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Thirty years of charter schools: What does lottery-based research tell us?

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Abstract

Charter schools are highly debated in policy and political discussions about delivering public education. As "laboratories of innovation" that often use lotteries to assign spots, they hold the potential to generate rigorous evidence about effective educational practices. This paper synthesizes and summarizes findings from charter lottery studies and identifies priority areas for future lottery-based research. Existing evidence shows that charter schools can improve academic achievement and longer-term outcomes like four-year college enrollment, particularly among lower-performing students, non-white students, low-income students, and students with disabilities. However, these findings are limited to oversubscribed schools and primarily come from studies that take place in large urban areas in a few states. Future lottery-based charter school research should expand the geographic coverage of existing studies, update the evidence on K-12 academic outcomes, and explore understudied areas such as non-test-score outcomes, college outcomes, and earnings. Studying these topics would bolster existing evidence and inform future education policymaking within the charter sector and beyond.

1 Introduction

Charter schools educate a growing number of students nationwide. First established in Minnesota in 1991, they now operate in 43 states and educate 3.7 million students, or 7 percent of the K-12 student population (NCES, 2021). In some urban areas, such as New Orleans, San Antonio, Washington, D.C., and Detroit, they represent a much larger share of students (Xu, 2022). But the impact of charter schools extends beyond the students who attend them. As "laboratories of innovation," they present the opportunity to try out new educational practices that traditional public schools could replicate. Additionally, because they often use lotteries to assign spots, charter schools provide a setting for rigorous research about effectiveness. Therefore, charter schools hold the potential to inform our understanding of what educational practices drive student success. To ensure that charter schools serve this purpose, it is important to study them rigorously, highlight key takeaways, and identify limitations of existing research. This paper summarizes the existing lottery-based evidence on the impacts of charter schools and outlines areas for future inquiry.

Charter schools are independently run public schools. Like traditional public schools, charters are taxpayer-funded, cannot charge tuition or turn students away unless at capacity, and must adhere to such accountability standards as reporting on state standardized tests. However, they have more freedom to define curriculum, hire (and fire), and experiment with new programs and practices than traditional schools. Charter schools are also schools of choice. When they have more applicants than capacity, charter schools assign seats via lottery. In addition to allocating seats equitably among applicants, lotteries allow researchers to rigorously evaluate the impact of charter schools on student outcomes.

Lottery studies, which are naturally occurring experiments, are the most credible methodology available for determining the impacts of oversubscribed charter schools. A charter school lottery mimics an experiment by randomly assigning students to a charter school (treatment condition) or not (control condition). Randomly selecting which students receive a charter school offer ensures that lottery winners and lottery losers have the same expected outcomes *before* attending a charter school. Researchers can then compare outcomes of lottery winners with those of lottery losers, and attribute any subsequent differences to charter attendance itself. By contrast, non-lottery studies compare outcomes of students who *opt into* charter schools with those of students who do not. However, students who opt to attend charter schools may be different from students who opt to attend traditional public schools; differences in outcomes between these two groups may be the result of baseline differences in students who elect to enroll in either type of school, rather than of attendance at a charter school. Lottery studies offer the most trustworthy evidence about the causal impact of charter schools on student outcomes by ensuring comparisons are made between similar groups of students.

This paper summarizes the existing evidence on the impacts of charter schools, using research that leverages charter school lotteries. We attempt to gather all lottery-based studies of charter schools that have been released since 2000, including peer-reviewed studies, white papers, policy reports, and working papers. As we describe below, the corpus of research shows that charter schools can have large positive effects on academic achievement, including among lower-performing students, low-income students, non-white students, English language learners, and students with disabilities. Several studies indicate that charter schools can improve such longer-term outcomes as four-year college enrollment and civic participation. However, one drawback of lottery studies is that they are only possible in oversubscribed schools that rely on

lotteries to allocate seats. Furthermore, existing studies primarily take place in large urban areas in a few select states like Massachusetts and New York, as shown in Figure 1. They are also becoming outdated; no studies use charter lottery data from 2016 onward (Figure 4).

Charter sector growth, the adoption of centralized school assignment mechanisms that streamline the lottery process, and the passage of time since charter schools were founded create new opportunities to address these limitations. Future lottery-based charter school research should expand the geographic scope; update evidence on K-12 academic outcomes in light of changes to the charter sector and public education system writ large since COVID-19; explore effective charter school practices and models; study non-test score outcomes; and examine long-term effects on college outcomes and earnings. More research on these topics would strengthen the evidence base for future education policymaking, both within the charter sector and beyond.

The remainder of the paper is organized as follows. Section 2 provides background on charter schools, including common arguments for and against them. Section 3 describes how charter school lotteries work and the methods underlying lottery-based studies. Section 4 summarizes existing evidence on the impact of charter schools on academic achievement, behavior, health, and post-secondary outcomes, as well as differential effects for student subgroups. Section 5 explains sources of variation in the charter school sector and what lottery-based studies can tell us about what works (and what doesn't). Section 6 highlights gaps in the existing literature. Section 7 concludes.

2 Charter schools

2.1 Charter school features

Charter schools are independently run public schools that are granted greater flexibility than traditional public schools in exchange for stricter accountability. For instance, charter schools have more autonomy over curriculum, textbooks, instructional methods, and class schedules than do traditional public schools. To maintain or renew their charters, charter schools must demonstrate performance in terms of student achievement, organizational stability, and financial viability.

Charter schools vary considerably, but have some defining features that characterize their governance structures, accountability mechanisms, admissions procedures, and funding sources. Charter authorizers govern charter schools through contracts that set performance expectations and timelines. If a charter school does not meet these expectations, the authorizer can revoke the charter and shut down the school. By contrast, traditional public schools are typically overseen by local school boards and must adhere to state-wide laws and regulations that apply to all public schools within a given state.

As schools of choice, charter schools cannot count on guaranteed enrollment based on residential boundaries.[1] Instead, they must find ways to attract applicants. Because they are public schools, charter schools cannot turn students away if they have space. Once they reach capacity, charter schools generally use lotteries to allocate seats among applicants. Local bargaining contracts with teachers typically do not apply to charter schools, which means they

[1] In some places, such as Los Angeles, charter schools have taken over some traditional public schools, assuming their attendance boundaries. When this occurs, students within the residential boundary have guaranteed access to the "conversion" charter school; any remaining seats are assigned by lottery to applicants from outside the residential zone (LAUSD Board, 2022).

have greater flexibility to hire and fire. Like traditional public schools, charters are taxpayer-funded based on the number of enrolled students. They cannot charge tuition, but often supplement their budgets with grants and private donations.

Variation among charter schools

State laws account for some of the variation in charter schools. States decide which entities can authorize charter schools, such as state or local boards of education, universities, or other educational institutions. Further, states may determine performance criteria, funding, and caps on the number of charter schools. Some states, such as Florida, Ohio, and Michigan, permit for-profit charter schools, while others do not.

Charter schools also vary in who operates them. Some are independently managed, while others belong to a charter management organization (CMO). CMOs are non-profit groups of schools that share such features as core mission, curriculum, theme, policies, and practices. CMOs may operate in a specific region, like Success Academy schools in New York City, or nationally, as in the case of the Knowledge Is Power Program (KIPP). Roughly a quarter of charter schools belong to a CMO (White & Xu, 2022). The for-profit equivalents of CMOs are Education Management Organizations (EMOs). EMOs operate 9 percent of the nation's charter schools (White & Xu, 2022). The way charter schools deliver instruction varies, too. While most charters are brick-and-mortar schools, charters that operate primarily or entirely online serve 9 percent of charter school students (Common Core of Data, 2022).

Charter schools further vary by theme and model. Some charter schools emphasize themes such as civics, college preparation, or STEM. A charter school's model refers to its broader approach. One charter school in Denver, for example, specializes in "expeditionary learning," which focuses on "learning expeditions, case studies, projects, fieldwork, and service

learning projects" in and outside of the classroom (Grigg & Borman, 2014). A common charter approach that we will refer to throughout the paper is the "No Excuses" model. Such charter schools emphasize high academic expectations, strict disciplinary practices, and extended time in class (Golann & Torres, 2018). Many charter schools that previously identified as No Excuses schools now prefer to be described as "High Expectations, High Support," though we will refer to No Excuses schools throughout this paper to align with the language used by the studies we summarize.

The charter school sector has grown considerably since it was first established in 1991. Figure 2 shows this growth in terms of schools and students. As of 2021, 7 percent of K-12 students attend charter schools, though many urban areas have much higher charter enrollment (NCES, 2021). Charter schools are disproportionately located in urban areas, and they tend to serve a lower-income population and a higher proportion of non-white students than traditional public schools, as shown in Figure 3.

2.2 Potential benefits of charter schools

Proponents highlight several potential benefits of charter schools. First, charter schools may offer families with poor-performing neighborhood schools alternative schooling options. Indeed, charter schools are disproportionately located in urban areas (Figure 3), which tend to have lower-performing traditional public schools. Charter schools may also simply provide *different* schooling options that families prefer. Because charter schools have more autonomy than traditional public schools, they may offer educational experiences unavailable elsewhere. For instance, some charter schools offer longer school days or specific curricula that families may like.

Another advantage of charter schools is their potential to serve as "laboratories of innovation" for the public education system writ large. Because charter schools are exempt from many of the laws that govern other public schools, they can experiment with curricula, textbooks, and instructional methods. In theory, traditional public schools could adopt and scale up practices that prove successful in the charter school setting. In practice, charter management organizations implement many of the same practices across multiple schools. It is an open question whether traditional public schools have benefited from innovations in the charter school setting.

A third argument for charter schools is that competition among schools for students could drive improvement, both within the charter sector and beyond (Chubb & Moe, 1990; Friedman, 1955). This theory emphasizes the fact that charters face an incentive to outperform traditional public schools in order to attract and maintain enrollment. Traditional public schools face a similar incentive to improve in order to avoid losing students and associated funding to charters. Families can "vote with their feet" by opting to attend whichever school they prefer, creating competitive pressure that rewards continued improvement in both charter and traditional public schools.[2]

2.3 Potential drawbacks of charter schools

Common criticisms of charter schools include concerns that they stratify the public school system, drain resources from traditional public schools, over-emphasize tested subjects, and rely on a less-experienced workforce. Because students have to opt into charter schools, less-informed families may be deterred by the administrative and procedural barriers to enrollment

[2] The competitive effects are beyond the scope of this review; see Cohodes & Parham (2021) for an overview of existing quasi-experimental research on this topic.

(Gross et al., 2015; Corcoran et al., 2018; Cohodes et al., 2022). The opt-in nature of charter schools can contribute to a segregating effect (Monarrez et al., 2022). Further, charter schools themselves may seek out high-performing students who would reflect well on the school and make it easier to meet state standards. "Cream-skimming" high-performing students could concentrate the most disadvantaged and low-performing students in traditional public schools.

A second, related criticism is that charter schools drain regular public schools of financial and other resources. As school systems typically allocate money based on enrollment, traditional schools may lose funding when students switch to charters (Epple et al., 2016). Some states, like Massachusetts, have laws that ensure that funding at traditional public schools does not drop in the short run with enrollment. But over time, if charter enrollment increases, such guarantees may not continue. Funding shifts would be of particular concern if charters indeed "cream skim," attracting "easier to educate" students while leaving traditional schools with a larger share of students who have more challenging and costly learning needs.

