From Disruption to Recovery:

Charter School Performance During and After the COVID-19 Pandemic

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Abstract

In recent decades, an increasing number of students have pursued alternative educational options, including charter schools, as school choice has continued to expand. This trend was accelerated by the COVID-19 pandemic. While it is well established that students experienced widespread learning loss during the pandemic, it remains unclear whether the extent of that loss or the pace of recovery has differed between charter and traditional public schools (TPS). In the current study, we examine the effects of Tennessee charter schools on student achievement during and after the pandemic. Using student-level data from 2017-18 to 2022-23, we estimate the charter school effect using propensity score inverse probability weighting. Results show that charter school and TPS students performed comparably during the pandemic in 2020-21. Post-pandemic, in 2021-22 and 2022-23, charter school students demonstrate greater academic growth. This growth was driven primarily by schools in the broader Nashville region and in elementary and middle schools. The findings of this study suggest lessons can be learned from Tennessee charter schools on learning loss recovery.

Traditionally, across the United States, most students enroll in their neighborhood school. However, in recent decades, more students have pursued alternative options as school choice continues to expand. This trend accelerated during the COVID-19 pandemic. In the first school year following the start of the pandemic, enrollment in traditional public schools (TPSs) dropped by over a million students – a decline of 3.4% of public school students (Dee, 2023; Veney & Jacobs, 2021). While this shift was partially driven by delayed school entry (Doughtery et al., 2025) and pre-existing declines in the school-aged population (Dee, 2023), families also moved their students into alternative schooling options during the pandemic at rates higher than previously observed (Dee, 2023; Dee & Murphy, 2021; Veney & Jacobs, 2021). This increased enrollment trend was especially prominent in the charter school sector. According to the National Alliance for Public Charter Schools, during the 2020-21 school year, charter school enrollment grew by 7%, the largest increase recorded in the last decade (Veney & Jacobs, 2021).

Although parents increasingly enrolled their students in charter schools during the pandemic, it is unknown how charter school performance compared to TPSs during or after the COVID-19 pandemic. Unlike TPSs that are tied to the rules and regulations of school districts, charter schools have more operational and instructional autonomy, which theoretically may have made them better positioned to pivot during and after the pandemic to serve students. At present, research has only begun to provide initial insights into the academic achievement of students during the pandemic, with evidence that students generally experienced pandemic learning loss (Cohodes et al., 2022; Fahle et al., 2023; Goldhaber et al., 2023; Kogan & Lavertu, 2021; Kuhfeld et al., 2022a, 2022b; Maldonado & De Witte, 2022; Relyea et al., 2023; Sass & Ali, 2022; Sparks, 2022). As policymakers and school leaders continue to seek out techniques that are effective for

addressing the persistent issue of learning loss, it is important to understand how learning loss and recovery differed for students across various school sectors, including charter schools.

In this study, we use longitudinal administrative records from Tennessee to examine the performance of charter school students relative to similar TPS peers during and after the pandemic. Our analysis highlights that while the performance of charter school students statewide was on par with TPS students during the pandemic, charter school students outperformed TPS students in post-pandemic years, which was driven by strong performance in the broader Nashville region and at elementary and middle charter schools. These findings suggest that Tennessee's charter sector offers valuable lessons for addressing ongoing learning loss and guiding educational efforts during future crises like the one onset by the COVID-19 pandemic.

Literature Review

Our study falls at the intersection of two relevant literatures. We first review the research on nationwide student achievement across the pandemic and then turn our attention to the literature on charter schools and their effectiveness. While this research does not come from Tennessee, it provides helpful context of the larger trends present during the pandemic and in the charter sector. Following a review of each separate literature, we put the two in concert with one another to frame the current study examining charter school performance amid the pandemic.

Student Achievement Amid the Pandemic

In March 2020, schools across the country transitioned from in-person to remote instruction for the remainder of the 2019-20 school year. While remote instruction was consistently adopted for those initial months of the pandemic, schools' instructional modalities varied widely in the following 2020-21 school year. Many schools continued with remote instruction, while others started in person and still others used a hybrid approach (Courtemanche et al., 2021; Goldhaber et

al., 2021; Harris et al., 2021). Additionally, there were periods throughout the 2020-21 school year in which schools switched between in-person and remote instruction depending on local COVID-19 conditions. Overall, schools in rural areas and/or more conservative states were more likely to provide in-person instruction (Valant, 2020) while remote instruction was more common in districts with higher proportions of disadvantaged student populations (Jack et al., 2023; Goldhaber et al., 2023).

Across all regions of the United States, research has provided clear evidence that the pandemic had adverse effects on student achievement and that students generally experienced learning loss during this time (Cohodes et al., 2022; Fahle et al., 2023; Goldhaber et al., 2023; Kogan & Lavertu, 2021; Kuhfeld et al., 2022a, 2022b, 2023; Maldonado & De Witte, 2022; Relyea et al., 2023; Sass & Ali, 2022; Sparks, 2022). One national study estimated that, by fall 2021, approximately a year and a half after the onset of the pandemic, students in grades 3 to 8 were scoring 0.20 to 0.27 standard deviations lower in math and 0.09 to 0.18 standard deviations lower in reading compared to same-grade peers prior to the pandemic in fall 2019 (Kuhfeld et al., 2022a).

However, learning loss was not equally experienced by all students. Research has found that learning loss was greatest for students who remained in remote or hybrid learning environments for longer periods (Fahle et al., 2023; Goldhaber et al., 2023; Relyea et al., 2023; Sass & Ali, 2022). Given that remote instruction was especially prominent in districts with disadvantaged populations (Jack et al, 2023; Goldhaber et al., 2023), Black and Hispanic students on average experienced greater learning loss than their peers (Fahle et al., 2023; Goldhaber et al., 2023; Jack et al., 2023; Sass & Ali, 2022). While these racially minoritized student groups are overrepresented in the charter sector (Epple et al., 2016; Kho et al., 2020), it is important to note that charter schools were not more or less likely to offer in-person instruction than TPSs (Cohodes

& Pitt, 2022), suggesting that if there are any differences in student achievement across TPS and charter schools, it is unlikely the result of instructional modality. Thus, while research highlights that instructional modality shaped learning loss during the COVID-19 pandemic, a critical component of students' learning environment has yet to be explored – school sector.

Charter Schools: Practices and Performance

Charter schools are publicly financed but operated independently from school districts in hopes that these schools will be more responsive to family needs through innovation (Finn et al., 2000). By granting charter schools with greater autonomy, these schools can experiment with different curriculum, organizational structures, and strategies that may drive school improvement (Nathan, 1996). However, two critical questions are how charter schools use their autonomy and whether it leads to improved performance.

Research provides some insights into the practices of charter schools as a result of their autonomy. Many charter schools throughout the United States have adopted comprehensive reforms such as "No Excuses" models that increase instructional time in reading and math and establish strict discipline policies that minimize learning disruptions. While prior research has generally found positive impacts of "No Excuses" schools on student achievement (Abdulkadiroglu et al., 2011; Angrist et al., 2013; Cheng et al., 2017; Dobbie & Fryer, 2013; Hastings et al., 2012), this evidence has been limited to oversubscribed schools. Further, some argue these policies ultimately hinder students' personal growth and may contribute to distorted ideas of postsecondary education (Ellison & Iqtadar, 2022; Golann, 2015, 2021). Alternatively, some charter schools leverage their autonomy to adopt more incremental and less controversial strategies. These practices include extending the school day, the school year, and/or holding classes on weekends; requiring intensive professional development and coaching of teachers;

eliminating teacher licensure or certification requirements and providing more competitive and/or performance-based compensation; and increasing technology use through one-to-one student devices (Ableidinger & Hassel, 2010; Chabrier et al., 2016; Furgeson et al., 2012; Gross & Pochop, 2008; Pane et al., 2017).

Based on the numerous ways in which charter schools can provide a unique educational experience, there is a large literature examining the impact charter schools have on student achievement. However, nearly all of this literature predates the pandemic (Cohodes & Roy, 2024; Zimmer et al., 2021). Therefore, little is known of the performance of charter schools relative to TPSs both during and after the pandemic. Overall, the literature examining pre-pandemic student achievement is mixed with some studies showing charter schools with a positive effect on student achievement while other studies showing null or negative effects (Cohodes & Parham, 2021; Zimmer et al., 2021; Tong et al., 2023). This literature also suggests that the relative effectiveness of charter schools vary by urbanicity (Raymond et al., 2023), instructional modality (Buddin & Zimmer, 2005; Fitzpatrick et al., 2020; Zimmer et al., 2009), school operator (Raymond et al., 2023), and the methodology used to examine these effects (Epple et al., 2016). For example, while suburban charter schools and those serving more economically advantaged students tend to have no effect or negative effects on student achievement relative to TPSs, urban charter schools and charter schools serving more low-income and racially minoritized students are more effective at raising student achievement (Angrist et al., 2013; Clark et al., 2015; Gleason et al., 2010; Raymond et al., 2023).

In addition to these variations by charter school characteristics, reports from the Center for Research on Education Outcomes (CREDO) have also provided insights into how charter school impacts have changed over time. This research is also the most relevant for our current analysis

because the nationwide trends are disaggregated by individual states, including Tennessee (Raymond et al., 2023). CREDO analyzes student performance at charter schools relative to if they attended a TPS through a matching approach in which they use baseline year data to create a "virtual twin" control student for each charter student. While CREDO has conducted this study three times since 2009, the most recent report on student performance in 2018-19 was the first to demonstrate significant, positive charter effects. The study found that on average, across the country, charter school students gained 0.028 SD in reading and 0.011 SD in math relative to TPS students. In Tennessee, the effects were larger; charter students gained an average 0.058 SD in reading and 0.067 SD in math. While informative to understanding national and state-level charter school effects, this evaluation only examined pre-pandemic performance and provides no insights into the performance of charter schools both during and after the pandemic.

Like the CREDO study, the broad literature of charter school effectiveness has focused on pre-pandemic performance and generally not examined the performance of charter schools both during and after the pandemic. To our knowledge, the only study that has examined the performance of charter schools during the pandemic found that Ohio's charter school advantage from pre-pandemic years persisted during the pandemic, at least in English Language Arts (Lavertu, 2024). The study provides some good initial insights, but it relied upon school-level data, which makes it more difficult to address concerns of selection bias including students switching schools because of the COVID-19 pandemic.

Charter Schools: From Prior to Amid the Pandemic

Despite the lack of quantitative evidence on charter school performance during the pandemic, an understanding of charter school practices pre- and during- the pandemic provides insights into how charter schools may have served students differently during this time. In general,

principals and teachers at charter schools report higher levels of autonomy than their counterparts at TPSs (Gawlik, 2008; Oberfield, 2016). Charter schools often also offer smaller class sizes, fewer curriculum options (e.g., honors, general, remedial, Advanced Placement, International Baccalaureate), and paired or team-teaching (Gross & Pochop, 2008)– all of which can contribute to increased flexibility when responding to unforeseen circumstances. For instance, evidence from prior to the pandemic has shown that charter schools can often swiftly respond to teacher absences by combining classrooms or assigning other teachers or staff members to cover classes (Griffith, 2017). Charter schools also tend to have more streamlined procurement processes, allowing charter schools to more quickly obtain needed materials and supplies (Gross & Pochop, 2008; CREDO, 2022).

