(0.019)	(0.018)

Note. The table reports the results of models estimated using the specification in equation F2. Each coefficient is from a separate regression. Standard errors clustered by school appear in parentheses below coefficient estimates. Coefficients in bold are significant at the p<0.05 level.

Table F7. Annual impact of charter high schools serving a general student population (by achievement)

	Attend. hours	Attend. rate	Chronic abs. (0,1)	Discipline (0,1)
Low achievement	−8.187	0.005	**−0.030**	**−0.036**
	(6.472)	(0.004)	(0.012)	(0.009)
High achievement	−12.529	**0.005**	**−0.022**	**−0.023**
	(6.523)	(0.002)	(0.008)	(0.006)

Note. The table reports the results of models estimated using the specification in equation F2. Each coefficient is from a separate regression. Standard errors clustered by school appear in parentheses below coefficient estimates. Coefficients in bold are significant at the $p<0.05$ level.

Appendix G: Statewide estimates across all charters (grades 5–8 and 9–12)

The literature estimating the impact of charter schools has validated methods for within-district comparisons of school quality. Estimates of student learning gains are likely to yield biased estimates of charter school quality if comparisons are not between students within districts (for example, see Bifulco, 2012). However, some Ohio charter schools draw students statewide. These schools must be included in estimates of charter school quality if one wants to characterize the quality of the Ohio charter sector as a whole. To generate such estimates, I removed the fixed effects from equation B1 (for elementary grades) and from equation E1 (for high school grades). To help address potential bias, I included cubic polynomials of two prior years of student achievement (instead of one). Because of this second lag, I am no longer able to generate estimates for grade 4, and I lose observations of students for whom I do not have two prior years of data.

As Tables G1 and G2 reveal, these analytic samples include nearly all charter and traditional public schools serving grades 5–12. Table G3 reveals similar estimated effects for site-based charter schools serving a general population to those in Appendixes B–F, though they appear lower across the board (which might be due to the omission of grade 4). The estimates for all charters serving elementary grades (regardless of type) indicate positive effects for ELA and negative effects for math. The estimates for all charters serving high school grades (regardless of type) reveal null effects in English and for the ACT but significant negative effects for geometry and algebra. One cannot know whether this method sufficiently addresses the problems related to the unusual circumstances under which students choose virtual charter schools or those that cater to students with special needs (for example, dropout-prevention and recovery schools, which are charter schools in Ohio), but it likely offers our best statewide estimate of the effectiveness of the entire charter school sector.

Table G4 presents estimates by year. To maximize statistical power, estimates for each year are generated simultaneously by interacting each year indicator with the charter attendance indicator. The results indicate some overall improvements in the charter sector over time.

Table G1. Descriptive statistics for analytic sample based on schools serving grades 5–8 (2016–19)

	Charter school students	Site-based / gen. ed. charter school students	Traditional public school students
Overall counts			
Unique districts	61	41	608
Unique schools	295	230	2,481
Unique students	47,011	35,581	752,438
Student-year observations	81,693	63,723	1,595,421
Student race			
Black (percent of students)	52.90	63.84	12.38
Hispanic (percent of students)	8.51	9.63	4.94
White (percent of students)	31.42	19.68	75.74
Student designations			
Special education (percent of students)	17.71	14.90	12.69
Economically disadvantaged (percent of students)	82.75*	88.58*	45.43*
LEP (percent of students)	3.16	3.97	1.14
School location			
Big 8 (percent of students)	71.55	79.40	9.86
City (percent of students)	74.57	82.65	12.38
Suburb (percent of students)	22.38	16.04	49.63
Town (percent of students)	2.55	0.79	13.75
Rural (percent of students)	0.51	0.52	23.90
Student outcomes			
ELA (average in standard deviations)	−0.45	−0.48	0.06
Mathematics (average in standard deviations)	−0.57	−0.56	0.09
Attendance (average annual rate)	0.94	0.94	0.95
Attendance (average annual hours of schooling)	1,025	1,042	1,018
Chronically absent (average annual rate)	0.19	0.18	0.09
Disciplinary incidents (average annual rate)	0.18	0.20	0.08

Note. The table presents descriptive statistics for the data used in the analysis of charter school effects for grades 5–8. The ELA and mathematics scores capture the number of standard deviations from the statewide mean by grade, subject, and school year. The statistics for economic disadvantage are starred because they should be interpreted with caution. They incorrectly identify students who attended schools in which all students participate in free- or reduced-price lunch programs regardless of a given student's economic status.

