NATIONAL
CENTER *for* ANALYSIS *of* LONGITUDINAL DATA *in* EDUCATION RESEARCH

TRACKING EVERY STUDENT'S LEARNING EVERY YEAR

A program of research by the American Institutes for Research with Duke University, Northwestern University, Stanford University, University of Missouri-Columbia, University of North Carolina at Chapel Hill, University of Texas at Dallas, and University of Washington

A Comprehensive Picture of Achievement Across the COVID-19 Pandemic Years: Examining Variation in Test Levels and Growth Across Districts, Schools, Grades, and Students

Dan Goldhaber
Thomas J. Kane
Andrew McEachin
Emily Morton

WORKING PAPER No. 266-0522 • May 2022

A Comprehensive Picture of Achievement Across the COVID-19 Pandemic Years: Examining Variation in Test Levels and Growth Across Districts, Schools, Grades, and Students

Dan Goldhaber
American Institutes for Research/CALDER
University of Washington/CEDR

Thomas J. Kane
Harvard University

Andrew McEachin
NWEA

Emily Morton
NWEA

Contents

Acknowledgments

This research was supported by the Carnegie Corporation of New York, the Walton Family Foundation, the Kenneth C. Griffin Foundation, and an anonymous foundation. CALDER is funded by a consortium of foundations (for more information about CALDER funders, see www.caldercenter.org/about-calder).

CALDER working papers have not undergone final formal review and should be cited as working papers. They are intended to encourage discussion and suggestions for revision before final publication. Any opinions, findings, and conclusions expressed in these papers are those of the authors and do not necessarily reflect the views of our funders or the institutions to which the authors are affiliated. Any errors are attributable to the authors.

We are grateful to Nate Jensen, Megan Kuhfeld, and Anna McDonald for their assistance with various aspects of this work.

CALDER • American Institutes for Research
1400 Crystal Drive 10th Floor, Arlington, VA 22202
202-403-5796 • www.caldercenter.org

A Comprehensive Picture of Achievement Across the COVID-19 Pandemic Years: Examining Variation in Test Levels and Growth Across Districts, Schools, Grades, and Students

Dan Goldhaber, Thomas J. Kane, Andrew McEachin, Emily Morton

CALDER Working Paper No. 266-0522
May 2022

Abstract

In this paper, we use NWEA MAP test data to examine variation in students' achievement and growth during the pandemic across multiple dimensions. Consistent with prior evidence, we find that students' test scores in fall 2021, on average, were substantially below historic averages. Moreover, the average scores of students of color, students attending high poverty schools, and students in elementary school were more negatively impacted, and more so in math than reading. We present novel evidence on the distributions of test scores and growth in fall 2021 relative to pre-pandemic distributions, finding disproportionately larger declines for students with lower previous achievement levels across districts. However, between districts, there was considerable variation in the extent to which their fall 2021 achievement and growth distributions shifted from their historical distributions by subject, student subgroups, and baseline achievement levels. Therefore, accurately targeting students and choosing interventions for pandemic-related recovery will require careful assessment by districts of their students' achievement and growth in the 2021-22 school year (and into the future): assuming that students in a district reflect the national trends of achievement will often lead to incorrect conclusions about the degree to which they suffered pandemic-related learning losses and the amount of support they will need to recover.

1. Introduction

There is now abundant evidence that the COVID-19 pandemic has had a profound impact on schools and student achievement. All schools closed during spring of the 2019–20 school year, and many of these schools stayed closed or operated hybrid models for much of the 2020–21 school year. So far in 2021–22, schooling has been disrupted in numerous systems across the country. Given all this and the broader impacts of the COVID-19 pandemic, it is no surprise that numerous studies now show that students made substantially less academic progress last year relative to previous years. This finding is reflected on state assessments (e.g., Kogan & Lavertu, 2021) and on benchmark tests used by districts (e.g., Amplify Education, 2021; Darling-Aduana et al., 2022; Dorn et al., 2021; Education Policy Innovation Collaborative [EPIC], 2021; Lewis et al., 2021; Lewis & Kuhfeld, 2021).

Average test scores were significantly lower than typical across all grades in mathematics and reading, but the relative declines were largest in mathematics and in earlier elementary grades; for the sake of parsimony, we refer to this decline as "learning loss."[1] Relative declines were also disproportionately large for students in high-poverty schools and for students of color, exacerbating preexisting achievement gaps (EPIC, 2021). For instance, students in fall 2021 scored 9–11 percentile points lower in mathematics and 3–7 percentile points lower in reading compared to prepandemic years, on average (Curriculum Associates, 2021; EPIC, 2021; Lewis & Kuhfeld, 2021). Black and Hispanic students were found to be even further behind, scoring 9–15 percentile points lower than their prepandemic scores in mathematics and 3–10 percentile points lower than their prepandemic scores in reading.[2]

Much evidence has documented the average negative impacts of the pandemic on students across the country (e.g., Amplify Education, 2021; Dorn et al., 2021; EPIC, 2021; Lewis & Kuhfeld, 2021), and a growing body of research indicates that average pandemic-related changes in test scores vary across schools and districts. Indeed, research suggests that the pandemic impacted students' learning experiences differently across schools and districts based on a variety of interrelated local factors, such as regional COVID-19 case rates, unemployment rates, political partisanship, the percentage of the year that schooling was remote, and the urbanicity of the area (e.g., Goldhaber et al., 2022; EPIC, 2021; Grossmann et al., 2021; Jack et al., 2021). For instance, in the early weeks of the pandemic, concerns arose about how the "digital divide" might disrupt schooling more dramatically in rural areas, where internet access is less available.

[1] Note that "learning loss" does not necessarily imply that individual students' raw test scores decreased over time or that they necessarily "lost" content knowledge; rather, we use the term "learning loss" to refer to the differences between students' scores and their expected scores based on historical averages and typical patterns for students in the same grade with similar prior achievement.
[2] Similarly, a McKinsey study found that students in majority-Black schools lost 6 months of learning in mathematics and reading, compared to 4 months of mathematics learning and 3 months of reading learning lost among students in majority-White schools (Dorn et al., 2021).

Students' access to the internet may have contributed to the decisions that district officials made about instructional mode (e.g., virtual, in-person, hybrid; Cameron, 2021; Dorn et al., 2021). As of February 2021, rural districts were substantially more likely to offer fully in-person instruction (49%) than were urban districts (17%; Schwartz et al., 2021). Dorn et al. (2021) found that, relative to those of their peers in rural areas, the spring 2021 test scores of students in Grades 1 through 6 in urban schools were approximately an additional month of schooling behind in both mathematics and reading by the end of the 2020–21 school year. On average, the urban students were 5 months behind in mathematics and 4 months behind in reading, whereas rural students lost 4 months of learning in mathematics and 3 months in reading.

Although the existing papers are indicative of differential average effects of the pandemic on achievement across subjects, student subgroups, and grades, there is little evidence to date on changes in the *distributions* of test achievement. Understanding how achievement has changed along the test performance distribution and whether there is heterogeneity in performance distributions across districts will be crucial for the effective targeting of academic recovery initiatives and resources to the students and districts most in need.

Fortunately, schools have substantial resources to help with academic recovery. The American Rescue Plan's Elementary and Secondary School Emergency Relief (ESSER) Fund provides public schools nearly $200 billion to get back on track, with $22 billion of this funding dedicated specifically to addressing unfinished learning using "evidence-based interventions" (Boughton et al., 2021). With evidence of such variation in the impacts of the pandemic across subjects, grades, and subgroups of students, basing decisions of policy and practice on average or median estimates of achievement declines may not be sufficiently nuanced. School districts will need to know just how far behind (and how far apart) different students are relative to a typical, prepandemic year to determine which initiatives to implement and which students to target for each initiative.

In this paper, we use NWEA data to assess student test performance during the pandemic and the heterogeneity of test performance across multiple dimensions. We replicate earlier work (Lewis & Kuhfeld, 2021) on changes in test scores for different student subgroups and grades, and we extend this work in several ways: (a) we provide analysis showing the degree to which test *performance and growth distributions* in fall 2021 have changed from prepandemic years for observationally comparable students; (b) we test whether performance and growth distributions vary across school districts, across grades, by school poverty, and for different racial subgroups of students, and (c) we present the fall 2021 achievement distributions for a coalition of large, urban and suburban districts with which we are working to evaluate COVID-19 academic recovery programs, and describe the types of programs being used and the types of students targeted for recovery.

Consistent with prior evidence, we find that students in fall 2021 were, on average, considerably farther behind what would be expected based on prior years' typical growth in test achievement. Moreover, students of color, those enrolled in higher poverty schools, and those in earlier grades tend to be even further behind, more so in mathematics than reading. More novel are our findings on the distributions of test scores across districts, schools, and prior levels of student achievement. In particular, though there is little change across years in the overall variation in test achievement that is explained at the district and school levels, there is considerable heterogeneity across school systems in terms of the relative achievement levels and gains by subject and for students along the prior achievement distribution. This suggests that targeting students accurately for pandemic-related recovery will require careful assessment by districts of where students stand academically in the 2021-22 school year (and into the future): assuming that students in a district reflect the national trends of achievement will often lead to incorrect conclusions about the degree to which they suffered pandemic-related learning losses.

2. Data and Analysis

2.1. Data Sources

The data in this study are from the Growth Research Database at NWEA. School districts partner with NWEA to administer the NWEA Measures of Academic Progress (MAP) Growth assessments. Districts typically administer MAP Growth three times per year: in the fall, winter, and spring. Districts choose the week(s) that they administer the assessment each term; in the fall terms included in our sample, more than 95% of districts reported generally testing students between the second and fifth weeks of the school year. Though some assessments were administered remotely during the pandemic, nearly all tests were completed in person at the students' schools during the four fall terms included in the present study.

The tests are computer adaptive, meaning that the difficulty of test questions increases or decreases in response to a student's performance. Relative to fixed-form (i.e., nonadaptive) tests, adaptive assessments are designed to more precisely capture achievement at the high and low ends of the achievement distribution (Kingsbury et al., 2014). Furthermore, the MAP Growth tests are vertically scaled, allowing for meaningful comparisons of scores across different grades. This feature is particularly important for measuring unfinished learning related to the pandemic because more students are scoring below grade-level expectations.

We also use student-level demographic data from the NWEA database and school-level demographic data from the National Center for Education Statistics (NCES) Common Core of Data (CCD). The NWEA data capture students' race/ethnicity and gender, and the CCD data include the percentage of students eligible for free or reduced-price lunch and urbanicity. CCD data were not yet available for the 2021–22 school year, so we assigned the most recent available 2019–20 school year values to the 2021–22 observations.

Sample

Our sample includes achievement data for Grades 3 through 8 from four terms: fall 2017, fall 2018, fall 2019, and fall 2021. When examining students' 2-year growth, we include baseline data from Grades 1 and 2 to estimate growth for students in Grades 3 and 4.[3] We restrict our sample to the set of U.S. public schools that tested at least 10 students in each of the four terms. This restriction helps prevent any observed differences in achievement across two terms from being driven by schools that tested in only one year or tested very few students in one year.

The resulting analytic sample includes more than 28 million NWEA MAP Growth mathematics and reading tests taken by more than 7 million students in more than 12 thousand schools. Means and standard deviations of students' test scores by term, grade, and subject for the terms included in the present analyses are displayed in Table A1 in Appendix A.

We report descriptive statistics for our analytic samples in Grades 3–8 in 2019–20 in Appendix Table A2. The cross-sectional achievement samples from each of the four terms include an average of 3.3 million students who tested in mathematics and 2.7 million students who tested in reading in Grades 3–8. The longitudinal mathematics and reading growth samples, respectively, include an average of 2.5 million and 2.0 million students who are in Grades 3–8 in the follow-up year.

Notably, the samples of students in the longitudinal growth samples are smaller than those in the cross-sectional achievement samples. Given that the longitudinal samples span three school years, some "missingness" is expected because students who move districts (to a district that does not use MAP Growth) would not test in the follow-up year. However, the data do not enable us to distinguish whether students who did not test in a term are missing data because they were not enrolled in the school that year or because they were enrolled and did not take the test. Consistent with Lewis and Kuhfeld's (2021) study, we found that the overall 2-year attrition rate from fall 2019 to fall 2021 was greater than the prepandemic 2-year attrition rate. Specifically, among the students who tested in the 2017 and 2019 baseline years, we observe attrition rates of 23% and 30%, respectively, in mathematics and 25% and 37% in reading in the 2019 and 2021 follow-up years. Attrition rates did not vary significantly based on students' race or their achievement in the baseline year.[4] It is unclear how the higher overall rate of attrition

---

[3] We estimate growth from fall 2017 to fall 2019 and from fall 2019 to fall 2021, so we include Grades 1 and 2 in the fall 2017 baseline sample and the fall 2019 baseline sample for the respective growth analyses.

[4] That attrition rates did not vary based on prior achievement is consistent with Lewis and Kuhfeld's (2021) findings but contrasts with other, previous research (e.g., Austin et al., 2021). One potential explanation for this finding could

between 2019 and 2021 may have affected our results; if students with lower growth were more likely to be missing a score in fall 2021 than during the prepandemic period, then our estimates could be underestimating the magnitude of the achievement losses.

Representing U.S. Public Schools

The set of schools in the analytic sample includes approximately 16% of the public schools serving students in Grades 3–8 in the United States. Appendix Table A2 provides comparisons of our sample to the CCD universe of public school students in Grades 3–8 in 2019–20. Relative to the universe of students, our samples are demographically very similar, though our sample has a smaller proportion of Hispanic students and a larger proportion of students who identify as a race other than Asian, Black, Hispanic, or White. Although the NWEA sample of students is quite large and demographically similar to the population of U.S. public school students, it is important to note that all schools and districts in the sample choose to partner with NWEA, so they are distinct from schools not included in the sample in that way.

District Partners and Academic COVID-19 Recovery Initiatives

In addition, we examine heterogeneity in fall 2021 achievement for a subset of 14 large urban and suburban school districts with which we are partnering to evaluate the various COVID-19 academic recovery programs[5] they are implementing during the 2021–22 school year. The districts participating in this consortium are located across the United States, include more than 800 thousand students, and serve higher proportions of students of color and students attending high-poverty schools relative to the average U.S. public school district. A crucial first step of this partnership was to provide information about the status of mathematics and reading achievement in fall 2021 in each district to identify the students and schools most in need of additional support. Not all the consortium districts have tested consistently across the four terms examined in the present study; thus, we use a cross-sectional sample of the consortium's fall 2021 test scores to examine heterogeneity in achievement among these districts following the pandemic. Furthermore, we use information collected through district interviews to describe the types of programs that districts are implementing and which students the programs target.

---

be that schools were more motivated than usual to test their low-achieving students in fall 2021, following the pandemic.

[5] Our study defines academic COVID-19 recovery initiatives as programs that add academic time (broadly defined) for students and are (a) new or expanded since the pandemic, (b) considered by the district to be important for students' academic recovery, and (c) supported by the American Rescue Plan's ESSER funds. Examples of these programs include academic afterschool programming, Saturday school, summer learning programs, tutoring programs, extended school days and/or years, intersessions, and virtual learning programs.

2.2. Analytic Approach

Our analysis focuses on changes in students' outcomes in two ways. The first is to look at how students' achievement levels in fall 2021 compare to those during the three prior prepandemic falls (2017, 2018, and 2019). By using multiple periods prior to the onset of the pandemic, we can examine whether there were preexisting trends in distributional changes in achievement in the years preceding the pandemic. For this analysis, we convert the NWEA MAP Growth test scores into standardized scores that are more interpretable and can be compared to other standardized test score outcomes. For our purposes, we normalize these scores using the mean and standard deviation of fall 2019, the last fall testing period unaffected by the pandemic.

Our second set of analyses examines students' 2-year academic growth over the course of the pandemic, from fall 2019 to fall 2021, relative to their expected 2-year growth. More specifically, we estimate expected 2-year growth on the MAP Growth assessment across the distribution of achievement using the prepandemic, 2-year change in students' scores from fall 2017 to fall 2019. This analysis enables us to show the extent to which growth was atypical during the pandemic period, and for whom.

We present these distributional achievement and growth analyses for our national sample, as well as subgroups of that sample by student race/ethnicity, school poverty, and school urbanicity, and the intersection of these groups. We also present the distribution of our consortium districts' fall 2021 test scores and describe their ongoing COVID-19 recovery initiatives and which students they are targeting using a random effects framework.

Analysis 1. Compare Baseline Achievement Across Fall 2017, 2018, 2019, and 2021

To examine heterogeneity in the distribution of students' achievement following the pandemic, we compare cross-sections of students' mathematics and reading scores across schools in fall 2017, 2018, 2019, and 2021. Because the date that students take the MAP Growth assessment during the fall term varies across schools and years, we need to account for differences across students in the amount of school they had between their first day of school and the date of their fall test to compare scores across the fall testing windows. We use a regression adjustment to standardize students' MAP Growth scale scores accounting for the testing windows. We also use this regression adjustment to norm scores around the fall 2019 distribution, so we can examine how the *distribution* of achievement each year varied from the fall 2019 baseline. We start with a simple regression of a student's fall 2019 score (separately for each grade and subject) regressed on the date of the student's assessment centered on the mean for the fall 2019 term:

$$RIT_{i,2019} = \alpha + \beta_{2019} * \left(Date_{i,2019} - \overline{Date}_{2019}\right) + \varepsilon_{i,2019}, \quad (1)$$

where $RIT_{i,2019}$ is the fall mathematics or reading score for student *i* in fall 2019, and $\left(Date_{i,2019} - \overline{Date}_{2019}\right)$ is the date of assessment for student *i* centered on the term average. We then store the estimated regression coefficients $\hat{\alpha}_{2019}$ and $\hat{\beta}_{2019}$ and apply them to other school years (i.e., fall 2017, 2018, and 2021) to generate a measure of fall achievement adjusted for when the test was administered during the school year:

$$\hat{\varepsilon}_{it} = RIT_{it} - \left(\hat{\alpha}_{2019} + \hat{\beta}_{2019} * (Date_{it} - \overline{Date}_t)\right). \quad (2)$$

Finally, we standardize the adjusted fall scores by the root-mean-square error (RMSE) from Equation 1 and use the following adjusted scores in our analyses:

$$Y_{it} = \frac{\hat{\varepsilon}_{it}}{\sqrt{\frac{1}{n}\sum_{i=1}^{n}\left(\hat{\varepsilon}_{i,2019}\right)^2}}. \quad (3)$$

There are two advantages to standardizing each year of achievement data using the fall 2019 distribution. The first is that fall 2019 was the most recent prepandemic fall testing period for students, so the distribution of students provides the best chronological counterfactual for what the distribution of achievement might have been in fall 2021 if the pandemic had not happened. Second, it allows us to compare the distributions of each of the fall terms in the sample all on a common scale.

We use this standardized measure of achievement to compare the distribution of fall achievement using kernel density plots. We also compare the median test score for student subgroups (race/ethnicity) and school poverty (low, medium, and high), and the intersection of these two.

Finally, we estimate the share of the variance in test scores that occurs across districts and within districts across schools. We do so by running two simple, ordinary least squares (OLS) regressions separately by grade, subject, and fall term:

$$Y_{it} = \alpha_0 + \tau_d + e_{it}, \quad (4)$$

where Y_{it} is the standardized achievement for student *i* in time *t*, τ_d is a vector of district fixed-effects, and e_{it} is an idiosyncratic error term. We store the R_d^2 from this regression and repeat the exercise using school rather than district fixed-effects, and store the R_s^2. We document the share of the variation in Y_{it} due to between-district factors as R_d^2, the share of the variation in Y_{it} due to within-district, across-school factors as $R_s^2 - R_d^2$, and the share of unexplained variation as $1 - R_s^2$.

Analysis 2. Heterogeneity in Student Growth Rates (Visual Analysis)

To examine heterogeneity in the distribution of academic growth during the pandemic to that of prepandemic growth, we focus on students tested in fall 2019 and fall 2021 (pandemic cohort) and compare them to students tested in fall 2017 and fall 2019 (prepandemic cohort). To do so we first generate their expected growth using the prepandemic cohort of students, estimated separately by grade and subject:

$$Y_{isd,2019} = \alpha_0 + \beta * f\left(Y_{isd,2017}\right) + \varepsilon_{isd,2019}, \quad (5)$$

where $Y_{isd,2019}$ is the standardized mathematics or reading achievement for student *i* in school *s* and district *d* in fall 2019, $f(Y_{isd,2017})$ is a cubic of twice-lagged standardized achievement in mathematics or reading, and $\varepsilon_{isd,2019}$ is an idiosyncratic error term. We store these regression coefficients to generate out-of-sample projected fall 2021 growth estimates for the pandemic cohort:

$$\tilde{Y}_{isd,2021} = \hat{\alpha}_0 + \hat{\beta} * f(Y_{isd,2019}), \quad (6)$$

where $\tilde{Y}_{isd,2021}$ is the predicted fall 2021 achievement for student *i* based on the parameters of the relationship between baseline achievement and achievement 2 years later for the prepandemic cohort.

We also estimate Model 5 using fall 2021 as the current year and fall 2019 as the twice-lagged year and similarly estimate students' projected test scores:

$$\hat{Y}_{isd,2021} = \gamma_0 + \delta * f(Y_{isd,2019}) + \eta_{isd,2021}, \quad (7)$$

where $\hat{Y}_{isd,2021}$ is the standardized mathematics or reading achievement for student *i* in school *s* and district *d* in fall 2021, $f(Y_{isd,2019})$ is a cubic of twice-lagged standardized achievement in mathematics or reading, and $\eta_{id,2021}$is an idiosyncratic error term. We store these regression coefficients to generate the fall 2021 growth estimates for the pandemic cohort:

$$\hat{Y}_{isd,2021} = \hat{\gamma}_0 + \hat{\delta} * f(Y_{isd,2019}), \quad (8)$$

where $\hat{Y}_{isd,2021}$ is the predicted fall 2021 achievement for student *i* based on the parameters of the relationship between baseline achievement and achievement 2 years later for the pandemic cohort.

To reiterate, $\tilde{Y}_{isd,2021}$ captures students' predicted growth in fall 2021 (conditional on fall 2019 achievement) assuming they grew at the same rate as the most recent prepandemic cohort, and $\hat{Y}_{isd,2021}$ captures students' predicted growth in fall 2021 (conditional on fall 2019 achievement) using actual pandemic growth rates.

We extend this analysis by looking for differential growth by student race/ethnicity, school poverty, and the intersection of these two demographic characteristics. We examine these differences by separately estimating the growth models by subgroup, grade, and subject.

Our final analysis examines the heterogeneity in achievement growth across the districts in our sample. We extend Model 6 to include district random effects and coefficients:

$$Y_{isd,2019} = \alpha_0 + \beta * f(Y_{isd,2017}) + f(Y_{isd,2017}) * \tau_{dk} + \tau_{d0} + e_{isd,2019}. \quad (9)$$

In Model 9, τ_{d0} represents the random effects (or intercepts) for each of the districts in our sample, and τ_{dk} represents the random components of the relationship between prior achievement $f(Y_{isd,2017})$ and current achievement $Y_{isd,2019}$ that vary across districts. We then repeat the exercise of estimating students' expected and observed growth (e.g., Model 7) with the addition of these random components, and use the estimated regression coefficients and random components (i.e., Best Linear Unbiased Predictors of district-specific components to student achievement growth):[6]

$$\tilde{Y}_{isd,2021} = \hat{\alpha}_0 + \hat{\beta} * f(Y_{isd,2017}) + f(Y_{isd,2017}) * \hat{\tau}_{dk} + \hat{\tau}_{d0} \quad (10a)$$
$$\hat{Y}_{isd,2021} = \hat{\gamma}_0 + \hat{\delta} * f(Y_{isd,2017}) + f(Y_{isd,2017}) * \hat{\varphi}_{dk} + \hat{\varphi}_{d0} \quad (10b).$$

To characterize the difference in growth rates from fall 2019 to fall 2021 using the cohort's actual growth rate compared to the prepandemic growth rate for each district, we calculate the median predicted fall 2021 achievement for each assumed growth rate (i.e., $median_d(\hat{Y}_{isd,2021})$ and $median_d(\tilde{Y}_{isd,2021})$) and then plot the difference between these two medians for each district in a scatter plot.

3. Results

3.1. *Student Achievement Levels: Overall and Decomposition of Variance*

We first report simple kernel density plots documenting the distribution of student achievement across Grades 3–8 in mathematics and reading in fall 2017, 2018, 2019, and 2021. These figures are all normalized relative to the 2019 mean and standard deviation of the test distributions in each subject area; thus, they illustrate the extent to which the distributions in achievement have shifted relative to the 2019 anchor year.

As is readily apparent from visual inspection of **Figures 1** (elementary grades) and **2** (middle school grades), we report the prepandemic distributions in math and reading test scores differ very little prior to the pandemic, but there is a large shift to the left—the medians decrease by roughly 0.20 SD in mathematics and 0.10 SD in reading—in 2021. In Appendix A (Figures A1–A6), we show similar figures separately by grade; there is clear evidence that the pandemic had a disproportionate impact on the early grades.

We further show the changes in achievement across the fall terms in Tables 1 and 2. In these tables we report the 10th, 25th, 50th, 75th, and 90th percentiles for test achievement in fall of each year. These tables help expand our understanding of the impact of the pandemic on students' achievement across the distribution. For example, the difference in the 10th percentile for Grade 3 mathematics is on the order of 0.25 SD between the pandemic cohort of 2021 compared to the prior three falls, but only approximately 0.06 SD at the 90th percentile of achievement. All these figures are in line with research findings on pandemic-related learning

[6] Our best linear unbiased predictions are equivalent to Empirical Bayes estimates of districts' contribution to student achievement growth, see Rabe-Hesketh and Skrondal (2012).

loss[7] reported elsewhere using different data sources or metrics for measuring student achievement using test scores (e.g., Dorn et al., 2021; EPIC, 2021; Kogan & Lavertu, 2021; Lewis & Kuhfeld, 2021).

One way to put the magnitudes of these changes in context is to compare them to changes in student achievement associated with Hurricanes Katrina and Rita in Louisiana. As Sacerdote (2012) reports, students who were displaced by the hurricanes experienced declines in test scores of between 0.07 and 0.20 standard deviations in achievement. In other words, the changes we observe from the NWEA national data are of the same order of magnitude (indeed larger) to what has been considered large negative impacts associated with hurricane-related disruptions.