Theoretically, such autonomy and malleability may make charter schools well suited for dealing with crises. One example of this is the use of widespread charter school conversions in New Orleans. Following the devastation of Hurricane Katrina in 2005, the state of Louisiana took control of New Orleans public schools and eventually transitioned them into charter schools. While the implementation of charter conversions in New Orleans has been critiqued for its minimization of community involvement in schooling (Henry, 2021; Henry & Dixson, 2016; Jabbar, 2016), the state takeover is one example of how charter schools were used during a crisis because of their organizational agility.

Similarly, the structural advantages of charter schools might have allowed them to respond more quickly and innovatively than TPSs to the COVID-19 pandemic. One study that analyzed the publicly available plans of charter schools and TPS districts during the pandemic suggests that charter schools were more likely to set expectations that teachers provide real-time instruction, regularly check-in with students, and monitor attendance (Boast et al., 2020). While we are not

aware of any other studies that compare the practices of charter and TPSs during the pandemic, there are some that offer insight into how charter school leaders navigated the pandemic. These studies highlight that charter school leaders leveraged flexibility and consistent communication to sustain student attendance while adapting to remote instruction (Childs et al., 2023; Neugebauer Schoettler & Marshall, 2024; Vanourek, 2020). In some cases, charter schools also had the capability to conduct daily check-ins with students based on pre-existing mentorship programs or the ability to quickly set up new systems of communication (CREDO, 2022; Neugebauer Schoettler & Marshall, 2024; Vanourek, 2020). Finally, CREDO (2022), using survey data from California, New York, and Washington charter schools, found that it took only 3.5 days on average for charter schools to transition to online instruction. These studies suggest that the flexibility afforded to charter schools was central to the way they responded to the COVID-19 pandemic.

While the evidence remains limited regarding charter school practices during the pandemic, there are a myriad of other advantages that could be anticipated based on an understanding of charter school practices prior to the pandemic. For instance, charter school students might have already become accustomed to tutors and tutoring, a common strategy that schools utilized during the pandemic (Kim & Miratrix, 2023; Dobbie & Fryer, 2011). Greater reliance on technology such as one-to-one device programs would have also allowed for more seamless transitions to virtual learning for both instructors and students. In fact, CREDO (2022) found that right before the pandemic, approximately 60% of students in charter schools in California, New York, and Washington had devices and internet connectivity, and within two months of the pandemic onset, this increased to 94%. In comparison, a separate report provides information that allows us to calculate that nine months after the onset of the pandemic, approximately 20% of public K-12 students nationwide still lacked access to adequate internet

connections and 10% to remote e-learning devices (Ali et al., 2021). This comparison suggests that charter school technology practices from prior to the pandemic may have helped support a smoother transition to remote learning than that experienced by TPSs.

On the flip side, however, TPSs may have been more likely to have greater staff capacity and the existing infrastructure to request federal support, implement evidence-based practices, offer summer programs, and support students' social and emotional well-being both during and after the pandemic. For instance, charter schools in some states have less regulations for the certification or licensure requirements of financial management staff than TPS districts (Brent & Finnigan, 2009). Therefore, charter school staff may have been less equipped to request federal funds such as from the Elementary and Secondary School Emergency Relief Funds. Similarly, charter schools may not have had the resources to employ counselors to address declines in students' well-being, belonging, and engagement, which may be a precursor to learning loss (Osher et al., 2025). Together, these TPS advantages may have led to reduced learning loss during the pandemic and greater ability compared to charter schools to address learning loss post-pandemic.

Overall, while charter schools did have the autonomy to react quickly to the pandemic and the challenges of addressing learning loss, they may not have had the infrastructure to fully address these challenges. In this paper, we empirically examine the performance of charter schools relative to TPSs to provide insights into each sectors' abilities to address challenges during the COVID-19 pandemic and combat learning loss in subsequent years.

Tennessee Charter Schools and Pandemic Policies

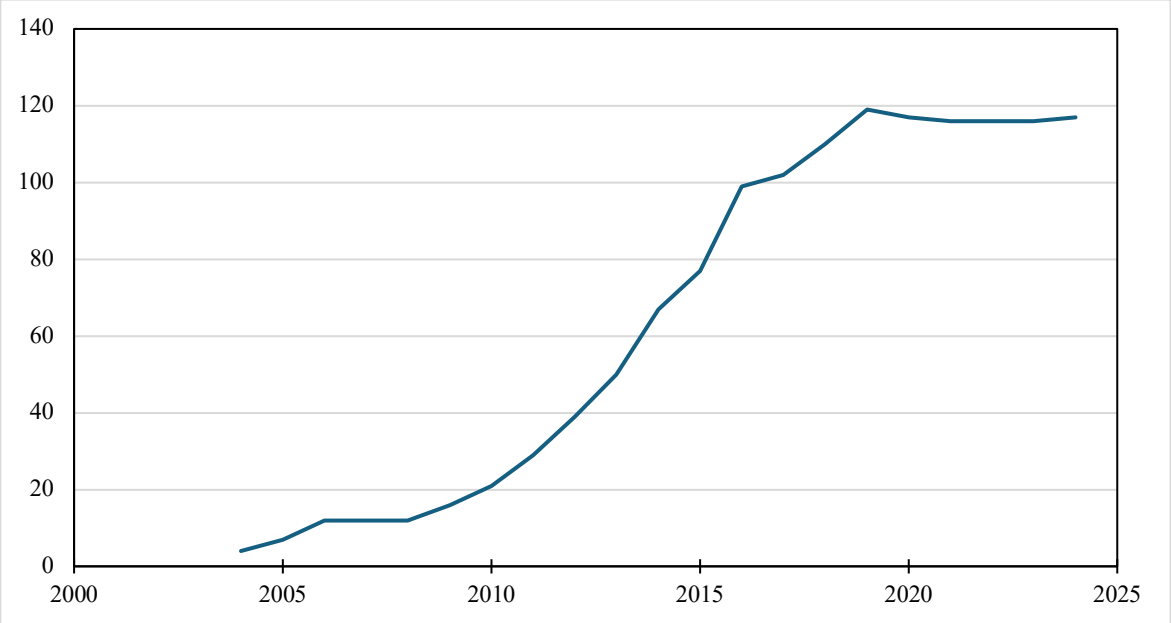
This study specifically focuses on charter school performance in Tennessee during and after the pandemic. Given that states vary both in their charter school legislation and pandemic responses, we offer insight into the Tennessee context in the following sections.

Charter Schools

Charter schools proliferated across the United States in the 1990s, but Tennessee was relatively late in embracing charter schools as it adopted a charter school law in 2002 with the first charter school opening in 2003. Initially, the state installed a cap of 50 charter schools and stipulated that only students from public schools that were failing to meet adequate yearly progress were allowed to attend charter schools (Office of School Models and Programs, 2019). These new charter schools could be authorized by school districts and, subsequently, four urban districts began authorizing charter schools.

The charter sector rapidly grew in Tennessee, which led to the expansion of the cap to 90 schools in 2009, and in 2011 the cap was removed altogether. Simultaneously in 2011, Tennessee also started the Achievement School District (ASD), a state-created school district to turnaround low-performing schools – often by turning the management of TPSs over to charter management organizations (Zimmer et al., 2017). As the cap of charter schools and paths for charter authorization expanded, so did the number of charter schools as shown in Figure 1.

Figure 1: Number of charter schools by year



Sources: Tennessee Score https://tnscore.org/assets/documents/Charter-History_0327.pdf
and Office of School Models:
https://www.tn.gov/content/dam/tn/education/documents/2019%20Charter%20Report%20final.pdf

In addition to the avenues of opening a charter either through district authorization or ASD takeover, Tennessee also allows rejected applicants to appeal to the state. Originally the responsibility of the State Board of Education, the Tennessee Public Charter School Commission was created in 2021 to assume this responsibility. As of the 2023-24 school year, about one-third of charter school applications were approved by their respective local boards and about one-third of charter school appeals to the state were successful (Tennessee State Department of Education, 2024). Based on this additional avenue, six authorizers had active charter schools as of the 2023-24 school year – four urban school districts (Metropolitan Nashville Public Schools, Memphis-Shelby County Schools, Hamilton County Schools, and Knox County Schools), the ASD, and the Tennessee Public Charter School Commission.[1] However, it is notable that all charter schools are

[1] As of the 2024-25 school year, two additional school districts have authorized their first charter schools.

within the geographical boundaries of the original four school districts that opted to authorize charter schools.

Tennessee's charter law not only stipulates the entities that can authorize charter schools, but also certain parameters for charter schools. In Tennessee, charter schools must be non-profit entities and cannot be virtual schools. The latter of these stipulations makes Tennessee an ideal state in which to evaluate performance during the pandemic because all charter schools faced the same initial challenge of transitioning fully to virtual instruction like their TPS counterparts. Additionally, all charter schools are subject to the same state accountability standards as TPSs and must participate in all state assessments, offering an avenue to compare charter school students to their TPS peers during and after the pandemic.

COVID-19 School Policies

Like the rest of the country, Tennessee schools, including charter schools, closed for in-person instruction in mid-March of 2020 due to the onset of the COVID-19 pandemic and provided remote instruction for the remainder of the 2019-20 school year (The Tennessee Commission on Education Recovery and Innovation, 2020). During the following 2020-21 school year, 90% of Tennessee school districts allowed families to decide whether they wanted to continue with virtual instruction or attend school in-person. Across the state, the vast majority of families decided to attend in person. However, over the course of the school year, schools changed between in-person and virtual modalities depending on the spread of COVID-19. By the end of 2020-21, Tennessee public schools were largely opened with in-person instruction and limited disruptions (BallotPedia, n.d). Throughout this time, charter schools primarily mirrored the opening and modality decisions of TPSs within their geographical school district (Rau, 2021).

Methods

To evaluate the charter school effect in Tennessee during and after the COVID-19 pandemic, we compare charter school students to similar TPS students. Across charter school studies, it is common to identify comparison TPS students through charter school lottery systems for enrollment. In these cases, researchers can use instrumental variable methods that rely on the lottery's random assignment of lottery "winners" and "losers" who are or are not chosen for admission into an oversubscribed charter school. While these experimental studies tend to have high internal validity, most charter schools are not oversubscribed and therefore do not use lotteries. In fact, prior studies have found as few as 7.5% and only as many as 15% of charter schools conduct lottery-based admissions (Tuttle et al., 2012; Furgeson et al., 2012). Given this, charter lottery studies, while high in internal validity, lack external validity for the majority of charter school attendees.