Table G2. Descriptive statistics for analytic sample based on schools serving grades 9–12 (2016–19)

	Charter school students	Site-based / gen. ed. charter school students	Traditional public school students
Overall counts			
Unique districts	69	28	609
Unique schools	176	59	883
Unique students	21,947	7,975	571,771
Student-year observations	46,836	17,675	1,221,203
Student race (grade 8)			
Black (percent of students)	32.12	57.13	14.66
Hispanic (percent of students)	5.80	8.21	4.15
White (percent of students)	55.91	28.76	75.23
Student designations (grade 8)			
Special education (percent of students)	22.16	16.05	13.88
Economically disadvantaged (percent of students)	74.34*	81.76*	46.29*
LEP (percent of students)	1.76	3.50	1.05
Student Test Scores (grade 8)			
ELA (average in standard deviations)	−0.44	−0.40	−0.08
Mathematics (average in standard deviations)	−0.45	−0.35	0.06
Student outcomes (grades 9–12)			
ELA 1 (average in standard deviations)	−0.41	−0.33	−0.15
ELA 2 (average in standard deviations)	−0.37	−0.31	−0.09
Algebra I (average in standard deviations)	−0.63	−0.53	−0.22
Geometry (average in standard deviations)	−0.59	−0.53	−0.22
ACT (average score)	16.93	16.91	19.24
Diploma (graduation rate)	0.70	0.82	0.92
Attendance (average annual rate)	0.90	0.89	0.92
Attendance (average annual hours of schooling)	910	942	983
Chronically absent (average annual rate)	0.31	0.32	0.21
Disciplinary incidents (average annual rate)	0.11	0.16	0.12

Note. The table presents descriptive statistics for the data used in the analysis of charter school effects for grades 9–12. The "student outcomes" variables are observed in grades 9–12, whereas baseline student characteristics and test scores are from grade 8. Test scores for grade 8 math and ELA and for end-of-course exams (ELA 1, ELA 2, geometry, and algebra) capture the number of standard deviations from the statewide mean by subject and school year. The statistics for economic disadvantage are starred because they should be interpreted with caution. They incorrectly identify students who attended schools in which all students participate in free- or reduced-price lunch programs regardless of a given student's economic status.

Table G3. Impact of charter schools serving grades 5–8 and 9–12—overall and by type (2016–19)

	Grades 5–8			Grades 9–12				
	Average (math/ELA)	Math (SDs)	ELA (SDs)	ACT (1–36)	ELA1 (SDs)	ELA2 (SDs)	ALG1 (SDs)	GEOM (SDs)
All charters	−0.010	**−0.051**	**0.028**	**0.337**	−0.017	0.019	**−0.085**	**−0.048**
	(0.018)	(0.025)	(0.012)	(0.133)	(0.017)	(0.013)	(0.021)	(0.019)
Site based (general ed.)	**0.036**	0.017	**0.054**	**0.362**	**0.045**	**0.052**	−0.013	−0.014
	(0.10)	(0.12)	(0.009)	(0.155)	(0.019)	(0.022)	(0.029)	(0.024)
Virtual (general ed.)	**−0.174**	**−0.292**	**−0.067**	0.404	**−0.042**	**0.032**	**−0.124**	−0.050
	(0.012)	(0.023)	(0.007)	(0.254)	(0.021)	(0.012)	(0.029)	(0.033)
Site based (spec. ed. / drop.)	**−0.077**	**−0.160**	−0.002	0.008	**−0.091**	**−0.112**	**−0.144**	**−0.110**
	(0.020)	(0.026)	(0.021)	(0.147)	(0.031)	(0.031)	(0.024)	(0.016)
Virtual (special ed. / dropout)	**−0.241**	**−0.379**	**−0.115**	−0.245	**−0.143**	**−0.106**	**−0.218**	**−0.165**
	(0.016)	(0.017)	(0.026)	(0.284)	(0.020)	(0.022)	(0.019)	(0.024)

Note. The table reports the results of models estimated using the specification in equations B1 and E1 except that they account for two years of prior achievement and do not include district fixed effects. Each coefficient is from a separate regression. Standard errors clustered by school appear in parentheses below coefficient estimates. Coefficients in bold are significant at the $p<0.05$ level.