Critics also fault charters for overemphasizing tested subjects. In many states, charter schools need to meet performance standards as measured by standardized tests in math and English language arts (ELA) as part of their contracts. Some argue that such standards induce charter schools to devote disproportionate classroom time to subjects that are tested or "teach to the test" at the expense of providing a well-rounded education. This is an empirical question that could be answered with additional research that examines the non-test score and long-term outcomes of charter school students.

Concern about the emphasis on rote learning and testing is paired with criticism of harsh disciplinary practices. Urban charter schools often have higher suspension rates than their traditional counterparts (Angrist et al., 2013; Losen et al., 2016; Felix, 2020). No Excuses charter

schools, in particular, used to explicitly rely on strict disciplinary practices, though these policies are changing.

A final critique of charter schools relates to the teacher workforce. Because local bargaining contracts between teachers and school districts often do not apply to charter schools, teachers are less likely to be unionized, tend to be less experienced, report working longer hours, and have higher turnover rates than their counterparts in traditional schools (National Center for Education Statistics, 2023; Bruhn et al., 2022; Barrett et al., 2020; Carruthers, 2012; Cowen & Winters, 2013; Stuit & Smith, 2010).

Throughout the rest of this paper, we will discuss what lottery-based studies reveal about the benefits and critiques of the charter school sector. We will also highlight areas that currently lack empirical evidence and suggest opportunities for future research.

3 Why lottery studies?

3.1 The selection bias problem

Parents, education practitioners, policymakers, and researchers want to know the causal impact that charter schools have on students. Yet, simple comparisons of outcomes between students who attend charter schools and those who do not may be misleading. This is due to "selection bias," which occurs when the individuals who opt into a treatment are different from those who do not. Charter students are, on average, more likely to live in urban settings in lower-income households, be non-white, and have lower baseline achievement scores than is the case for the K-12 population overall (Figure 3). Even within a given city, the students who opt to attend charter schools may be different from those who enroll in their local public schools. Therefore, differing

outcomes of charter school students and traditional public school students may be due to baseline differences in students, not the relative effectiveness of either type of school.

While researchers can account for observable differences in students (like baseline test scores or demographic characteristics) that drive selection bias statistically, they cannot account for unobservable differences. For example, administrative data does not measure the academic and emotional support students receive at home. Such unobservable characteristics may affect both whether students enroll in charter schools and their academic or other outcomes. Selection into treatment (e.g., charter schools) based on unobservable characteristics is a fundamental challenge in research.

In medical and natural sciences, selection bias is often solved by conducting randomized controlled trials (RCTs). RCTs randomly assign participants in a study to either a treatment condition or a control condition. Random assignment ensures that, all else equal, we would expect the outcomes for the two groups to be the same. We can therefore attribute any differences in ultimate outcomes to the treatment itself. In the social sciences, randomly assigning a treatment or control condition is often not possible for ethical or feasibility reasons. As a result, reliably estimating the *causal* impact of policies or programs ("treatments") can be a challenge.

The use of lotteries in the charter school sector creates a "natural experiment," mimicking the random assignment used in RCTs and empowering researchers to rigorously evaluate the causal impact of charter schools on student outcomes. We expect winners and losers of charter school lotteries to be the same, on average, in terms of observable and unobservable characteristics at baseline because of the random nature of the lottery. Therefore, any differences in outcomes between these groups later on must be the result of enrollment in charter schools.

3.2 Lotteries in practice

Charter schools use lotteries to allocate available seats when they are "oversubscribed," i.e., when more students apply than there are spots available.[3] If a student loses the lottery and does not receive a charter school offer, she may be placed on a waitlist to receive an offer later if a seat becomes available. Because families can apply to multiple schools, it is common for seats to open up. Many charter schools run their own lotteries, though some districts have centralized assignment systems or common applications. Such systems allow families to submit a single list of rank-ordered school preferences to a central office instead of applying to individual schools, increasing efficiency and fairness. School seats are allocated in a manner that reflects student preferences and school priorities (e.g., keeping siblings in the same school) using an algorithm (e.g., the deferred acceptance algorithm).

3.3 Estimating causal charter effects

Researchers leverage charter lotteries to estimate the causal impact of charter attendance by comparing the outcomes of students who received a charter offer with those who did not. Not all students who receive an offer actually end up enrolling in a charter school, so researchers adjust these comparisons to account for such situations. The most common method to do this comparison and adjustment uses an instrumental variables framework known as two-stage least squares (2SLS).

[3] One common exception to admission by lottery is sibling preferences. Charter schools often guarantee entry to siblings of students who already attend their schools. For schools that span multiple school levels, priority may also be given to students who are already in the lower school and are transitioning to the upper school. In some cases, preference is also given to applicants based on where they live. Other than these few exceptions, oversubscribed schools tend to use lotteries to assign seats given limited capacity.

2SLS addresses selection bias in who enrolls in charter schools by using the random assignment of the charter offer to predict the likelihood of eventually enrolling in a charter school. The "first stage" estimates how receiving a charter offer changes the likelihood that a student will enroll in a charter school. This is the difference in charter attendance rates between the students who are offered a seat during the lottery and those who are not. The "second stage" estimates the effect of charter school attendance, as predicted by the first stage, on a student-level outcome. The estimates from a 2SLS model represent the causal effect of attendance at a charter school on a given student-level outcome for "compliers"—students who would enroll in a charter school if they get an offer and would not enroll in a charter school if they do not. The 2SLS estimate is also known as the local average treatment effect (LATE), or the effect for students who were induced to attend charter schools as a result of receiving a lottery offer (Angrist, Imbens, & Rubin, 1996).

The first-stage model is:

$$D_i = \gamma + \pi Z_i + \mu_i$$

where D_i indicates whether a student enrolls in the charter school, and Z_i indicates whether a student received a lottery offer. Z_i is known as an instrumental variable. The coefficient π measures the effect of winning the lottery on charter attendance.[4] The second stage is:

$$Y_i = \phi + \rho \widehat{D}_\iota + \epsilon_i$$

where the effect of interest, ρ, measures the impact of charter school attendance on a student-level outcome, Y_i, for compliers. Here, $\widehat{D}_\iota$ is the predicted enrollment in a charter school from the

[4] Attendance can be defined either as a binary indicator (0 for non-attendance, 1 for attendance) or by *years* of attendance. For the former, the first stage will often be less than one and will measure the difference between attendance rates between offered and non-offered students. For the latter, the first stage can be greater than one and measures the difference in average number of years spent in a charter school between offered and non-offered students.

first stage. In addition to the 2SLS estimate, researchers sometimes estimate a "reduced-form" or intent-to-treat (ITT) effect. The ITT is the causal effect of an *offer* to a charter school on a given student outcome. The ITT model takes the following form:

$$Y_i = \alpha + \beta Z_i + v_i$$

The 2SLS and ITT estimators are closely related: The 2SLS is the reduced-form effect scaled by the first-stage estimate of how a lottery offer changes the charter attendance rate, on average. Some researchers prefer the ITT because it reveals a policy-relevant treatment effect of an *offer* of charter school admission. The LATE, on the other hand, describes the average causal effect for students who actually *attend* charter schools. The relationship between the 2SLS and reduced-form is:

$$2SLS\ (LATE) = \frac{Reduced\ Form\ (ITT)}{First\ Stage}$$

When there is perfect compliance—meaning that every student who received an offer of admission to a charter school enrolls—and no non-offered student enrolls, the 2SLS and reduced form coincide. In practice, this is rarely the case.

The simple models described above are often augmented to account for applications to multiple schools with the inclusion of risk sets (lottery fixed effects); to increase precision with the inclusion of covariates; and to estimate effects for multiple types of charter schools. Econometric methods that leverage lotteries have improved as a growing number of school districts use centralized assignment systems. Such systems generate many natural experiments that can illuminate the causal effects of attendance at any of the schools in the centralized system at once.

A common way to estimate 2SLS in a setting with centralized school assignment is to include risk set fixed effects in the estimation strategy. Risk sets are defined as groups of

students who applied to the exact same set of schools and ranked them in the same order. Within each risk set, students face the same likelihood of receiving a lottery offer. Therefore, including risk set fixed effects compares outcomes between students who applied to the same schools and faced the same likelihood of receiving a lottery offer. This approach allows lottery estimates to be generated for a group of charter schools that have varying numbers of applications and seats (and therefore a differential likelihood of an offer) at the same time.

Abdulkadiroglu et al. (2017) develop empirical methods that extend this study design to fully exploit the random assignment embedded in centralized assignment mechanisms. Specifically, they show that conditioning on the probability of random assignment to treatment ("propensity score") for participating students recovers a more representative average causal effect with more efficiency than the risk set fixed effects approach. For a more detailed explanation of lottery methods, see Angrist, Hull, & Walters (2023).

3.4 Limitations of lottery studies

By removing selection bias, lottery-based estimates of charter school effectiveness attain strong *internal validity*. That is, they convincingly identify the true causal impact of charter schools within the setting being studied. Still, such studies have their limitations. First and foremost, lottery studies can only evaluate oversubscribed schools. This limits their *external validity*, i.e., the extent to which their findings can be generalized to other settings. Even within a single district, oversubscribed charters may not be representative of all charter schools in the area. Oversubscription rates in the charter sector are not well documented. However, one data point from the 2006-07 school year suggested that only 26 percent of charter middle schools had more applicants than available seats (Clark Tuttle et al., 2012). The schools that have the most demand—oversubscribed charters—may also be those that families consider to be the highest

quality. Outcomes at these oversubscribed schools, therefore, may not be indicative of those at nearby undersubscribed schools. More broadly, lottery estimates offer credible localized results but do not necessarily capture national trends. To the extent that oversubscribed charter schools are not evenly distributed across the country, lottery-based estimates may not reflect the charter sector as a whole. Another impediment to generalizing from existing studies relates to the selection bias phenomenon described earlier. The students who opt to apply to charter schools may be different from students in the rest of the district. Therefore, if non-charter students were to switch to charter schools, they would not necessarily achieve the same outcomes as estimated in lottery-based studies.

Lottery studies are further limited in the way that treatment can be defined. Because students receive an offer (or not) to a school, treatment is defined by all the features that comprise a given school. For instance, No Excuses charter schools are characterized by longer school days, longer school years, high expectations for student performance, strict disciplinary practices, and contracts between families and the school. While many studies estimate the overall causal effect of No Excuses charter schools, lottery-based studies cannot causally identify which specific aspects of the No Excuses model drive the observed impact. At best, lottery studies can offer correlational evidence about features of schools that tend to have the largest causal effects, as some existing studies do (Angrist et al., 2013; Dobbie & Fryer, 2013).

Finally, on the logistical side, the validity of lottery studies depends on accurate and comprehensive record-keeping. For some of the first lottery studies, researchers had to match lottery records by hand with administrative records of students. Without clear records, identifying treatment and control students could be a challenge. Further, if not all schools are equally meticulous in their record-keeping, the results may be particular to charter schools that

have better records. As schools and districts increasingly use digital platforms to run their lotteries and maintain records, these quality issues are subsiding. Still, changing technology platforms used for admissions and staff turnover can result in the loss of records that are necessary to leverage lotteries and implement methods to recover credible causal estimates. Students who leave the public school system entirely present a different type of validity challenge, leading to attrition from the study sample and outcomes that are unobserved altogether.