Given the lack of lottery data and the importance of understanding how the pandemic changed learning for all students, we considered other non-experimental approaches. The most common non-experimental approach is a student fixed effect approach (Zimmer et al., 2021). Student fixed effect models focus on students who switch school types (e.g., student moves from a TPS to a charter school) to examine how a student's achievement compares pre- and post-switch. In this case, students serve, in a sense, as their own comparison groups. However, without an external comparison group, the student fixed effect approach would reduce the number of charter school students observed and, in the context of the pandemic, would undoubtedly confound learning loss as a result of the pandemic with the charter school effect, making the two indistinguishable from one another. Based on this limitation, we opt to construct a comparison group through a propensity score approach. While this approach is not experimental, studies have

shown that when observational research approaches incorporate baseline test scores and consider geographical contexts, the results are consistent with using a randomized approach (Abdulkadiroglu, et al., 2011; Bifulco, 2012; Cook et al., 2008; Fortson et al., 2015). This suggests that observational studies, such as those that employ propensity score approaches, can have strong internal as well as external validity. In the following sections, we detail how we leveraged data from Tennessee to construct a comparison group of TPS students that facilitated the estimation of the charter school effect during and after the pandemic.

Data

In this study, we use longitudinal student-level data from 2017-18 through 2022-23 provided by the Tennessee Department of Education. The dataset includes a unique student identifier with the school(s) students attend, the respective grades, and math and English test scores from the state's standardized assessments. In Tennessee, students in grades 3-8 annually complete the Tennessee Comprehensive Assessment Program (TCAP) exams and high school students complete End-of-Course exams for respective courses (e.g., English I & II, Algebra I & II, Geometry).[2] For this study, we convert the test scores into standardized units by subject/course, grades, and years, allowing us to have a common metric across years and grades. In addition, we have student gender, race/ethnicity, special education status, English as a second language status, and economic disadvantage status[3].

For this study, we refer to the 2020-21 year as "during the pandemic" and the 2021-22 and 2022-23 years as "post-pandemic." In estimating effects for the 2020-21 school year, we use 2018-

[2] Like other states, Tennessee did not administer a statewide test in the 2019-20 academic year because of pandemic related school closures in the spring of 2020.

[3] While most studies utilize students' receipt of free or reduced-price lunch as an indicator of socioeconomic status, Tennessee stopped collecting this information after 2016-17. In this study, we instead use economic disadvantage as a proxy for socioeconomic status. A student is identified as economically disadvantaged if they are eligible for free or reduced-price lunch through direct certification, participated in Tennessee's voluntary Pre-K program, or is identified as a runaway, migrant, foster child, or experiencing homelessness.

19 math and English test scores as the baseline test scores. For the 2021-22 and 2022-23 school years, we use test scores in the 2020-21 school year as the baseline test scores.[4] Given these lags, we ultimately include students in grades 5-12 in the 2020-21 and 2022-23 analyses and students in grades 4-12 in the 2021-22 analyses.

For our analysis, we present our results statewide, by grade level (i.e., elementary, middle, and high schools), and two regions of the state.[5] Specifically, we focus on the two urban areas that contain a majority of Tennessee's charter schools – the broader geographical Nashville region which has over 30 charter schools and the broader geographical Memphis region which has over 70 charter schools. Approximately 20% of students in both urban areas attended a charter school in 2022-23. Across all four of the urban areas in our study, charter schools were generally authorized by the local school districts. However, in some cases, charter schools were authorized by the state or the Achievement School District. Because these charter schools reside within the geographical boundaries of local school districts, we assign them to the regions associated with the local school districts in order to include them in the study and identify appropriate counterfactuals.

Sampling and Weighting Procedure

In the evaluation of charter schools, selection bias is a common concern as students who choose to attend a charter school may be different in observed and unobserved ways. To address this concern, we use inverse probability weighting based on propensity scores, which allows us to make valid comparisons to a group of TPS students within the same urban area with a doubly robust approach. More specifically, we first assign inverse probability weights based on propensity

[4] Later, in a sensitivity analysis, we use a consistent baseline year of 2018-19 test scores for both the pandemic and post-pandemic periods. We find similar results.
[5] The sample sizes are too small in the remaining two regions to ensure anonymity of schools.

score estimates of the likelihood of TPS students attending charter schools. By using weights generated from a propensity score approach, we have a set of TPS control students who at any given propensity score have, on average, similar measured baseline test scores and demographic characteristics as the treatment set of charter students. We elaborate on our approach further below.

To ensure that results were not skewed by the performance of opening or closing schools, our primary sample only includes schools that were open for all academic years included in the analysis (2017-18[6] through 2022-23)[7]. At the student level, some students may have made enrollment decisions during and after the pandemic based on school performance or policies as a result of the pandemic. To avoid confounding the performance of charter schools with effects of the pandemic (through student transfer decisions), we excluded all students who made nonstructural changes between schools (i.e., switching schools when the switch is not required as a result of completing the highest grade in the school) or switched between the charter and TPS sector after the start of the pandemic. Students in magnet, virtual, alternative, and optional enrollment schools were also excluded. In subsequent analyses, we adjust the samples to include the respective schools and students for each of these sample restrictions to test the sensitivity of our primary findings. Results are robust across these exclusion criteria.

Among the students included in our sample, we calculated propensity scores for attending a charter school and applied inverse probability weighting to increase the comparability of TPS and charter students (Imbens & Woolridge, 2009; McEachin et al., 2020; Willet & Murnane, 2011). Specifically, we assigned weights to students based on their probability of attending a

[6] While our main analyses do not include outcomes from 2017-18, we use this sample criteria to ensure that we are not capturing charter school effects within their first year, in which lower performance is expected (Sass, 2006; Booker et al., 2009).

[7] Between 2017-18 and 2022-23, 150 unique charter schools operated in Tennessee. 48 schools were newly opened or closed during this time period (Tennessee Department of Education, 2024) and were therefore excluded from our main analyses. In subsequent sensitivity analyses, we remove this exclusion and find similar results (see Figure 4).

charter school as opposed to a TPS. These probabilities were obtained through the estimation of the following logistic regression:

$$Charter_{it} = \beta_0 + \beta_1 math_{it\text{-}n} + \beta_2 English_{it\text{-}n} + \beta_3 X_i + \varepsilon_i$$

This model includes the treatment as the outcome (i.e., a student attending a charter school) and student characteristics that predict attending a charter school as covariates, including students' baseline standardized test scores in math and English. In estimating for the 2020-21 school year, we use 2018-19 math and English test scores as the baseline test scores. For the 2021-22 and 2022-23 school years, we use math and English test scores in the 2020-21 school year as the baseline test scores. In addition to prior achievement, the model includes a vector of student characteristics (X_i) including a student's gender, race/ethnicity, economic disadvantage, special education status, English as a second language status, grade, and region.

Propensity score estimation was limited to students who had complete data on all covariates, including baseline test scores and were estimated for each analytic sample (across all four regions, the broader Nashville region, the broader Memphis region, elementary school students, middle school students, and high school students) separately. This separation supported the best balance of covariates between TPS and charter school students for each analysis.

For students in each sample, the predicted values from the model returned propensity scores that indicated the probability that a student would attend a charter school. These propensity scores ($P(X_i)$) were used in the following equation to estimate inverse probability weights for TPS students:

$$w_i = \frac{P(x_i)}{1 - P(x_i)}$$

This estimation procedure gives more weight to TPS students who have larger propensity scores, or in other words, look more like charter school students. Along with the weights for TPS students, all charter school students were assigned a weight equal to 1.

To ensure reliability of our estimates, we employed a trimming procedure that excludes students, both TPS and charter, who have an estimated propensity score greater than 0.9[8]. This cut-off is consistent with the upper bound from Crump et al.'s (2009) rule of thumb for trimming. We additionally tested our analysis with trimming at the recommended lower-bound of 0.1[9] and found that the results were not sensitive to the specification change.

Through the weighting of included students, the samples of charter school and TPS students become more similar based on demographics and baseline achievement. Although propensity score approaches assume that weighting on these observable characteristics makes the outcomes independent of treatment status, it is notable that unobservable characteristics may exist that correlate with both student outcomes and charter school enrollment. To the extent that these unobservable characteristics differentiate charter and TPS students, the effect estimates based on propensity scores will be biased. While it is not possible to directly assess for differences among unobservable characteristics, we conduct balance checks to ensure that the treatment group and the comparison group are similar on observable characteristics. Table 1 provides an example of these balance checks.[10] This table shows student characteristics before and after weighting for the

[8] While this study utilized the upper-bound of 0.9 for trimming, propensity scores were not frequently observed in extreme values. The use of this upper bound only resulted in the exclusion of four student observations from one regression.

[9] In the primary analysis of this study, we did not utilize the lower-bound cutoff of 0.1. One of the four regions has a relatively small number of charter schools compared to TPS. This small market share of charter schools resulted in students in that region having small propensity scores, and utilizing the lower-bound cutoff would have removed a large proportion of charter school students in this region. Thus, to ensure students in this region were represented in the statewide analysis, we did not utilize the lower bound.

[10] We also checked for balance in the post-covid analyses and when the sample was limited to the broader Nashville region, the broader Memphis region, elementary, middle, and high school students. Similar to Table 1, weighting

statewide sample included in the during-COVID analysis. As designed, the weighting approach significantly reduced all observable differences in student characteristics among the charter school and comparison TPS samples. In analyses following our main results, we also conduct additional robustness checks to examine the extent to which unobservable characteristics could nullify our results.

Table 1. Baseline Covariate Balance of Charter and TPS Students for Statewide During-COVID Analysis

Characteristic	Unweighted		Math - Weighted		English - Weighted	
	Charter	TPS	Charter	TPS	Charter	TPS
Female	**50.95%**	**48.69%**	51.80%	52.08%	51.81%	52.31%
Race						
Hispanic	26.17%	21.01%	30.20%	29.05%	30.92%	29.28%
Black	**62.93%**	**36.57%**	56.88%	59.26%	55.85%	58.80%
Asian	**1.06%**	**3.02%**	1.32%	1.22%	1.38%	1.20%
Native American	**0.13%**	**0.40%**	0.11%	0.11%	0.11%	0.11%
Native Hawaiian or Pacific Islander	**0.04%**	**0.19%**	0.03%	0.03%	0.04%	0.03%
Economically Disadvantaged	**56.10%**	**40.75%**	53.36%	54.59%	53.70%	55.45%
Special Education	**10.42%**	**11.73%**	10.16%	9.99%	9.72%	9.97%
English Second Language	10.21%	11.23%	9.55%	9.45%	9.45%	9.02%
Baseline Math Score	-0.217	-0.178	-0.199	-0.256	-0.183	-0.246
Baseline English Score	-0.323	-0.187	-0.308	-0.351	-0.295	-0.322

Notes: This table includes students across the four urban areas of the state with charter schools. Baseline characteristics from 2018-19 are displayed for the respective student pool in the "During-COVID" (2020-21) analysis. Statistically significant differences at the 5% level are bolded. Results for binary variables are represented in percentage of the sample with the given characteristics. Results for continuous variables represent mean values.