Table G4. Total impact of all charter schools serving grades 5–8 and 9–12, by year

	2016	2017	2018	2019
Grades 5–8				
Average (math/ELA)	**−0.055**	**−0.042**	0.006	0.048
	(0.015)	(0.020)	(0.023)	(0.026)
Math	**−0.124**	**−0.083**	−0.014	0.014
	(0.024)	(0.025)	(0.029)	(0.033)
ELA	0.013	−0.003	0.021	**0.077**
	(0.012)	(0.016)	(0.018)	(0.021)
Grades 9–12				
ACT	----	**0.393**	**0.356**	**0.263**
		(0.158)	(0.140)	(0.127)
ELA1	0.007	**−0.093**	0.022	0.004
	(0.026)	(0.026)	(0.021)	(0.028)
ELA2	**0.172**	−0.047	**−0.047**	−0.011
	(0.013)	(0.028)	(0.021)	(0.022)
ALG1	−0.048	**−0.109**	**−0.056**	**−0.119**
	(0.028)	(0.033)	(0.027)	(0.033)
GEOM	**−0.050**	**−0.069**	−0.005	**−0.067**
	(0.017)	(0.022)	(0.040)	(0.026)

Note. The table reports the results of models estimated using the specification in equations B1 and E1 except that they account for two years of prior achievement, do not include district fixed effects, and feature interaction terms for each calendar year. Each row of coefficients is from a separate regression. Standard errors clustered by school appear in parentheses below coefficient estimates. Coefficients in bold are significant at the $p<0.05$ level.

Table G5. Impact of site-based charter schools serving grades 5–8 and 9–12—overall and by type (2016–19)

	Grades 5–8			Grades 9–12				
	Average (Math/ELA)	Math (SDs)	ELA (SDs)	ACT (1-36)	ELA1 (SDs)	ELA2 (SDs)	ALG1 (SDs)	GEOM (SDs)
Cincinnati	**−0.038**	**−0.070**	−0.003	−0.054	0.006	−0.043	−0.022	−0.022
	(0.019)	(0.021)	(0.020)	(0.166)	(0.026)	(0.029)	(0.021)	(0.016)
Cleveland	**0.042**	0.023	**0.059**	0.049	−0.011	−0.024	−0.057	**−0.115**
	(0.018)	(0.326)	(0.017)	(0.262)	(0.015)	(0.018)	(0.039)	(0.024)
Columbus	**0.092**	**0.082**	**0.102**	**0.498**	0.057	**0.089**	0.078	**0.082**
	(0.021)	(0.029)	(0.018)	(0.184)	(0.039)	(0.028)	(0.069)	(0.042)
Dayton	**0.061**	**0.043**	**0.078**	0.296	**0.154**	0.173	0.012	−0.096
	(0.030)	(0.041)	(0.025)	(0.252)	(0.039)	(0.122)	(0.075)	(0.056)
Toledo	0.015	−0.005	0.035	**1.165**	0.040	0.036	**−0.072**	0.000
	(0.026)	(0.034)	(0.022)	(0.275)	(0.022)	(0.042)	(0.019)	(0.014)

Note. The table reports the results of models estimated using the specification in equations B1 and E1, except that they account for two years of prior achievement and do not include district fixed effects. Each coefficient is from a separate regression. Standard errors clustered by school appear in parentheses below coefficient estimates. Coefficients in bold are significant at the $p<0.05$ level.

References

Abdulkadiroglu, Atila, Joshua D. Angrist, Susan M. Dynarski, Thomas J. Kane, and Parag A. Pathak. "Accountability in Public Schools: Evidence from Boston's Charters and Pilots." *Quarterly Journal of Economics* 126, no. 2 (2011): 699–748.

Abott, Carolyn, Vladimir Kogan, Stéphane Lavertu, and Zachary Peskowitz. "School District Operational Spending and Student Outcomes: Evidence from Tax Elections in Seven States." *Journal of Public Economics* 183 (2020): 104142.

Ahn, June and Andrew McEachin. "Student Enrollment Patterns and Achievement in Ohio's Online Charter Schools." *Educational Researche*r 46, no. 1 (2017): 44–57.

Angrist, Joshua D., Parag A. Pathak, and Christopher Walters. "Explaining Charter School Effectiveness." *American Economic Journal: Applied Economics* 5, no. 4 (2013): 1–27.

Angrist, Joshua D., Sarah R. Cohodes, Susan M. Dynarski, Parag A. Pathak, and Christopher R. Walters. "Stand and Deliver: Effects of Boston's Charter High Schools on College Preparation, Entry, and Choice." *Journal of Labor Economics* 34, no. 2 (2016): 275–318.

Bifulco, Robert. "Can Nonexperimental Estimates Replicate Estimates Based on Random Assignment in Evaluations of School Choice? A Within-Study Comparison." *Journal of Policy Analysis and Management* 31, no. 2 (2012): 729–51.