Alternative econometric methods that draw on observational administrative data can complement lottery studies. Many studies estimate charter school impacts using quasi-experimental methods. Regression, matching, and difference-in-differences techniques can shed light on some of the questions that lottery-based studies cannot, but such methods may not fully eliminate selection bias as described above. In this paper, we chose to focus on lottery-based studies because we believe they offer the most credible causal estimates of the impact of charter schools. For an overview of quasi-experimental studies of charter school effectiveness, see Cohodes & Parham (2021).

4 What do lottery studies tell us?

4.1 Papers included in this review

We aimed to identify all studies that met our inclusion criteria, which we defined as studies that: (i) estimate the impact of charter school programs on academic, behavioral, health, civic, or labor market outcomes; (ii) use lottery methods or other forms of random assignment; (iii) are published in peer-reviewed journals, working papers, government publications, or independently published white papers after 2000; and (iv) are located in the United States and enroll students in

K-12. We began by compiling a list of papers from the references of the most recently published review of rigorous studies of charter school effectiveness (Cohodes & Parham, 2021). We identified all the papers cited in Cohodes & Parham (2021) that fit our inclusion criteria or were themselves review papers. We combed the bibliographies of the papers in this list to find additional papers that fit the inclusion criteria. We also searched for forward citations of the review papers we identified. Separately, we conducted a search of databases of peer-reviewed journal articles, dissertations, research reports, and working papers. Our sources included Harvard's library (Hollis), MIT's online libraries, the National Bureau of Economic Research (NBER), and the National Education Working Paper Series (EdWorkingPapers) compiled by the Annenberg Institute. We used combinations of four search terms: (i) charter school, (ii) lottery, (iii) random assignment, and (iv) school choice.

We identified 40 lottery-based studies of charter schools. Some of these papers have been released as both draft working papers and peer-reviewed journal articles. In cases when the analysis or sample differed substantively, we included both versions. Otherwise, we included the peer-reviewed, published version of the study. We also reviewed meta-analyses and systematic reviews of the literature on charter school impacts. Table 2 summarizes the studies by the outcome that they report. Thirty-one studies analyze standardized test scores, 12 analyze other K-12 outcomes, and 10 analyze post-secondary outcomes. While lottery studies of charter schools have been done in many settings, they are more likely to take place in urban areas in a few states, use lottery data from 2015 and before, and focus on middle and high schools. These factors should be kept in mind before making generalizations based on the results summarized in this paper.

Although charter schools operate in 43 states, lottery studies included in this paper report findings for only 14 states that we could identify.[5] Figure 1 depicts the uneven geographic distribution of charter schools and charter lottery studies. Table 1 shows the number of studies that use lottery data from each state.[6] Most lottery-based studies use data from Massachusetts (19 studies) and New York (nine studies). Within these states, studies often take place in large urban centers like Boston and New York City. For instance, 12 of the Massachusetts studies use data from Boston's charter schools. Charter schools in much of the country, particularly in suburban and rural areas, have not received as much scrutiny. This gap in the research is significant given the large variability in charter school laws across states, as well as in programs and practices of different types of charter schools.

Evidence on charter school effectiveness for the past 5 to 10 years is not well-documented by lottery methods. Figure 4 shows the number of studies that use lottery data from each year between 2000 and 2023. The evaluations use lottery data from between 2000 and 2015, with no studies using lottery data from 2016 and onwards. Outcome data for these studies could (and often does) come from later years. Estimating charter school impacts on long-term outcomes like enrollment in and persistence through college necessitates data from earlier years: Students finishing college this year, in 2023, would have participated in a middle school charter lottery in 2012 (or earlier, if they did not go straight through high school and college). However, researchers could use more recent lottery data to estimate impacts on K-12 academic, behavioral, and health outcomes.

[5] A national study of charter schools by Gleason et al. (2010) examines charter schools in 15 states, however they do not specify which states these are.

[6] Some studies use data from multiple states, so the total number adds up to more than the total number of lottery studies included in this paper (40).

Charter lottery studies disproportionately evaluate middle schools. Overall, 11 studies evaluate elementary schools, 32 evaluate middle schools, and 19 evaluate high schools (see appendix table A3). This sampling does not reflect the actual composition of charter schools. Charter elementary school students outnumber charter middle and high school students, as shown in Figure 3. Some studies evaluate the combined impacts of elementary and middle schools or middle and high schools, and in a few cases, K-12 schools. Some charter lottery studies focus on a specific model like No Excuses schools (26 studies) or a charter management organization like KIPP (18 studies examine CMO charter schools, eight have a focus on KIPP specifically; see appendix table A3). These studies can shed light onto what practices may contribute to the causal impacts of charter schools but cannot offer definitive evidence about whether the model or CMO affiliation in itself drives results.

Finally, the studies included in this paper vary in their sample sizes. In some cases, researchers focus on a single charter school, while others analyze entire charter systems or use data from entire states. For instance, three of the nine studies that took place in New York City estimate the impact of specific schools: Promise Academy in the Harlem Children's Zone (Dobbie & Fryer, 2011; Dobbie & Fryer, 2015) and Democracy Prep (Gill et al., 2020). To put this figure in perspective, New York City is home to more than 250 charter schools (New York State Education Department Charter Schools Directory, 2023).

4.2 Charter school impacts on test scores in math and ELA

Lottery-based studies tend to find that, on average, charter schools have a large positive impact on standardized test scores in both math and ELA, with larger effects in math (Hoxby et al., 2009; Angrist et al., 2016; Abdulkadiroglu et al., 2017; Cohodes et al., 2021; Angrist, Pathak, &

Zarate, 2023; Reber et al., 2023). Table 3 summarizes the results of the 31 studies that estimate the impact of charter schools on standardized test scores. Most lottery studies report impacts on math and ELA because these scores are readily available in administrative data for both traditional and charter school students and are predictive of longer-term positive outcomes (Goldhaber & Özek, 2019; Chetty et al., 2014).

Large, positive effects of charter schools on math and ELA achievement often come from studies of urban, No Excuses charter schools. For example, an early study of Boston's charter schools found score gains of 0.42 standard deviations (SD) in math and 0.25 SD in English per year at the middle school level and slightly smaller but similar results at the high school level (Abdulkadiroglu et al., 2011). These effect sizes are typical of other estimates from Boston's charter schools (Angrist et al., 2011; Cohodes et al., 2013; Angrist et al., 2013). No Excuses charter schools in New York City, Newark, Chicago, and Los Angeles also deliver achievement gains relative to non-charter schools (Angrist, Pathak, & Zarate, 2023; Dobbie & Fryer, 2013; Unterman, 2017; Winters, 2020; Reber et al., 2023).

Several exceptions emerged to the broadly positive findings about the impacts of charter schools on standardized test scores. Two national studies find that charter schools have a negligible or negative impact on student test scores (Gleason et al., 2010; Clark et al., 2015). However, these top-line results varied considerably across schools and students. Two studies that have more restricted geographic samples report null impacts of charter schools on test scores (Grigg & Borman, 2014; Ridley & Terrier, 2018). Grigg & Borman (2014) is a small study of two schools, while Ridley & Terrier (2018), which uses data from across Massachusetts, notes heterogeneity across student populations, similar to the national studies. Three factors could

explain the varying results: different students, different counterfactuals, and different school practices.

Charter schools in suburban or rural areas are more likely to have no impact or a negative impact on student achievement than are urban charters (Gleason et al., 2010; Angrist et al., 2011; Angrist et al., 2013; Clark et al., 2015; Grissmer et al., 2023). In a large nationwide lottery-based evaluation of charter schools, researchers estimate the impact of 33 charter middle schools in 13 states and find slightly negative but insignificant effects on student achievement (Clark et al., 2015). This is one of a few studies where a significant portion of the school sample (22 schools, or 67 percent) came from non-urban charter schools. The sample also differed from that of other charter school studies and charter schools nationally: Students were more likely to be white and less likely to receive free or reduced-price lunch (FRPL), and they had higher baseline achievement scores. While its student and school sample is less representative of the charter school sector overall, the study offers an important insight: Results from urban charters do not necessarily generalize to other settings. Within the study population, results varied considerably across schools and students, with positive impacts for schools in urban areas and those serving more disadvantaged populations and smaller or negative impacts for schools in non-urban areas and serving more advantaged student populations (Clark et al., 2015). But this, too, is not always the case: A for-profit charter school network in Michigan benefited non-poor students outside urban areas more than it did low-income students in urban areas (Dynarski et al., 2018). This finding stands in contrast to most other lottery-based charter school research.

Charter schools in Massachusetts follow a similar pattern to the national study described above. Urban charters in Massachusetts produce large, statistically significant impacts on math and ELA achievement, while charter schools in suburban areas negatively affect student

achievement (Angrist et al., 2013; Ridley & Terrier, 2018). Angrist et al. (2013) try to disentangle whether this is the case because urban charter schools themselves are particularly effective, or whether the students who attend urban charter schools are more susceptible to experiencing gains from attending any charter school (urban or not). Indeed, the student populations served by schools in these settings differ: Students in non-urban charter schools have higher baseline scores, on average, than students in urban charter schools (Angrist et al., 2013). The authors find that while the particular population served by urban charters partly explains the large gains seen in urban charter schools, the urban schools are more effective at educating low-income, non-white students and students with low baseline test scores than non-urban charters. In other words, the difference in student populations served by urban and non-urban charters does not fully account for the overall difference in effectiveness of these schools (Angrist et al., 2013).

The quality of non-charter school options in urban and non-urban settings could explain, in part, the larger effect sizes of urban charters relative to non-urban charters. For instance, the non-charter options in urban settings may be weaker than those available to suburban students. In Chicago, estimated treatment effects depend on where students would be expected to attend if they did not get an offer at a top-choice school (Angrist, Pathak, & Zarate, 2023). In this setting, exam schools (not charter schools), which are widely considered to be high-performing schools, appear to *negatively* impact student achievement. This negative effect of the exam schools is driven by students who would otherwise attend high-performing charter schools in Chicago. These findings show that the *counterfactual* school can play an important role in the estimated treatment effect of a charter school. This point applies more generally to other studies: Charter

schools have the largest impact on students whose alternative school options are low-performing (Chabrier et al., 2016).

In some charter lottery studies, the counterfactual is not clear or may be other charter schools. For instance, SEED charter school, a No Excuses boarding school in Washington, D.C., positively affects student achievement (Curto & Fryer, 2014). However, students who do not receive an offer at SEED may end up attending a different charter school in the Washington area. Similarly, Promise Academy charter schools in the Harlem Children's Zone (HCZ) in New York City positively affect math and ELA scores at the elementary school level and math scores at the middle school level (Dobbie & Fryer, 2011). However, the counterfactual schools for the elementary student sample include other charter schools in New York. Therefore, the effects at the elementary level are specific to Promise Academy relative to other charter schools *and* traditional public schools, not to traditional public schools only.

The positive and significant gains of charter students in math and ELA are encouraging given that educational interventions at the high school level may be considered "too late" to be effective. Even more notably, charter schools can significantly improve achievement for students with lower baseline achievement (Walters, 2018). Furthermore, where we have evidence over time, charter schools show sustained positive effects even as the sector has expanded, suggesting that these results may not be driven only by differences in unobservable characteristics of early adopters (Cohodes et al., 2013; Cohodes et al., 2021).