Analytic Methodology

Utilizing the weighted sample of charter and TPS students, we employed a doubly robust approach by estimating the average treatment effect on the treated with the following ordinary

also yielded better balances for these analyses, diminishing all statistically significant differences in the mean characteristics of charter and TPS students. Results are available upon request.

least squares linear regression integrating the inverse probability weights and controlling for student characteristics:

$$Y_{igsrt} = \beta_0 + \beta_1 T_{is} + \beta_2 Y_{igt\text{-}n} + \beta_3 Z_{st\text{-}n} + \beta_4 X_i + \lambda_g + \delta_r + \varepsilon$$

The outcome Y_{igsrt} represents the standardized test score for student *i* in grade *g* in school *s* in region *r* in year *t*. We examine performance in math and English separately for academic years 2020-21, 2021-22, and 2022-23. For each analysis, the corresponding baseline test score ($Y_{igt\text{-}n}$) is included as a predictor along with an indicator for a school's average standardized test score in the given subject in the baseline year ($Z_{st\text{-}n}$). School baseline achievement is added as a predictor to account for the educational setting that students are situated in, which can affect subsequent achievement. Additionally, the estimation procedure includes the same vector of student characteristics used in the estimation of propensity scores. Fixed effects for grade (λ_g) and region (δ_r) are utilized in the estimation procedure to ensure that treatment effects reflect a comparison among students in the same grade and district. The treatment effect of attending a charter school is provided by the coefficient of T_{is} in each analysis and can be interpreted as the difference in charter school students' standardized test scores attributable to attending a charter school rather than TPS.

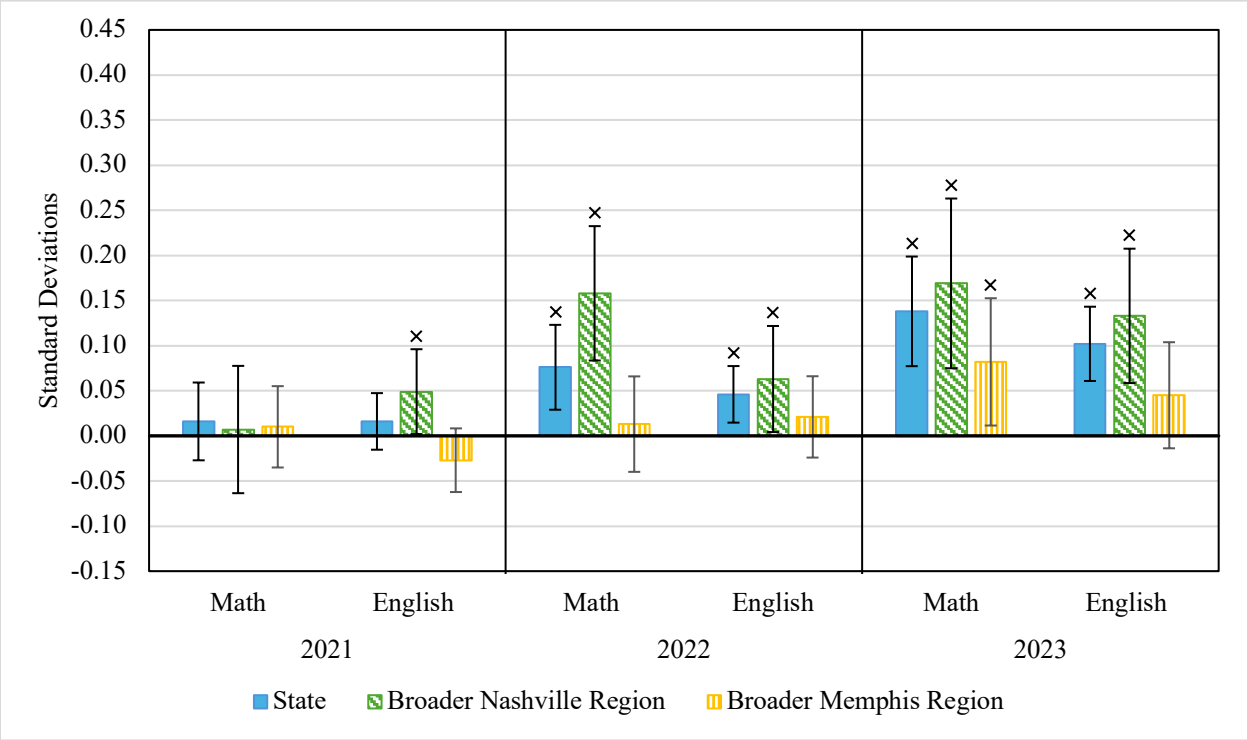
Results

In Figure 2, we display the results of the math and English achievement analysis both for charter school students statewide and separately for the broader Nashville and Memphis regions.[11] The first set of bars shows the performance of students in charter schools relative to similar TPS students for the 2020-21 school year, which we define as during the pandemic. The second and

[11] Results are shown in tabular format in Table A-1 of the appendix. Full estimates for the state-level analysis are included in Table A-2 of the appendix. Full estimates for subsamples are available upon request.

third set of bars shows the same comparisons for the 2021-22 and 2022-23 school years, which we define as post-pandemic.

Figure 2. Performance of Charter School Students Relative to Traditional Public School Students During and Post-Pandemic



Notes: 95% confidence intervals are displayed for each estimate. "X" indicates statistical significance.

During the pandemic (in 2020-21), the performance of charter school students was generally on par with TPS students. During this period, charter school students in the broader Nashville region demonstrated a slight, statistically significant, positive effect in English. No other estimate statewide or in either region was statistically distinguishable from the performance of comparable TPS students. Overall, these results do not imply that charter school students were not experiencing learning loss in charter schools. Rather, it means that the learning loss of charter school students was similar to the learning loss of TPS students with similar backgrounds and baseline achievement scores. This suggests that the degree to which charter schools had greater

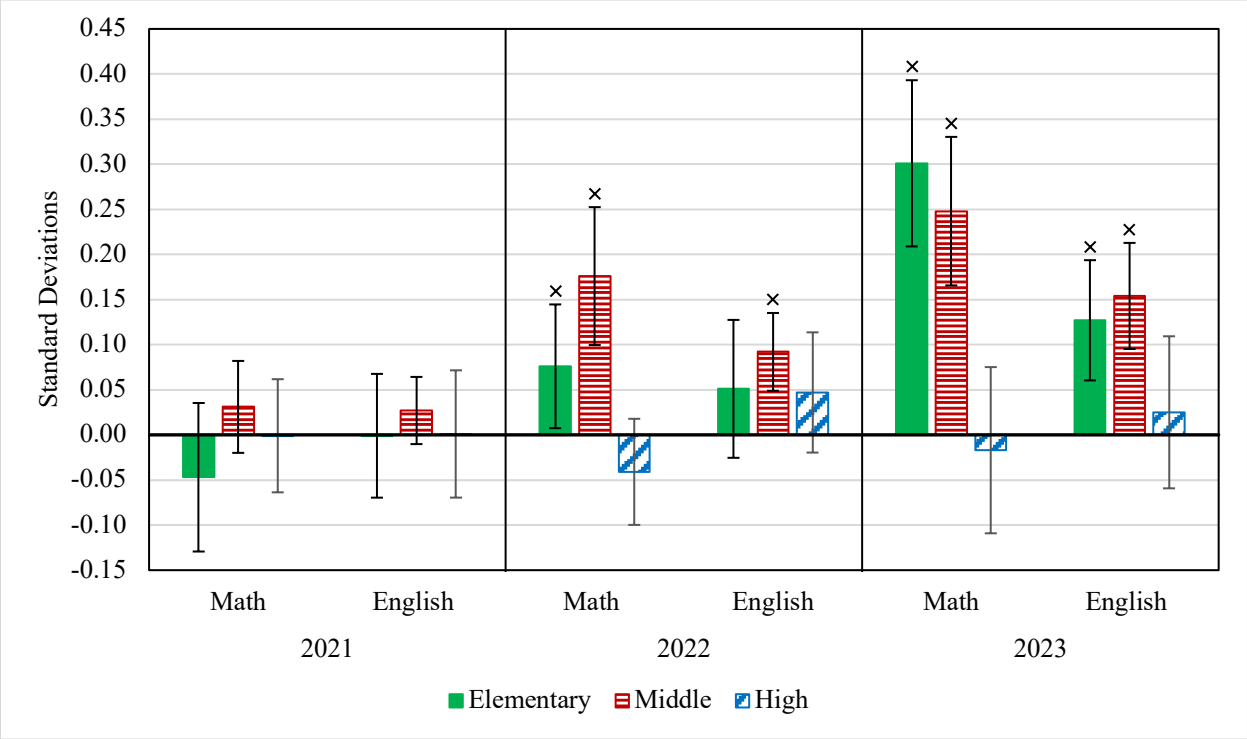
flexibility when responding to the onset of the pandemic did not lead to any student achievement advantage.

However, in the post-pandemic period (in 2021-22 and 2022-23), charter school students consistently outperformed TPS students both statewide and in the broader Nashville region, indicating an advantage in learning loss recovery. The statewide effect estimates range from 0.05 to 0.14 standard deviations. Estimates from the broader Nashville region ranged from 0.06 to 0.17 standard deviations. In the broader Memphis region, the charter school student performance was largely on par with comparable TPS students; only the estimate for math in the 2022-23 school year was statistically different from TPS students by 0.08 standard deviations.

In Figure 3, we further disaggregate the statewide trends to show the results for elementary, middle, and high school students, respectively.[12] For elementary and middle school students, the results are largely consistent with the overall statewide results that highlight students at charter schools performed on par with TPS students in the pandemic year of 2020-21. For the post-pandemic academic years, elementary and middle school students at charter schools outperformed TPS students by a statistically significant margin. However, charter high school students performed on par with TPS students in all years considered.

[12] Results are shown in tabular format in Table A-1 of the appendix.

Figure 3. Performance of Charter School Students by Grade Level



Notes: 95% confidence intervals are displayed for each estimate. "X" indicates statistical significance.

Overall, at the state level, the results generally suggest that charter students were on par with TPS students during the pandemic period but outperform comparable TPS students post-pandemic. The positive results during the post-pandemic years are at least partially driven by the strong performance in the broader Nashville region, where charter students outperformed TPS students in both subjects in both years. Similarly, the overall positive achievement effects for charter students are primarily driven by strong performance at the elementary and middle school levels.