Chetty, Raj, John N. Friedman, and Jonah E. Rockoff. "Measuring the Impacts of Teachers II: Teacher Value-Added and Student Outcomes in Adulthood." *American Economic Review* 104, no. 9 (2014): 2633–79.

Cohodes, Sarah, Elizabeth Setren, and Christopher Walters. "Can Successful Schools Replicate? Scaling Up Boston's Charter School Sector." *American Economic Journal: Economic Policy* (forthcoming)

Cook, Jason B. "The Effect of Charter Competition on Unionized District Revenues and Resource Allocation." *Journal of Public Economics* 158 (2019): 48–62.

Cook, Jason B., Vladimir Kogan, Stéphane Lavertu, and Zachary Peskowitz. "Government Privatization and Political Participation: The Case of Charter Schools." *Journal of Politics* 82, no. 1 (2020): 300–14.

Center for Research on Education Outcomes (CREDO). *Multiple choice: Charter school performance in 16 states*. Stanford, CA: CREDO, 2009.

Center for Research on Education Outcomes (CREDO). *Charter school performance in Ohio*. Stanford, CA: CREDO, 2014.

Center for Research on Education Outcomes (CREDO). *Charter school performance in Ohio*. Stanford, CA: CREDO, 2019.

Deming, David J. "Using School Choice Lotteries to Test Measures of School Effectiveness." *American Economic Review Papers and Proceedings* 104, no. 5 (2014): 406–11.

Dobbie, Will, and Roland G. Fryer. "Getting Beneath the Veil of Effective Schools: Evidence from New York City." *American Economic Journal: Applied Economics* 5, no. 4 (2013): 28–60.

Dobbie, Will, and Roland G. Fryer. "Charter Schools and Labor Market Outcomes." *Journal of Labor Economics* (forthcoming).

Epple, Dennis, Richard Romano, and Ron Zimmer. "Charter Schools: A Survey of Research on Their Characteristics and Effectiveness." National Bureau of Economic Research Working Paper 21256, 2015.

Hanushek, Eric A. Ohio's Economic Future: Testimony for the Ohio Senate Education Committee on January 31, 2018.

Hanushek, Eric A., Jens Ruhose, and Ludger Woessmann. "Knowledge capital and aggregate income differences: Development accounting for U.S. states." *American Economic Journal: Macroeconomics* 9, no. 4 (2017): 184–224.

Hill, Carolyn J., Howard S. Bloom, Alison R. Black, and Mark W. Lipsey. "Empirical Benchmarks for Interpreting Effect Sizes in Research." *Child Development Perspectives 2*, no. 3 (2008): 172–77.

Kraft, Matthew A. 2020. "Interpreting Effect Sizes of Education Interventions." *Educational Researcher* (early access).

McEachin, Andrew, Douglas Lee Lauen, Sarah Crittenden Fuller, and Rachel M. Perera. "Social Returns to Private Choice? Effects of Charter Schools on Behavioral Outcomes, Arrests, and Civic Participation." *Economics of Education Review* 76 (2020): 101983.

Monarrez, Tomas, Brian Kisida, and Matthew Chingos. *Charter School Effects on School Segregation*. Washington, DC: Urban Institute, 2019.

Sass, Tim, Ron Zimmer, Brian Gill, and Kevin Booker. "Charter High Schools' Effects on Long-term Attainment and Earnings." *Journal of Policy Analysis and Management* 35, no. 3 (2016): 683–706.

Singleton, John D. "Incentives and the Supply of Effective Charter Schools." *American Economic Review* 109, no. 7 (2019): 2568–612.

Walters, Christopher R. "The Demand for Effective Charter Schools." *Journal of Political Economy* 126, no. 6 (2018): 2179–223.

Wang, Ke, Amy Rathbun, and Lauren Musu. *School Choice in the United States: 2019* (NCES 2019-106). U.S. Department of Education. Washington, DC: National Center for Education Statistics, 2019. Retrieved June 1, 2020 from https://nces.ed.gov/pubsearch.

Zimmer, Ron, Brian Gill, Kevin Booker, Stéphane Lavertu, Tim Sass, and John Witte. *Charter Schools in Eight States: Effects on Achievement, Attainment, Integration, and Competition*. RAND: MG-869, 2009.

THOMAS B. FORDHAM INSTITUTE
ADVANCING EDUCATIONAL EXCELLENCE

P.O. Box 82291
Columbus, OH 43202
www.fordhaminstitute.org/ohio