4.3 Other academic outcomes

Studies have shown charter schools to improve outcomes in areas beyond math and ELA scores, including higher performance on science exams and high school exit exams (which often involve

subjects other than math and ELA); increased participation in college-prep courses and improvements on associated exams (including AP and SAT); and enhanced chances for merit aid (Dobbie & Fryer, 2011; Dobbie & Fryer, 2015; Angrist et al., 2016; Dynarski et al., 2018; Setren, 2021; Cohodes & Feigenbaum, 2023; Grissmer et al., 2023; Angrist, Pathak, & Zarate, 2023). One exception to these positive results comes from Los Angeles, where recent evidence shows that No Excuses charter high schools have no effect on AP course-taking or high school GPA, but do increase the likelihood of students taking a calculus class (Reber et al., 2023). Table 4 summarizes results from studies of academic outcomes other than math and ELA scores. Positive (or null) effects across many different measures of academic achievement assuage concerns that charter schools' emphasis on test-based achievement comes at the cost of students' broader academic experience.

Some initial evidence from Boston suggests that charter schools do not "teach to the test" to a greater extent than their traditional public school counterparts (Cohodes, 2016). To explore this topic, Cohodes (2016) leverages variation in how often certain topics appear on standardized exams to see whether charter school students perform disproportionately well in areas that are tested most often. In Boston's charter schools, students perform better than students at traditional public schools across *all* subscales of math and ELA, including those that are tested less frequently, and in lower-stakes subjects like science (Cohodes, 2016). If charter schools strategically allocated time to focus only on often-tested subjects, we may instead expect that students in these schools would perform better on these topics and less well on topics that are rarely tested. The author argues that because charter students perform similarly on all subscales, charter schools must not be teaching to the test to a greater extent than their counterparts in traditional public schools. Still, the analysis does not rule out the possibility that charter schools

allocate time away from non-tested subjects or that charter schools in other settings participate in test preparation.

Evidence on the effects of charter schools on on-time grade progression and graduation is mixed. In Los Angeles, charter high schools have a small, statistically insignificant positive effect on the likelihood of receiving a high school diploma (Reber et al., 2023). Charter students in Boston graduate from high school within four years *less* often than their public school counterparts, with no differences after five years (Angrist et al., 2016; Cohodes & Feigenbaum, 2023; Setren, 2021). Charter students in the Harlem Children's Zone, on the other hand, graduate on time *more* often than other students (Dobbie & Fryer, 2015). In this case, charter and traditional public school students have similar graduation rates after six years.

4.4 Behavior and health

The lottery-based evidence on student behavior and health outcomes is sparse. There is no strong consensus across studies and study contexts regarding the impacts of charter schools on in-school disciplinary records, risky behaviors (e.g., alcohol and drug use), and criminal activity. Four studies estimate the impact of charter schools on suspensions or disciplinary incidents but with mixed results (Angrist et al., 2013; Felix, 2020; Gleason et al., 2010; Dynarski et al., 2018). Students who attend urban, No Excuses charter schools in Massachusetts are more likely to be suspended than their counterparts in traditional public schools (Angrist et al., 2013; Felix, 2020). This effect was larger before Massachusetts passed Chapter 222, which made suspending students in all schools more difficult. After the law passed, charter schools continued to suspend students to a greater degree, but the rate was no longer statistically higher than that of non-charters (Felix, 2020).

Two other studies find no impact of charter schools on disciplinary outcomes (Gleason et al., 2010; Dynarski et al., 2018). A for-profit charter school network operating in Michigan that shares many of the same practices as No Excuses charter schools, including a focus on test-based assessment of core academic subjects and requiring students and parents to sign a behavior contract, does not impose disciplinary actions against students at a higher rate than its non-charter counterparts (Dynarski et al., 2018). Charter middle schools in 15 states similarly do not affect student suspensions (Gleason et al., 2010).

Measures like suspensions provide an incomplete picture of behavioral outcomes. Based on administrative data alone, it is unclear if they reflect actual differences in student behavior or differing disciplinary practices in charter schools. Many charter schools, particularly No Excuses charters, used to rely on strict disciplinary practices (Golann & Torres, 2018). KIPP schools, for example, focus on behavior and discipline as part of their "high expectations" pillar for success. Given stricter disciplinary practices, charter schools may impose harsher penalties than regular public schools for the same behaviors.

Charter students in middle schools in six states report getting into trouble *more* and are more likely to participate in "undesirable behaviors" than their traditional school counterparts, according to self-reported survey results (Clark Tuttle et al., 2013). On the other hand, high school students at No Excuses charter schools in Los Angeles report getting into trouble and getting suspended at similar rates to their public school counterparts (Reber et al., 2023). Such findings could capture either an actual difference in behavior or a difference in student perceptions of "good behavior" and "bad behavior."

Five lottery studies report on other aspects of student behavior, including student effort, tardiness, and absences, with mixed and inconclusive results. No Excuses charter high schools in

Los Angeles and KIPP charter middle schools in six states do not affect student effort (Reber et al., 2023; Clark Tuttle et al., 2013). A broader sample of charters in 15 states similarly found no effect of charter schools on student effort (Gleason et al., 2010). Charter impacts on student absences are mixed: Promise Academy in Harlem Children's Zone (HCZ) in New York reduces student absences relative to students in other schools (Dobbie & Fryer, 2011), while for-profit charter schools in Michigan have no effect on absences (Dynarski et al., 2018). No Excuses charter high schools in Los Angeles causally reduce the likelihood of students skipping class (Reber et al., 2023).

Four studies report on student health, which we broadly define to include student well-being and attitudes as well as physical and mental health in this paper (Table 2). Research on student well-being and attitudes has yielded mixed results. A national study found that charter students were more well-adjusted than non-charter students according to their parents (Gleason et al., 2010). In a study of KIPP schools in six states, charter schools had no impact on student attitudes towards school according to self-reported survey results (Clark Tuttle et al., 2013).

Finally, two papers study the impact of charter schools on risky behaviors such as alcohol, tobacco, and drug use; sexual activity and pregnancy; and criminal behavior. Both studies find that charter school students see lower rates of extremely risky behaviors, including sex without contraception, pregnancy, and incarceration (Wong et al., 2014; Dobbie & Fryer, 2015). However, students in and out of charter schools experience similar rates of alcohol, tobacco, and drug use (Wong et al., 2014). Dobbie & Fryer (2015) also study physical and mental health, with null results.

4.5 Post-secondary educational attainment

Studies of post-secondary outcomes generally find that charter school offers and attendance boost four-year college enrollment (Angrist et al., 2016; Davis & Heller, 2019; Coen et al., 2019; Setren, 2021; Nichols-Barrer et al., 2022; Cohodes & Feigenbaum, 2023; Angrist, Pathak, & Zarate, 2023; Reber et al., 2023). Given that many charter schools focus on college preparation, a growing number of studies have sought to assess whether gains during middle or high school translate to postsecondary success. Impacts on college outcomes may depend on students' full trajectories through K-12. One recent study of KIPP charter schools finds that attendance at a KIPP charter middle school does not impact college enrollment but suggests that attending both a KIPP charter middle school and a KIPP charter high school increases college enrollment significantly (Demers et al., 2023). Table 5 summarizes results from the lottery studies that analyze the impacts of charter schools on postsecondary outcomes.

Several studies find that charter students continue to outpace their traditional public school counterparts in terms of four-year college enrollment over time, not just immediately after high school graduation (Davis & Heller, 2019; Coen et al., 2019; Nichols-Barrer et al., 2022; Cohodes & Feigenbaum, 2023). However, one study in the Harlem Children's Zone found that by the sixth year out of high school, college-enrollment rates of Promise Academy charter school students do not differ from those of their non-charter counterparts (Dobbie & Fryer, 2015).

Studies of post-secondary effects differ in what they find drives the bump in four-year college enrollment. Charter schools may induce students who were not planning to attend college at all to enroll in a four-year college. Consistent with this idea, most of the studies that report on two-year and four-year college enrollment find small or no increases in two-year college enrollment combined with larger positive impacts on four-year college enrollment (Davis &

Heller, 2019; Coen et al., 2019; Nichols-Barrer et al., 2022; Cohodes & Feigenbaum, 2023). Another explanation for the increase in four-year college enrollment could be that charter schools influence students who would have otherwise enrolled in two-year colleges to enroll in four-year colleges. This would make sense given that some charter schools emphasize college preparation and selective post-secondary programs. Students who attended No Excuses charter high schools in Los Angeles, for example, were more likely to report that their teachers encouraged and expected them to go to college than their public school counterparts (Reber et al., 2023). Along these lines, charter schools in Boston cause students to shift enrollment from two-year colleges to four-year colleges, rather than causing students who were not planning to attend college at all to enroll (Angrist et al., 2016). Empirically, Angrist et al. (2016) documents an increase in four-year college enrollment paired with a decrease in two-year college enrollment. In another study of Boston's charter schools, Setren (2021) documents a similar pattern of results for non-special needs students, though the negative impact on two-year college enrollment is not statistically significant.

Charter schools may also affect what types of four-year colleges students attend. In some cases, charter schools cause students to enroll in higher-quality post-secondary institutions, as measured by SAT scores of peers, college graduation rates, and admission rates (Davis & Heller, 2019; Cohodes & Feigenbaum, 2023; Demers et al., 2023). On the other hand, Coen et al. (2019) found no impact of charter schools on the quality of colleges attended.

In addition to college enrollment, researchers have studied persistence through college, with mixed results. Lottery winners who attend charter schools in Chicago persist through college at significantly higher rates than their traditional public school counterparts (Davis & Heller, 2019). However, findings from other studies of college persistence are less conclusive.

Students who receive an offer to attend a KIPP middle school are no more likely to graduate or be on track to graduate from a four-year college than students who do not receive an offer (Demers et al., 2023; Nichols-Barrer et al., 2022). Other studies report imprecise findings, primarily because they lack sufficient long-term data on outcomes (Angrist et al., 2016; Coen et al., 2019; Dobbie & Fryer, 2015). For example, Angrist et al. (2016) find positive but imprecise impacts of charters on student enrollment after three semesters of college. After five academic semesters, the effect is very small and imprecise.

Many of the charter schools that opened in the late 2000s only now have large enough graduate classes to allow for empirical study of long-term outcomes. The impact of charter schools on college enrollment is typically positive, but the sample of schools is quite limited. College persistence is even more difficult to assess, with smaller sample sizes and fewer studies.

4.6 Civic participation

Two lottery-based charter school studies have analyzed the impact of charter school attendance on measures of civic life such as voter registration and turnout. Attending Democracy Prep school—a charter middle and high school in New York City that sets out to "educate responsible citizen scholars for success in the college of their choice and a life of active citizenship"—increased voting in the 2016 presidential election, but had no significant impact on voter registration rates (Gill et al. 2020).

What about outcomes for students who attend charter schools without a civic mission? Cohodes & Feigenbaum (2023) analyze the impact of charter schools on civic outcomes for a larger sample of schools than Gill et al. (2020). They find that charter attendance at Boston's schools—which follow a No Excuses model but are not necessarily civics-focused—boosts voter turnout in the first presidential elections after high school graduation. As in Gill et al. (2020),

they find no effect on voter registration. The effect on voter turnout is specific to the first presidential election after graduation and is driven by an increase in *women's* voter turnout.