Robustness Checks

In our main analyses, we made a series of choices to create appropriate counterfactuals and minimize selection bias in our estimates. To examine whether our results are sensitive to these choices, we conducted several robustness checks that replicate our primary analysis with changes

to inclusion criteria or procedural elements. Through comparing the results of our primary analysis to these alternative models, we can draw conclusions regarding the stability of our main estimates. Figure 4 highlights the results of six robustness checks against our primary state-level analysis.[13] While we conducted these robustness checks for all analytic samples, we focused on the state-level analysis here, which is representative of the trends observed with regional and grade-specific samples. In Figure 4, we display results for each school year in separate panels (i.e., Panel A – 2021, Panel B – 2022, Panel C – 2023). The left side of each panel includes math results, the right English. The results from the main analysis are the first in each panel and subject, indicated by the solid blue bar.

Although the six robustness checks we present indicate the sensitivity of estimates to our team's decisions, it is notable that these analyses face the same inferential limitations as our primary models. As previously discussed, the approach of inverse probability weighting is reliant on the assumption that a comparable control group of TPS students can be constructed based on observable characteristics. However, the extent to which unobservable characteristics influence selection into charter schools can bias estimates. While we cannot observe student characteristics outside of those we already control for, we complement our analyses with a series of estimated measures that indicate the sensitivity of our results to unobserved student characteristics. These measures are presented in Table 2, offering insight into the degree to which unobserved characteristics may have influenced the conclusions of this study. Below, we discuss each of these analyses and the respective results in depth.

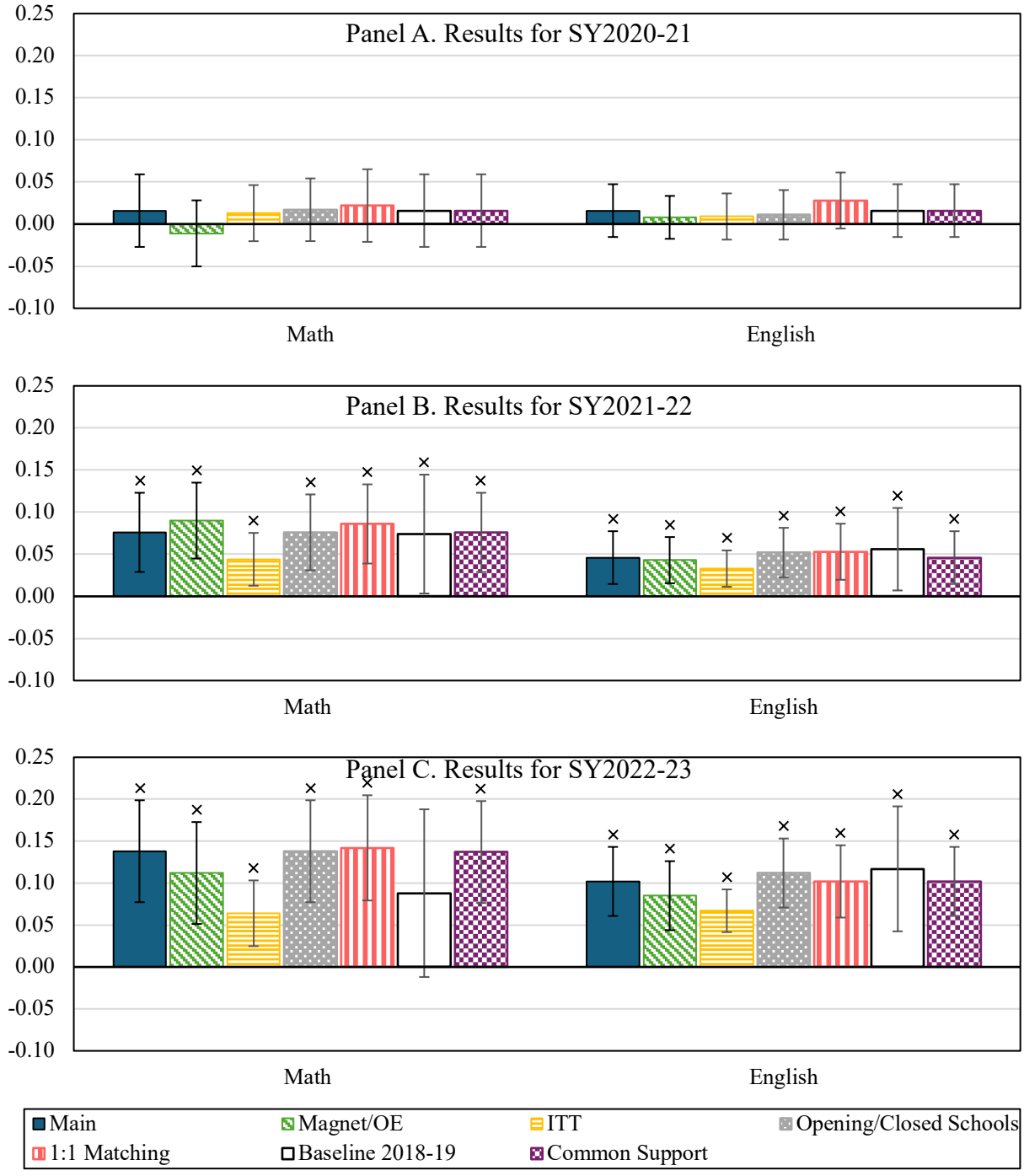
[13] Estimates of all robustness checks for the statewide analysis can be found in a tabular format in Appendix A-3. The same robustness checks were also conducted for all other samples reflected in the primary analysis and are available upon request.

Sample Restrictions

For our robustness checks, we first sought to examine the sensitivity of our estimates to our sample inclusion criteria. The first inclusion criteria we tested was based on school characteristics. In our primary analysis, we limit the comparison group to TPS students which excluded students in magnet, optional enrollment, virtual, and alternative schools. This inclusion criterion was implemented to ensure the effect of charter schools was estimated against traditional schooling environments rather than alternative educational interventions. However, in some urban areas of Tennessee, magnet and optional enrollment schools are common and should be considered a counterfactual enrollment option for charter school students. Therefore, we conduct a robustness check that includes students at magnet and optional enrollment schools in the control group, the results of which are indicated by the green, diagonal-striped bars in Figure 4.[14] These analyses demonstrate that while the sample of students weighted in the analysis substantially expands, the observed trends of student performance largely remain consistent with our primary analysis. We do not observe any changes in statistical significance and the results of the 2021-2022 year are within 0.015 SDs of the primary analysis. However, the estimated effect of attending a charter school in the 2022-23 school year is smaller for both math and English which may suggest that learning loss recovery was stronger in magnet and optional enrollment schools than TPS but still occurred at a slower rate than at charter schools.

[14] We continue to omit alternative and virtual schools in our comparison pool as students in these settings are likely different from those selecting into charter schools. Students in alternative schools may have been assigned to, rather than selected into, such schools based on prior low academic performance or behavioral concerns. Students in virtual schools likely have circumstances such that they are seeking for a learning environment completely online.

Figure 4. Robustness Analyses



Notes: Results are displayed utilizing the full sample. Magnet/OE includes Magnet and Optional Enrollment (OE) schools in the comparison. ITT = Intent to Treat estimates. Opening/Closed Schools includes newly opened schools and schools that closed in the study period (formerly excluded). 1:1 Matching utilizes traditional one-to-one propensity score methods (rather than inverse probability weighting). Baseline 2018-19 establishes a common baseline among all during- and post-pandemic years. Common Support enforces common support among charter schools and traditional public schools. 95% confidence intervals are displayed for each estimate. "X" indicates statistical significance.

The second inclusion criteria we evaluated was student movement. Our primary analysis excludes students, at both TPS and charter schools, who made nonstructural school changes after the pandemic because their decisions may have been partially driven by school performance or other reasons as a function of the COVID-19 pandemic. To reintroduce these students into the analysis without bias, we utilized an intent-to-treat (ITT) approach which made students' sector (TPS/charter) and region time-invariant characteristics based on their school enrollment in the pre-pandemic period (2018-19). The results of this analysis are indicated in Figure 4 by the bars with horizontal, yellow lines. While these analyses highlight that the estimated effects of charter school attendance with this approach are consistently smaller (up to 0.07 SDs) in the post-pandemic years than in our primary analysis, the results lead to the same substantive conclusion that there is a statistically significant achievement advantage of students attending charter schools. Some of the difference in the estimates may be driven by TPS to charter switchers who benefitted from charter schools but are assigned to the control group in this analysis. Alternatively, the performance patterns of switchers may be systematically different than other students which emphasizes the importance of our initial inclusion criteria.

The third inclusion criteria we tested in our robustness checks was at the school level. We specifically tested the sensitivity of our estimates to the inclusion of schools that opened, closed, or did not have achievement data for all years during our analytic period. The primary analysis of this study excluded these schools because they would not be able to contribute to all analyses, limiting the comparability across pandemic and post-pandemic years. When included, we observe that the estimates closely align with those of the primary analysis which reflects the relative stability of the charter market throughout the pandemic. These results are indicated by the gray, polka-dot bars in Figure 4.

Procedures

In addition to evaluating the stability of our estimates to various inclusion criteria, we also evaluate how procedural elements of our analysis influenced results. Our primary analysis utilized an inverse probability weighting approach which was selected based on advantages for external validity, incorporating a broader sample of control students than alternative propensity score methodologies. However, prior charter school effectiveness studies commonly favor propensity score matching, which is a narrower application of weighting where the possible weights for comparison students are zero or one. Through this approach, charter school students are only compared to their most similar TPS peer rather than an average of all similar peers. We tested the robustness of our results when a one-to-one matching approach is utilized, the results of which are indicated with vertical, red bars in Figure 4. The substantive conclusions hold in the analysis and the coefficient estimates mirror our primary results with the exception of a small 0.01 SD increase in the effect of charter school attendance on math in 2021-22.

Through our robustness checks we additionally assess the stability of our results when a consistent baseline year is used for all models. Although our primary analysis utilizes different baseline years for the pandemic and post-pandemic periods, a consistent baseline year increases comparability of estimates over time. Notable, however, is that this approach has trade-offs for sample inclusion. In our robustness check, we set the baseline year as 2018-19 meaning that the lowest grade included in our analysis is 6th and 7th graders for the 2021-22 and 2022-23 analyses, respectively. Despite this change, we only observe changes of 0.01 SDs in all but one post-pandemic estimate. The only estimate where a substantial change is observed is the effect on math in the 2022-23 year which loses statistical significance and drops in magnitude by 0.03 SDs. Contextualized by the gradual decline of our primary results for this estimate as grade level

increases, these results make sense due to the loss of 5th and 6th graders in this analysis. These results are displayed as the white bars in Figure 4.

The final robustness check we conducted on procedural elements additionally increases the confidence we have in our results. The primary analysis of this study utilized a trimming approach that excluded student observations with extreme propensity score values above 0.9. Alternatively, a common approach is to impose common support, requiring that all control observations have a propensity score within the range of values observed among treatment observations. The trade-off to this approach is that control observations with propensity scores near the value of one may be included and skew results based on assigned inverse probability weights. Despite this trade-off, we observe stability in our results across trimming and common support approaches, as indicated by the purple, checkered bars in Figure 4.