To better assess how the pandemic may have affected the distribution of achievement, we decompose the variance of student mathematics and reading test score test achievement levels in each of the fall terms included in this study. Separately by grade, **Figures 3** (for math) and **4** (for reading) show the variance decomposition in test score levels across school districts and within districts between schools. Perhaps surprisingly, the decompositions for mathematics and reading achievement do not show differences between the prepandemic terms and the pandemic-affected term in the share of variance explained by schools within districts, but they do show a notable increase in the share of variance explained by districts. As has been well-documented, districts responded to the pandemic differently in terms of instructional modality and student requirements and learning expectations.[8] Indeed, the increase we observe in the share of variance in achievement explained across districts aligns with evidence that the percentage of the school year a district operated remotely was negatively related to students' growth during the pandemic (Goldhaber et al., 2022; EPIC, 2021; Grossmann et al., 2021; Jack et al., 2021).

In **Figures 5** (for math) and **6** (for reading), we report on student achievement across five ethnoracial categories (Asian, Black, Hispanic, Other, and White) by grade in fall 2017, 2018, 2019, and 2021. The bars represent median standardized mathematics and reading scores normed using the 2019 distribution. As is readily apparent, median achievement in both mathematics and reading tends to be lower in each grade in fall 2021 than in all prior years for all student subgroups (the exception is Asian students in Grades 7 and 8 in reading). But the degree to which we see lower achievement in fall 2021 varies substantially by group. In mathematics, for

---

[7] Note that we use the term "learning loss" as a shorthand to indicate changes in the levels or growth of typical test achievement associated with the pandemic (not necessarily to indicate that any individual student's test achievement or growth was lower than it had been in prior years).

[8] In particular, decisions about modality have differed substantially by district urbanicity, with rural districts tending to offer in-person learning more often than urban districts (Schwartz et al., 2021). The timing and frequency of school closures have also varied regionally with changes in local public health conditions (Miller & Sanger-Katz, 2022). In addition, some schools have adjusted learning expectations and graduation requirements in response to the pandemic. These adjustments include allowing pass/fail marks in place of letter grades, expanding options for students to recover credit for failed courses, promoting students to the next grade regardless of their performance, and lowering the GPA requirement for high school graduation (King 5 Staff, 2021; Taylor & Nierenberg, 2021).

instance, where the effects are larger, the drop in median achievement is between 0.17 and 0.23 SD (depending on grade) for White students, but it is far larger for Black (0.25 to 0.40 SD) and Hispanic (0.25 to 0.40 SD) students.

The differences between the bars across student subgroups represent the achievement gaps by race and ethnicity. The achievement gaps were large in the prepandemic years—in the range of 0.44 to 0.78 SD between underrepresented minority students and White and Asian students in mathematics, depending on the grade, and 0.50 to 0.68 SD in reading. These gaps grew substantially in fall 2021 to 0.57 to 0.93 SD in mathematics and 0.51 to 0.70 SD in reading.

In **Figures 7** (for math) and **8** (for reading), we extend this analysis to compare median achievement by school poverty, grouping schools into either high, middle, or low poverty.[9] The figures show large preexisting gaps in mathematics and reading achievement among these schools prior to the pandemic. For example, in fall 2019, the median achievement of high-poverty schools was 0.32 to 0.46 SD below the average, whereas that of mid-poverty schools was approximately .04 to 0.10 SD above the average and that of low-poverty schools was approximately 0.49 to .57 SD above the average. We see a similar trend in reading.

The disproportionately large impact of the pandemic on schools serving high-poverty students is readily apparent, with median achievement across grades for high-poverty schools decreasing to 0.70 to 0.79 SD below the fall 2019 average for mathematics, and to 0.44 to 0.65 SD below the fall 2019 average for reading. Median achievement also declined for students in mid- and low-poverty schools in fall 2021, but the drops were less dramatic.

In **Figures 9** (for math) and **10** (for reading), we look at achievement trends across school urbanicity, grouping schools into city, rural, suburban, and town schools using CCD designations. We again see preexisting differences across groups, though with small differences among the four types of schools. Schools in rural and suburban areas had similar mathematics and reading achievement levels, approximately 0.20 SD above the 2019 average in mathematics and reading. Schools in towns had achievement levels in mathematics and reading close to the 2019 average, and city schools had median achievement levels in mathematics and reading just below the 2019 average.

Particularly for elementary grades, the pandemic hit the schools located in cities harder than in the other three locations. City schools' median mathematics achievement in elementary school, for example, dropped from approximately 0.02 to .10 SD below the 2019 mean in prepandemic years to 0.38 SD below the mean (a change of 0.33 SD) in fall 2021. Elementary grades in other

---

[9] A school is classified as low poverty if less than 25% of the students are eligible for free or reduced-price lunch. Mid-poverty schools are those in which 25%–75% of students are eligible. In high-poverty schools, more than 75% of students are eligible.

geographic locations also had declines in their median mathematics achievement, but to a lesser extent of about 0.22 to 0.20 SD.

Finally, we look at the distributional differences in achievement levels by subgroup in **Figures 11-14** —for parsimony, we focus on the differences between Black students and the national sample and differences between students in high- and low-poverty schools, and we report the differences for other groups in Appendix A. Each figure shows mathematics outcomes in the top two graphs and reading outcomes in the bottom two graphs, with elementary grades in the first column and middle school grades in the second column. The *y* axis shows students' achievement-level percentiles based on the fall 2019 distribution, which we refer to as the *reference* percentile. The *x* axis shows the students' achievement percentiles relative to the group-grade-year-subject distribution (e.g., Black students in mathematics, Grade 3, and fall 2021), which we refer to as the *relative* percentile. We then plot the relationship between the reference percentile and the relative percentile for students' fall 2019 and fall 2021 achievement.

In **Figure 11**, we use the *relative* achievement for Black elementary school students to show how their achievement levels changed between fall 2019 and fall 2021 on the *reference* distribution, and how this compares to the fall 2019 and fall 2021 change for the national sample; **Figure 12** shows the same comparison for Black middle school students. A few key points stick out. There were large preexisting achievement differences between Black students and the national sample prior to the pandemic. For example, Black students at the 40th percentile of the relative distribution (i.e., their group-grade-year) for elementary school mathematics had a reference percentile of 26 compared to the national sample with a reference percentile of 44, a gap of 18 percentile points. Similar gaps existed across the relative distribution (we provide numbers for the 20th, 40th, 60th, and 80th percentiles). Further, we see those Black students at the 60th percentile of their relative distribution had the same reference percentile (44th percentile) as the national sample's 40th percentile of the relative distribution.

The figure also documents how the pandemic differentially impacted Black students relative to the national sample and how that differential varies across their relative distributions. Again in elementary school mathematics, Black students at the 40th percentile of the relative distribution fell from the 26th percentile in the reference distribution in fall 2019 to the 15th percentile in fall 2021. The national sample experienced a drop of 12 percentile points (from the 44th percentile to the 32nd percentile). Further, the impact of the pandemic on students' elementary mathematics achievement started to taper off by the 80th percentile of the national sample but had a larger impact on Black students at their 80th percentile. In the national sample, students at the 80th percentile in the relative distribution only dropped 4 percentile points in the reference distribution, compared to 12 percentile points for Black students at the 80th percentile of the relative distribution.

In **Figure 13** we show a similar analysis comparing elementary school students in high- versus low-poverty schools; the analysis is repeated for middle school students in **Figure 14**. Again, there were large preexisting achievement differences between students in high- and low-poverty schools. Students in high-poverty schools at the 40th percentile of their relative distribution had a median percentile of 28 on the reference distribution compared to the 62nd percentile for students in low-poverty schools, a gap of 34 percentile points. At the same relative location in 2021, students in high-poverty schools dropped to the 15th percentile in the reference distribution, and students in low-poverty schools only dropped 6 percentile points to the 56th percentile. At the high end of the distribution (i.e., 80th percentile of the relative distribution), students in low-poverty schools only dropped 3 percentile points, from the 88th percentile in the reference distribution to the 85th percentile. However, not only did students in high-poverty schools score 23 percentile points lower than their peers in low-poverty schools prior to the pandemic, this gap widened to 32 percentile points during the pandemic.

3.2. Student Achievement Growth by Student Subgroup, Prior Achievement, and School Type

The preceding findings show clear evidence of declines in student achievement *levels* in the pandemic and are consistent with previous findings (e.g., Dorn et al., 2021; EPIC, 2021). These findings are particularly pronounced for historically disadvantaged students. Thus, in this subsection, we focus on measures of test achievement *growth*, exploring heterogeneity in growth across student subgroups, prior achievement levels, and school types.

In **Figures 15 and 16** we use Equations 6 and 8 to show how *growth* varies across years by grade level (elementary grades in **Figure 15** and middle grades in **Figure 16**) and students' baseline achievement (i.e., fall 2019). The dashed line represents students' average predicted fall 2021 mathematics or reading achievement conditional on their fall 2019 achievement (*x* axis), assuming students progressed at the same rate as the most recent prepandemic cohort. The solid line shows the predicted fall 2021 mathematics or reading achievement conditional on their fall 2019 achievement (*x* axis) using students' actual growth rates during the pandemic. If the pandemic slowed students' achievement growth, then the solid line will be below the dashed line, and vice versa. As expected, based on the results of the achievement levels presented in Section 3.1, student achievement growth slowed during the pandemic, especially in mathematics for students in elementary grades. For example, elementary mathematics students with baseline scores 1 to 2 standard deviations below the mean of fall 2019 mathematics achievement had fall 2021 test scores that were 0.36 SD and 0.42 SD below their prepandemic peers. And though the decline in growth was smaller at the top of the distribution, even students with baseline scores 2 SDs above the mean of fall 2019 had fall 2021 scores that were 0.16 SD lower than those of their prepandemic peers.

In our next analysis, we estimate Models 5 and 7 separately by student race, school poverty, and school urbanicity and generate the median predicted growth for the pandemic cohort using actual pandemic growth rates (i.e., median ($\hat{Y}_{isd,2021}$)) and the median predicted growth for the pandemic cohort using prepandemic growth rates (i.e., median ($\tilde{Y}_{isd,2021}$)) for each subject, grade, and subgroup. In **Figures 17–27** we then plot the difference between these two medians (i.e., median ($\tilde{Y}_{isd,2021}$) − median ($\hat{Y}_{isd,2021}$)).[10] A negative value indicates that, for a given subgroup, subject, and grade, the pandemic cohort experience slower achievement growth than their prepandemic peers.

Gains are lower across the board for the pandemic cohort, but as was the case for the analyses of levels of student achievement (in Section 3.1), Black and Hispanic students, students in the early grades, and students in high-poverty schools and urban/city schools are especially far behind where they would be projected to be compared to prepandemic growth trends.

3.3. Heterogeneity by District Along the Prior Performance Distribution

The preceding subsection documents the extent to which test achievement growth varies by student subgroup, prior test achievement, and school type. In this subsection, we focus on the extent to which there is heterogeneity in those findings across districts. This analysis is important given that districts may want to target students for academic COVID-19 recovery support. If there is significant heterogeneity across districts, the assumption that local distributions closely mirror the national distribution would be misleading and might thus lead to inaccurate targeting of student needs.

In **Figure 28**, we show the predicted fall 2021 test scores of students in elementary grades, conditional on fall 2019 test scores (the *x* axis), based on prepandemic parameter estimates, juxtaposed against fall 2021 test scores conditional on fall 2019 test scores (the *y* axis), based on pandemic parameter estimates; **Figure 29** shows the same analysis for students in middle grades. As is readily apparent, the majority of districts in the sample fall below the 45-degree line, indicating that median student achievement is below what would be expected given prepandemic growth rates. But note also the significant heterogeneity that exists in the sample of districts. For example, for elementary mathematics, although 88.5% of districts are below the 45-degree line, a number of districts, 11.5%, are above the line, indicating that median pandemic test achievement levels exceeded what would have been predicted based on prepandemic expectations.[11]

[10] See Equation 6 for more information about how these figures are derived.
[11] Note that the district estimates should not be interpreted as the causal impact of schools in each district on student achievement because both in-school and outside-of-school factors could have affected the achievement of students enrolled in each district.

In **Figures 30 and 31** we show the kernel density distributions for the districts' differences in their median growth rates (the points in the scatter plot in Figures 28 and 29), for elementary and middle school, in mathematics and reading. These results reaffirm the importance of considering heterogeneity in achievement across districts because the standard deviations of these differences are all about 0.16 standard deviation.

3.4. Achievement Heterogeneity and Academic COVID-19 Recovery Initiatives in Partnership Districts

Academic COVID-19 Recovery Initiatives

The types of academic recovery initiatives, their subject area foci, and range of grades served by the initiatives in the consortium districts are presented in Table 3. Across the consortium, seven categories of academic recovery initiatives emerged in fall 2021: (a) summer learning, (b) tutoring, (c) push-in and pull-out interventions, (d) extended school years and intersessions, (e) out-of-school time programming (after school, before school, and Saturdays), (f) additional instructional blocks (i.e., "double-dosing"), and (g) virtual learning programs. Whereas summer learning programs were ubiquitous, all other types of programs were being implemented in only some of the districts, demonstrating the variation in districts' approaches. As a whole, the consortium focuses approximately equally on mathematics and literacy initiatives and serves students across Grades K–8 for most types of initiatives. However, substantial variation exists in the subjects and grades served between districts as well as within districts between initiatives because many districts will target one initiative for a specific grade or set of grades and subject while offering another initiative to all students.

Although some similarities in programming exist across the districts, districts vary widely in the students and schools they target and in other key features of the implementation of their initiatives. The students or schools targeted for an initiative more consistently vary by the type of the initiative: Most push-in and pull-out intervention times and tutoring primarily serve students who are performing below a district-determined threshold; most extended school years, intersessions, and additional instructional blocks serve low-performing schools; and summer learning is generally open to all students, with priority given to disadvantaged and low-performing students. Virtual learning is targeted inconsistently across districts, occasionally used with all students in a grade range, or used as an intervention support for struggling students. Other key characteristics of the initiatives that vary within and across districts include the intended frequency and duration (i.e., "dose"), student–teacher ratio, provider type and qualifications, mode of instruction (i.e., remote vs. in-person) and location of delivery, and time of day.

Beyond the specific features of the initiatives, variation also occurred in districts' timelines for beginning programming, the barriers and successes they faced in implementing their initiatives, and their state's requirements and recommendations regarding their academic recovery strategies. For example, some districts will not begin some of their programming until spring 2021 or fall 2022; some districts will not serve all the students they intended to serve because of unexpected staffing shortages or transportation issues; and some districts have prescriptive state requirements for their programming, whereas others have near-complete autonomy about the initiatives they choose to invest in. Understanding the heterogeneity in districts' initiatives and implementations, along with the related (or unrelated) heterogeneity in districts' baseline achievement in fall 2021, will be essential for interpreting the efficacy of each initiative and for forming broader recommendations about recovery strategies.

4. Discussion and Conclusions

The descriptive evidence we provide is consistent with the now mountain of research showing that the pandemic had profound negative impacts on student test achievement, particularly for students of color and those in high-poverty schools. The magnitudes of the changes in test levels and growth are staggering—the learning losses suffered across the country are of the same order of magnitude as what has only been documented in the case of hurricanes that disrupted schooling in Louisiana.

The academic recovery needs are clearly widespread and daunting, but research on academic recovery of students in Louisiana shows that large learning losses can be ameliorated over time. Harris and Larsen (2022), for instance, found that post-Katrina school reforms in New Orleans led to big improvements in test scores, high school graduation rates, and college attendance and graduation rates.[12] And the findings were particularly positive for low-income and Black students; hence, achievement gaps were reduced. Although one cannot definitely rule out non-schooling interventions as an explanation for the student achievement gains, the authors concluded that school reforms were the main mechanism for the student gains.

Importantly, however, there was major reform of New Orleans's schools (including increases in spending of nearly $1,400 per pupil relative to comparison districts in Louisiana). What would it take to see this type of recovery across the country? One way to quantify the magnitude of the effort needed would be to convert the learning losses measured in standard deviations into lost instructional weeks (using the NWEA prepandemic norms) and then ask how much of a district's budget would typically be spent over such a period (e.g., 10 weeks of lost learning would

[12] Test scores are estimated to have increased by 0.40–0.47 SDs, high school graduation by 9–13 percentage points, college attendance by 7–11 percentage points, and college completion by 2–3 percentage points.

represent 25% of a typical school year budget, assuming that district expenditures on teacher salaries are allocated over 40 calendar weeks).[13]

The above conversion will likely underestimate the cost because the marginal cost per unit increase in achievement is likely to be higher from extending the school year, lengthening the school day, or adding tutors. In Goldhaber et al. (2022), we estimate that the learning losses represented roughly 40% of a school year in districts with above-average poverty that spent more than half of the year in 2020–21 remote or hybrid. Those districts that were remote or hybrid received about the same share of a year's budget in federal aid—implying that the average district in that group would have to spend essentially *all of the federal aid* on academic recovery to catch up.[14]

Between January and March of 2022, the federal Institute of Education Sciences collected data on the achievement of a large national sample of students in 4th and 8th grade mathematics and reading. Commonly known as the "Nation's Report Card", the Main National Assessment of Educational Progress (NAEP) has been conducted regularly since 1990 and, when the results are released in the fall, it will be the first set of results on the NAEP since the pandemic began. Our results imply that we should be expecting large declines in achievement in mathematics and reading for Grades 4 and 8, as well as sharp increases in achievement gaps by race and ethnicity. Given that gaps in achievement by race and ethnicity have been slowly but steadily declining over the past 30 years, our findings imply a reversal in that trend, and the largest increase in educational inequity test achievement in a generation.

Nevertheless, students (and their teachers) are resilient, and districts have federal funds to pay for academic recovery efforts. As noted above, student achievement for Louisiana students who were evacuated following Hurricane Katrina recovered their losses within two years. As part of the Road to Recovery project, we will be monitoring the pace of progress, starting with analyzing growth from fall 2021 to winter 2022. District partners should start with a plan that is commensurate with the losses observed as of fall of 2021, which are documented in this paper. If student achievement is improving at a rate faster (or slower) than predicted by pre-pandemic growth norms, districts will be able to scale up or scale down their recovery plans accordingly.

[13] You can use the NWEA MAP Growth norms to estimate the test score gains per week of instruction (Thum & Kuhfeld, 2020). See Goldhaber et al. (2022) as an example application of this approach.

[14] One surprising finding from Goldhaber et al. (2022) is that the vast majority of the widening gap in achievement by race and baseline achievement was due to between-school differences in the magnitude of achievement losses, rather than within-school differences. In other words, the achievement of Black and Hispanic and students with lower baseline scores fell more than other students between the schools they attended were disproportionately affected during the pandemic. If school districts aim to reduce achievement gaps—whether pre-existing or due to the pandemic—leaders should be targeting lowering-achieving subgroups within and between schools. However, if their goal is to eliminate pandemic-related achievement losses, districts should consider targeting all students in schools that were hardest hit (i.e., the schools with the largest declines in achievement) rather than subgroups of students within schools.

Given that the federal aid must be committed by the end of calendar year 2024 (just two full school years from now), it will be easier to scale back than the scale up recovery efforts.

References

Amplify Education. (2021, February). *COVID-19 means more students not learning to read.* https://amplify.com/wp-content/uploads/2021/02/Amplify-mCLASS_MOY-COVID-Learning-Loss-Research-Brief_022421.pdf

Austin, W., Figlio, D., Goldhaber, D., Hanushek, E. A., Kilbride, T., Koedel, C., Lee, J. S., Lou, J., Özek, U., Parsons, E., Rivkin, S. G., Sass, T. R., & Strunk, K. O. (2021, August). *Academic mobility in U.S. public schools: Evidence from nearly 3 million students* (Working Paper No. 227-0220-2). CALDER. https://caldercenter.org/sites/default/files/CALDER%20WP%20227-0220-2.pdf

Bacher-Hicks, A., Goodman, J., & Mulhern, C. (2020, July 15). *What Google search data reveal about learning during the pandemic*. Education Next. https://www.educationnext.org/google-search-data-reveals-about-learning-pandemic/

Boughton, H., De Barros, J., Goldhaber, D., Payne, S., & Schwartz, N. (2021, September 22). *A once-in-a-generation opportunity: What states and school districts can learn from the American Rescue Plan*. The 74. https://www.the74million.org/article/a-once-in-a-generation-opportunity-what-states-and-school-districts-can-learn-from-the-american-rescue-plan/

Cameron, P. (2021, January 21). *Rural schools have battled bad internet, low attendance and academic decline through the pandemic. Now the push is on to return students to classrooms—safely.* The 74. https://www.the74million.org/article/rural-schools-have-battled-bad-internet-low-attendance-and-academic-decline-through-the-pandemic-now-the-push-is-on-to-return-students-to-classrooms-safely/

Curriculum Associates. (2021, June). *Academic achievement at the end of the 2020–2021 school year: Insights after more than a year of disrupted teaching and learning.* https://www.curriculumassociates.com/-/media/mainsite/files/i-ready/iready-understanding-student-needs-paper-spring-results-2021.pdf

Darling-Aduana, J., Woodyard, H. T., Sass, T. R., & Barry, S. S. (2022, January). *Learning-mode choice, student engagement, and achievement growth during the COVID-19 pandemic* (Working Paper No. 260-0122). CALDER. https://caldercenter.org/sites/default/files/CALDER%20WP%20260-0122.pdf

Dorn, E., Hancock, B., & Sarakatsannis, J. (2021, July 27). *COVID-19 and education: The lingering effects of unfinished learning*. McKinsey & Company. https://www.mckinsey.com/industries/education/our-insights/covid-19-and-education-the-lingering-effects-of-unfinished-learning

Education Policy Innovation Collaborative (EPIC). (2021, December). *K–8 student achievement and achievement gaps on Michigan's 2020–21 benchmark and summative assessments*. https://epicedpolicy.org/wp-content/uploads/2022/01/EPIC_BenchmarkII_Rptv1_Dec2021.pdf

Goldhaber, D., Kane, T., McEachin, A., Morton, E., Patterson, T., & Staiger, D. (2022). *The Consequences of Remote and Hybrid Instruction During the Pandemic.* CALDER Working Paper No. 267-0522. https://caldercenter.org/publications/consequences-remote-and-hybrid-instruction-during-pandemic

Grossmann, M., Reckhow, S., Strunk, K., & Turner, M. (2021). *All states close but red districts reopen: The politics of in-person schooling during the COVID-19 pandemic* (EdWorkingPaper: 21-355). Annenberg Institute at Brown University. https://doi.org/10.26300/cb1f-hq66

Harris, D., & Larsen, M. F. (2022). Taken by storm: The effects of Hurricane Katrina on medium-term student outcomes in New Orleans. *Journal of Human Resources*, *57*(3). http://jhr.uwpress.org/content/early/2022/03/31/jhr.58.5.0819-10367R2

Jack, R., Halloran, C., Okun, J., & Oster, E. (2021, December). *Pandemic schooling mode and student test scores: Evidence from U.S. school districts*. https://emilyoster.net/wp-content/uploads/MS_for_Submission.pdf

King 5 Staff. (2021, March 12). *High school seniors can waive certain graduation requirements during pandemic*. King 5. Retrieved from https://www.king5.com/article/news/education/high-school-seniors-graduation-requirements-waivers-covid-19-pandemic/281-6f712c47-3880-4360-9c9f-0154a3cca342

Kingsbury, G. G., Nesterak, M., & Freeman, E. (2014, March). The potential of adaptive assessment. *Education Leadership*, *71*(6). https://www.nwea.org/research/publication/the-potential-of-adaptive-assessment/

Kogan, V., & Lavertu, S. (2021). *The COVID-19 pandemic and student achievement on Ohio's third-grade English language arts assessment.* http://glenn.osu.edu/educational-governance/reports/reports-attributes/ODE_ThirdGradeELA_KL_1-27-2021.pdf

Lewis, K., & Kuhfeld, M. (2021, December). *Learning during COVID-19: An update on student achievement and growth at the start of the 2021–22 school year.* Northwest Evaluation Association (NWEA). https://www.nwea.org/content/uploads/2021/12/Learning-during-COVID19-An-update-on-student-achivement-and-growth-at-the-start-of-the-2021-2022-school-year-Research-Brief.pdf

Lewis, K., Kuhfeld, M., Ruzek, E., & McEachin, A. (2021, July). *Learning during COVID-19: Reading and math achievement in the 2020–21 school year*. Northwest Evaluation Association (NWEA). https://www.nwea.org/content/uploads/2021/07/Learning-during-COVID-19-Reading-and-math-achievement-in-the-2020-2021-school-year.research-brief-1.pdf

Miller, C. C., & Sanger-Katz, M. (2022, February 28). School is back in person, but the five-day school week often isn't. *The New York Times.* https://www.nytimes.com/2022/02/28/upshot/schools-covid-closings.html

Rabe-Hesketh, S., & Skrondal, A. (2012). *Multilevel and longitudinal modeling using Stata, fourth edition*. Stata Press. https://www.stata.com/bookstore/multilevel-longitudinal-modeling-stata/

Sacerdote, B. (2012). When the saints go marching out: Long-term outcomes for student evacuees from Hurricanes Katrina and Rita. *American Economic Journal: Applied Economics*, *4*(1), 109–135. https://doi.org/10.1257/app.4.1.109

Schwartz, H. L., Diliberti, M. K., Berdie, L., Grant, D., Hunter, G. P., & Messan Setodji, C. (2021). *Urban and rural districts showed a strong divide during the COVID-19 pandemic: Results from the second American School District Panel Survey*. RAND Corporation. https://www.rand.org/pubs/research_reports/RRA956-2.html

Taylor, K., & Nierenberg, A. (2021, May 27). Should every student move up to the next grade? *The New York Times.* https://www.nytimes.com/2021/05/26/us/covid-grade-promotion.html

Thum, Y. M., Kuhfeld, M. (2020). NWEA 2020 MAP growth norms for student and school achievement status and growth. NWEA.