4.7 Student subgroups

Studies that examine differential effects of charter schools by baseline student achievement widely find that lower-scoring students experience the largest gains from charter attendance relative to their peers (Angrist et al., 2012; Angrist et al., 2013; Cohodes et al., 2013; Angrist et al., 2016; Cohodes, 2016; Walters, 2018; Setren, 2021; Curto & Fryer, 2014). Many of these same studies also find that charter schools have particularly large effects on low-income or non-white students (Angrist et al., 2013; Cohodes et al., 2013; Walters, 2018; Winters, 2020). Such is the case, for example, for Black and Hispanic students attending charter schools in Massachusetts (Angrist et al., 2013; Cohodes et al., 2013). In one study, low-income students appear to experience larger effects than non-low-income students, but the small sample size of the study limits the ability to detect whether this effect is statistically different (Curto & Fryer, 2014). Another study reports that low-income or non-white students experience similar, positive gains compared with other students (Hoxby et al., 2009). An exception to these broadly positive findings for low-income and non-white students is Dynarski et al. (2018), which estimates the impact of a large for-profit charter school network on students in Michigan. This study finds larger gains for white and Asian, non-urban, and non-economically disadvantaged students compared with Black and Hispanic, urban, and economically disadvantaged students, respectively.

The differential impacts of charter schools by gender vary by outcome and study. For instance, charter schools have a larger impact on civic outcomes like voting behavior for girls

than for boys (Gill et al., 2020; Cohodes & Feigenbaum, 2023). Differential impacts by gender on math and ELA performance vary, with some studies finding similar results across boys and girls (Hoxby et al., 2009; Angrist et al., 2016; Reber et al., 2023) and others finding larger or smaller gains depending on the subject. For example, at middle schools in Boston, charter effects are smaller for boys and larger for girls in math, but do not differ in ELA (Cohodes et al., 2013). In the study of the SEED charter schools in Washington, D.C., charter school effects were entirely driven by girls in both math and ELA (Curto & Fryer, 2014). Charter schools have similar impacts on postsecondary outcomes for boys and girls (Davis & Heller, 2019; Demers et al., 2023; Reber et al., 2023).

Several studies explore differential impacts of charter schools by special education (SPED) status, with overall positive gains for students with disabilities. Some studies find that SPED and non-SPED students experience similar gains from charter schools in terms of test scores (Cohodes et al., 2013; Setren, 2021). Others find even larger effects of charter schools for SPED students relative to students overall (Angrist et al., 2012; Angrist et al., 2016). Walters (2018) finds statistically similar effects for SPED students in math and larger effects for SPED students in reading relative to the main charter effect. When it comes to college, SPED students experience a particularly large boost in two-year college graduation rates relative to their non-charter counterparts (Setren, 2021). All of the studies examining SPED students mentioned here take place in Boston, with samples differing slightly by school level, school type, and the years studied.

Finally, six studies examine the impacts on English language learners. Most find that ELL students experience gains from charter school attendance that are similar to, and in some cases larger than, those of their non-ELL counterparts (Cohodes et al., 2013; Walters, 2018;

Cohodes et al., 2021; Setren, 2021). These studies assess impacts on test scores and post-secondary outcomes. Setren (2021) notes that charter schools positively impact four-year college enrollment for ELL students, relative to their non-charter counterparts. However, a recent nationwide study finds that KIPP charter schools do not have any detectable effect on enrollment and persistence through college for students whose main language at home is not English, though the subgroups are small and underpowered (Demers et al., 2023). When it comes to civic outcomes, charter schools in Boston have statistically similar, positive effects for ELL students and non-ELL students, though these effects are also imprecise (Cohodes & Feigenbaum, 2023).

Researchers report that charter schools produce the largest impact on the students least likely to attend them. For instance, ELL students and low-scoring students see large effects on test scores, but these students are less likely to apply to and attend a charter school than their non-ELL and higher-scoring counterparts (Cohodes et al., 2013). Similarly, Walters (2018) notes that disadvantaged students, including non-white students, low-income students, and students with lower baseline achievement scores, experience particularly large gains from charter school attendance. However, these students enroll in charter schools at lower rates than their more affluent and white peers. These findings suggest that charter schools would continue to produce positive outcomes for students if the sector grows.

4.8 Alignment with non-lottery studies

This review focuses on lottery-based research of charter schools. Given the limited locations that have been subject to such study, we consider how the results align with non-lottery studies of charter school effectiveness. Few studies directly compare different methods of assessing charter school impacts, but the ones that do generally find that lottery and non-lottery estimates of the

same schools are similar (Abdulkadiroğlu et al., 2011; Dobbie & Fryer, 2013; Abdulkadiroglu et al., 2016; Abdulkadiroglu et al., 2017; Clark Tuttle et al., 2015; Fortsan et al., 2015; Foreman et al., 2019). However, schools that are oversubscribed and save their records may be different from other schools. Abdulkadiroglu et al. (2011) find similar impacts for lottery- and regression-based estimates of charter school effectiveness, but bigger impacts for charter schools that have lottery records and are oversubscribed.

The broadest investigations of charter school effectiveness come from a research group at Stanford, the Center for Research on Education Outcomes (CREDO), which has collected a formidable amount of data from states over the years to compare charter school students to non-charter students using matching methods. As discussed above, these estimates may still be subject to selection bias. However, the general conclusions from the research align with the lottery-based research. Earlier reports find few impacts on test score gains, though the most recent nationwide analysis that used data from 2015 to 2019 shows that charter school students, on average, experienced small reading and math gains compared with their traditional public school counterparts (CREDO, 2009; CREDO, 2013; CREDO, 2023). The top-line results in these national studies mask a lot of variation. Consistent with lottery-based research, charters in urban areas and from some CMOs produce the largest test score gains (CREDO, 2015b; CREDO, 2017a). When compared with their public school peers, Black, Hispanic, and ELL students also experience stronger test score growth when they attend charter schools (CREDO, 2023).

Non-experimental methods are particularly helpful in assessing the impact of virtual charter schools since such charters are rarely oversubscribed and therefore cannot be studied using lottery methods. Almost universally, researchers find that virtual charter schools make

students worse off, at least when it comes to standardized test scores (CREDO, 2015a; Bueno, 2020; Ahn, 2016; Ahn & McEachin, 2017; Fitzpatrick et al., 2020). Initial evidence shows that these poor effects at the K-12 level extend to poorer labor market outcomes (Yoo et al., 2023).

5 What can lottery studies tell us about what works?

By design, charters can vary more in their curricula, programs, and operations than regular public schools. These design choices likely contribute to different outcomes for students. Indeed, the research that includes a wide variety of charter schools across the nation finds null top-line results (Gleason et al., 2010; Clark et al., 2015). But these null findings mask heterogeneity by school characteristics, as we have discussed. Given that charter schools are intended to serve as "laboratories of innovation," identifying which specific educational practices or policy settings predict success is a sensible goal. However, because lotteries do not randomly assign different practices to schools, we cannot use lottery methods, per se, to disentangle which specific aspects of a charter school drive its overall effect.

The "treatment" being studied in lottery-based research of charter schools is often a bundle of features that distinguish a specific charter school or group of schools. For example, the estimated impact of a No Excuses charter school combines all the elements that make up its model, including high academic expectations, strict disciplinary practices, and an extended school day and school year. Lottery studies do not allow us to identify which of these features drives the estimated impact. Just as school practices are not randomly assigned, neither is the setting in which charter schools operate. Differences in state charter legislation and associated authorizer practices likely affect charter impacts but cannot be studied with lottery methods.

In theory, researchers could conduct field experiments that randomly assign practices to different schools to estimate the causal impact of specific practices, as in the case of Fryer (2014). When field experiments are not feasible, the next best option, analytically, is to correlate lottery evidence with school characteristics, which has been done formally (Angrist et al., 2013; Dobbie & Fryer, 2013) and informally by researchers like us when we summarize trends in lottery-based research. Based on correlating causal lottery impacts with school features, Dobbie & Fryer (2013) identified five attributes that predict effectiveness: strong teachers and school leaders, targeted tutoring, data-driven instruction, a structured school culture defined by both a school rubric and student and parent behavior contracts, and more time spent in the classroom. These practices are explained in detail in Dobbie & Fryer (2013).

Angrist et al. (2013) attribute the efficacy of urban lottery charters in Massachusetts in part to their embrace of the No Excuses approach, as do studies of schools in other cities like New York and Newark (Unterman, 2017; Winters, 2020). Through this type of analysis—which documents the characteristics of the schools that have large positive effects—we can infer what educational practices are likely to have the greatest impact. Similar studies could be done on state authorizing practices. For example, we may ask what the authorizing practices look like in *states* that have effective charter schools. Still, it must be emphasized that correlation does not necessarily mean causation.

6 Gaps in the literature

The charter sector's growth presents many new opportunities to bolster and expand upon existing research. Increased demand for charter schools has led to more oversubscribed schools, providing new geographic settings for lottery-based research. On the data side, the adoption of

centralized school assignment mechanisms, digitization of administrative records, and education technology capable of capturing rich student-level information create new avenues to leverage charter school lotteries for research. Researchers can now estimate causal impacts on a wider variety of outcomes in more locations. Here, we summarize five key areas for future lottery research and discuss charter schools as a setting for other types of rigorous study.

6.1 Geographic and time coverage

The existing charter lottery literature is dominated by studies in a handful of large urban centers, including Boston, New York, and Chicago. Despite charter schools operating in 43 states, the lottery studies discussed in this paper come from just 14 states.[7] Research in the Midwest (e.g., Indiana, Ohio, Minnesota, Wisconsin), South (e.g., Florida, North Carolina), and the Southwest (e.g., Arizona), and in more non-urban areas would expand the external validity of the charter lottery findings.

Additionally, existing lottery-based research is becoming outdated, relying on data from 2001 to 2015. Evaluating charter schools that have opened more recently as the sector has grown and charter school models have evolved would shed light on whether large positive gains can be sustained as more (and different) students enroll. Furthermore, evaluating charter effectiveness since COVID-19 could yield insights into how to get students back on track academically given documented learning loss since 2020 (Kane & Reardon 2023).

[7] One national study takes place in 15 states, but does not identify which states these are (Gleason et al., 2010).

6.2 Charter types and practices

While there is substantial evidence on the effectiveness of KIPP charter schools and No Excuses charter schools, less lottery-based research has been conducted on other large CMOs and popular charter models. Such large-scale CMOs as Imagine Schools, Harmony Public Schools, IDEA Public Schools, and Uncommon Schools have yet to be evaluated with lottery-based methods. Because these organizations operate many schools on a regional or national level, rigorous evidence about their effectiveness would have clear implementation and scale-up potential.

As we have noted, one of the potential benefits of charter schools is that they serve as "laboratories of innovation." Studying charter schools that embrace different practices, policies, and curricula could shed light on additional models of success. Even though lottery studies cannot causally identify which specific practices are most effective, per se, evidence from additional studies in different settings would offer correlational insights about practices that have a high likelihood of success and may be worth replicating elsewhere. In theory, field experiments like Fryer (2014) could generate strong, causal evidence of the impacts of particular practices on student outcomes.