Overall, across the robustness checks, our substantive conclusions generally hold with relatively small changes in the magnitude of our estimates in nearly all cases. This provides greater confidence in our conclusions.

Selection on Unobservable Characteristics

Because inverse probability weighting relies on observable characteristics in the construction of the comparison group, unobservable characteristics correlated with those observed may bias our estimates. To further strengthen our confidence in the conclusions drawn, we additionally considered how important unobservable student characteristics would have to be to nullify our statistically significant results. To do this, we employed the strategies proposed by Oster (2019) and Frank et al. (2013) to quantify the issue of selection on unobservable characteristics. The results of these approaches for the state-level analysis are presented in Table 2. Given that these robustness checks focus on conditions necessary for the nullification of results

(in other words, that the true effect is found to not be different from zero), we solely present findings here for the post-Covid period.

The first set of results presented in Table 2 offer insights from Oster's (2019) approach to understanding unobservable selection and coefficient stability. This approach facilitates the estimation of two measures: (1) the ratio of unobservable to observable characteristics (δ) that would be needed to invalidate the conclusion and (2) a lower bound estimate of the treatment effect (β) assuming that δ = 1. Oster's approach is based on the work of Altonji et al. (2005) but adjusts the assumption of how much variation in the outcome can be explained by the combination of observed and unobserved characteristics. Given issues such as measurement error, Oster demonstrates that it is reasonable to assume that the explainable variation in the outcome is equivalent to $1.3R^2$ of the model with solely observable characteristics. Based on this assumption, we estimate the δ and lower bound β of our statistically significant post-Covid estimates. For context, a δ of two would suggest that unobservable characteristics would have to be twice as important as observable characteristics to nullify the result. As seen in Table 2, the range of estimated δ values for our models is 2.99-12.77 which suggests that our models would have had to omit very strong and important predictors of charter attendance to invalidate our results. Consequently, the lower bound treatment effect estimates are all within 0.02 of our main estimates.

Table 2. Robustness to Selection on Unobservable Characteristics

	Post-Covid (2022)		**Post-Covid (2023)**	
	Math	English	Math	English
Main Estimate	0.076**	0.046**	0.138***	0.102***
δ (unobs./obs. for null result)	3.601	2.989	10.265	12.767
Lower bound of β at δ = 1	0.053	0.030	0.117	0.090
% bias for null result	38.78%	32.85%	56.40%	58.70%

Notes: The main estimates are the same as demonstrated by the blue solid bars in Figures 2 and 4 and are shown for reference, with * for p<0.05, ** for p<0.01, and *** for p<0.001.

Complementing these measures, Frank et al. (2013) offer an analytic procedure to quantify the extent of bias necessary in a given estimate to nullify the causal inference. For our statistically significant results in the post-Covid period, we find that over 32% of each estimate would have to be attributed to bias to invalidate our results[15]. While there is not a standard benchmark of this measure that constitutes a robust inference, we compare these values to the bias that is induced when an observed, known confounder is removed from our estimation procedure. For this comparison, we removed the indicator for economic disadvantage from our estimation of propensity scores and treatment effects. When economic disadvantage is not accounted for, our estimates are biased by at most 6.5%. This suggests that for our results to be invalidated by bias from an unobserved confounder, the variable's relationship with charter school attendance and academic achievement would need to be at least five times the strength of economic disadvantage. Given that our models included the known important predictors of charter school attendance, this is unlikely.

Across these robustness checks, we observe that the 2023 estimates are less sensitive to unobservable characteristics than the 2022 estimates. This trend is in alignment with expectations given that 2023 estimates are significant at the 99.9% confidence threshold compared to the 99% confidence threshold for 2022 estimates. Despite the observed differences between the two post-Covid years, these measures provide confidence in the robustness of all statistically significant estimates.

[15] The robustness measure proposed by Frank et al. (2013) has been estimated for all studies included in the What Works Clearinghouse, representing the highest quality of causal inferences. When compared to the distribution of this measure for quasi-experimental studies with the same outcome, our estimates are found to be more robust than at least 27% of studies included in the What Works Clearinghouse (KonFound-It, n.d.)

Conclusions

This study provides insights into the effect of attending a charter school on academic achievement during and after the pandemic. Prior studies of student achievement have drawn mixed conclusions on the effects of charter schools (Harris, 2025; Zimmer, et al., 2021), but nearly all of this research was conducted pre-pandemic. From this pre-pandemic literature, the only estimate of Tennessee charter schools comes from a CREDO study of charter performance from 2014-15 to 2018-19 which found an advantage for students attending charter schools both nationwide and in Tennessee. While the CREDO study highlighted that the charter school effect has become more positive over time (Raymond et al., 2023), little is known at present about how charter schools performed during or after the pandemic. Theoretically, one could argue that charter schools may have performed better both during and after the pandemic as they may have greater flexibility and autonomy to change instructional practices to meet the needs of students during these periods. On the flip side, one could argue that TPSs may have had the existing infrastructure necessary to meet the social and emotional needs of students and were better equipped with staff to request federal ESSER money.

In this paper, we examined the performance of charter school students in Tennessee both statewide and in the two regions where the majority of charter schools reside, separately. While the performance of charter school students statewide was on par with TPS students during the pandemic, charter school students outperformed TPS students in post-pandemic periods. This trend was driven by the strong performance of elementary and middle charter school students, especially in the broader Nashville region.

Given that students generally experienced learning loss during the pandemic, these results suggest that there was no advantage of attending a charter school instead of a TPS at the onset of

the pandemic. While charter school leaders benefited from organizational flexibility and sometimes had unique systems in place to support student engagement (Childs et al., 2023; Neugebauer Schoettler & Marshall, 2024; Vanourek, 2020), they likely faced many of the same challenges that TPSs did with abruptly transitioning learning modalities. However, the significant positive effect of attending a charter school in the post-pandemic period suggests that lessons can be learned from Tennessee's charter sector on how to best approach recovery.

Relative to pre-pandemic trends, the positive effect associated with attending a charter school has rebounded from COVID-related learning loss in the post-pandemic years. Though the methods were not exactly comparable, we can compare the results of our study with that of CREDO's pre-pandemic report. In the 2018-19 school year, CREDO estimated the effect of attending a charter school as 0.058 SD for reading and 0.067 SD for math (Raymond et al., 2023). In our study, we found relatively similar effects in the first post-pandemic year highlighting that the charter school advantage had quickly resurfaced. In the second post-COVID year, the charter effect was even greater (0.102 SD in reading and 0.138 SD in math), suggesting that charter schools have been able to recover from pandemic-induced learning loss at a quicker and more substantial rate.

These results suggest that it is important to conduct additional research to explore the operation of charter schools, especially those in the broader Nashville region and elementary and middle charter schools, to understand schools' practices that drove these results. In doing so, hopefully, all schools can learn from charter school practices that are helping to address pandemic learning loss.

References

Abdulkadiroglu, A., Angrist, J., Dynarski, S., Kane, T., & Pathak, P. (2011). Accountability and flexibility in public schools: Evidence from Boston's charters and pilots. *Quarterly Journal of Economics, 126*(2), 699-748

Ableidinger, J., & Hassel, B. C. (2010). *Free to lead: Autonomy in highly successful charter schools.* National Alliance for Public Charter Schools. https://files.eric.ed.gov/fulltext/ED535213.pdf

Ali, T., Chandra, S., Cherukumilli, S., Fazlullah, A., Hill, H., McAlpine, N., McBride, L., Vaduganathan, N., Weiss, D., & Wu, M. (2021). *Looking back, looking forward: What it will take to permanently close the K-12 digital divide.* Common Sense Media. https://southerneducation.org/wp-content/uploads/documents/looking-back-looking-forward-report-01272021.pdf

Altonji, J. G., Elder, T. E., & Taber, C. R. (2005). An evaluation of instrumental variable strategies for estimating the effects of Catholic schooling. *Journal of Political Economy, 113*, 151-184.

Angrist, J. D., Pathak, P. A., & Walters, C. R. (2013). Explaining charter school effectiveness. *American Economic Journal: Applied Economics, 5*(4), 1-27.

BallotPedia. (n.d.). *School responses in Tennessee to the coronavirus (COVID-19) pandemic*. https://ballotpedia.org/School_responses_in_Tennessee_to_the_coronavirus_(COVID-19)_pandemic

Bayeler, K. (2022, August 2). *Examining Tennessee's landscape of charter schools.* Nashville Scene. https://www.nashvillescene.com/news/citylimits/examining-tennessee-s-landscape-of-charter-schools/article_59a12ef6-11f8-11ed-be9e-

9be1af776998.html#:~:text=This%20struggle%20for%20local%20control%20is%20at,available%20only%20to%20certain%20students%20in%20Nashville%2C

Bifulco R. (2012). Can nonexperimental estimates replicate estimates based on random assignment in evaluations of school choice? A within-study comparison. *Journal of Policy Analysis and Management, 31*(3), 729-751.

Boast, L., Clifford, B., & Doyle, D. (2020). *Learning in real time: How charter schools served students during COVID-19 closures.* National Alliance for Public Charter Schools.

Brent, B. O., & Finnigan, K. S. (2009). Financial management of New York's charter schools: A normative, descriptive, and prescriptive analysis. *Journal of School Choice, 3*(4), 368-396. https://doi.org/10.1080/15582150903425772

Buddin, R., & Zimmer, R. (2005). Student achievement in charter schools: A complex picture. *Journal of Policy Analysis and Management, 24*(2), 351–371. https://doi.org/10.1002/pam.20093

Center for Research on Educational Outcomes [CREDO]. (2022). Charter schools response to the pandemic in California, New York and Washington. https://credo.stanford.edu/wp-content/uploads/2022/02/Charter-School-COVID-Final.pdf

Chabrier, J., Cohodes, S., & Oreopoulos, P. (2016). What can we learn from charter school lotteries? *Journal of Economic Perspectives, 30*(3), 57-84.

Cheng, A., Hitt, C., Kisida, B., & Mills, J. N. (2017). "No excuses" charter schools: A meta-analysis of the experimental evidence on student achievement. *Journal of School Choice, 11*(2), 209-238. https://doi.org/10.1080/15582159.2017.1286210

Childs, J., Grooms, A., & Mozley, M. P. (2023). Hidden in (virtual) plain sight: A charter district's focus on attendance during COVID-19. *Education and Urban Society, 55*(7), 876–893. https://doi.org/10.1177/00131245211065414

Clark, M. A., Gleason, P. M., Clark Tuttle, C., Silverberg, M. K. (2015). Do charter schools improve student achievement? *Educational Evaluation and Policy Analysis, 37*(4), 419-436.