Figures

Figure 1: Distribution of Math and Reading Test Scores for Elementary Grades (2017-2021)

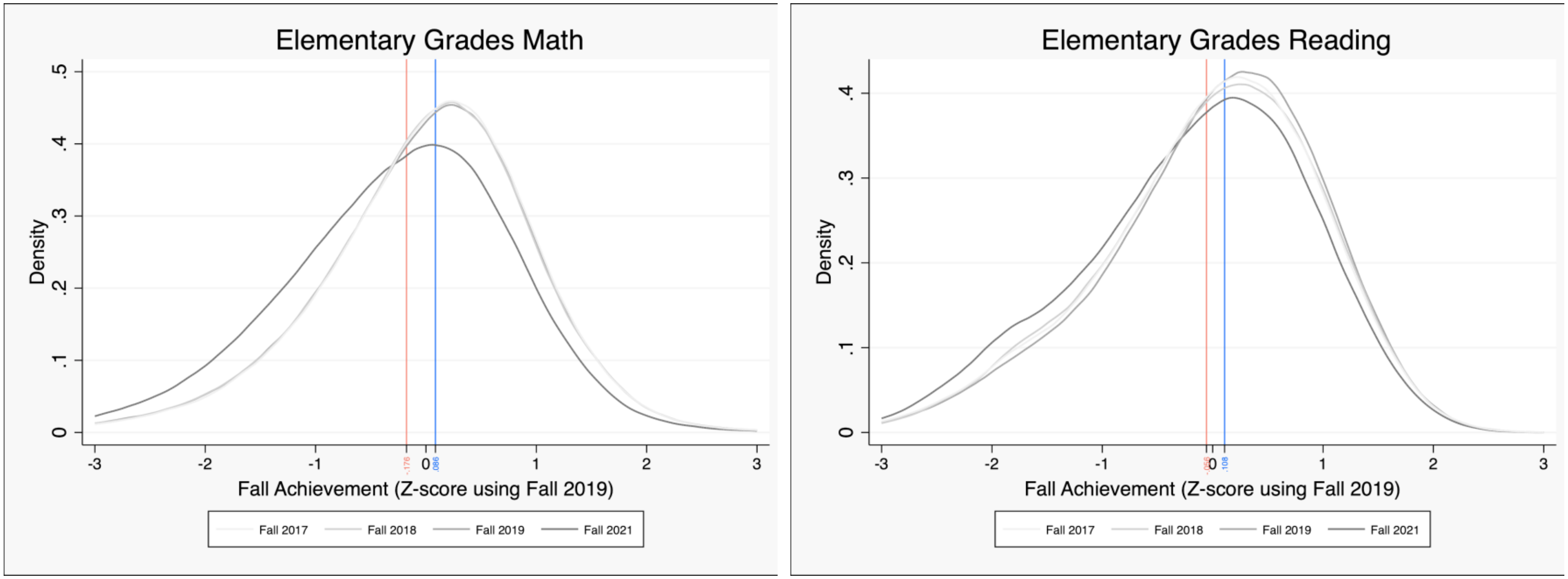


Figure 2: Distribution of Math and Reading Test Scores for Middle Grades (2017-2021)

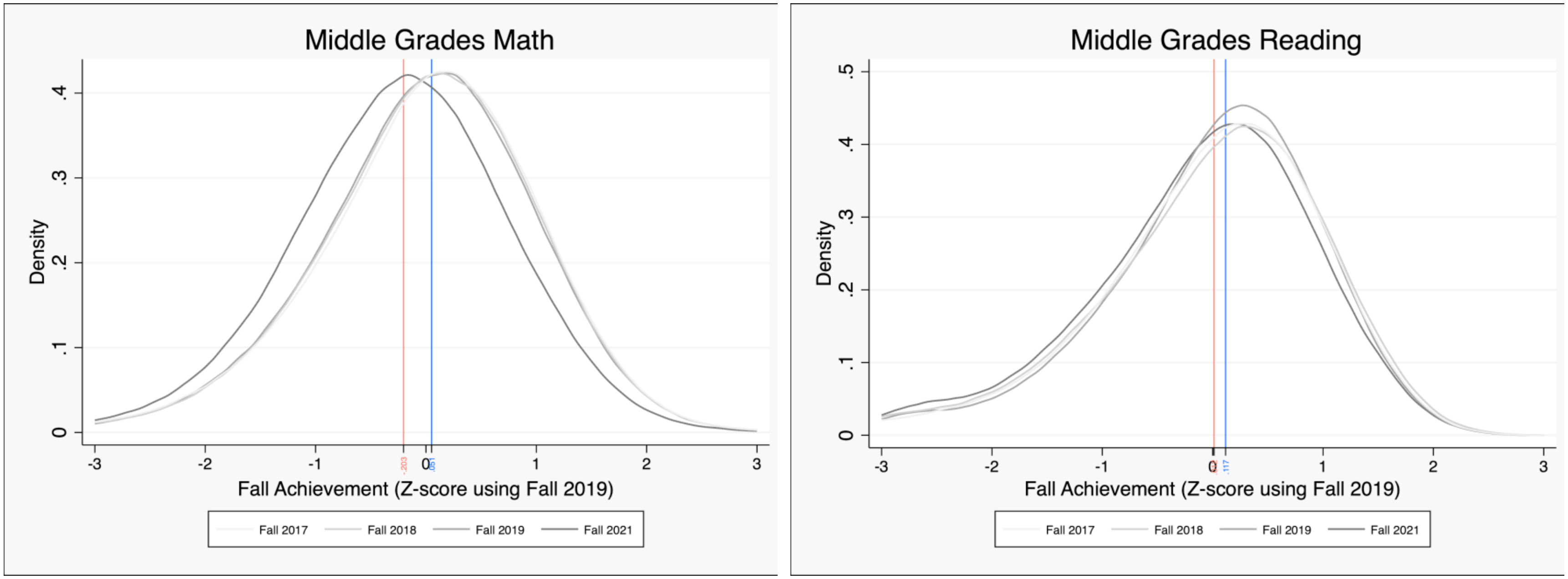


Figure 3: Variance Decomposition in Math Test Scores Across Districts and Schools, by Grade

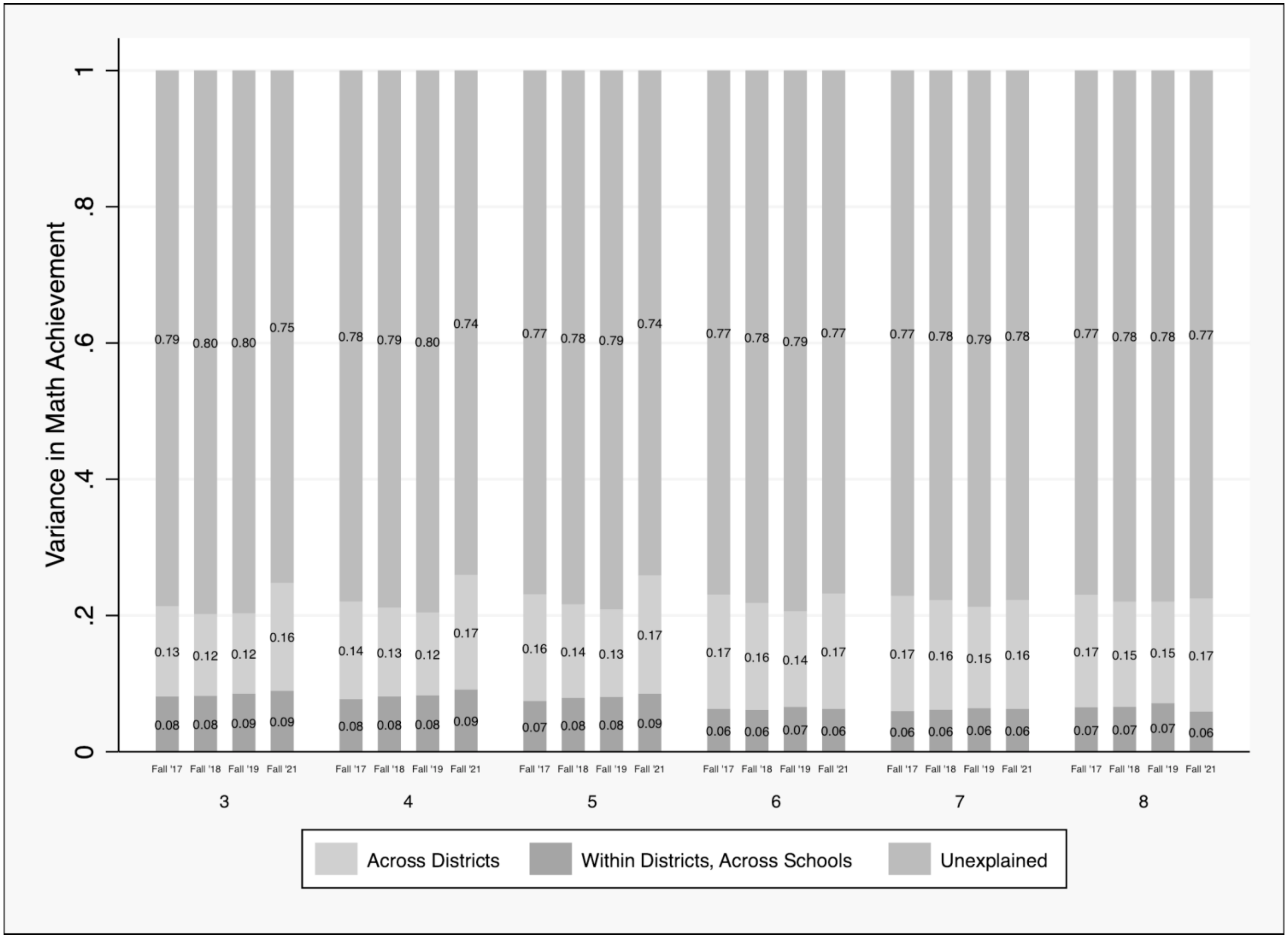


Figure 4: Variance Decomposition in Reading Test Scores Across Districts and Schools, by Grade

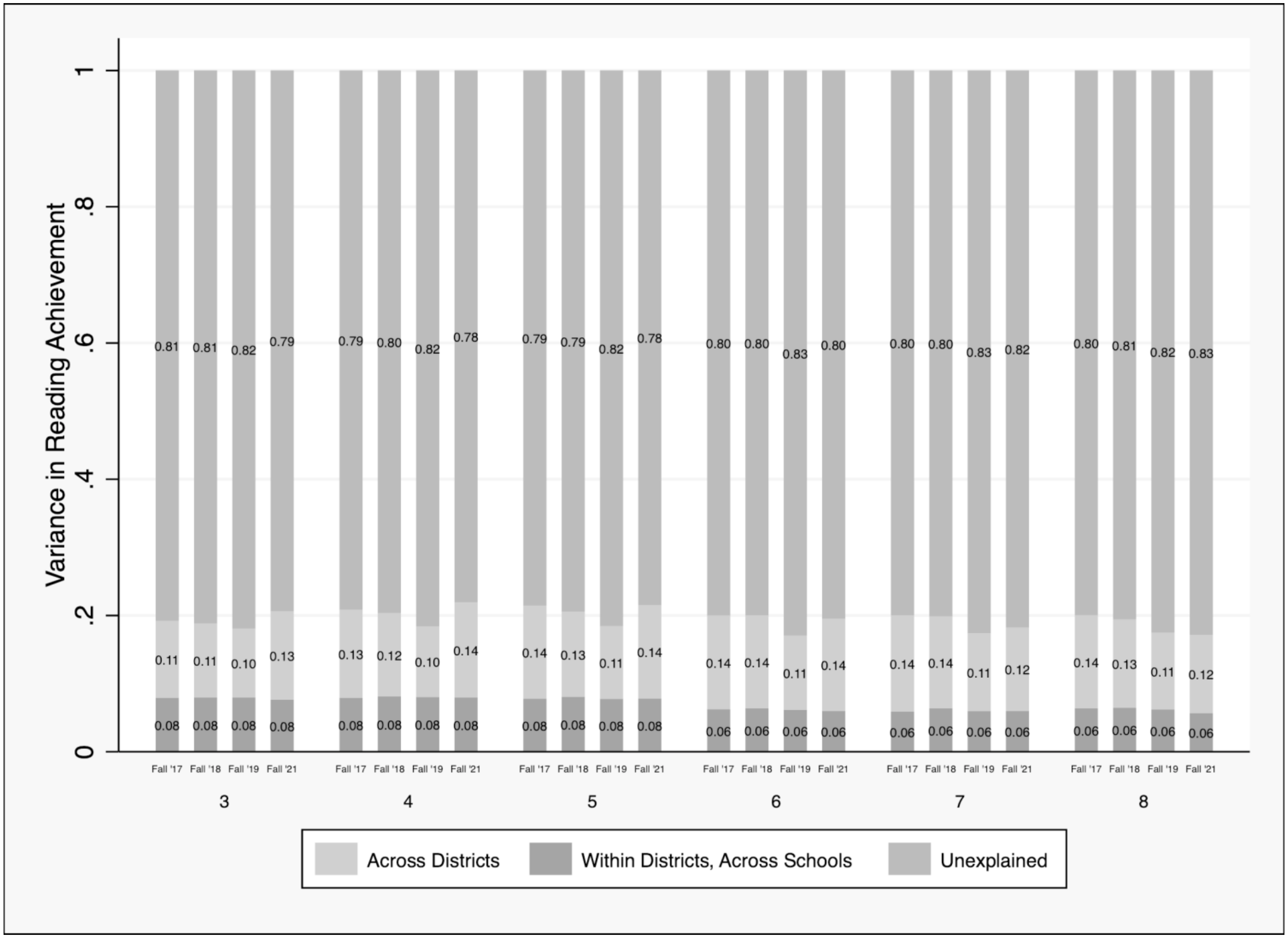


Figure 5: Trends in Median Math Achievement Across Ethnoracial Groups, by Grade (2017-2021)

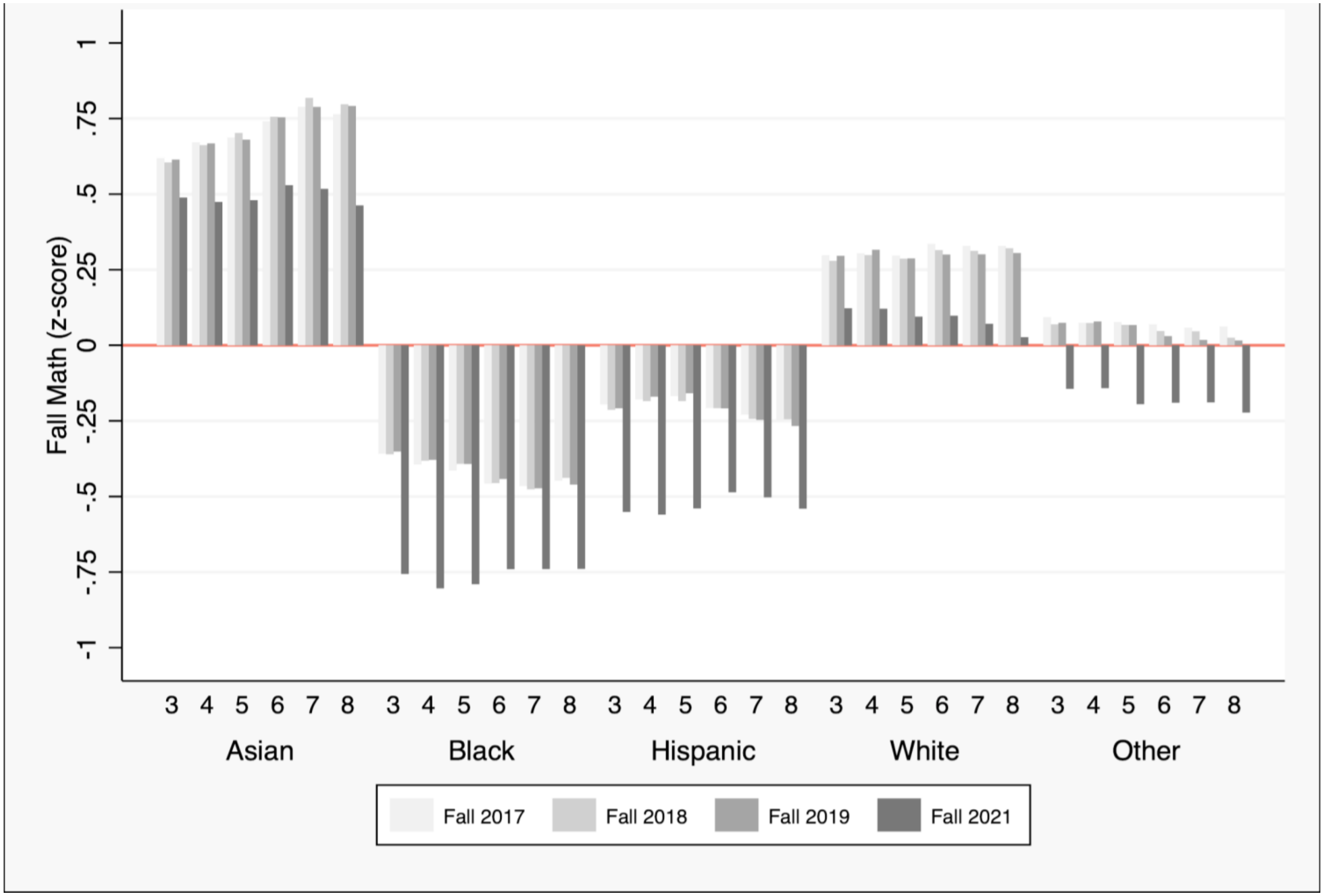


Figure 6: Trends in Median Reading Achievement Across Ethnoracial Groups, by Grade (2017-2021)

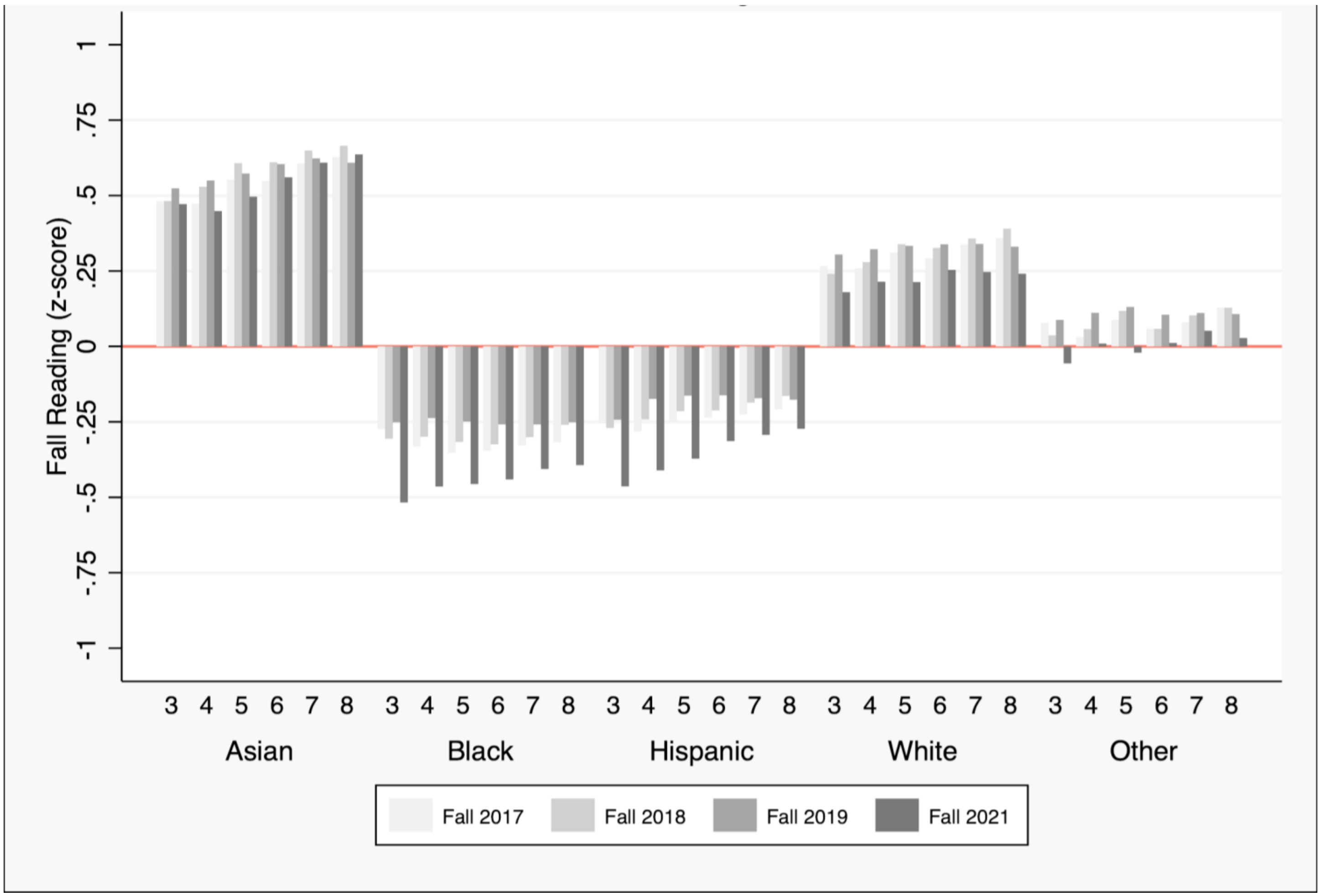
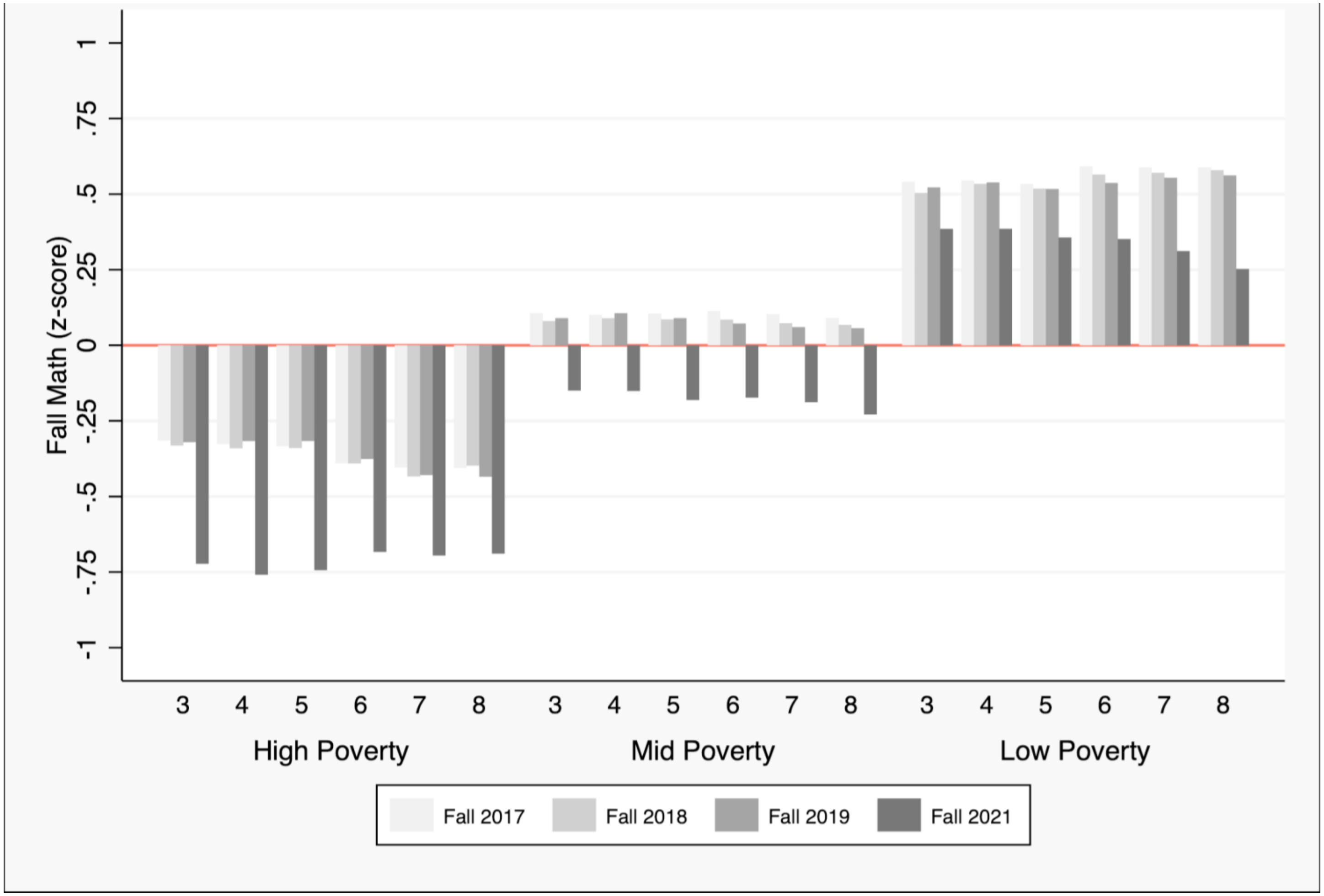
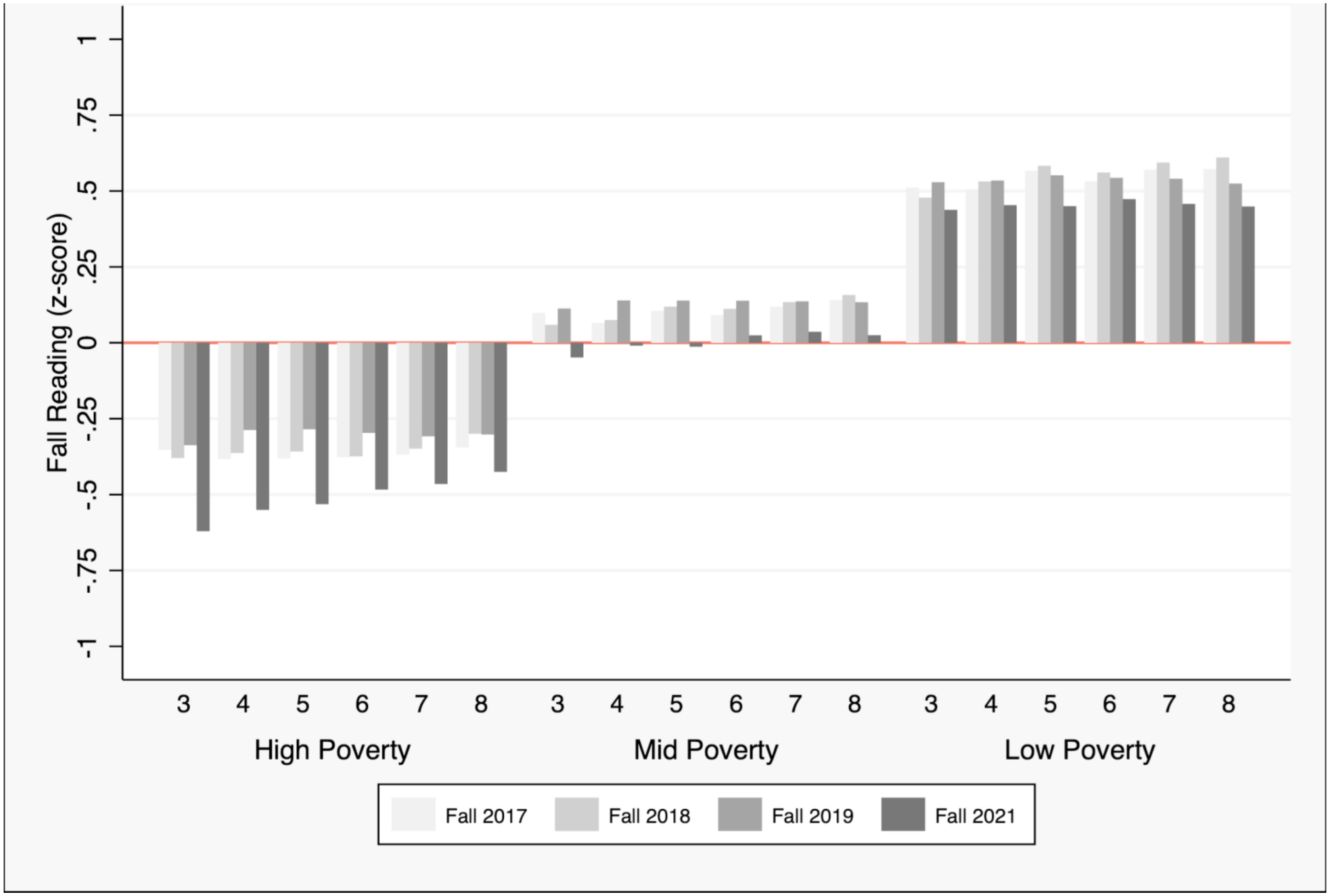