6.3 Non-test-score outcomes

Existing lottery-based evidence focuses largely on test-score outcomes. Estimating charter impacts on non-tested or lesser-tested subjects such as science and social studies, course-taking trajectories, and extra-curricular activities would offer more insight into the impact charters have on students' whole academic experience relative to their traditional public school counterparts. Furthermore, studying non-cognitive, social-emotional outcomes such as

persistence, perseverance, and grit would be valuable given that these short-term outcomes may contribute to long-term outcomes like college completion.

In light of questions raised about harsh disciplinary practices at some charters, the existing literature offers surprisingly little evidence on behavioral outcomes such as absenteeism, suspensions, and other disciplinary incidents. These outcomes often are negatively correlated with academic outcomes (Anderson et al., 2019). Differences in behavioral outcomes could reflect either differing practices of charter schools *or* differences in the non-cognitive skills of charter students. In either case, analyzing these outcomes given the changing approach to strict disciplinary practices in charter schools would contribute to a better understanding of the student experience in charter schools.

Finally, the existing literature lacks consensus on the impacts of charter schools on mental and physical health. Studying these outcomes would offer evidence about students' whole educational experience, which extends beyond academics. Understanding these impacts is particularly important in light of declining teen mental health (Abrams, 2023).

6.4 Long-term outcomes

Data constraints have limited the opportunity to study long-term outcomes like college persistence and graduation, civic participation, and labor market outcomes. Though a growing number of studies have examined the long-term effects of charters on early college outcomes and voting participation, more evidence is needed on these outcomes and others like college graduation and earnings. Such research will be possible as additional years of data become available and an increasing number of students move through the charter system. More studies of charter schools on college persistence and graduation will bolster existing evidence, which is

often imprecisely estimated and inconclusive. Studies of long-term outcomes could address whether the highly structured environments characteristic of many charter schools that lead to gains in cognitive skills and achievement in K-12 help prepare students to succeed in the long term. Expanding the settings where studies of long-term outcomes take place would shed light on whether the existing findings (e.g., Demers et al., 2023) translate elsewhere. Lottery evidence on earnings would contribute to a small quasi-experimental literature that finds mixed results (Dobbie & Fryer, 2020; Sass et al., 2016).

6.5 Systemic effects

Lottery-based research focuses on school-level effects of charter schools, leaving research on the system-wide and competitive effects of charters in the territory of non-experimental methods. However, a few studies (Walters, 2018; Ridley & Terrier, 2018; Felix, 2020) use lotteries in the context of other quasi-experimental and structural methods to anchor their estimates. For example, Felix (2020) leveraged a policy shock in Massachusetts that made it harder to suspend students to explore whether suspension rates drive charter school impacts on academic outcomes. Similarly, Ridley & Terrier (2018) compared lottery-based estimates of charter school effects before and after a 2011 reform that lifted the cap on charter schools. This approach allowed them to estimate the impact of charter schools on student achievement in traditional public schools. Expanding the practice of combining policy shocks with existing lottery-based measures of effectiveness could shed light onto how different features of charter laws relate to charter school effectiveness. This approach could also be used to explore topics that lottery methods alone cannot tackle, such as the role charter authorizers play in charter school effectiveness, the charter school teacher labor market, and charter school funding.

6.6 Charter schools as a setting for rigorous research

Charter schools themselves have naturally occurring lotteries, which have been a boon to research, as we have discussed throughout this paper. However, some questions about charter schools can be answered by researcher-designed experiments. Researchers studying "cream-skimming," for example, sent emails to charter and traditional public schools claiming to be parents of hypothetical students with a variety of different characteristics (Bergman & McFarlin, 2018). The study revealed that charter schools are less likely to respond to parents of students with poor behavior or significant special needs. Another example of researcher-designed experiments involved a field experiment that put the "laboratories of innovation" theory to the test. The study randomly selected traditional public schools in which to implement a bundle of best practices taken from the charter school sector, finding that techniques that proved effective in charter schools could indeed be replicated with some success in traditional public schools (Fryer, 2014). Researchers could design similar field experiments that randomize specific school practices (tutoring, technology, etc.) to different schools. Researchers could also design informational experiments around increasing access to charter schools, as Cohodes et al. (2022) did with high schools in New York.

7 Conclusion

Lottery-based research shows us what charter schools *can* do. We can think of the individual charters and CMOs with big impacts on student trajectories as existence proofs: These are school models that can change young people's lives. The lottery-based evidence shows that such

schools are not one-offs, with urban schools and those serving high-need students consistently showing benefits on a variety of outcomes. However, the evidence is based on a small sample of schools in a few geographic areas. Thus, the call for more: more time periods, more locations, more outcomes.

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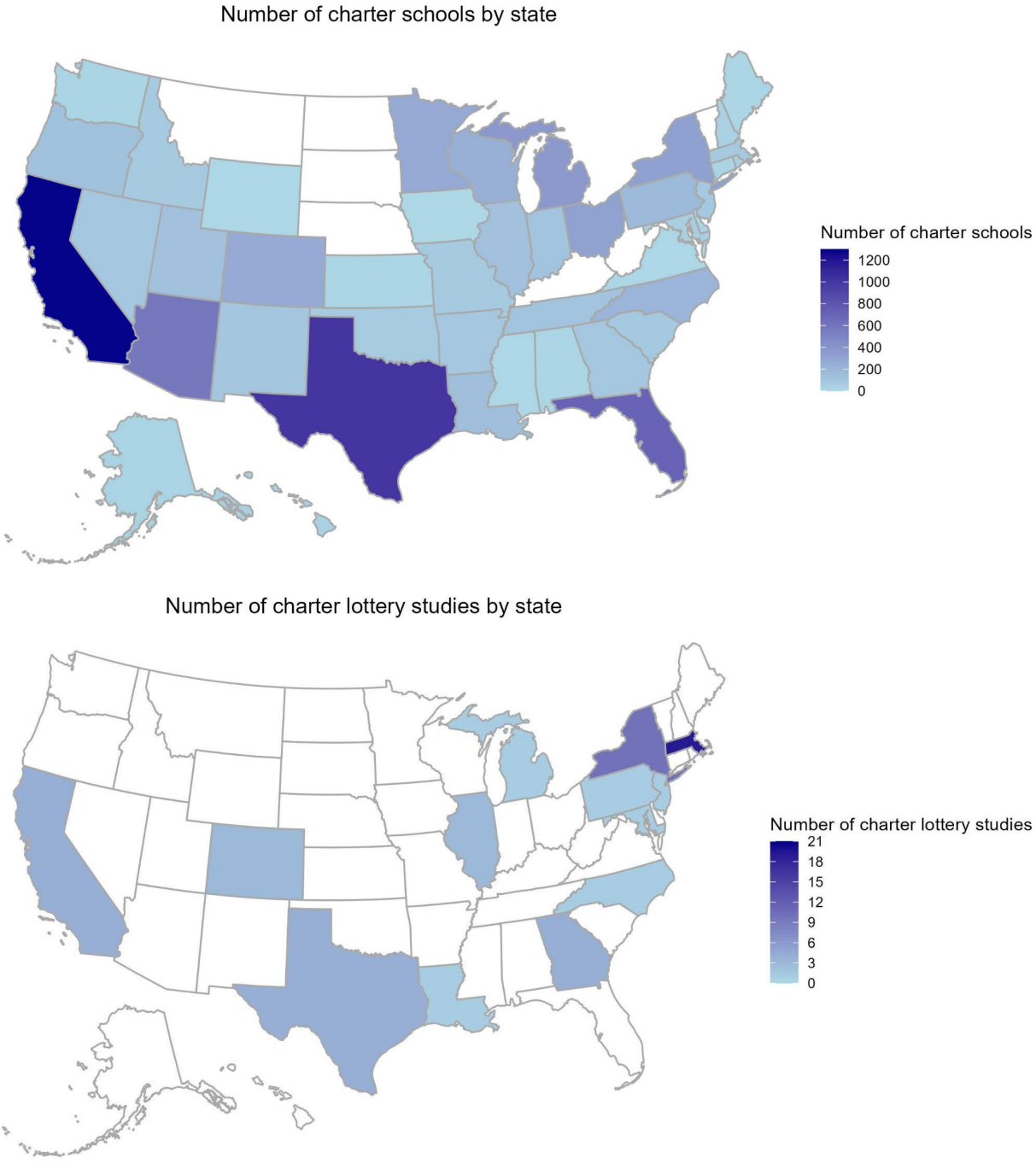
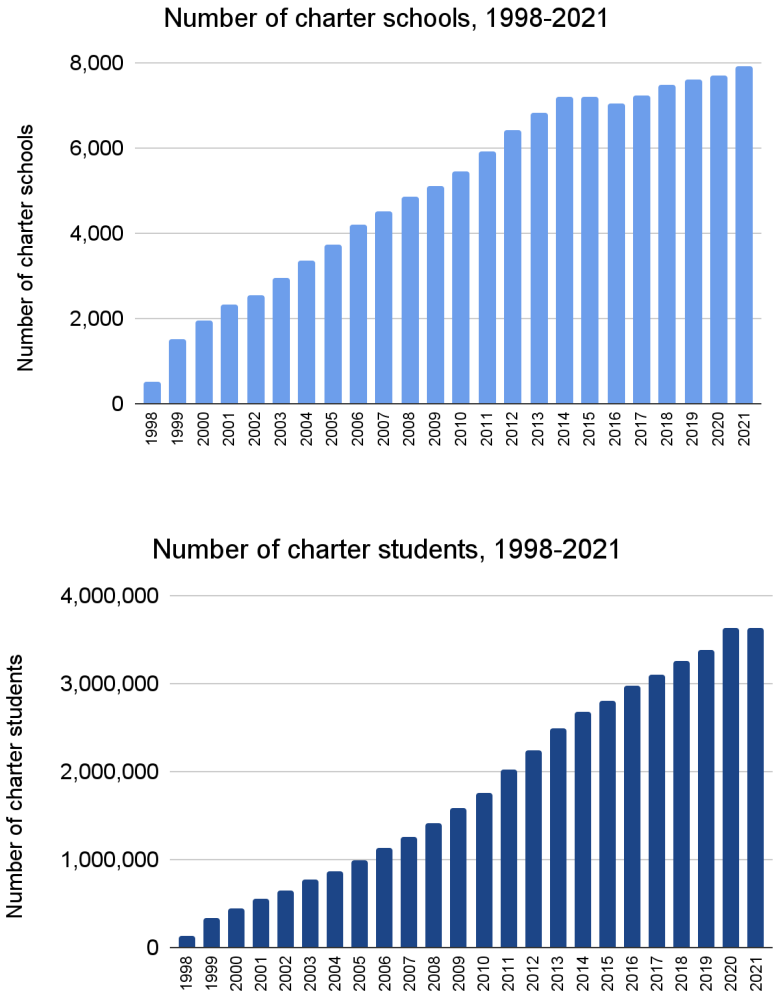
Tables & Figures