Cohodes, S. R., & Parham, K. S. (2021). *Charter schools' effectiveness, mechanisms, and competitive influence* (Working Paper No. 28477). National Bureau of Economic Research. http://www.nber.org/papers/w28477

Cohodes, S., Goldhaber, D., Hill, P., Ho, A., Kogan, V., Polikoff, M., Sampson, C., & West, M. (2022). *Student achievement gaps and the pandemic: A new review of evidence from 2021–2022.* Center on Reinventing Public Education. https://crpe.org/student-achievement-gaps-and-the-pandemic-a-new-review-of-evidence-from-2021-2022/

Cohodes, S., & Pitt, C. (2022). *A new COVID-19 data source for answering emerging pandemic questions.* Center on Reinventing Public Education. https://crpe.org/wp-content/uploads/final-COVID-school-data-hub-blog.pdf

Cohodes, S., & Roy, S. (2024). Thirty years of charter schools: What does lottery-based research tell us? *Journal of School Choice, 19*(1), 8-49. https://doi.org/10.1080/15582159.2024.2379644

Cook, T. D., Shadish, W. R., & Wong, V. C. (2008). Three conditions under which experiments and observational studies produce comparable causal estimates: New findings from within-study comparisons. *Journal of Policy Analysis and Management, 27*(4), 724–750.

Courtemanche, C. J., Le, A. H., Yelowitz, A., & Zimmer, R. (2021). *School reopenings, mobility, and COVID-19 spread: Evidence from Texas* (Working Paper No. 28753). National Bureau of Economic Research. http://www.nber.org/papers/w28753.

Crump, R.K., Hotz, V.J., Imbens, G.W., & Mitnik, O.A. (2009). Dealing with limited overlap in estimation of average treatment effects. *Biometrika Trust, 96*(1), 187-199.

Dee, T. S. & Murphy, M. (2021). Patterns in the pandemic decline of public school enrollment. *Educational Researcher, 50*(8), 566-569.

Dee, T. S. (2023). *Where the kids went: Nonpublic schooling and demographic change during the pandemic exodus from public schools.* Urban Institute.

Dobbie, W., & Fryer, R. G. (2013). Getting beneath the veil of effective schools: Evidence from New York City. *American Economic Journal: Applied Economics, 5*(4), 28-60. http://dx.doi.org/10.1257/app.5.4.28

Doughtery, S. M., Kistler, H. C., & Yoon, Y. Changes in public school enrollment: Evidence from the COVID-19 pandemic. In K. A. Couch (Ed.), *Handbook on inequality and COVID-19*. ElgarOnline.

Ellison, B. S., & Iqtadar, S. (2022). A qualitative research synthesis of the "no excuses" charter school model. *Educational Policy, 36*(5), 915-941.

Epple, D., Romano, R., & Zimmer, R. (2016). Charter schools: A survey of research on their characteristics and effectiveness. In E.A. Hanushek, S. Machin, & L. Woessmann (Eds.), *Handbook of the economics of education* (Vol. 5, pp.139-208). Elsevier.

Fahle, E. M., Kane, T. J., Patterson, T., Reardon, S. F., Staiger, D. O., & Stuart, E. A. (2023). *School district and community factors associated with learning loss during the COVID-*

19 pandemic. Center for Education Policy Research at Harvard University. https://cepr.harvard.edu/sites/hwpi.harvard.edu/files/cepr/files/explaining_covid_losses_5.23.pdf

Finn, C. E., Manno, B. V., & Vanourek, G. (2000). *Renewing public education: Charter schools in action.* Princeton University Press.

Fitzpatrick, B. R., Berends, M., Ferrare, J. J., & Waddington, R. J. (2020). Virtual illusion: Comparing student achievement and teacher and classroom characteristics in online and brick-and-mortar charter schools. *Educational Researcher, 49*(3), 161–175. https://doi.org/10.3102/0013189X20909814

Fortson, K., Gleason, P., Kopa, E., & Verbitsky-Savitz, N. (2015). Horseshoes, hand grenades, and treatment effects? Reassessing whether nonexperimental estimators are biased. *Economics of Education Review, 44*, 100-113.

Frank, K. A., Maroulis, S. J., Doung, M. Q., Kelcey, B. M. (2013). What would it take to change an inference? Using Rubin's causal model to interpret the robustness of causal inferences. *Educational Evaluation and Policy Analysis, 35*(4), 437-460.

Furgeson, J., Gill, B., Haimson, J., Killewald, A., McCullough, M., Nichols-Barrer, I., Teh, B., Verbitsky-Savitz, N., Bowen, M., Demeritt, A., Hill, P., Lake, R. (2012). *Charter-school management organizations: Diverse strategies and diverse student impacts.* Mathematica Policy Research. Center on Reinventing Public Education. https://files.eric.ed.gov/fulltext/ED528536.pdf

Gawlik, M. A. (2008). Breaking loose: Principal autonomy in charter and public schools. *Educational Policy, 22*(6), 783-804.

Gleason, P., Clark, M., Tuttle, C.C., Dwoyer, E., & Silverberg, M. (2010). *The evaluation of charter school impacts.* National Center for Education Evaluation and Regional Assistance.

Golann, J. W. (2015). The paradox of success at a no-excuses school. *Sociology of Education, 88*(2), 103-119.

Golann, J. W. (2021). *Scripting the moves: Culture and control in a "no-excuses" charter school.* Princeton University Press.

Goldhaber, D., Kane, T. J., McEachin, A., Morton, E., Patterson, T., & Staiger, D. O. (2023). The educational consequences of remote and hybrid instruction during the pandemic. *American Economic Review: Insights, 5*(3), 377–392. https://doi.org/10.1257/aeri.20220180

Griffith, D. (2017). *Teacher absenteeism in charter and traditional public schools*. Thomas B. Fordham Institute. https://fordhaminstitute.org/national/research/teacher-absenteeism-charter-and-traditional-public-schools

Gross, B., & Pochop, K. M. (2008). How charter schools organize for instruction. In R. J. Lake (Ed.), *Hopes, fears, & reality: A balanced look at American charter schools in 2008* (pp. 9-22). Center on Reinventing Public Education.

Harris, D., Ziedan, E., & Hassig, S. (2021). *The effects of school reopenings on COVID-19 hospitalization.* National Center for Research on Education Access and Choice. https://reachcentered.org/publications/the-effects-of-school-reopenings-on-covid-19-hospitalizations

Harris, D. (2025). Charter Schools. In D. Harris (Ed.), *Live handbook of education policy research.* Association for Education Finance and Policy.

Hastings, J. S., Neilson, C. A., & Zimmerman, S. D. (2012). *The effect of school choice on intrinsic motivation and academic outcomes* (Working Paper No. 18324). National Bureau of Economic Research. http://www.nber.org/papers/w18324

Henry, K. L., & Dixson, A. D. (2016). "Locking the door before we got the keys": Racial realities of the charter school authorization process in Post-Katrina New Orleans. *Educational Policy, 30*(1), 218–240. https://doi.org/10.1177/0895904815616485

Henry, K. L. (2021). "The price of disaster": The charter school authorization process in post-Katrina New Orleans. *Educational Policy, 35*(2), 235–258. https://doi.org/10.1177/0895904820988202

Imbens, Q.W. & Woolridge, J. M. (2009). Recent developments in the econometrics of program evaluation. *Journal of Economic Literature, 47*(1), 5-86.

Jabbar, H. (2016). The visible hand: Markets, politics, and regulation in post-Katrina New Orleans. *Harvard Educational Review, 86*(1), 1–26. https://doi.org/10.17763/0017-8055.86.1.1

Jack, R., Halloran, C., Okun, J., & Oster, E. (2023). Pandemic schooling mode and student test scores: Evidence from US school districts. *American Economic Review: Insights, 5*(2), 173–190. https://doi.org/10.1257/aeri.20210748

Kho, A., Zimmer, R., & Buddin, R. (2020). The economics of charter schools. In S. Bradley & C. Green (Eds.), *The economics of education* (2nd ed, pp. 531-542). Elsevier. https://doi.org/10.1016/B978-0-12-815391-8.00039-2

Kim, E. J., & Miratrix, L. W. (2023). *The causal impact of charter schools on private tutoring prevalence* (Working Paper No. 23 -756). Annenberg Institute at Brown University. https://doi.org/10.26300/qs5q-ga02

Kogan V., & Lavertu S., (2021) *The COVID-19 pandemic and student achievement on Ohio's third-grade English Language Arts assessment.* Ohio State University.

KonFound-It. (n.d.). *Sensitivity analysis benchmarks*. https://konfound-project.shinyapps.io/wwc-sensitivity-benchmark/

Kuhfeld, M., Soland, J., & Lewis, K. (2022a). Test score patterns across three COVID-19-impacted school years. *Educational Researcher, 51*(7), 500–506. https://doi.org/10.3102/0013189X221109178

Kuhfeld, M., Soland, J., Lewis, K., Ruzek, E., & Johnson, A. (2022b). The COVID-19 school year: Learning and recovery across 2020-2021. *AERA Open, 8*(1), 1-15. https://doi.org/10.1177/23328584221099306

Kuhfeld M., Lewis K., & Peltier T. (2023). Reading achievement declines during the COVID-19 pandemic: Evidence from 5 million US students in grades 3–8. *Reading and Writing, 36*(2), 245–261.

Lavertu, S. (2024). *Ohio charter schools after the pandemic: Are their students still learning more than they would in district schools?* Thomas B. Fordham Institute.

Maldonado, J. E., & De Witte, K. (2022) The effect of school closures on standardized student test outcomes. *British Educational Research Journal, 48*(1), 49–94.

McEachin, A., Lauen, D. L., Fuller, S. C., & Perera, R. M. (2020). Social returns to private choice? Effects of charter schools on behavioral outcomes, arrests, and civic participation. *Economics of Education Review, 76*.

Nathan, J. (1996). *Charter schools: Creating hope and opportunity for American education.* Jossey-Bass Inc.

Neugebauer Schoettler, N., & Marshall, D. T. (2024). “Hard work, patience, and a lot of grace”: Lessons learned from charter school leaders during the COVID-19. *Leadership and Policy in Schools,* 1–15. https://doi.org/10.1080/15700763.2024.2394655

Oberfield, Z. W. (2016). A bargain half fulfilled: Teacher autonomy and accountability in traditional public schools and public charter schools. *American Educational Research Journal, 53*(2), 296-323.

Office of School Models and Programs. (2019). *Charter Schools Annual Report*. Tennessee Department of Education. https://www.tn.gov/content/dam/tn/education/documents/2019%20Charter%20Report%20final.pdf

Osher, D., Jones, W., & Jagers, R. (2025). *Building supportive conditions and comprehensive supports to enhance student and educator well-being and thriving*. National Academy of Education Committee on Addressing Educational Inequities in the Wake of the COVID-19 Pandemic, National Academy of Education.

Oster, E. (2019). Unobservable selection and coefficient stability: Theory and evidence. *Journal of Business and Economic Statistics, 37*(2), 187-204. https://doi.org/10.1080/07350015.2016.1227711

Pane, J. F., Steiner, E. D., Baird, M. D., Hamilton, L. S., Pane, J. D. (2017). *Informing progress.* RAND Corporation.