Figure 7: Trends in Median Math Achievement by School Poverty Level (2017-2021)



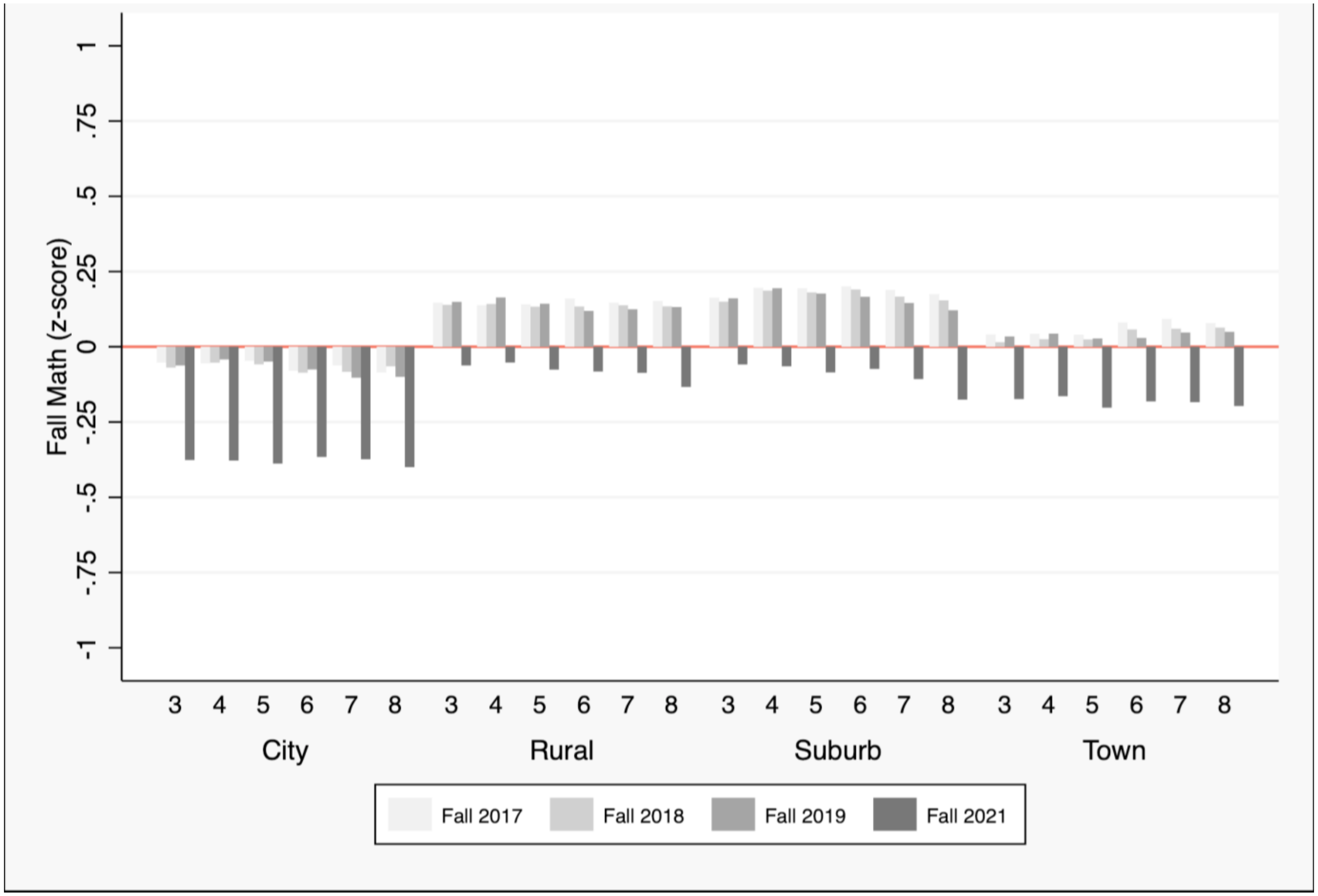
Note: Low poverty schools have less than 25% of students eligible for free or reduced-price lunch; Mid-poverty schools have 25-75% of students eligible for free or reduced-price lunch; and high poverty schools have more than 75% of students eligible for free or reduced-price lunch.

Figure 8: Trends in Median Reading Achievement by School Poverty Level (2017-2021)



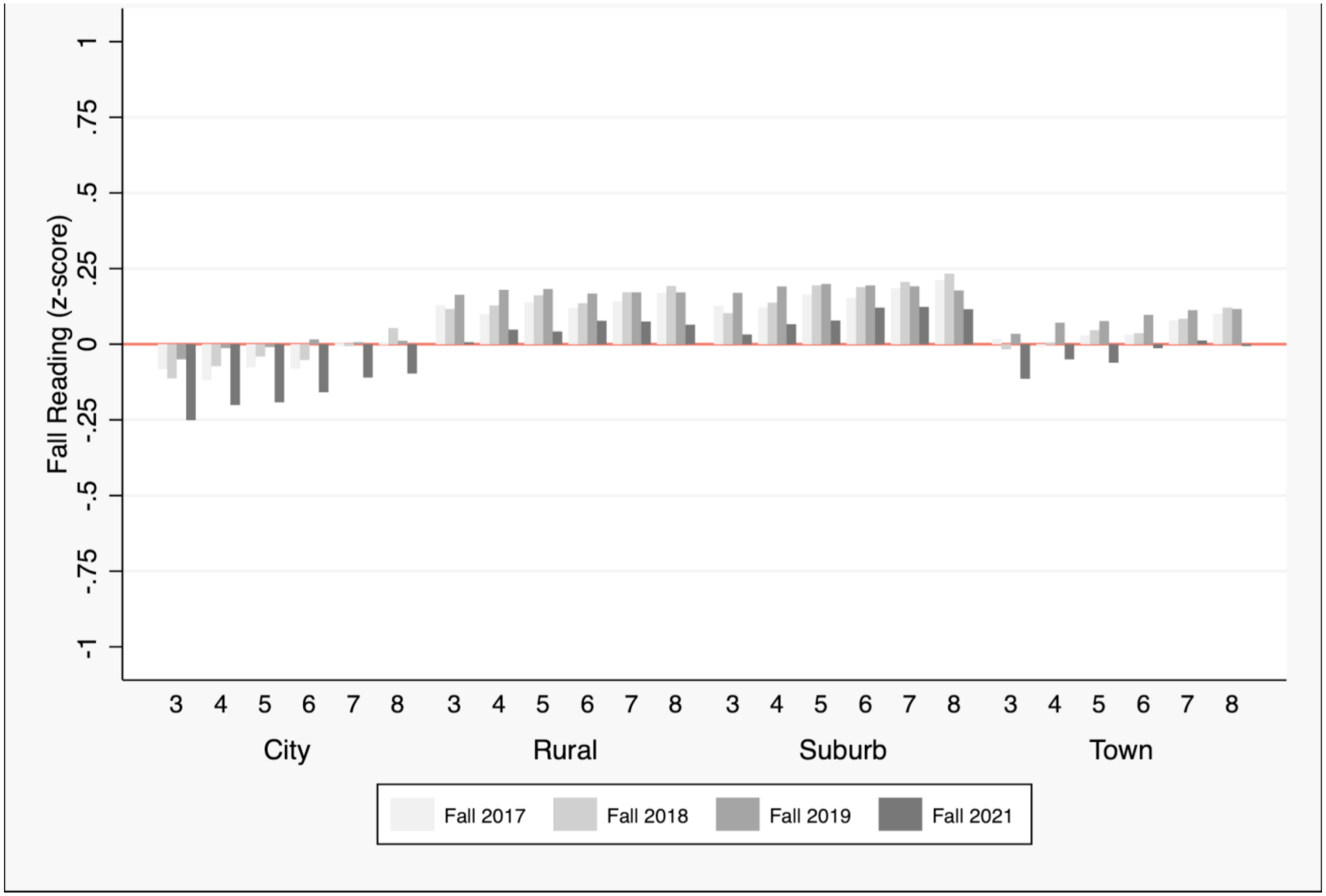
Note: Low poverty schools have less than 25% of students eligible for free or reduced-price lunch; Mid-poverty schools have 25-75% of students eligible for free or reduced-price lunch; and high poverty schools have more than 75% of students eligible for free or reduced-price lunch.

Figure 9: Trends in Median Math Achievement by School Urbanicity (2017-2021)



Note: Urbanicity categories are defined according to the Congressional District Code (CDC). For more information, see https://nces.ed.gov/ccd/pdf/INsc09101a.pdf; city refers to territories inside an urbanized area and inside a principal city; rural refers to a census-defined rural territory that is not in an urbanized area or urban cluster; suburb refers to a territory outside a principal city and inside an urbanized area; and town refers to a territory inside an urban cluster that is at least 10 miles from an urbanized area.

Figure 10: Trends in Median Reading Achievement by School Urbanicity



Note: Urbanicity categories are defined according to the Congressional District Code (CDC). For more information, see https://nces.ed.gov/ccd/pdf/INsc09101a.pdf; city refers to territories inside an urbanized area and inside a principal city; rural refers to a census-defined rural territory that is not in an urbanized area or urban cluster; suburb refers to a territory outside a principal city and inside an urbanized area; and town refers to a territory inside an urban cluster that is at least 10 miles from an urbanized area.

Figure 11: Distributional Differences in Achievement Levels between Black Elementary School Students and the National Sample, Fall 2019 and 2021

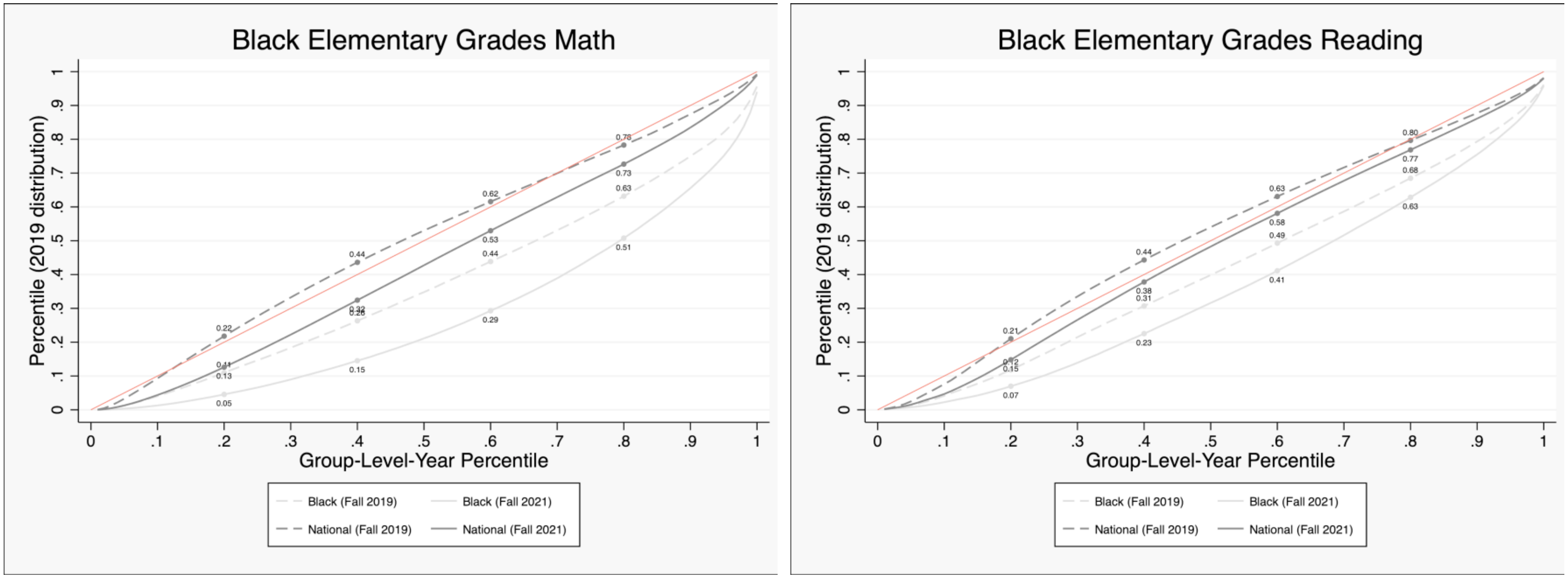


Figure 12: Distributional Differences in Achievement Levels between Black Middle School Students and the National Sample, Fall 2019 and 2021

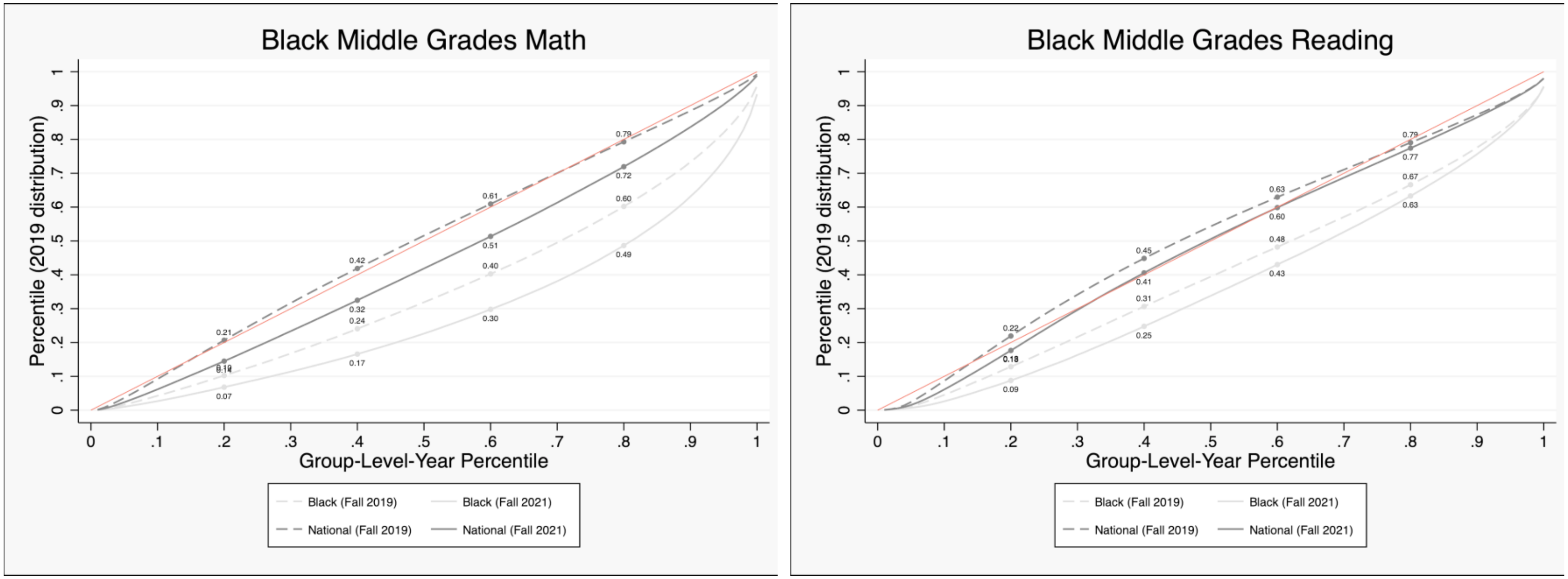
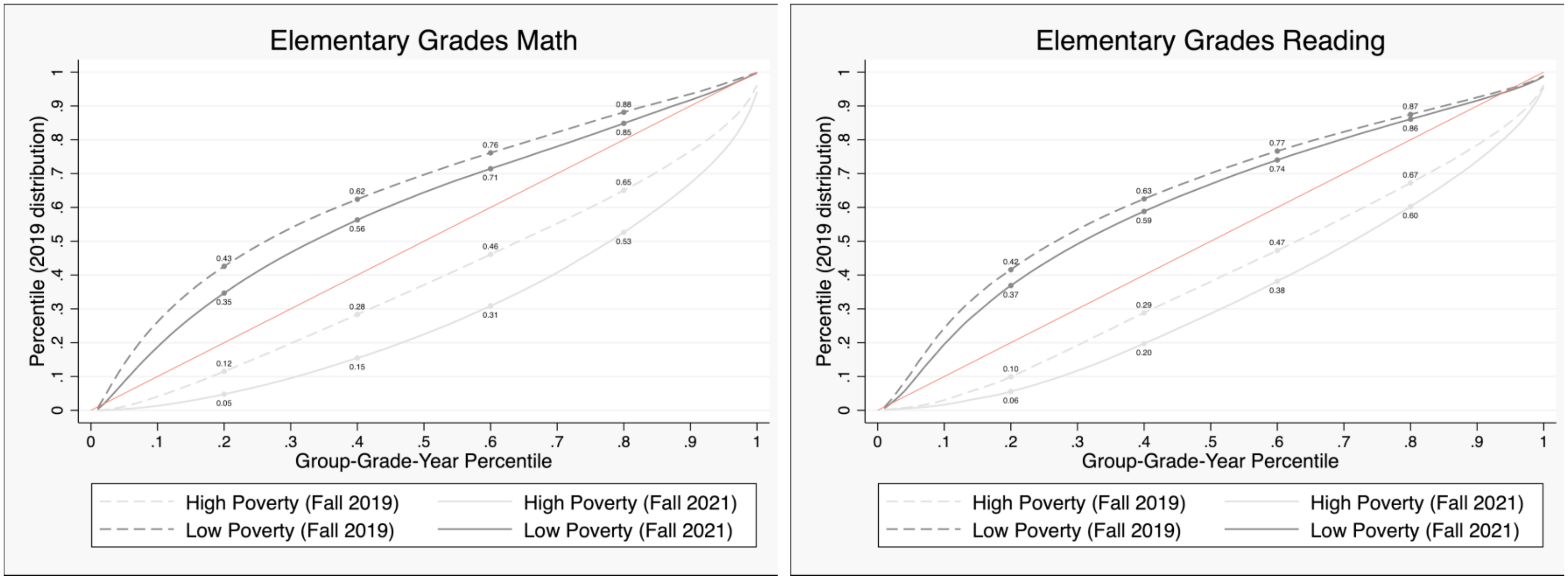
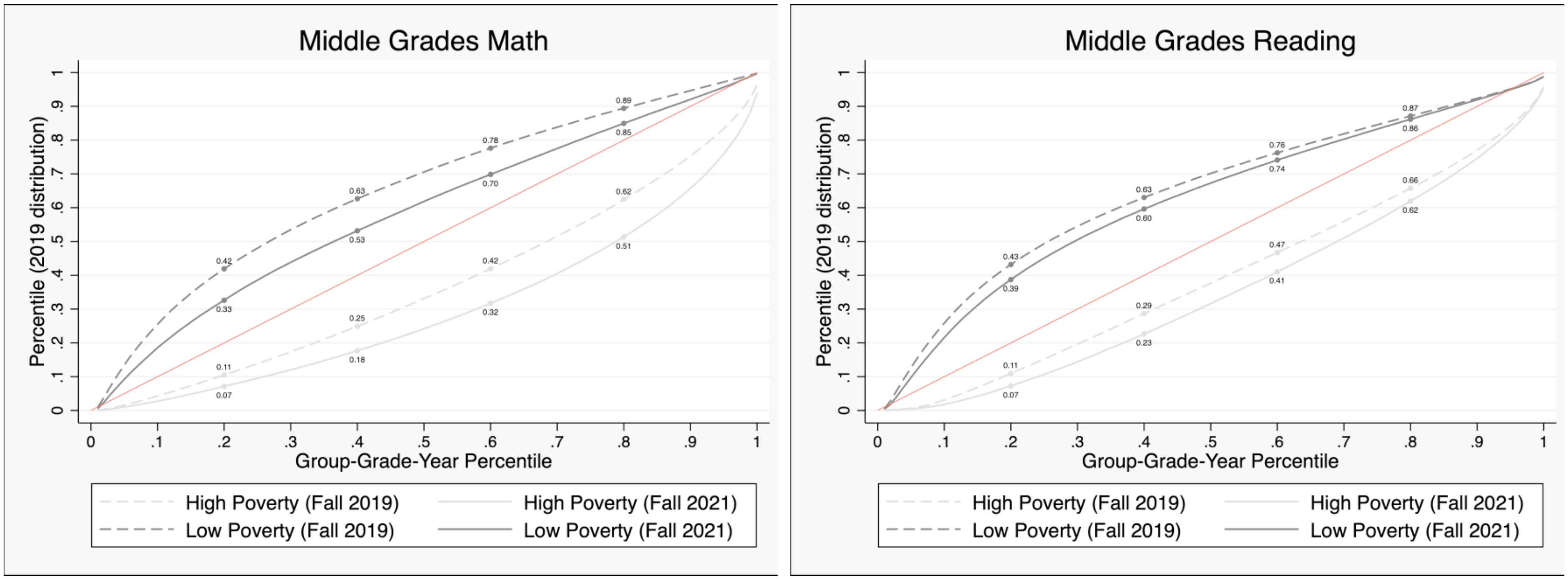


Figure 13: Distributional Differences in Achievement Levels between Elementary School Students in High and Low Poverty Schools, Fall 2019 and 2021



Note: Low poverty schools have less than 25% of students eligible for free or reduced-price lunch; Mid-poverty schools have 25-75% of students eligible for free or reduced-price lunch; and high poverty schools have more than 75% of students eligible for free or reduced-price lunch.

Figure 14: Distributional Differences in Achievement Levels between Middle School Students in High and Low Poverty Schools, Fall 2019 and 2021



Note: Low poverty schools have less than 25% of students eligible for free or reduced-price lunch; Mid-poverty schools have 25-75% of students eligible for free or reduced-price lunch; and high poverty schools have more than 75% of students eligible for free or reduced-price lunch.