Figure 1. Location of charter schools and charter lottery research



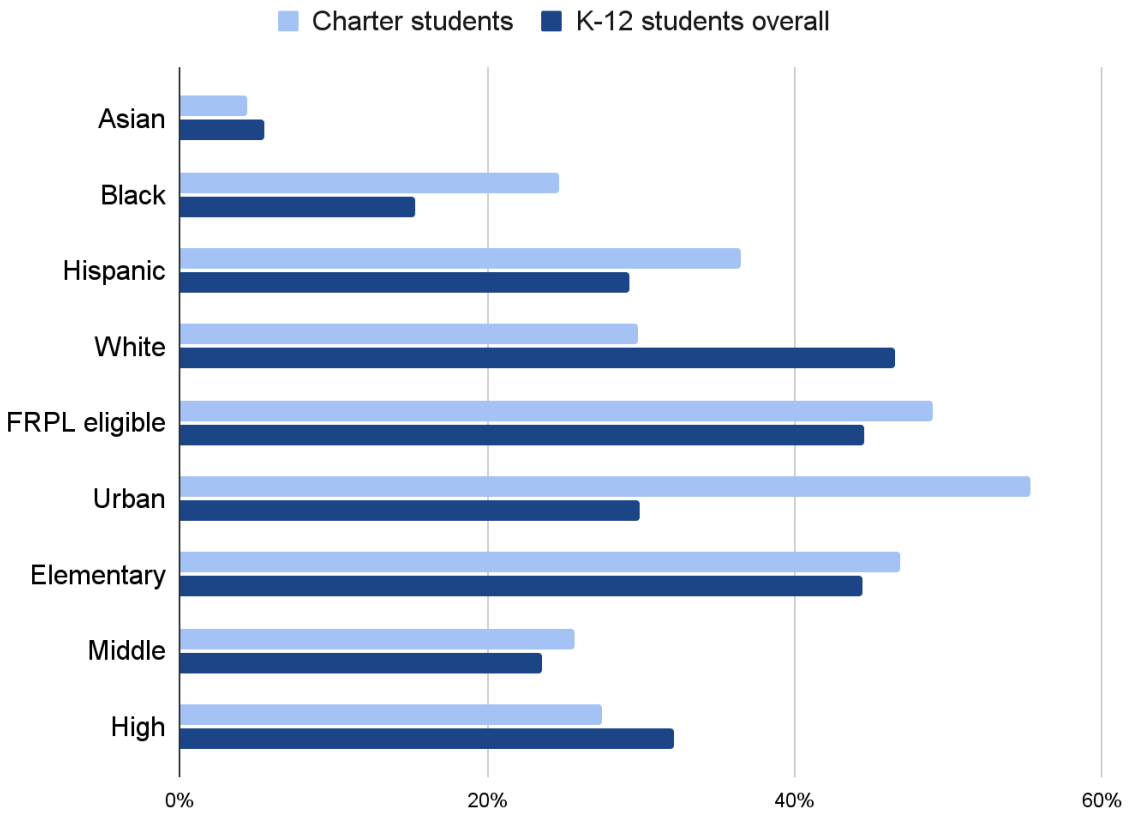
Notes: The top map shows the number of charter schools by state for the 2021-2022 academic year. States with no charter schools are displayed in white. The bottom map shows the number of charter lottery studies by state, as of 2023. See Table 2. States with no lottery study to date are displayed in white.

Figure 2: Charter schools and charter school enrollment over time



Notes: This figure shows the number of charter schools (top) and the number of students enrolled in charter schools (bottom) in the United States since 1998, when the indicator for charter schools first appeared in Public Elementary/Secondary School Universe Survey collected by the National Center for Education Statistics. Both the number of charter schools and enrollment in charters has increased steadily since the late 1990s.

Figure 3. Characteristics of charter students relative to K-12 students



Notes: This table reports characteristics of charter school students and the K-12 public school student population overall in all 50 states and the District of Columbia based on the 2021-22 Public Elementary/Secondary School Universe Survey. Percentages reflect the portion of students in the specified population (charter school students or K-12 public school students) associated with the specified category.

Table 1. Location of lottery-based charter studies

State	# of studies
Massachusetts	19
New York	10
Washington, DC	5
California	4
Georgia	4
Texas	4
Colorado	3
Illinois	3
Louisiana	1
Maryland	1
Michigan	1
New Jersey	1
North Carolina	1
Pennsylvania	1

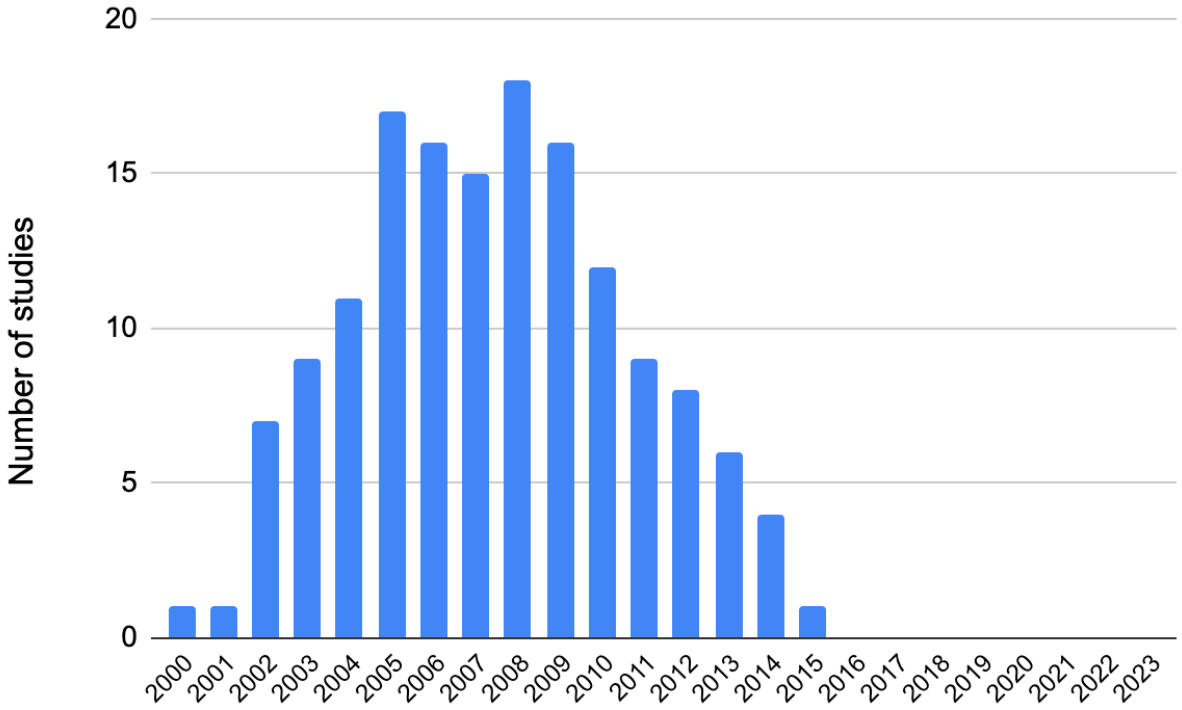
Notes: This table shows the number of studies reviewed in this paper, by state. Some studies use data from multiple states so the number of studies column sums to more than the total number of lottery-based studies included in this review (40). Some studies, including several of the studies in Massachusetts, use data from the same years and same schools.

Table 2. Outcomes analyzed in lottery-based charter studies

Outcome	# studies	Notes on outcome
Math/ELA test scores	31	Standardized test scores, state tests
Other K-12 academic	12	Graduation, grade-level, SAT, AP test taking/scores, merit scholarship eligibility
Health	4	Student well-being, attitudes, mental health, physical health
Behavior	9	Absences, effort, suspensions, risky behaviors like drinking, drugs, pregnancy
Post-secondary	10	Enrollment, 2-year vs. 4-year, persistence, quality of post-secondary institution
Civic	2	Voter registration, voting
Labor market	0	Employment, wages

Notes: This table shows the number of studies that analyze outcomes that fit into seven broad categories. Individual studies may include outcomes in multiple different outcome categories, so the total number of studies adds up to more than the total number of lottery-based studies included in this review (40).

Figure 4: Number of studies using lottery data from each year, 2000-2023



Notes: This figure shows a histogram of the years of lottery data used in each study included in this review. Years of treatment typically overlap or immediately follow lottery data years (e.g., if lottery data from 2005 was used for a study of middle schools, treatment years might be 2005-2008). Outcome data years may vary depending on the outcome. For instance, outcome data for studies that focus on math/ELA scores overlap or come soon after lottery data, whereas studies that focus on longer term outcomes like college enrollment experience a lag between when the lottery data was generated and when the outcome data became available.

Table 3. Lottery-based impacts of charter schools on math and ELA scores

Paper	Location	Math	ELA	Notes/exceptions
Hoxby & Rockoff (2005)	Illinois	↑	↑	
Abdulkadiroglu et al. (2009)	Massachusetts	↑	↑	
Hoxby et al. (2009)	New York	↑	↑	
Angrist et al. (2010)	Massachusetts	↑	↑	
Gleason et al. (2010)	15 states	–	–	Null results mask heterogeneity
Abdulkadiroglu et al. (2011)	Massachusetts	↑	↑	
Angrist et al. (2011)	Massachusetts	↑	↑	MS ELA effect is null
Dobbie & Fryer (2011)	New York	↑	↑	
Angrist et al. (2012)	Massachusetts	↑	↑	
Angrist et al. (2013)	Massachusetts	↑	↑	Negative effects in non-urban schools
Clark Tuttle et al. (2013)	6 states	↑	↑	
Cohodes et al. (2013)	Massachusetts	↑	↑	
Dobbie & Fryer (2013)	New York	↑	↑	HS ELA effect is null
Curto & Fryer (2014)	Washington, D.C.	↑	↑	
Grigg & Borman (2014)	Colorado	–	–	
Clark et al. (2015)	13 states	↓	↓	Heterogeneity across schools/students
Cohodes (2016)	Massachusetts	↑	↑	
Abdulkadiroglu et al. (2016)	2 states: LA, MA	↑	↑	
Abdulkadiroglu et al. (2017)	Colorado	↑	↑	
Unterman (2017)	New York	↑	↑	
Dynarski et al. (2018)	Michigan	↑	↑	
Frandsen & Lefgren (2018)	Massachusetts	↑		
Ridley & Terrier (2018)	Massachusetts	–	–	Urban: ↑; Suburban: math ↓, ELA null
Walters (2018)	Massachusetts	↑	↑	
Winters (2020)	New Jersey	↑	↑	
Cohodes et al. (2021)	Massachusetts	↑	↑	
Setren (2021)	Massachusetts	↑	↑	
Cohodes & Feigenbaum (2023)	Massachusetts	↑	↑	
Grissmer et al. (2023)	Colorado	↑	↑	
Angrist, Pathak, & Zarate (2023)	Illinois	↑	↑	
Reber et al. (2023)	California	↑	↑	

Notes: This table displays direction and significance of the main effects in the 31 lottery-based studies that estimate impacts on math and ELA. Results that are significant at the 5 percent level or higher are depicted with a darker color. Null results are denoted with a dash. We defer to authors on whether they characterize results as statistically insignificant or null. In many cases, studies do heterogeneity analyses that show different results for different groups. The results summarized here only pertain to the main results of each paper. Notes on heterogeneity are included in the last column.