Rau, N. (2021, January 26). *Several state-authorized schools remain virtual as Lee blasts Nashville and Memphis for not reopening*. Tennessee Lookout. https://tennesseelookout.com/2021/01/26/several-state-authorized-schools-remain-virtual-as-lee-blasts-nashville-and-memphis-for-not-reopening/

Raymond, M. E., Woodworth, J. L., Lee, W. F., Bachofer, S. (2023). *As a matter of fact: The national charter school study III 2023.* Center for Research on Education Outcomes. https://ncss3.stanford.edu/wp-content/uploads/2023/06/Credo-NCSS3-Report.pdf

Relyea, J. E., Rich, P., Kim, J. S., & Gilbert, J. B. (2023). The COVID-19 impact on reading achievement growth of grade 3-5 students in a U.S. urban school district: Variation across student characteristics and instructional. *Reading and Writing, 36*, 317-346.

Sass, T. R. & Ali, S. M. (2022). *Student achievement growth during the COVID-19 pandemic.* Georgia Policy Lab. https://gpl.gsu.edu/download/student-achievement-growth-during-the-covid-19-pandemic-spring-2022-update-report/?wpdmdl=2737&refresh=684ad315ea8251749734165

Sparks, S. D. (2022, Oct. 24). *Two decades of progress, nearly gone: National math, reading scores hit historic lows.* EducationWeek. https://www.edweek.org/leadership/two-decades-of-progress-nearly-gone-national-math-reading-scores-hit-historic-lows/2022/10

Tennessee Commission on Education Recovery and Innovation. (2020). *Preliminary report to the general assembly: Effects of the COVID-19 pandemic on Tennessee's educational systems.* https://www.tn.gov/content/dam/tn/stateboardofeducation/documents/education-recovery-and-innovation-commission/2020-report/ERIC_REPORT_ONE.pdf

Tennessee State Department of Education (2024). *2022-23 public charter schools annual report*. https://www.tn.gov/content/dam/tn/education/documents/Annual_Charter_Report_for_SY2022-23.pdf

Tong, T., Smith, S. L., Fienberg, M., & Kho, A. (2023). Charter schools: An alternative option in American schooling. *Encyclopedia, 3*(1), 362–370. https://doi.org/10.3390/encyclopedia3010022

Tuttle, C. C., Gleason, P., & Clark, M. (2012). Using lotteries to evaluate schools of choice: Evidence from a national study of charter schools. *Economics of Education Review, 31*, 237-253.

Valant, J. (2020). *School reopening plans linked to politics rather than public health*. Brown Center Chalkboard, Brookings Institution. https://www.brookings.edu/blog/brown-center-chalkboard/2020/07/29/school-reopeningplans-linked-to-politics-rather-than-public-health/

Vanourek, G. (2020). Schooling COVID-19: *Lessons from leading charter networks from their transition to remote learning.* Thomas B. Fordham Institute.

Veney, D. & Jacobs, D. (2021). *Voting with their feet: A state-level analysis of public charter school and district public school enrollment trends*. National Alliance for Public Charter Schools. https://publiccharters.org/news/voting-with-their-feet-a-state-level-analysis-of-public-charter-school-and-district-public-school-enrollment-trends/

Willet, R. J. & Murnane, J. B. (2011). *Methods matter: Improving causal inference in educational and social science research.* Oxford University Press.

Zimmer, R., Gill, B., Booker, K., Lavertu, S., Sass, T., & Witte, J. (2009). *Charter schools in eight states: Effects on achievement, attainment, integration, and competition.* RAND Corporation. https://doi.org/10.7249/MG869

Zimmer, R., Henry, G., & Kho, A. (2017). The effects of school turnaround in Tennessee's achievement school district and innovation zones. *Educational Evaluation and Policy Analysis, 39*(4), 670–696.

Zimmer, R., Buddin, R., Smith, S. A., & Duffy-Chipman, D. (2021). Nearly three decades into the charter school movement, what has research told us about charter schools? In B. P. McCall (Ed.), *The Routledge handbook of the economics of education* (pp. 73-106). Routledge.

Appendices

Appendix A-1.
Primary analyses by sample

	Covid (2021)		**Post-Covid (2022)**		**Post-Covid (2023)**	
	Math	English	Math	English	Math	English
State	0.016	0.016	0.076**	0.046**	0.138***	0.102***
	(0.022)	(0.016)	(0.024)	(0.016)	(0.031)	(0.021)
N	*63485*	*56810*	*69514*	*63453*	*49134*	*43977*
Region A	0.007	0.049*	0.158***	0.063*	0.169***	0.133***
	(0.036)	(0.024)	(0.038)	(0.030)	(0.048)	(0.038)
N	*16571*	*14637*	*18121*	*16439*	*12629*	*10917*
Region B	0.01	-0.027	0.013	0.021	0.082*	0.045
	(0.023)	(0.018)	(0.027)	(0.023)	(0.036)	(0.030)
N	*18061*	*15976*	*18317*	*16341*	*10781*	*9678*
Elementary	-0.047	-0.001	0.076*	0.051	0.301***	0.127***
	(0.042)	(0.035)	(0.035)	(0.029)	(0.047)	(0.034)
N	*11236*	*11222*	*22955*	*22939*	*9890*	*9900*
Middle	0.031	0.027	0.176***	0.092***	0.248***	0.154***
	(0.026)	(0.019)	(0.039)	(0.022)	(0.042)	(0.030)
N	*30631*	*30591*	*26429*	*26462*	*21015*	*21037*
High	-0.001	0.001	-0.041	0.047	-0.017	0.025
	(0.032)	(0.036)	(0.030)	(0.034)	(0.047)	(0.043)
N	*15637*	*10542*	*14267*	*9401*	*12181*	*8317*

Notes: All models include grade and region fixed effects. Standard errors are clustered at the school-level are reported in parentheses. * for p<0.05, ** for p<0.01, and *** for p<0.001

Appendix A-2
Full results of state-level primary analysis

	Covid (2021)		Post-Covid (2022)		Post-Covid (2023)	
	Math	English	Math	English	Math	English
Charter	0.016	0.016	0.076**	0.046**	0.138***	0.102***
	(0.022)	(0.016)	(0.024)	(0.016)	(0.031)	(0.021)
Female	0.019*	0.127***	-0.002	0.068***	-0.008	0.038**
	(0.009)	(0.009)	(0.009)	(0.007)	(0.011)	(0.012)
Hispanic	-0.119***	-0.066***	-0.01	-0.075***	0.002	-0.066***
	(0.021)	(0.019)	(0.016)	(0.014)	(0.019)	(0.019)
Black	-0.223***	-0.177***	-0.124***	-0.135***	-0.110***	-0.114***
	(0.022)	(0.016)	(0.016)	(0.014)	(0.020)	(0.017)
Asian	0.146***	0.113**	0.113**	0.050*	0.147***	0.039
	(0.029)	(0.038)	(0.037)	(0.025)	(0.042)	(0.026)
Native American	0.068	0.022	-0.13	0.061	0.126	-0.071
	(0.069)	(0.087)	(0.141)	(0.102)	(0.068)	(0.060)
Native Hawaiian or Pacific Islander	0.297**	-0.177	0.101	0.031	0.093	0.223
	(0.112)	(0.144)	(0.067)	(0.068)	(0.101)	(0.127)
Economically Disadvantaged	-0.075***	-0.101***	-0.072***	-0.080***	-0.077***	-0.075***
	(0.011)	(0.008)	(0.011)	(0.009)	(0.015)	(0.010)
Special Education	-0.058***	-0.232***	-0.252***	-0.262***	-0.315***	-0.337***
	(0.016)	(0.019)	(0.020)	(0.017)	(0.023)	(0.022)
English Second Language	-0.127***	-0.199***	-0.269***	-0.189***	-0.319***	-0.267***
	(0.020)	(0.019)	(0.018)	(0.016)	(0.027)	(0.019)
Baseline Math Score	0.490***		0.526***		0.520***	
	(0.012)		(0.012)		(0.013)	
Baseline English Score		0.609***		0.666***		0.640***
		(0.007)		(0.006)		(0.010)
School Average Baseline Math Score	0.173***		0.443***		0.301***	
	(0.031)		(0.041)		(0.065)	
School Average Baseline English Score		0.192***		0.237***		0.188***

		(0.017)		(0.019)		(0.040)
Constant	-0.251***	-0.024	0.295***	0.171***	0.334***	0.198***
	(0.034)	(0.028)	(0.041)	(0.023)	(0.049)	(0.031)
N	*63485*	*56810*	*69514*	*63453*	*49134*	*43977*

Notes: All models include grade and region fixed effects. Standard errors are clustered at the school-level. * for p<0.05, ** for p<0.01, and *** for p<0.001

Appendix A-3.
Results of robustness checks for statewide sample

	Covid (2021)		**Post-Covid (2022)**		**Post-Covid (2023)**	
	Math	English	Math	English	Math	English
Main Analysis	0.016	0.016	0.076**	0.046**	0.138***	0.102***
	(0.022)	(0.016)	(0.024)	(0.016)	(0.031)	(0.021)
N	*63485*	*56810*	*69514*	*63453*	*49134*	*43977*
Magnet Students	-0.011	0.008	0.090***	0.043**	0.112***	0.085***
	(0.020)	(0.013)	(0.023)	(0.014)	(0.031)	(0.021)
N	*92169*	*82383*	*94295*	*85711*	*69984*	*62743*
ITT	0.013	0.009	0.044**	0.033**	0.064**	0.067***
	(0.017)	(0.014)	(0.016)	(0.011)	(0.020)	(0.013)
N	*72086*	*64845*	*89677*	*82580*	*72250*	*64248*
Opening / Closing Schools	0.017	0.011	0.076***	0.052***	0.138***	0.112***
	(0.019)	(0.015)	(0.023)	(0.015)	(0.031)	(0.021)
N	*69680*	*62746*	*75500*	*69276*	*53990*	*48786*
1:1 Matching	0.022	0.028	0.086***	0.053**	0.142***	0.102***
	(0.022)	(0.017)	(0.024)	(0.017)	(0.032)	(0.022)
N	*24110*	*21243*	*21512*	*18726*	*13776*	*11920*
Baseline 2018-19	0.016	0.016	0.074*	0.056*	0.088	0.117**
	(0.022)	(0.016)	(0.036)	(0.025)	(0.051)	(0.038)
N	*63485*	*56810*	*39850*	*34539*	*27104*	*22692*
Common Support	0.016	0.016	0.076**	0.046**	0.137***	0.102***
	(0.022)	(0.016)	(0.024)	(0.016)	(0.031)	(0.021)
N	*62041*	*55493*	*68471*	*62420*	*46577*	*41481*

Notes: All models include grade and region fixed effects. Standard errors are clustered at the school-level and reported in parentheses. * for p<0.05, ** for p<0.01, and *** for p<0.001