Figure 15: Variation in Elementary School Students' Growth between Fall 2019 and Fall 2021 by Students' Baseline Achievement

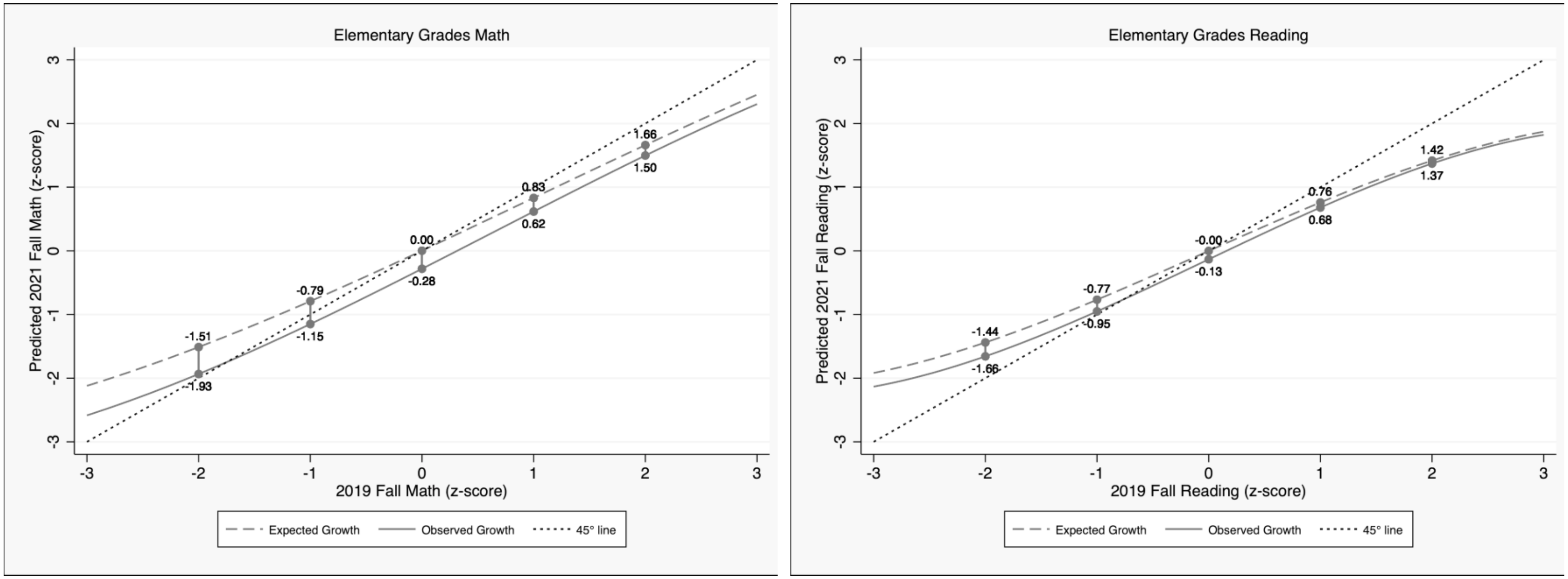


Figure 16: Variation in Middle School Students' Growth between Fall 2019 and Fall 2021 by Students' Baseline Achievement

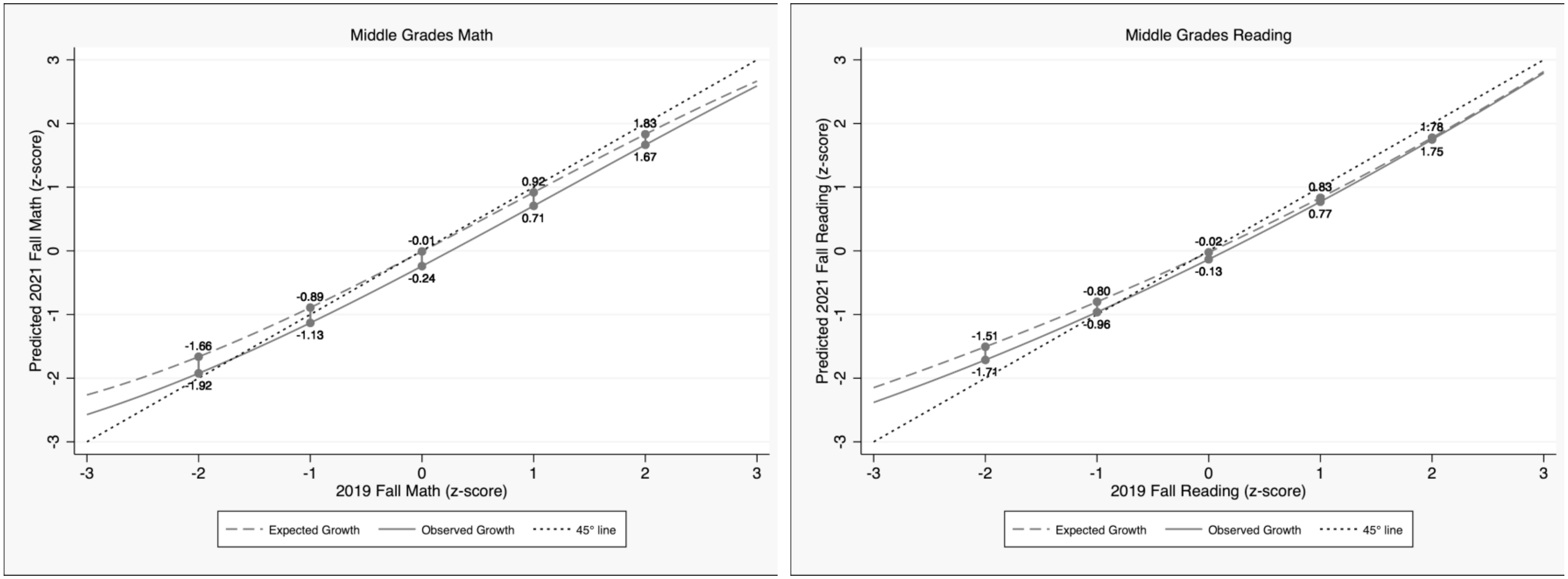


Figure 17: Difference between Median Predicted Math Growth for Pandemic Cohort Using Actual Pandemic Growth Rate and Median Predicted Math Growth Using Pre-Pandemic Growth Rates, by Race and Grade

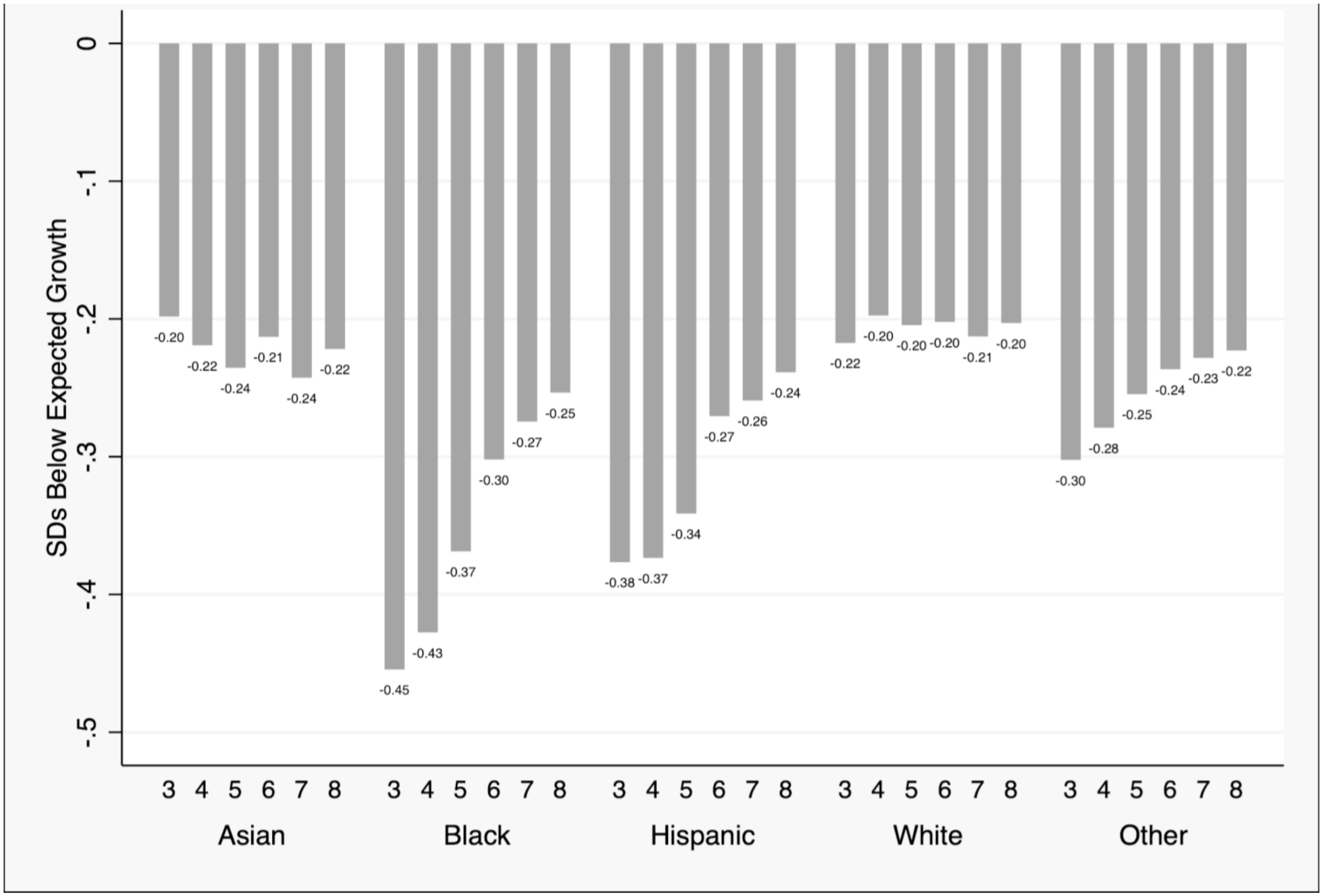


Figure 18: Difference between Median Predicted Reading Growth for Pandemic Cohort Using Actual Pandemic Growth Rate and Median Predicted Reading Growth Using Pre-Pandemic Growth Rates, by Race and Grade

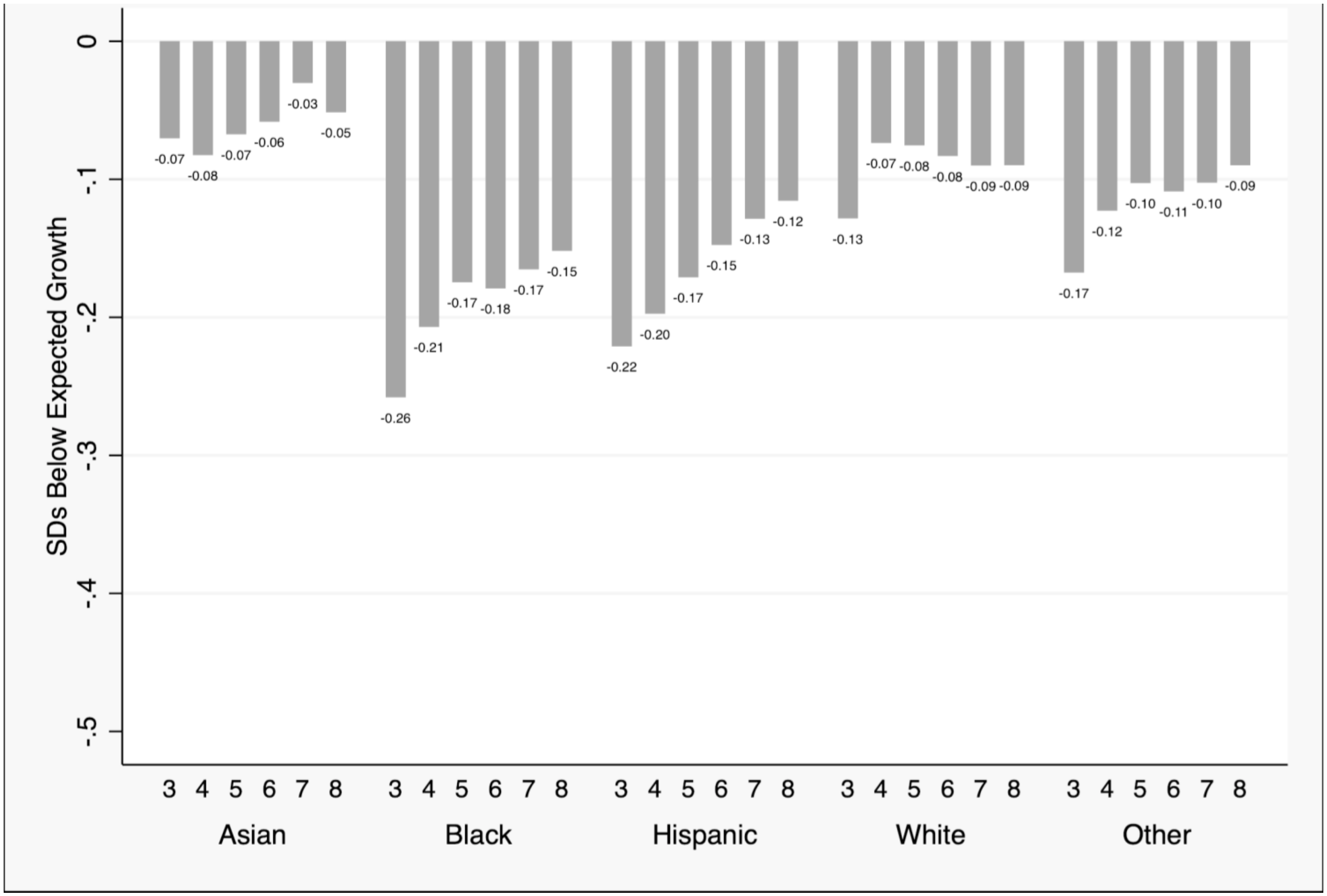
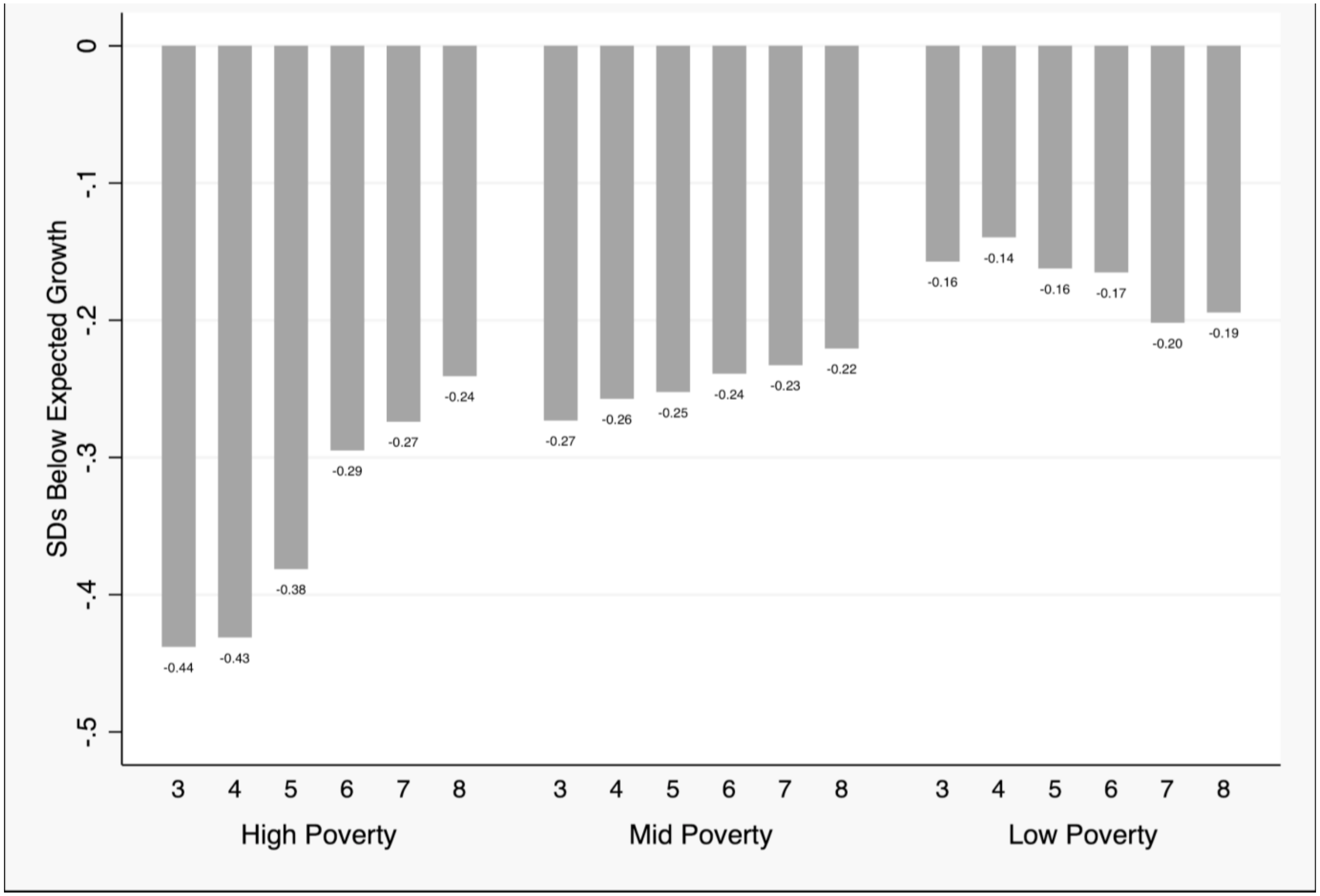
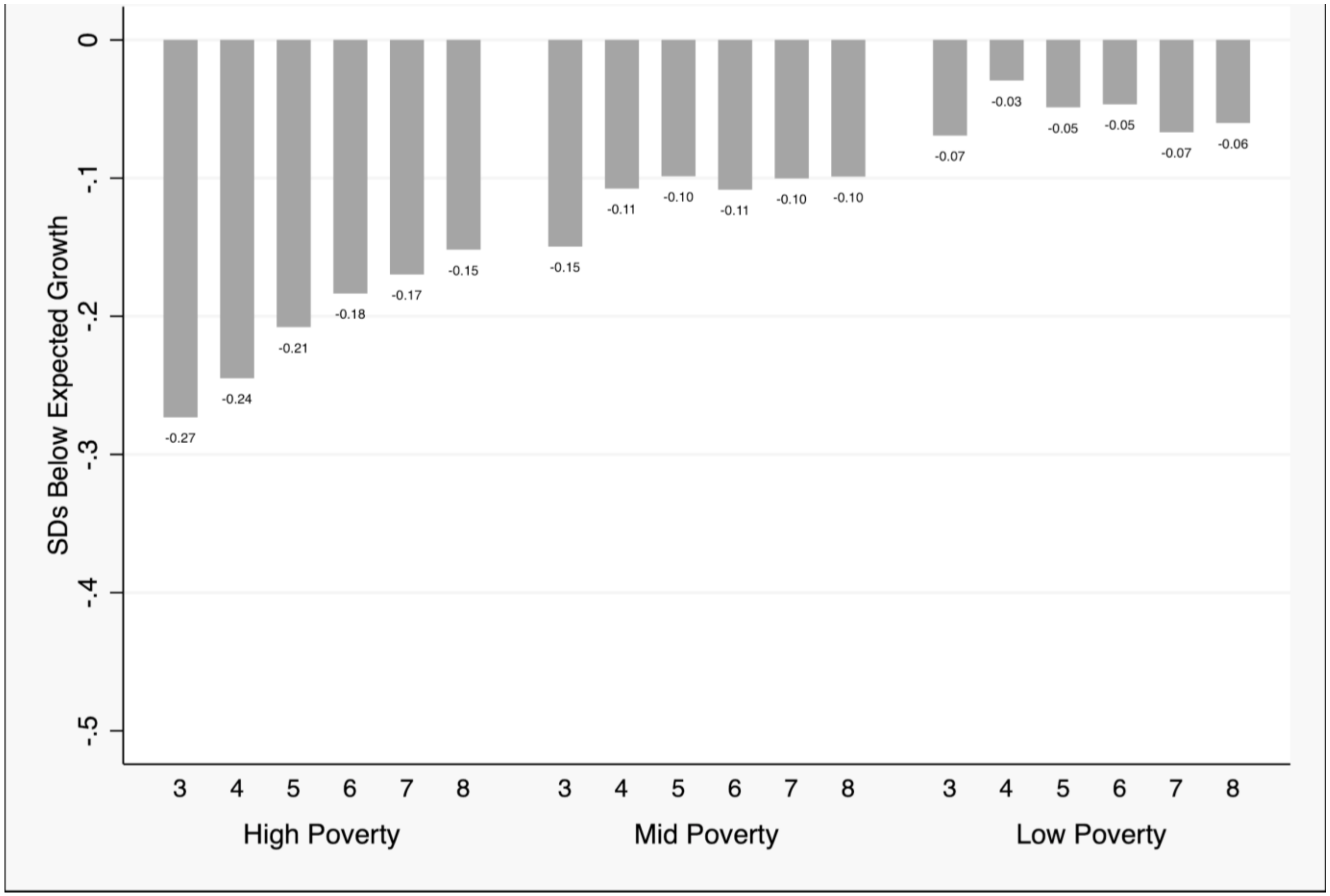


Figure 19: Difference between Median Predicted Math Growth for Pandemic Cohort Using Actual Pandemic Growth Rate and Median Predicted Math Growth Using Pre-Pandemic Growth Rates, by School Poverty Level and Grade



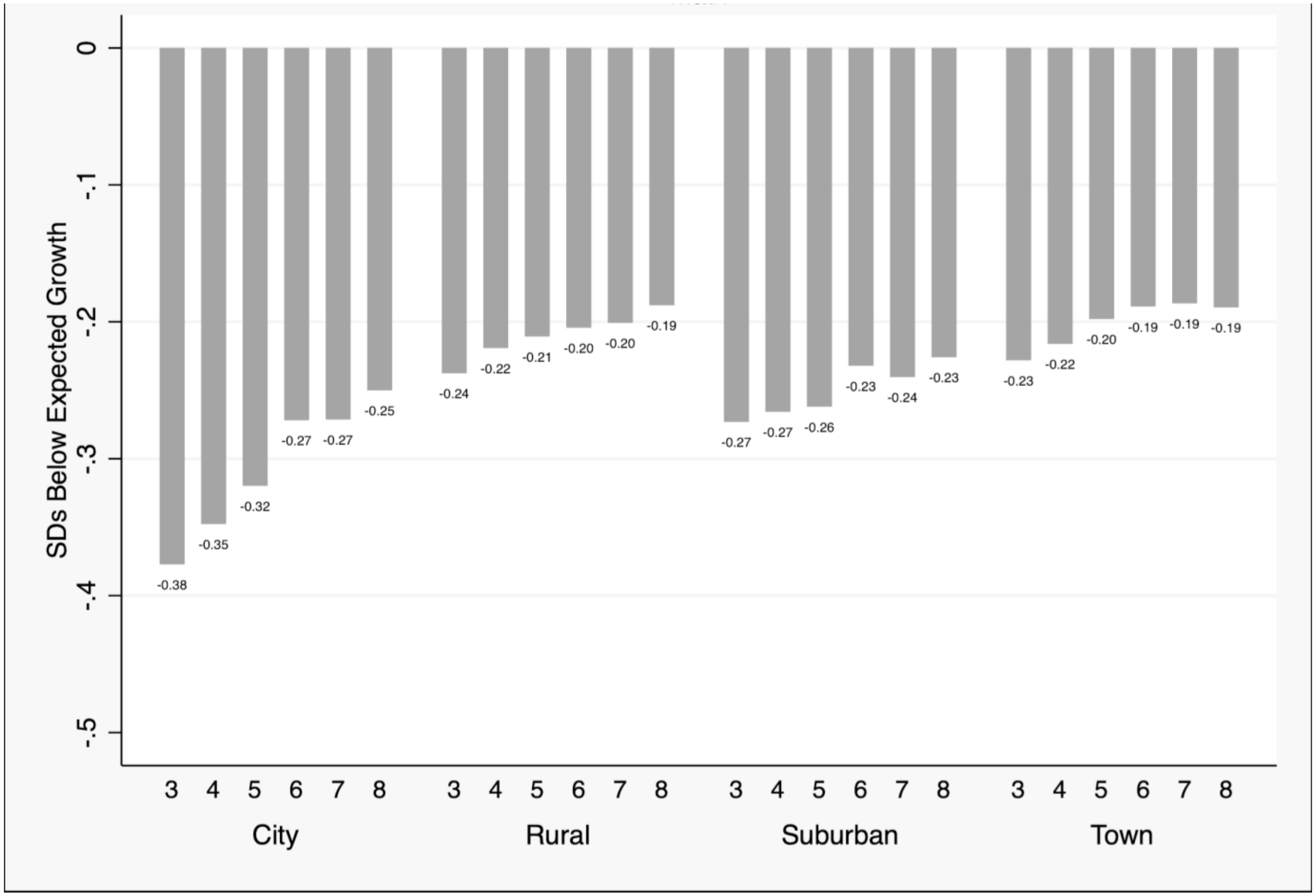
Note: Low poverty schools have less than 25% of students eligible for free or reduced-price lunch; Mid-poverty schools have 25-75% of students eligible for free or reduced-price lunch; and high poverty schools have more than 75% of students eligible for free or reduced-price lunch.

Figure 20: Difference between Median Predicted Reading Growth for Pandemic Cohort Using Actual Pandemic Growth Rate and Median Predicted Reading Growth Using Pre-Pandemic Growth Rates, by School Poverty Level and Grade



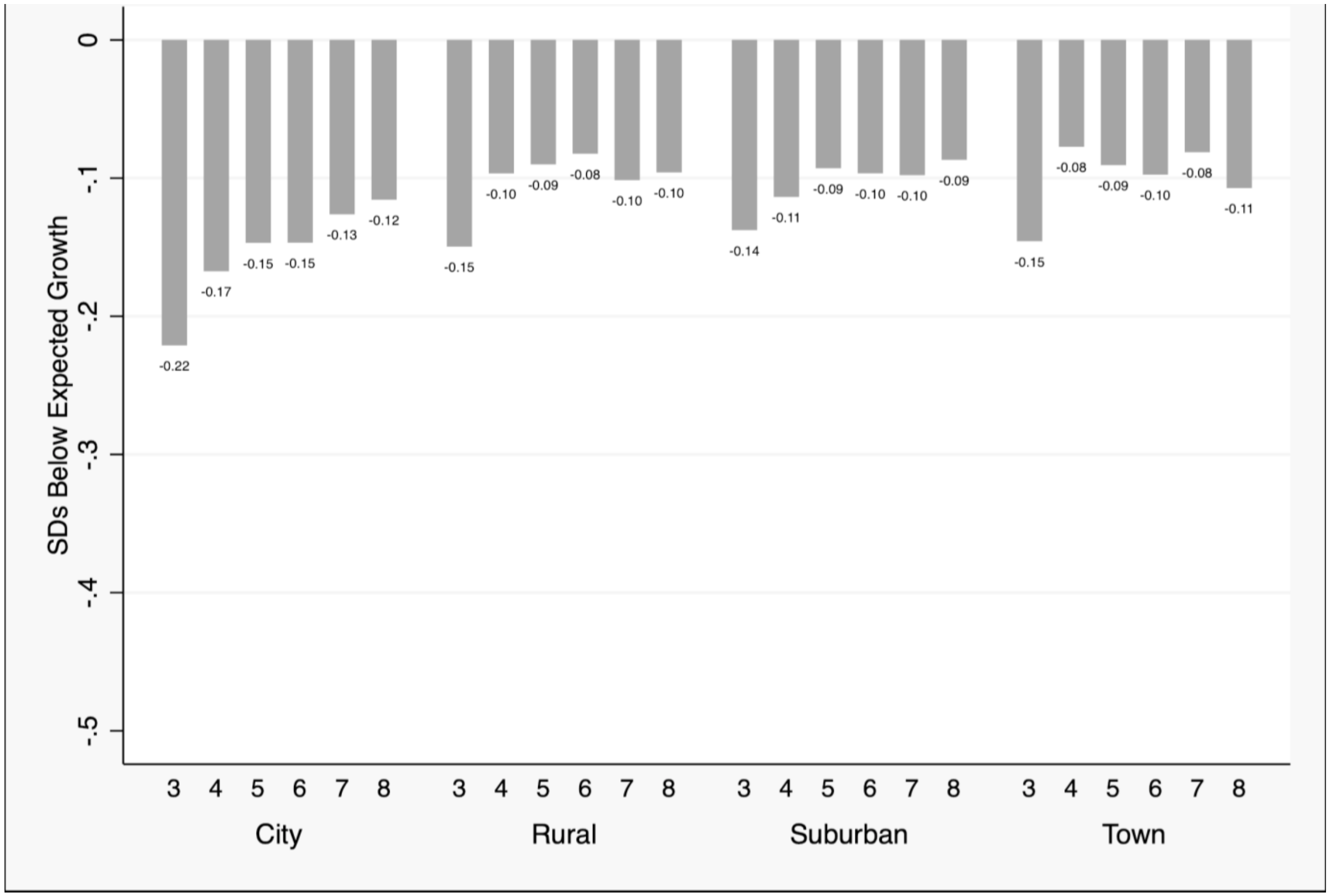
Note: Low poverty schools have less than 25% of students eligible for free or reduced-price lunch; Mid-poverty schools have 25-75% of students eligible for free or reduced-price lunch; and high poverty schools have more than 75% of students eligible for free or reduced-price lunch.