Legend

↑	Positive effect, statistically significant
↑	Positive effect, not statistically significant
–	No effect
↓	Negative effect, not statistically significant
↓	Negative effect, statistically significant

Table 4. Lottery-based impacts of charter schools on other K-12 academic outcomes

Paper	Location	Science	Take SAT	SAT score	ACT score	Take AP	AP score	# AP exams	GPA	Grade progression	Exit exam	On-time graduation
Dobbie & Fryer (2011)	New York									–		
Dobbie & Fryer (2015)	New York											↑
Cohodes (2016)	Massachusetts	↑										
Angrist et al. (2016)	Massachusetts		–	↑		↑	↑	↑	↓	↓	↑	↓
Dynarski (2018)	Michigan									–		
Setren (2021)	Massachusetts		↑	↑		↑	↑	↑				
Cohodes & Feigenbaum (2023)	Massachusetts		↑	↑		↑	↑	↑	↓	↓		↓
Grissmer et al. (2023)	Colorado	↑										
Angrist, Pathak, & Zarate (2023)	Illinois				↑							↓
Clark Tuttle et al. (2013)	6 states	↑										–
Reber et al. (2023)	California					–			–			

Notes: This table shows the direction and significance of lottery-based impacts of charter schools on academic outcomes other than math and ELA scores. Blank areas indicate that a study did not report on the given outcome. Results that are significant at the 5 percent level or higher are depicted with a darker color, while studies that describe insignificant or marginally significant findings are shown with a lighter color. Studies that report null findings are indicated with a dash. We defer to authors on whether they characterize results as statistically insignificant or null.

Legend

↑	Positive effect, statistically significant
↑	Positive effect, not statistically significant
–	No effect
↓	Negative effect, not statistically significant
↓	Negative effect, statistically significant

Table 5. Lottery-based impacts of charter schools on postsecondary outcomes

Paper	State	Immediate enrollment in college	2-year college enrollment	4-year college enrollment	Ever enrolled in college	Persistence through college	College quality	College graduation
Dobbie & Fryer (2015)	New York	↑		–	–	–		
Angrist et al. (2016)	Massachusetts	↑	↓	↑	–	↑		
Davis & Heller (2019)	Illinois	↑	↑	↑	↑	↑	↑	
Coen et al. (2019)	4 states	↑	–	↑	↑	–	–	
Setren (2021)	Massachusetts		↓	↑				–
Nichols-Barrer et al. (2022)	4 states	–	–	↑	↑	↑		
Cohodes & Feigenbaum (2023)	Massachusetts		–	↑	↑		↑	
Angrist, Pathak, & Zarate (2023)	Illinois			↑				
Demers et al. (2023)	9 states				↑	–	↑	–
Reber et al. (2023)	California	↑	–	↑	↑	↑	–	

Notes: This table shows the direction and significance of lottery-based impacts of charter schools on commonly studied post-secondary outcomes. Blank areas indicate that a study did not report on the given outcome. Results that are significant at the 5 percent level or higher are depicted with a darker color, while studies that describe insignificant or marginally significant findings are shown with a lighter color. Studies that report null findings are indicated with a dash. We defer to authors on whether they characterize results as statistically insignificant or null.

Legend

↑	Positive effect, statistically significant
↑	Positive effect, not statistically significant
–	No effect
↓	Negative effect, not statistically significant

↓ Negative effect, statistically significant

Appendix

Table A1. Descriptive statistics of charter school students

	K-12 student population overall	Charter school students
K-12 student population	47,766,406	3,631,556
	(100%)	(100%)
FRPL eligible	21,264,689	1,780,726
	(45%)	(49%)
Asian	2,647,076	158,627
	(6%)	(4%)
Black	7,335,932	897,478
	(15%)	(25%)
Hispanic	13,944,789	1,326,284
	(29%)	(37%)
White	22,216,872	1,080,461
	(47%)	(30%)
Elementary school	21,200,201	1,702,738
	(44%)	(47%)
Middle school	11,237,380	933,314
	(24%)	(26%)
High school	15,328,825	995,504
	(32%)	(27%)

Notes: This table reports characteristics of K-12 public school students in all 50 states and the District of Columbia based on the 2021-22 Public Elementary/Secondary School Universe Survey. Counts represent the number of students. Percentages, shown in brackets, reflect the portion of students in the specified population (column) associated with the specified category (row).

Table A2. Summary of charter lottery studies & outcomes

Paper	Outcome							Details	
	Math/ELA	Other K-12 academic	Health	Behavior	Postsecondary	Civic	Labor market	Location	Sample
Hoxby & Rockoff (2005)	✓							Illinois	<5K
Abdulkadiroglu et al. (2009)	✓							Massachusetts	<5K
Hoxby et al. (2009)	✓							New York	<100K
Angrist et al. (2010)	✓							Massachusetts	<500
Gleason et al. (2010)	✓	✓	✓	✓				15 states	<5K
Abdulkadiroglu et al. (2011)	✓							Massachusetts	<5K
Angrist et al. (2011)	✓							Massachusetts	<20K
Dobbie & Fryer (2011)	✓	✓		✓				New York	<5K
Angrist et al. (2012)	✓							Massachusetts	<1K
Angrist et al. (2013)	✓			✓				Massachusetts	<30K
Clark Tuttle et al. (2013)	✓	✓	✓	✓				6 states	<1K
Cohodes et al. (2013)	✓							Massachusetts	<20K
Dobbie & Fryer (2013)	✓							New York	<20K
Curto & Fryer (2014)	✓							Washington, DC	<500
Grigg & Borman (2014)	✓							Colorado	<500
Wong et al. (2014)			✓	✓				California	<1K
Clark et al. (2015)	✓							13 states	<5K
Dobbie & Fryer (2015)		✓	✓	✓	✓			New York	<500
Angrist et al. (2016)		✓			✓			Massachusetts	<5K
Cohodes (2016)	✓	✓						Massachusetts	<5K
Abdulkadiroglu et al. (2016)	✓							Louisiana, Massachusetts	<10K
Abdulkadiroglu et al. (2017)	✓							Colorado	<5K
Unterman (2017)	✓							New York	<5K
Dynarski et al. (2018)	✓	✓		✓				Michigan	<30K

Frandsen & Lefgren (2018)	✓							Massachusetts	<500
Ridley & Terrier (2018)	✓							Massachusetts	<3 mil*
Walters (2018)	✓							Massachusetts	<10K
Coen et al. (2019)					✓			4 states	<5K
Davis & Heller (2019)					✓			Illinois	<1K
Felix (2020)				✓				Massachusetts	<30K
Gill et al. (2020)						✓		New York	<5K
Winters (2020)	✓							New Jersey	<10K
Cohodes et al. (2021)	✓							Massachusetts	<5K
Setren (2021)	✓	✓			✓			Massachusetts	<5K
Nichols-Barrer et al. (2022)					✓			4 states	<5K
Angrist, Pathak, & Zarate (2023)	✓	✓			✓			Illinois	<30K
Cohodes & Feigenbaum (2023)	✓	✓			✓	✓		Massachusetts	<10K
Demers et al. (2023)					✓			9 states	<5K
Grissmer et al. (2023)	✓	✓						Colorado	<5K
Reber et al. (2023)	✓	✓		✓	✓			California	<5K
Count	31	12	4	9	10	2	0		

Notes: This table shows all of the lottery-based studies included in this study, the associated outcomes that they analyze, the location of each study, and the sample size. Sample sizes are categorized in general buckets to account for the fact that in many cases, the exact sample size depends on the outcome being studied. *Ridley & Terrier (2018) uses Massachusetts-wide data, but the sample of students who actually participate in charter school lotteries is much smaller.

Appendix Table A3 - Features of lottery study samples

	School level			Charter type			Other details	
	Elementary	**Middle**	**High**	**CMO**	**No-excuses**	**KIPP**	**Location**	**Sample**
Hoxby & Rockoff (2005)	✓	✓	✓	✓			Illinois	<5K
Abdulkadiroglu et al. (2009)		✓	✓		✓		Massachusetts	<5K
Hoxby et al. (2009)	✓	✓	✓				New York	<100K
Angrist et al. (2010)		✓		✓	✓	✓	Massachusetts	<500
Gleason et al. (2010)		✓					15 states*	<5K
Abdulkadiroglu et al. (2011)		✓	✓		✓		Massachusetts	<5K
Angrist et al. (2011)		✓	✓				Massachusetts	<20K
Dobbie & Fryer (2011)	✓	✓			✓		New York	<5K
Angrist et al. (2012)		✓		✓	✓	✓	Massachusetts	<1K
Angrist et al. (2013)		✓	✓		✓		Massachusetts	<30K
Clark Tuttle et al. (2013)		✓		✓	✓	✓	6 states	<1K
Cohodes et al. (2013)		✓	✓				Massachusetts	<20K
Dobbie & Fryer (2013)	✓	✓					New York	<20K
Curto & Fryer (2014)		✓			✓		Washington, DC	<500
Grigg & Borman (2014)	✓						Colorado	<500
Wong et al. (2014)			✓	✓			California	<1K
Clark et al. (2015)		✓					13 states	<5K
Dobbie & Fryer (2015)		✓			✓		New York	<500

Angrist et al. (2016)			✓		✓		Massachusetts	<5K
Cohodes (2016)		✓			✓		Massachusetts	<5K
Abdulkadiroglu et al. (2016)		✓		✓	✓		Louisiana, Massachusetts	<10K
Abdulkadiroglu et al. (2017)	✓	✓	✓	✓			Colorado	<5K
Unterman (2017)	✓			✓	✓		New York	<5K
Dynarski et al. (2018)	✓	✓	✓	*EMO			Michigan	<30K
Frandsen & Lefgren (2018)		✓		✓	✓	✓	Massachusetts	<500
Ridley & Terrier (2018)		✓					Massachusetts	<3 mil**
Walters (2018)		✓			✓		Massachusetts	<10K
Coen et al. (2019)		✓		✓	✓	✓	4 states	<5K
Davis & Heller (2019)			✓	✓	✓		Illinois	<1K
Felix (2020)		✓			✓		Massachusetts	<30K
Gill et al. (2020)		✓	✓	✓			New York	<5K
Winters (2020)	✓	✓	✓	✓	✓	✓	New Jersey	<10K
Cohodes et al. (2021)		✓			✓		Massachusetts	<5K
Setren (2021)	✓	✓	✓		✓		Massachusetts	<5K
Nichols-Barrer et al. (2022)		✓		✓	✓	✓	4 states	<5K
Angrist, Pathak, & Zarate (2023)			✓	✓	✓		Illinois	<30K
Cohodes & Feigenbaum (2023)		✓	✓		✓		Massachusetts	<10K
Demers et al. (2023)		✓	✓	✓	✓	✓	9 states	<5K
Grissmer et al. (2023)	✓			✓			Colorado	<5K
Reber et al. (2023)			✓		✓		California	<5K

Count	11	32	19	18	26	8

Notes: This table shows all of the lottery-based studies included in this study; the associated school level that was studied; whether the authors noted that the charter schools studied belonged to a CMO, followed a No Excuses model, or were specifically KIPP schools; the location of each study; and the sample size of the study. Sample sizes are categorized in general buckets to account for the fact that in many cases, the exact sample size depends on the outcome being studied. This table is intended to indicate whether authors note or discuss these charter school features in their study. In some cases, for example, a KIPP charter school may be among the schools in a study sample (e.g., Hoxby et al., 2009) but the authors do not characterize the study as a study of KIPP schools per se. In this case, "KIPP" would not be marked in the table.

* Gleason et al. (2010) reports that their sample includes charter schools in 15 states, but does not identify which states are included.

**Ridley & Terrier (2018) uses Massachusetts-wide data, but the sample of students who actually participate in charter school lotteries is much smaller.