Figure 21: Difference between Median Predicted Math Growth for Pandemic Cohort Using Actual Pandemic Growth Rate and Median Predicted Math Growth Using Pre-Pandemic Growth Rates, by School Urbanicity and Grade



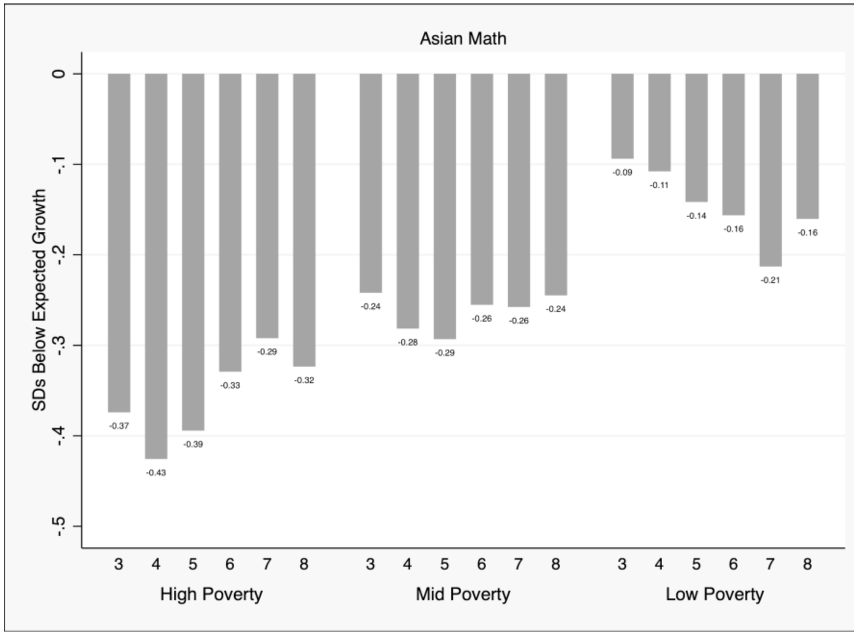
Note: Urbanicity categories are defined according to the Congressional District Code (CDC). For more information, see https://nces.ed.gov/ccd/pdf/INsc09101a.pdf; city refers to territories inside an urbanized area and inside a principal city; rural refers to a census-defined rural territory that is not in an urbanized area or urban cluster; suburb refers to a territory outside a principal city and inside an urbanized area; and town refers to a territory inside an urban cluster that is at least 10 miles from an urbanized area.

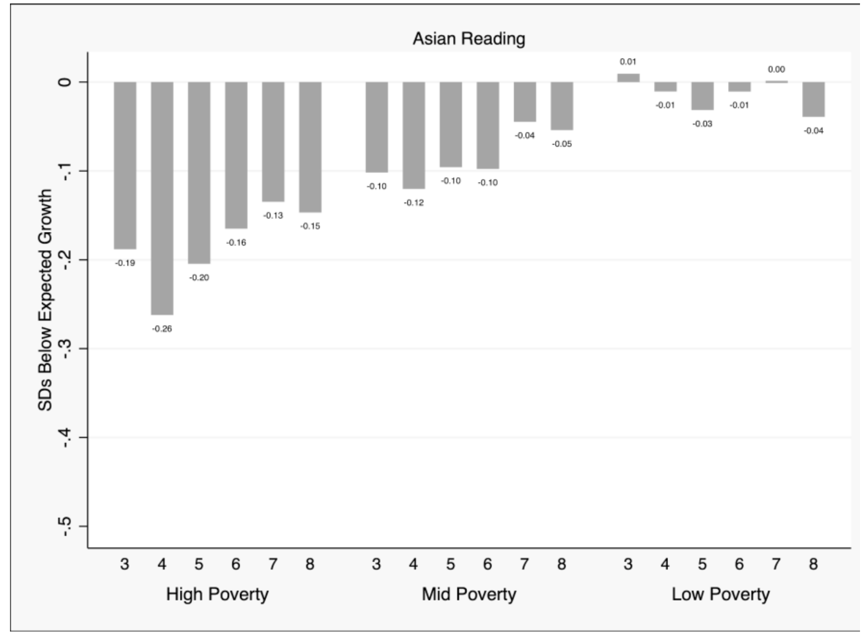
Figure 22: Difference between Median Predicted Reading Growth for Pandemic Cohort Using Actual Pandemic Growth Rate and Median Predicted Reading Growth Using Pre-Pandemic Growth Rates, by School Urbanicity and Grade



Note: Urbanicity categories are defined according to the Congressional District Code (CDC). For more information, see https://nces.ed.gov/ccd/pdf/INsc09101a.pdf; city refers to territories inside an urbanized area and inside a principal city; rural refers to a census-defined rural territory that is not in an urbanized area or urban cluster; suburb refers to a territory outside a principal city and inside an urbanized area; and town refers to a territory inside an urban cluster that is at least 10 miles from an urbanized area.

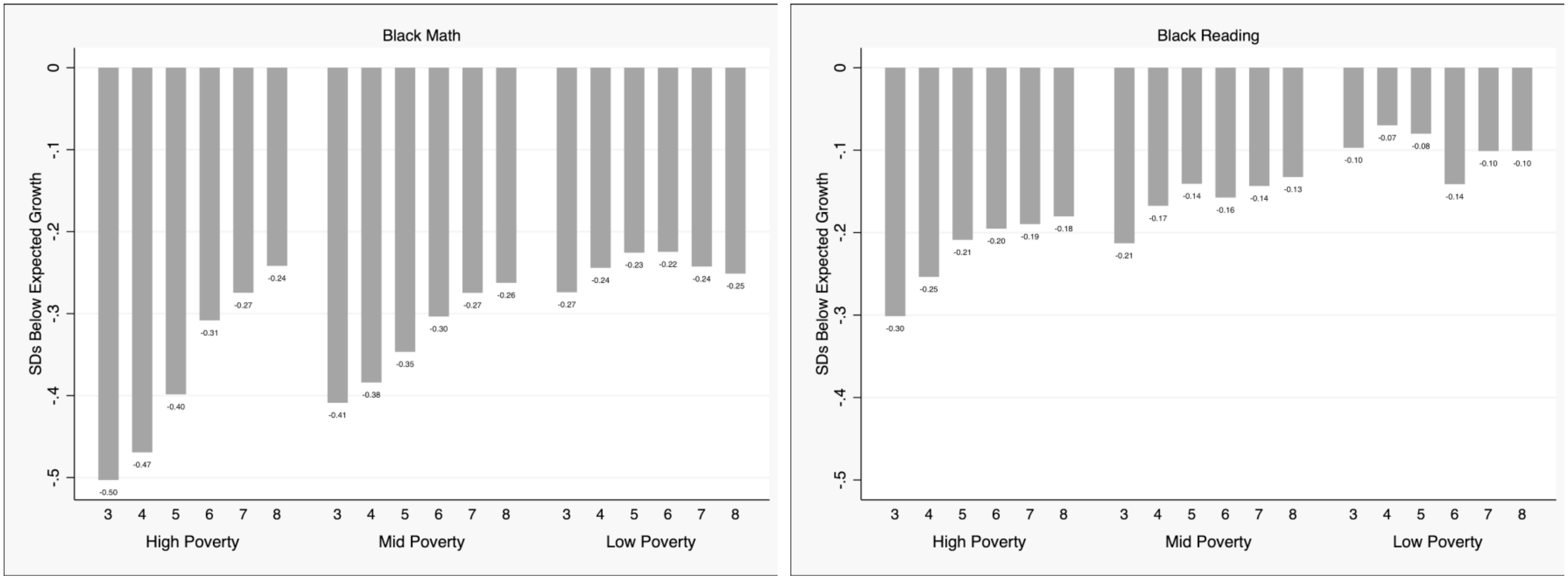
Figure 23: Difference between Median Predicted Math and Reading Growth for Asian Students Using Actual Pandemic Growth Rate and Median Predicted Math and Reading Growth Using Pre-Pandemic Growth Rates, by School Poverty Level and Grade





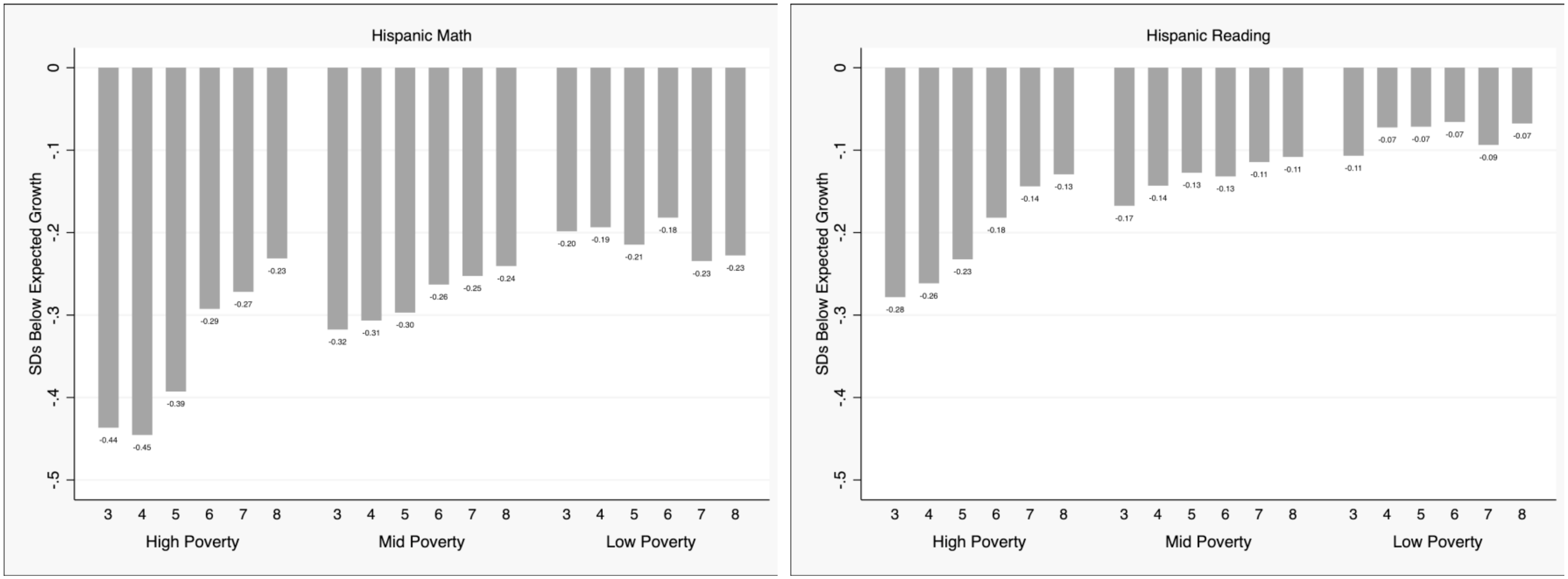
Note: Urbanicity categories are defined according to the Congressional District Code (CDC). For more information, see https://nces.ed.gov/ccd/pdf/INsc09101a.pdf; city refers to territories inside an urbanized area and inside a principal city; rural refers to a census-defined rural territory that is not in an urbanized area or urban cluster; suburb refers to a territory outside a principal city and inside an urbanized area; and town refers to a territory inside an urban cluster that is at least 10 miles from an urbanized area.

Figure 24: Difference between Median Predicted Math and Reading Growth for Black Students Using Actual Pandemic Growth Rate and Median Predicted Math and Reading Growth Using Pre-Pandemic Growth Rates, by School Poverty Level and Grade



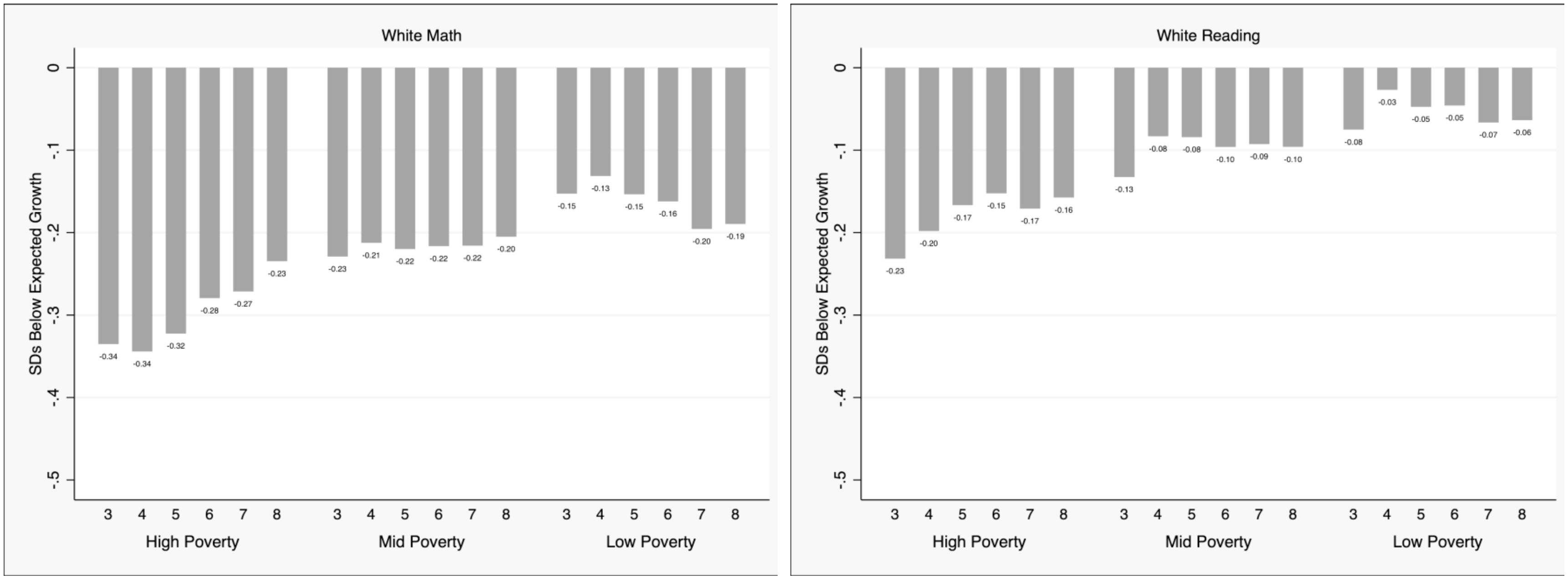
Note: Urbanicity categories are defined according to the Congressional District Code (CDC). For more information, see https://nces.ed.gov/ccd/pdf/INsc09101a.pdf; city refers to territories inside an urbanized area and inside a principal city; rural refers to a census-defined rural territory that is not in an urbanized area or urban cluster; suburb refers to a territory outside a principal city and inside an urbanized area; and town refers to a territory inside an urban cluster that is at least 10 miles from an urbanized area.

Figure 25: Difference between Median Predicted Math and Reading Growth for Hispanic Students Using Actual Pandemic Growth Rate and Median Predicted Math and Reading Growth Using Pre-Pandemic Growth Rates, by School Poverty Level and Grade



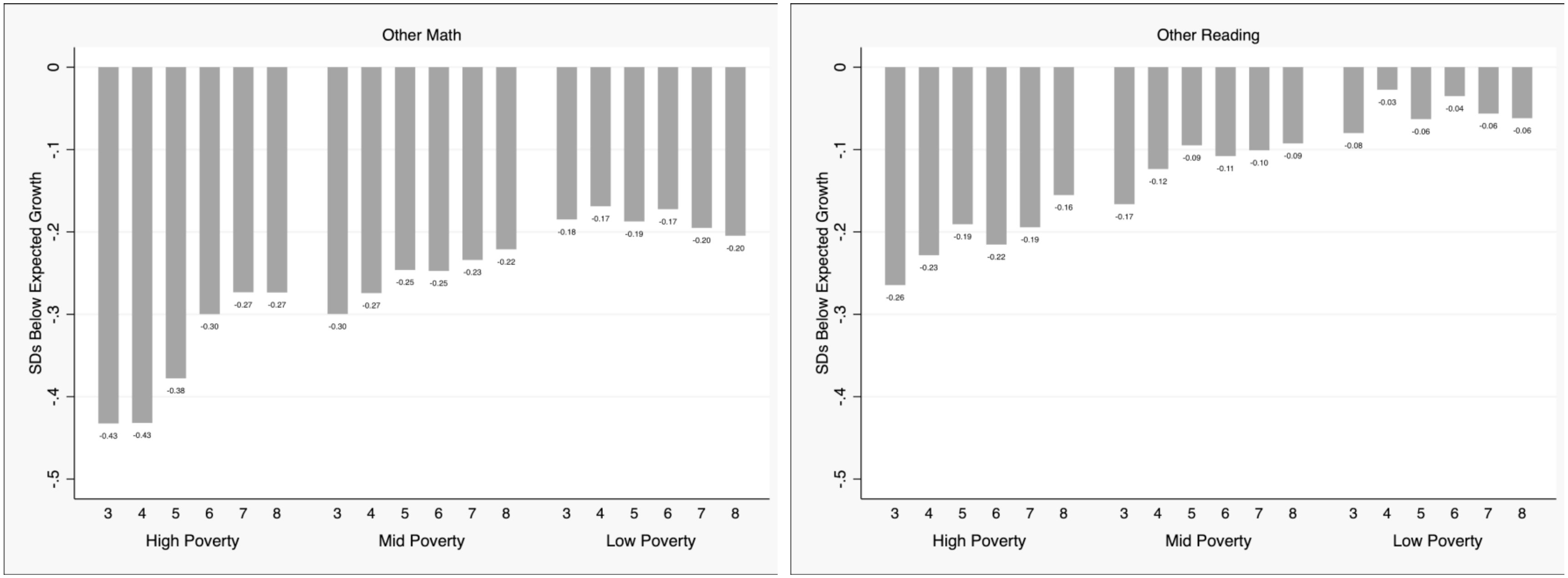
Note: Urbanicity categories are defined according to the Congressional District Code (CDC). For more information, see https://nces.ed.gov/ccd/pdf/INsc09101a.pdf; city refers to territories inside an urbanized area and inside a principal city; rural refers to a census-defined rural territory that is not in an urbanized area or urban cluster; suburb refers to a territory outside a principal city and inside an urbanized area; and town refers to a territory inside an urban cluster that is at least 10 miles from an urbanized area.

Figure 26: Difference between Median Predicted Math and Reading Growth for White Students Using Actual Pandemic Growth Rate and Median Predicted Math and Reading Growth Using Pre-Pandemic Growth Rates, by School Poverty Level and Grade



Note: Urbanicity categories are defined according to the Congressional District Code (CDC). For more information, see https://nces.ed.gov/ccd/pdf/INsc09101a.pdf; city refers to territories inside an urbanized area and inside a principal city; rural refers to a census-defined rural territory that is not in an urbanized area or urban cluster; suburb refers to a territory outside a principal city and inside an urbanized area; and town refers to a territory inside an urban cluster that is at least 10 miles from an urbanized area.

Figure 27: Difference between Median Predicted Math and Reading Growth for Other Students Using Actual Pandemic Growth Rate and Median Predicted Math and Reading Growth Using Pre-Pandemic Growth Rates, by School Poverty Level and Grade



Note: Urbanicity categories are defined according to the Congressional District Code (CDC). For more information, see https://nces.ed.gov/ccd/pdf/INsc09101a.pdf; city refers to territories inside an urbanized area and inside a principal city; rural refers to a census-defined rural territory that is not in an urbanized area or urban cluster; suburb refers to a territory outside a principal city and inside an urbanized area; and town refers to a territory inside an urban cluster that is at least 10 miles from an urbanized area; this figure shows predicted math and reading growth for students who identify as a race other than Asian, Black, Hispanic, or White.

Figure 28: Predicted Fall 2021 Test Scores for Elementary Grades Based on Prepandemic Parameter Estimates and Pandemic Parameter Estimates

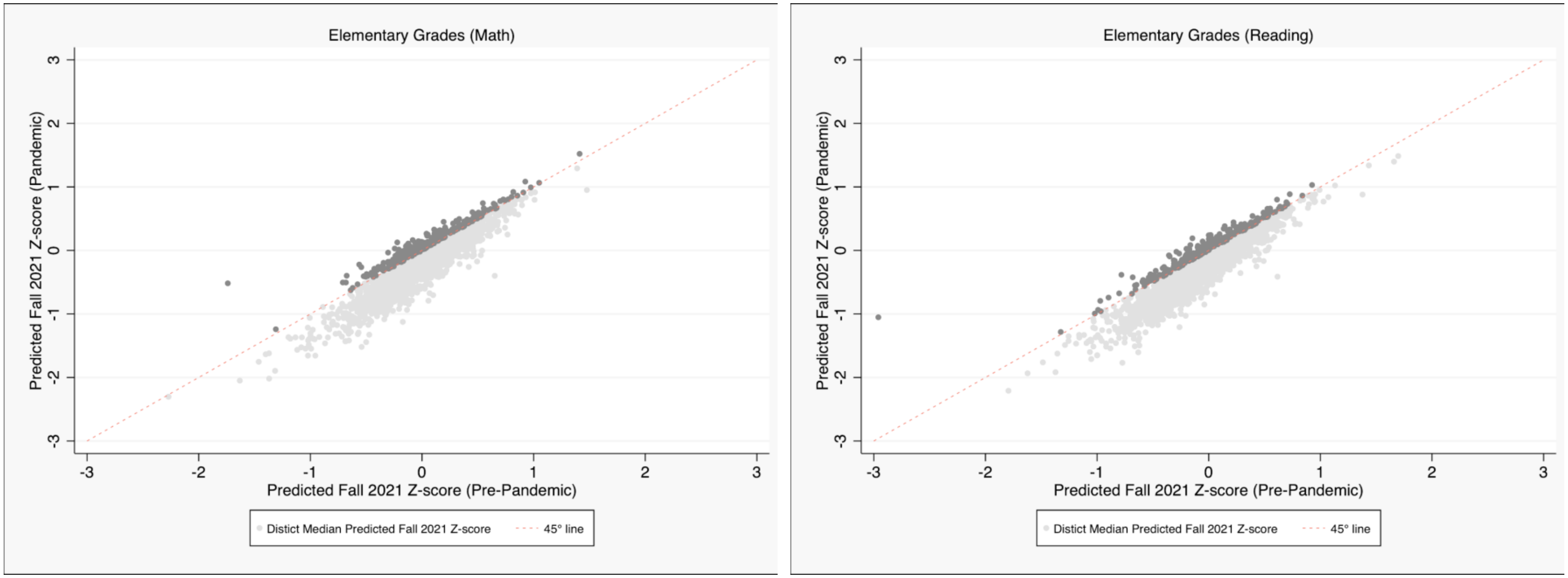
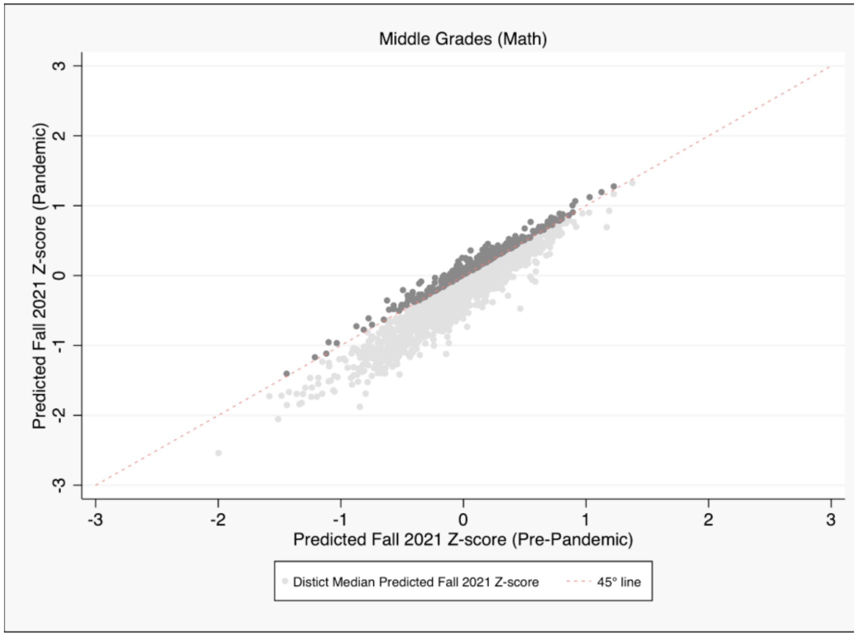


Figure 29: Predicted Fall 2021 Test Scores for Middle Grades Based on Prepandemic Parameter Estimates and Pandemic Parameter Estimates



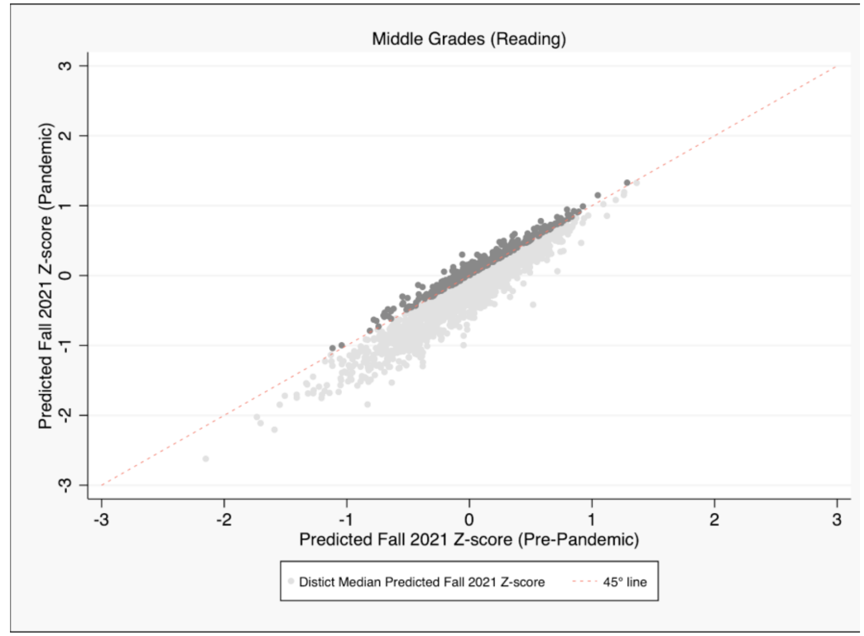


Figure 30: Histogram of the Districts' Differences in Median Growth Rates for Elementary Grades

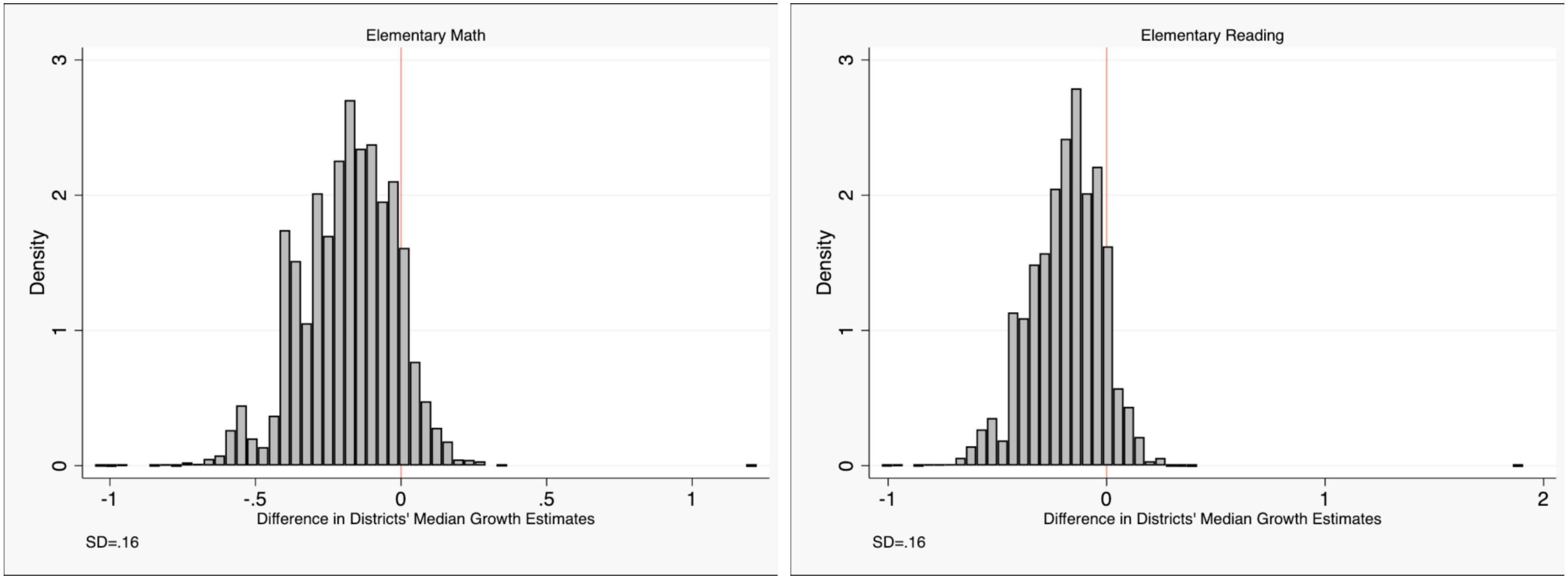
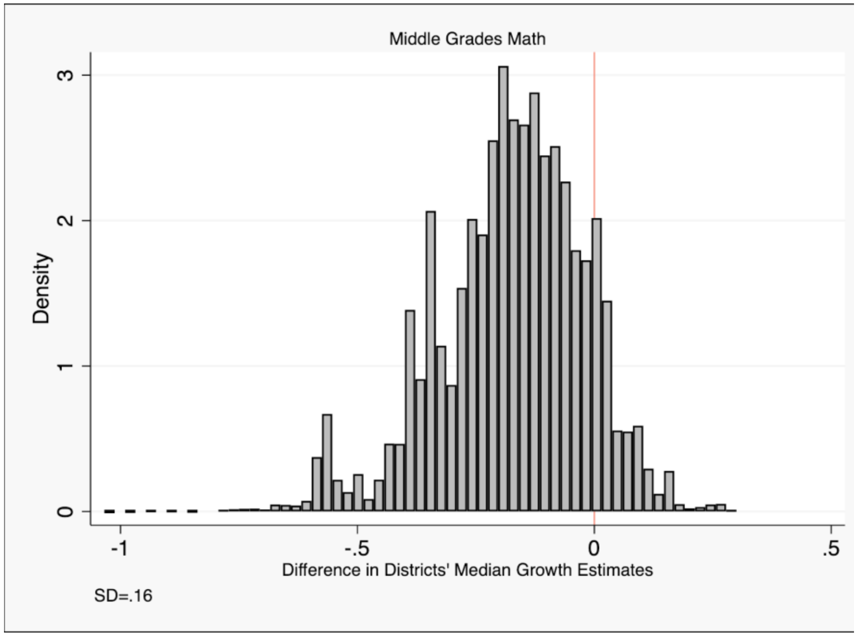
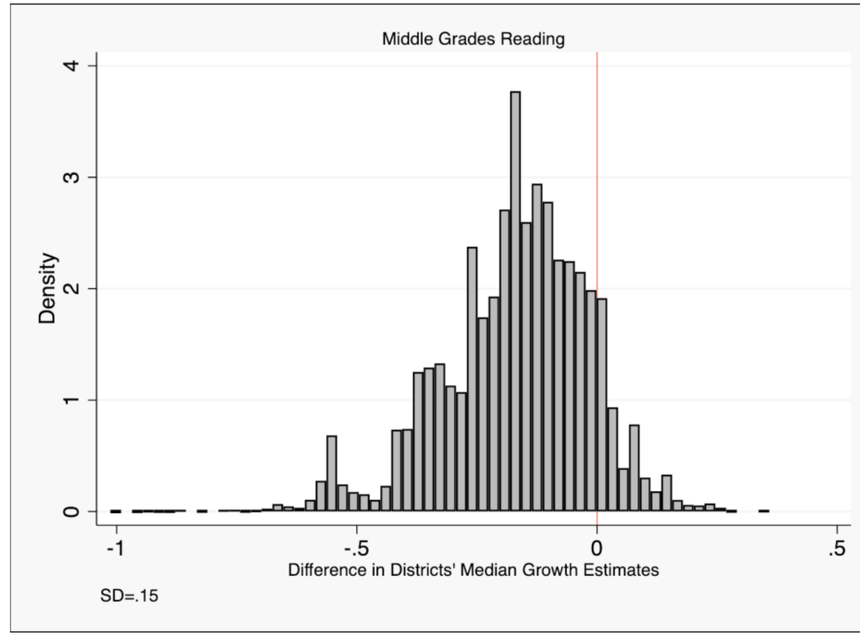


Figure 31: Histogram of the Districts' Differences in Median Growth Rates for Middle Grades





Tables

Table 1: Distribution of Math Test Scores by Year and Grade

	10th percentile	25th percentile	50th percentile	75th percentile	90th percentile
grade					
3					
year					
Fall 2018	-1.267	-0.565	0.083	0.665	1.179
Fall 2019	-1.321	-0.596	0.063	0.639	1.161
Fall 2020	-1.295	-0.575	0.077	0.665	1.190
Fall 2021	-1.715	-0.925	-0.170	0.484	1.042
4					
year					
Fall 2018	-1.231	-0.555	0.101	0.660	1.108
Fall 2019	-1.257	-0.570	0.089	0.656	1.111
Fall 2020	-1.268	-0.575	0.100	0.669	1.112
Fall 2021	-1.680	-0.939	-0.171	0.467	0.959
5					
year					
Fall 2018	-1.247	-0.544	0.103	0.662	1.196
Fall 2019	-1.261	-0.560	0.085	0.650	1.196
Fall 2020	-1.283	-0.574	0.082	0.642	1.178
Fall 2021	-1.642	-0.922	-0.187	0.451	0.999
6					
year					
Fall 2018	-1.304	-0.585	0.089	0.687	1.225
Fall 2019	-1.281	-0.596	0.070	0.667	1.204
Fall 2020	-1.278	-0.599	0.060	0.653	1.195
Fall 2021	-1.540	-0.856	-0.180	0.453	1.023
7					
year					
Fall 2018	-1.295	-0.596	0.089	0.714	1.256
Fall 2019	-1.284	-0.612	0.064	0.696	1.246
Fall 2020	-1.298	-0.627	0.050	0.681	1.237
Fall 2021	-1.500	-0.870	-0.200	0.439	1.015
8					
year					
Fall 2018	-1.292	-0.588	0.076	0.715	1.250
Fall 2019	-1.277	-0.600	0.061	0.706	1.240
Fall 2020	-1.298	-0.624	0.040	0.691	1.234
Fall 2021	-1.497	-0.882	-0.230	0.402	0.991

Table 2: Distribution of Reading Test Scores by Year and Grade

	10th percentile	25th percentile	50th percentile	75th percentile	90th percentile
grade					
3					
year					
Fall 2018	-1.459	-0.688	0.059	0.682	1.188
Fall 2019	-1.466	-0.728	0.027	0.663	1.188
Fall 2020	-1.422	-0.682	0.089	0.727	1.234
Fall 2021	-1.702	-0.943	-0.089	0.611	1.152
4					
year					
Fall 2018	-1.461	-0.658	0.044	0.652	1.146
Fall 2019	-1.453	-0.646	0.060	0.683	1.174
Fall 2020	-1.398	-0.578	0.116	0.705	1.183
Fall 2021	-1.662	-0.817	-0.047	0.587	1.089
5					
year					
Fall 2018	-1.400	-0.619	0.088	0.697	1.176
Fall 2019	-1.396	-0.607	0.109	0.719	1.185
Fall 2020	-1.322	-0.555	0.119	0.700	1.159
Fall 2021	-1.595	-0.767	-0.034	0.581	1.065
6					
year					
Fall 2018	-1.407	-0.630	0.059	0.656	1.142
Fall 2019	-1.459	-0.670	0.079	0.682	1.176
Fall 2020	-1.311	-0.562	0.119	0.686	1.160
Fall 2021	-1.514	-0.725	0.008	0.608	1.103
7					
year					
Fall 2018	-1.390	-0.611	0.103	0.704	1.188
Fall 2019	-1.413	-0.613	0.116	0.726	1.222
Fall 2020	-1.322	-0.559	0.119	0.689	1.166
Fall 2021	-1.503	-0.706	0.015	0.612	1.116
8					
year					
Fall 2018	-1.369	-0.580	0.126	0.718	1.197
Fall 2019	-1.382	-0.561	0.150	0.755	1.239
Fall 2020	-1.308	-0.545	0.113	0.686	1.161
Fall 2021	-1.490	-0.687	0.012	0.619	1.128

Table 3: List of District Initiatives by Grade Level

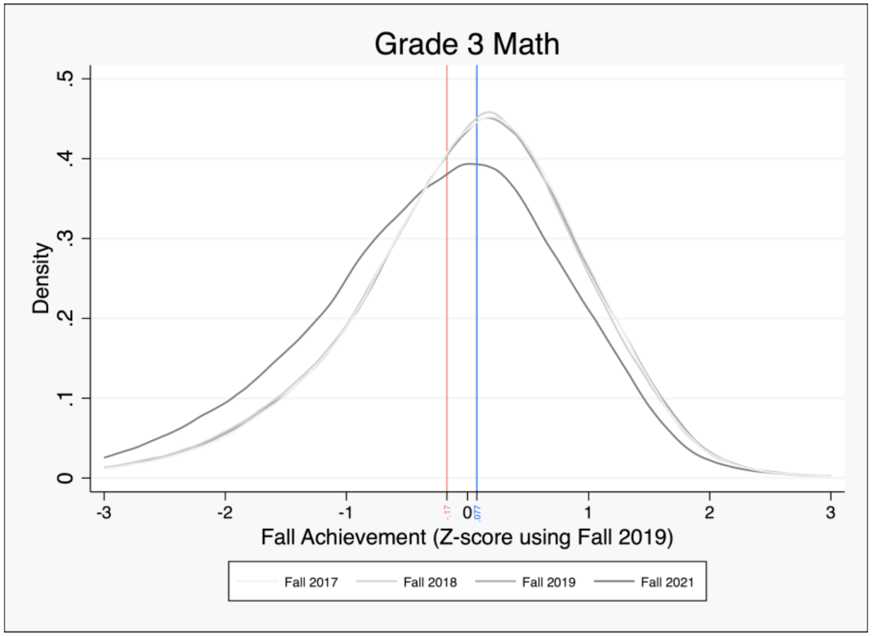
Recovery Initiative Type	Grades Targeted by Initiative		Total Districts
Additional instructional block ("double dosing")			
Math	n/a	6 to 8	1
Extended school year and/or intersessions			
Math and literacy	K to 8	K to 8	3
Intervention time (push-in/pull-out)			
Math	n/a	K to 8	3
Literacy	n/a	K to 8	4
Out-of-school time programming[1]			
Math	n/a	3 to 5	1
Math and literacy	n/a	K to 8	5
Summer learning			
Math and literacy	K to 8	K to 8	10
Tutoring			
Math	K to 8	K to 8	6
Literacy	K to 8	K to 8	5
Virtual learning			
Math	K to 8	K to 8	6
Literacy	K to 8	K to 8	5

[1] After school, before school, and/or Saturdays

Note: This table includes the 10 districts we had completed interviews with by January 2022.

Appendix A
Figures

Figure A1: Distribution of Math and Reading Test Scores for Grade 3 (2017-2021)



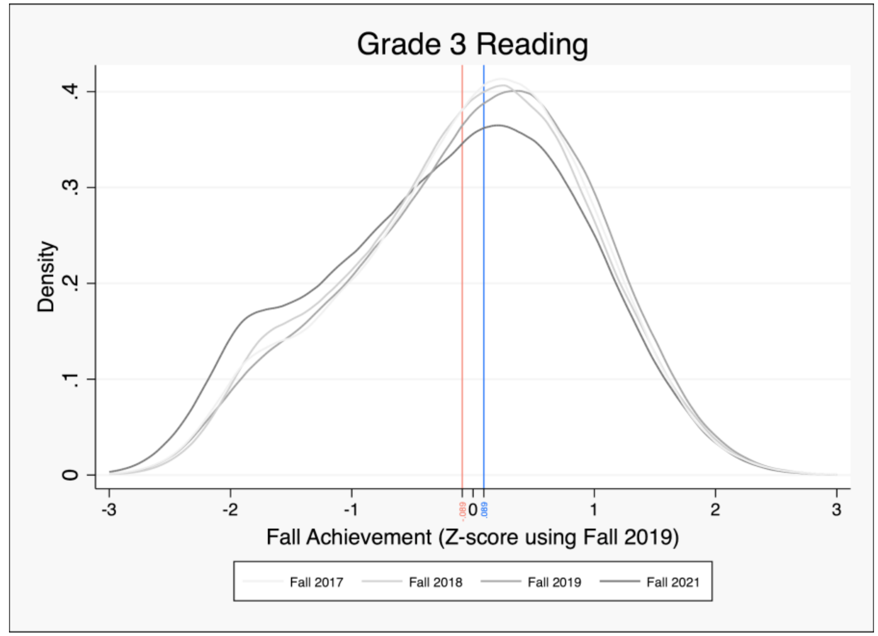


Figure A2: Distribution of Math and Reading Test Scores for Grade 4 (2017-2021)

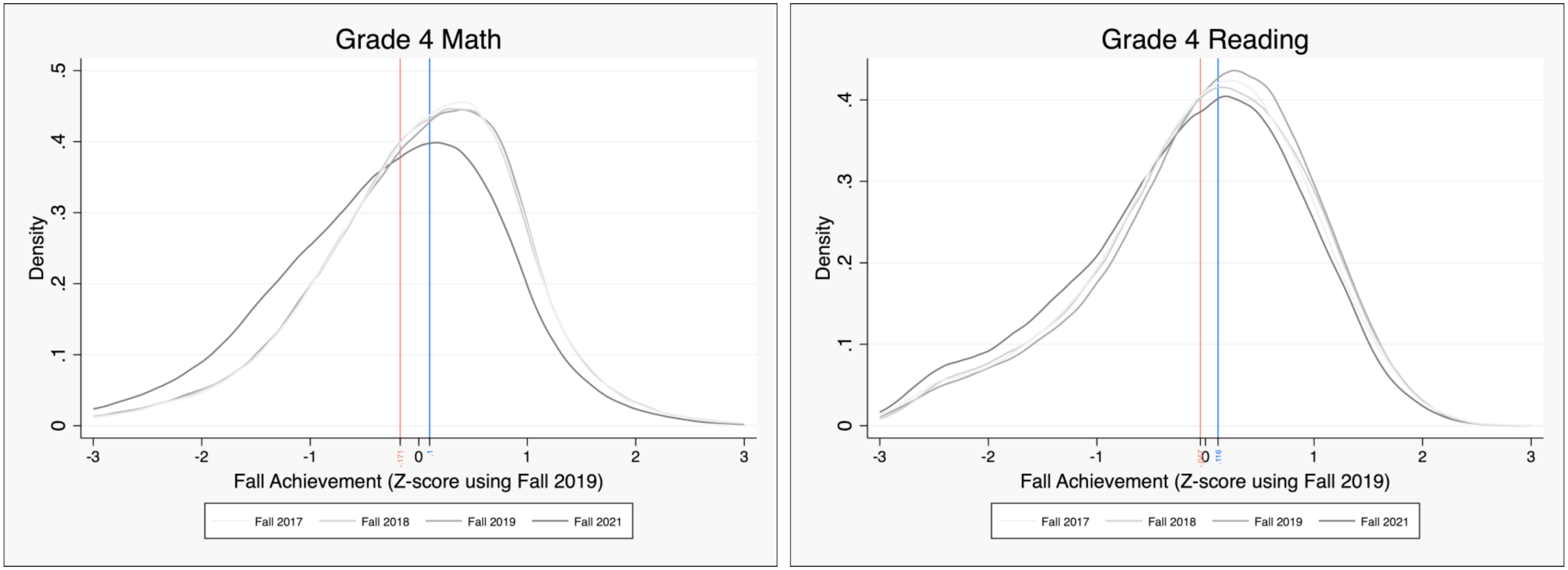
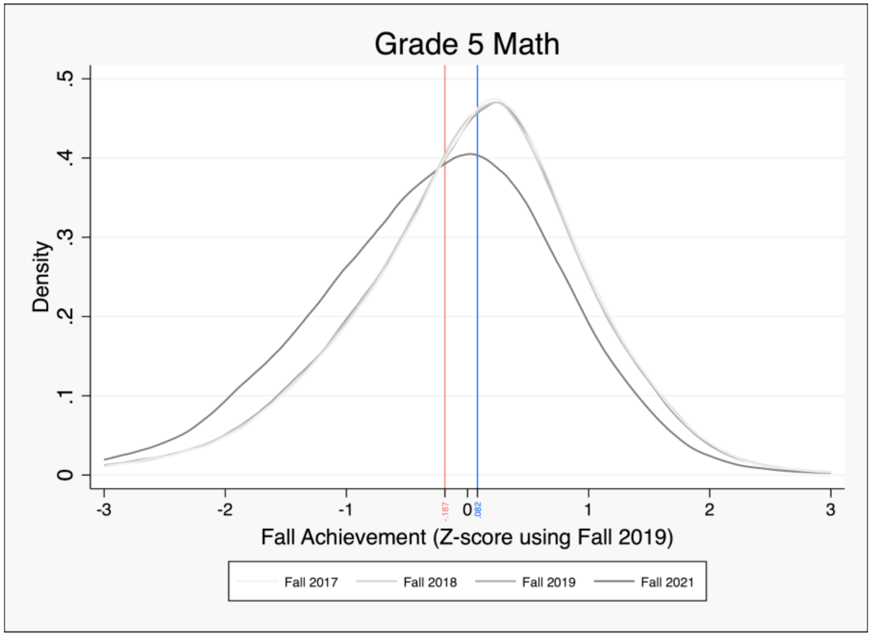


Figure A3: Distribution of Math and Reading Test Scores for Grade 5 (2017-2021)



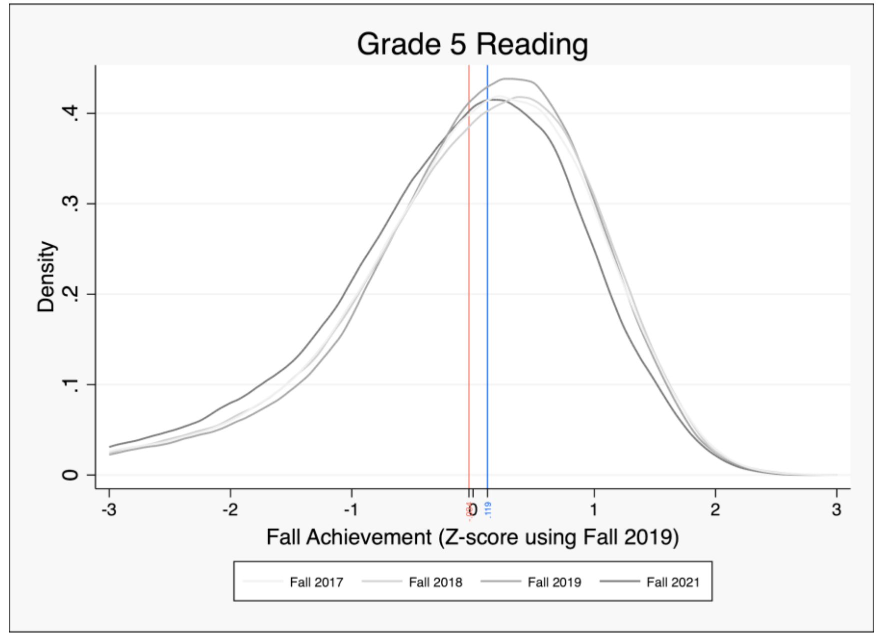
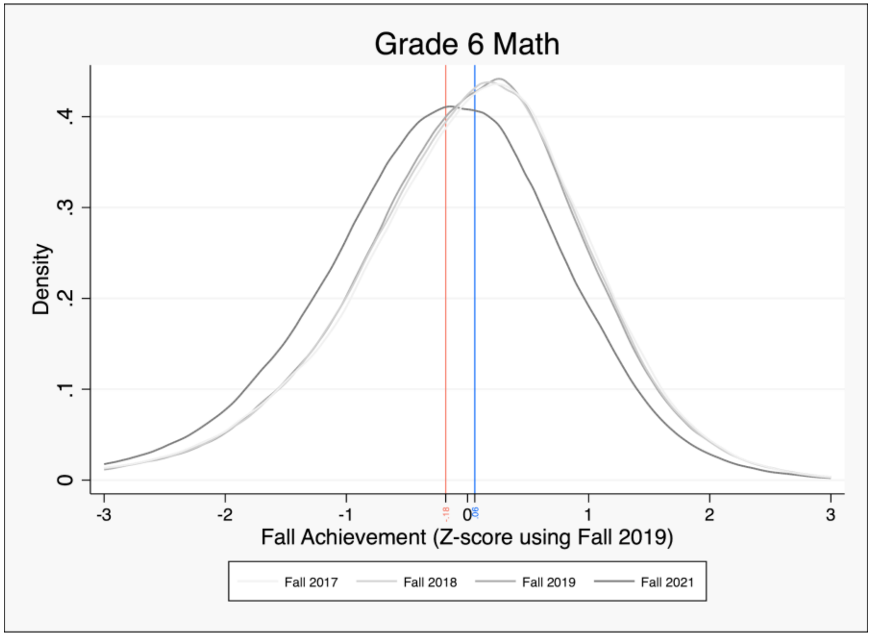


Figure A4: Distribution of Math and Reading Test Scores for Grade 6 (2017-2021)



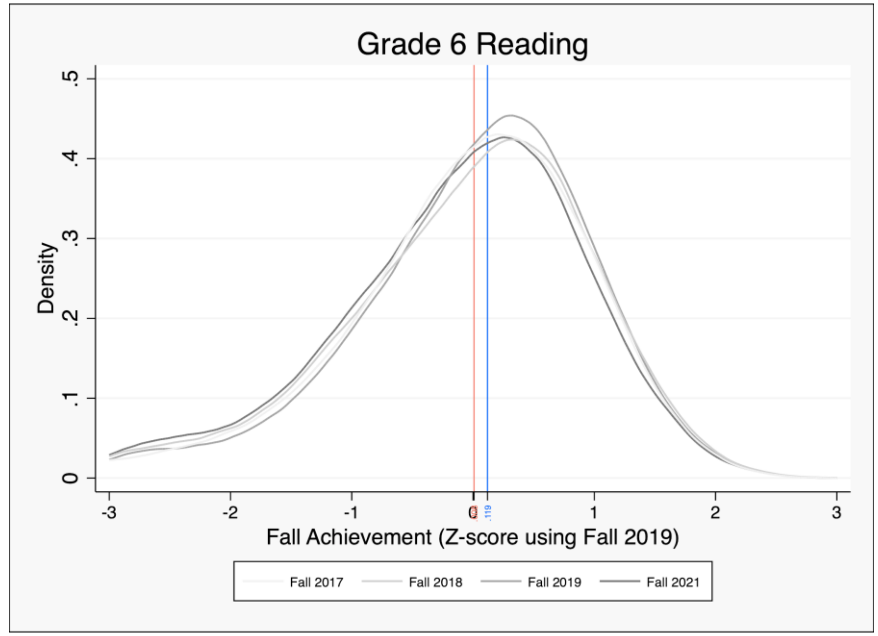
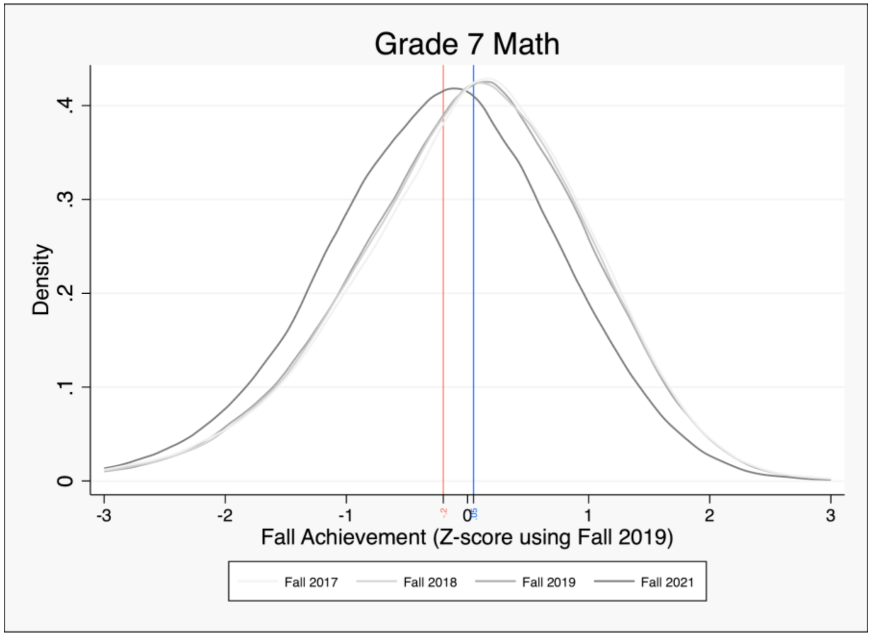


Figure A5: Distribution of Math and Reading Test Scores for Grade 7 (2017-2021)



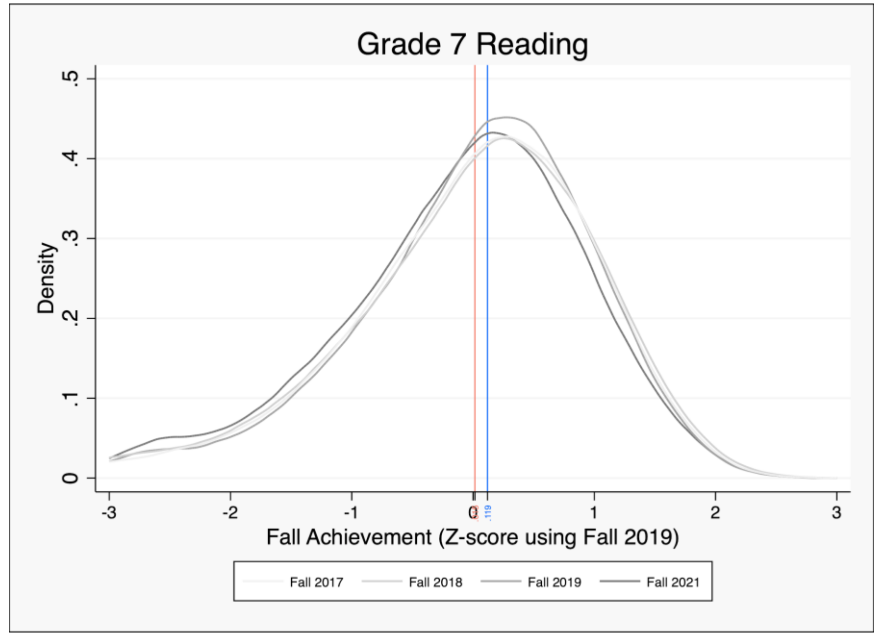
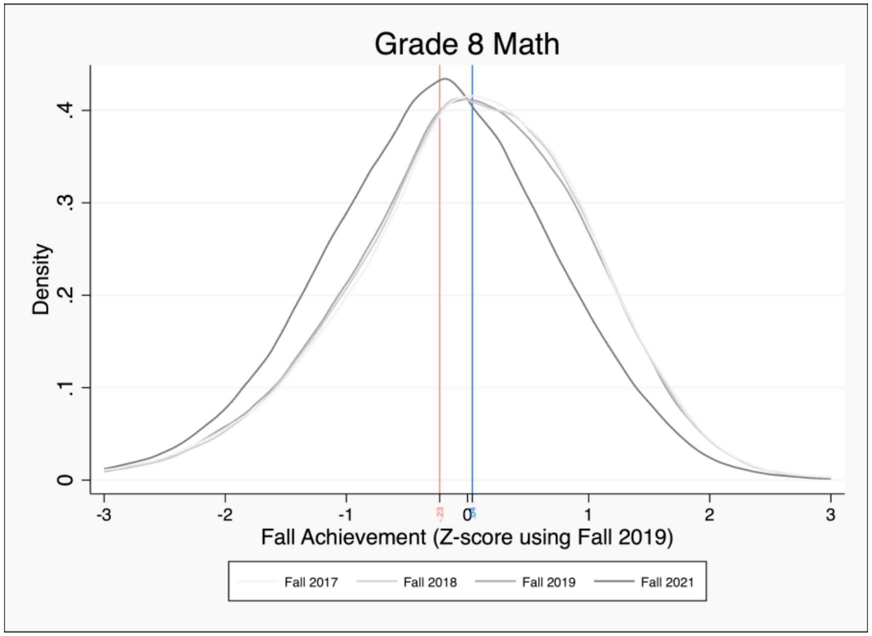


Figure A6: Distribution of Math and Reading Test Scores for Grade 8 (2017-2021)



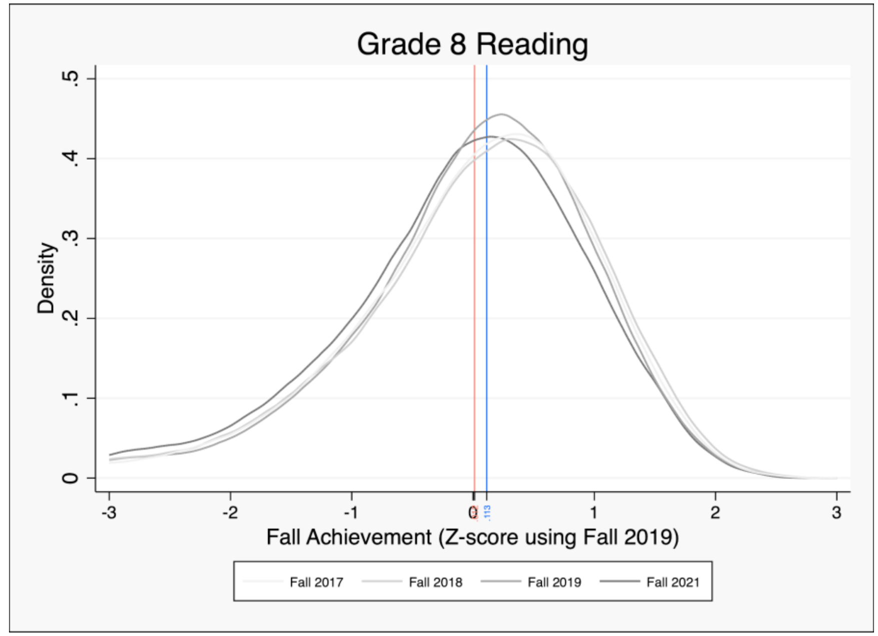
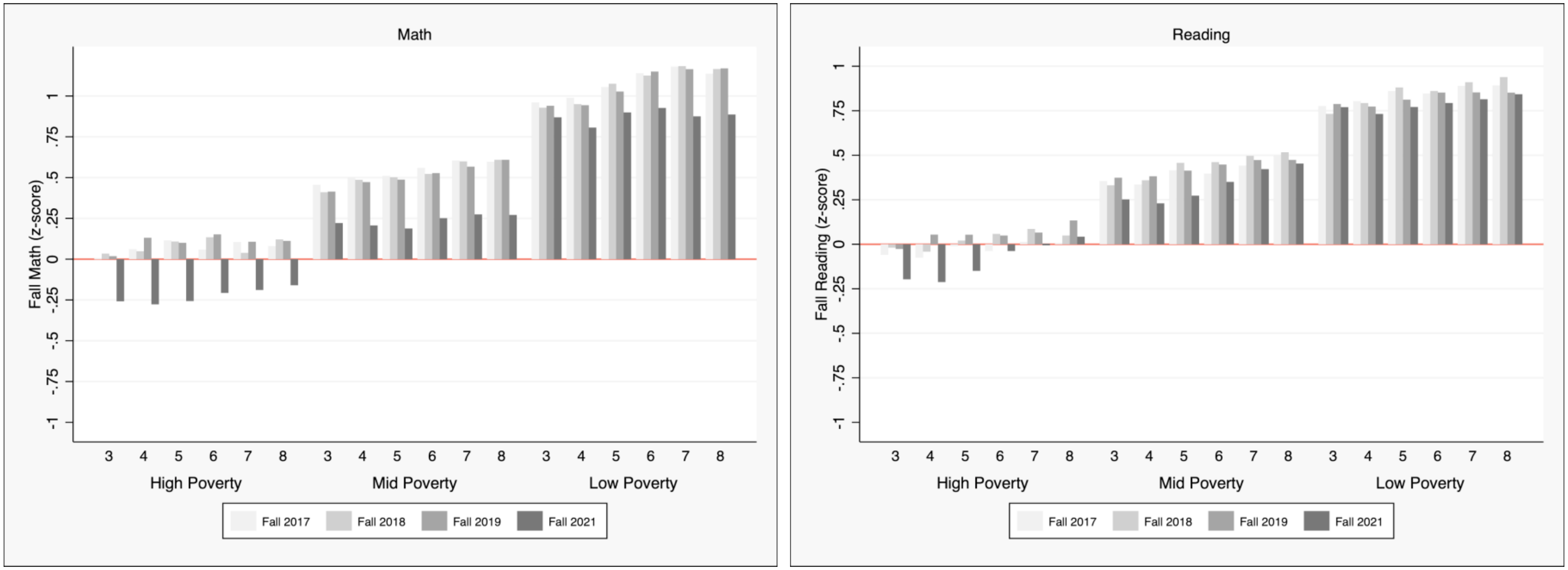
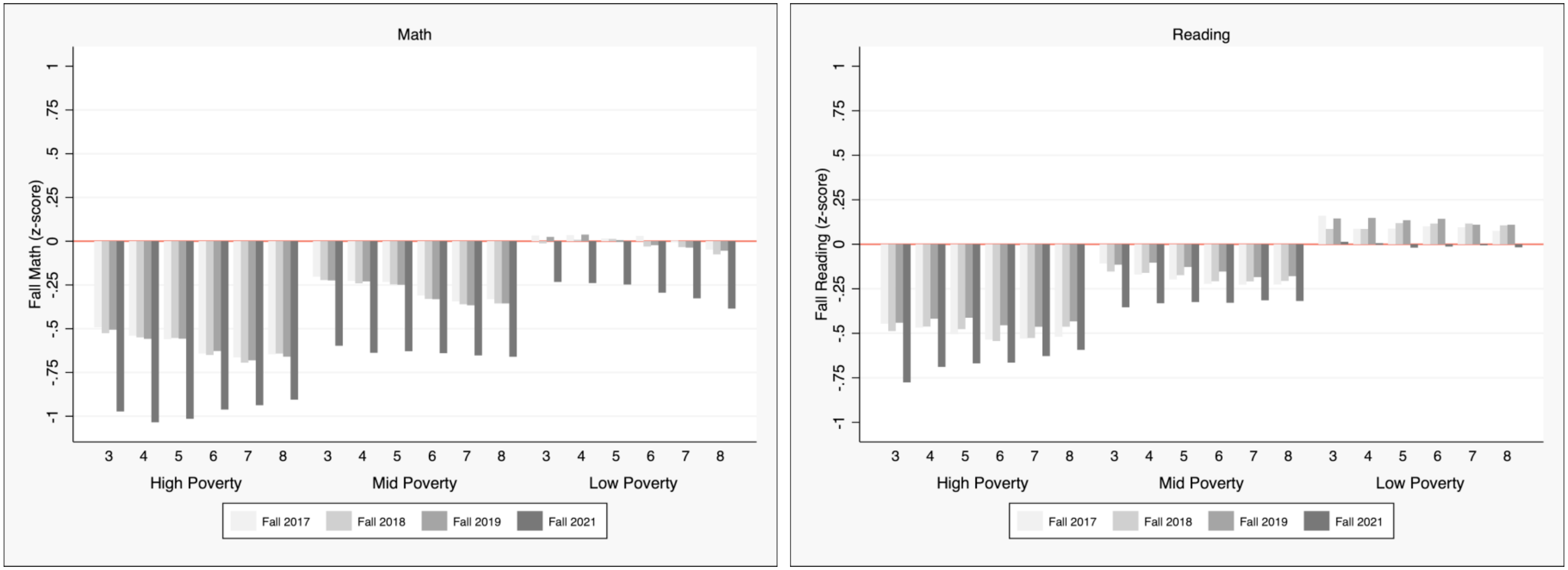


Figure A7: Trends in Median Math and Reading Achievement for Asian Students by School Poverty Level and Grade (2017-2021)



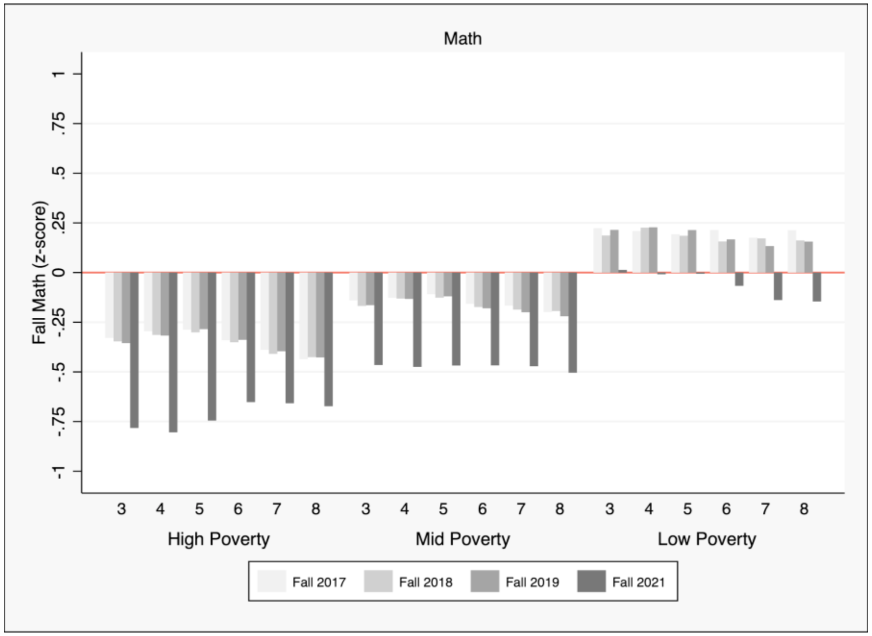
Note: Low poverty schools have less than 25% of students eligible for free or reduced-price lunch; Mid-poverty schools have 25-75% of students eligible for free or reduced-price lunch; and high poverty schools have more than 75% of students eligible for free or reduced-price lunch.

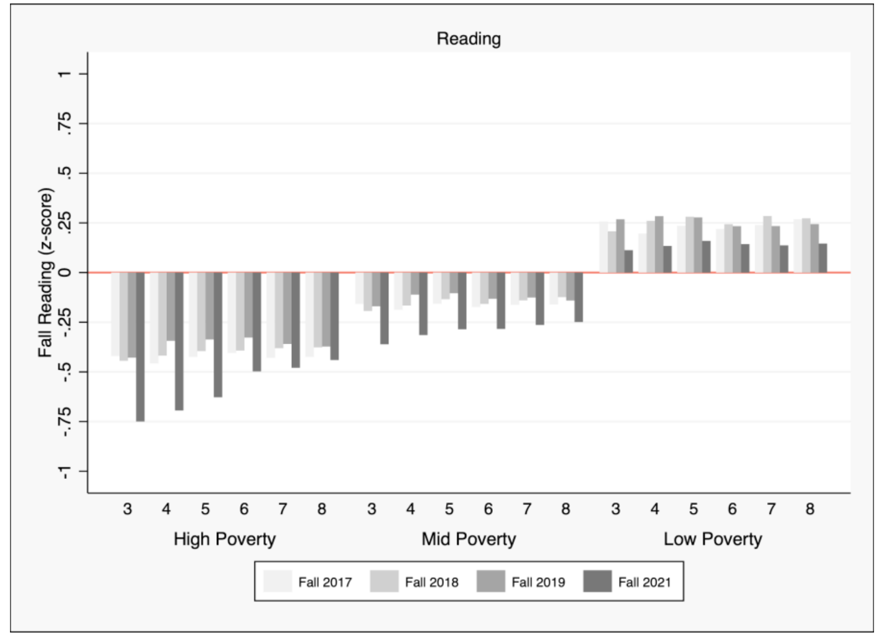
Figure A8: Trends in Median Math and Reading Achievement for Black Students by School Poverty Level and Grade (2017-2021)



Note: Low poverty schools have less than 25% of students eligible for free or reduced-price lunch; Mid-poverty schools have 25-75% of students eligible for free or reduced-price lunch; and high poverty schools have more than 75% of students eligible for free or reduced-price lunch.

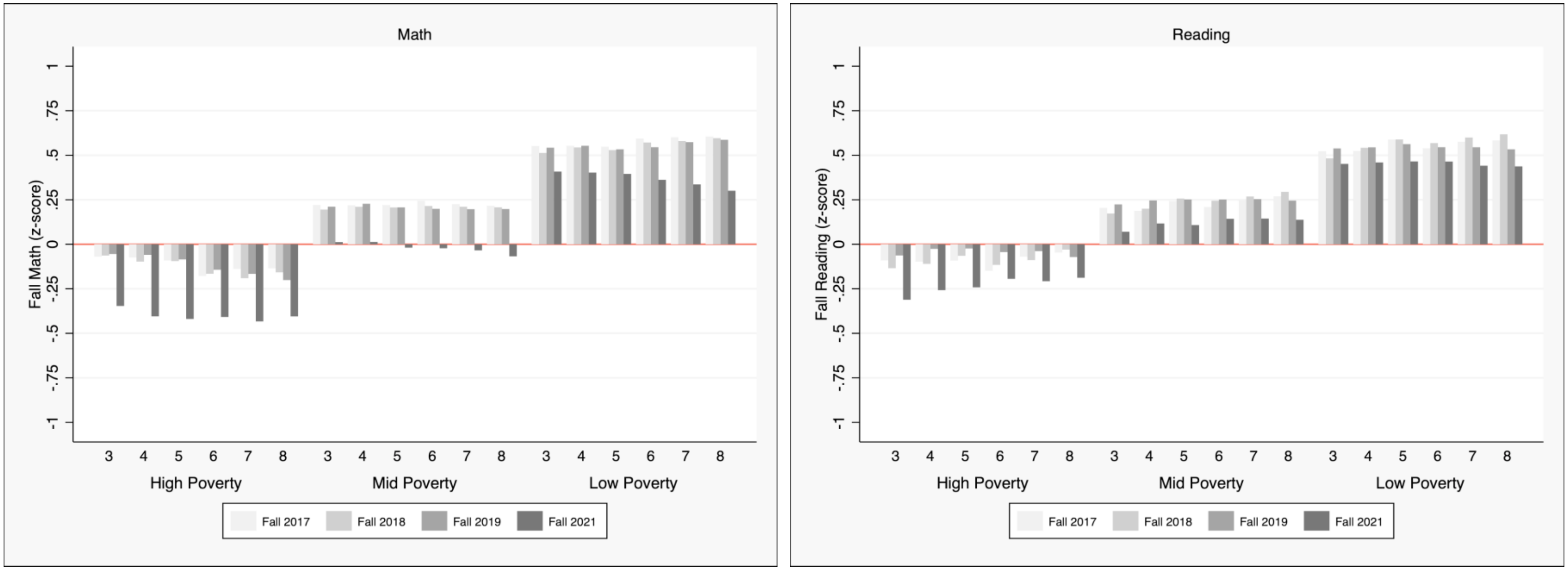
Figure A9: Trends in Median Math and Reading Achievement for Hispanic Students by School Poverty Level and Grade (2017- 2021)





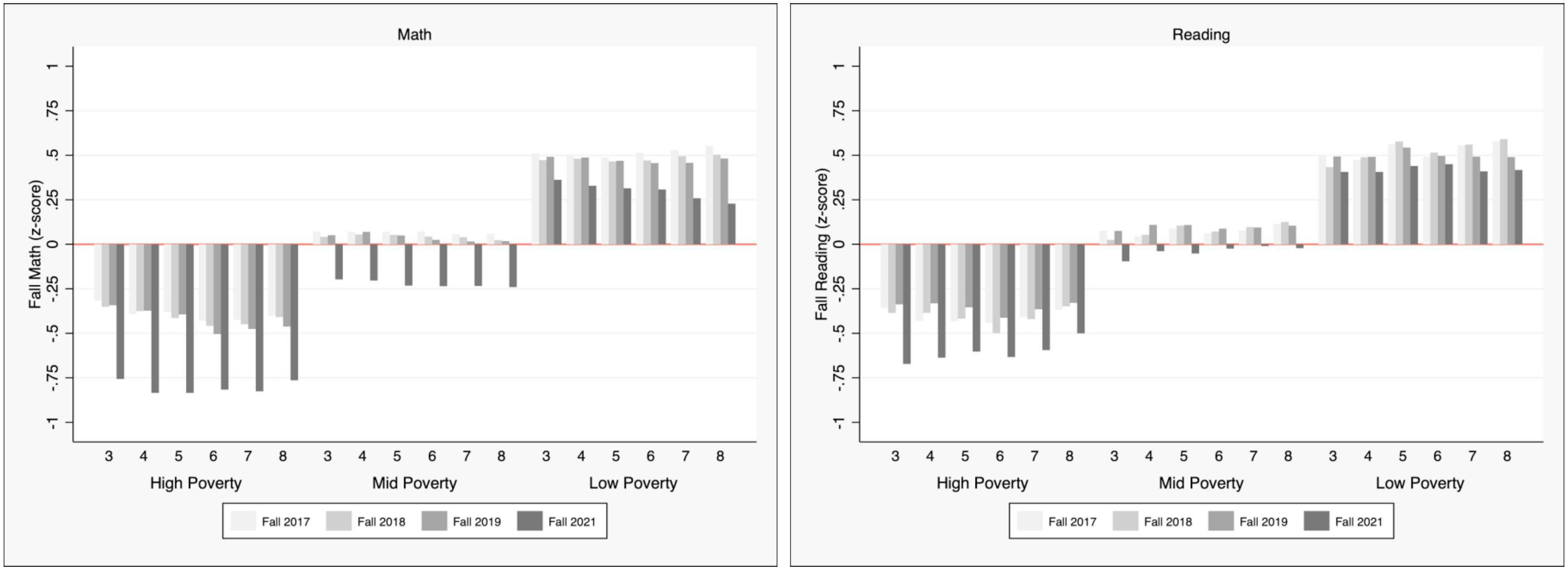
Note: Low poverty schools have less than 25% of students eligible for free or reduced-price lunch; Mid-poverty schools have 25-75% of students eligible for free or reduced-price lunch; and high poverty schools have more than 75% of students eligible for free or reduced-price lunch.

Figure A10: Trends in Median Math and Reading Achievement for White Students by School Poverty and Grade Level (2017- 2021)



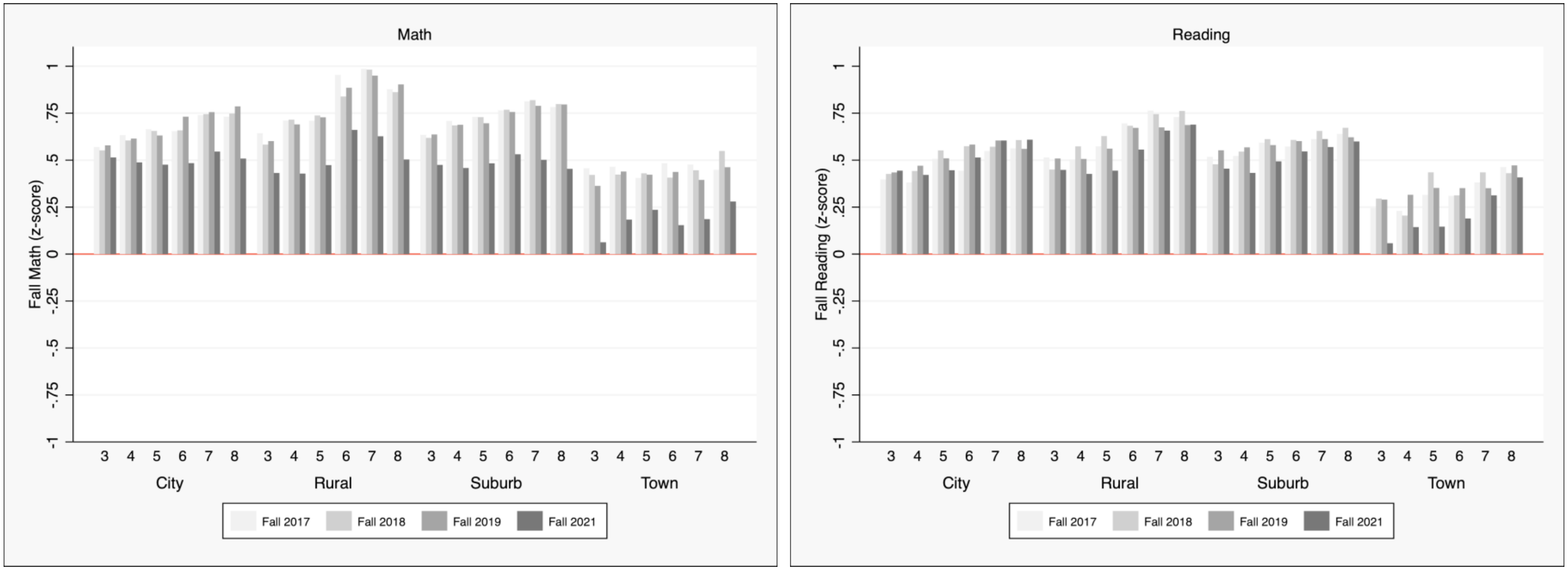
Note: Low poverty schools have less than 25% of students eligible for free or reduced-price lunch; Mid-poverty schools have 25-75% of students eligible for free or reduced-price lunch; and high poverty schools have more than 75% of students eligible for free or reduced-price lunch.

Figure A11: Trends in Median Math and Reading Achievement for Other Students by School Poverty Level and Grade (2017-2021)



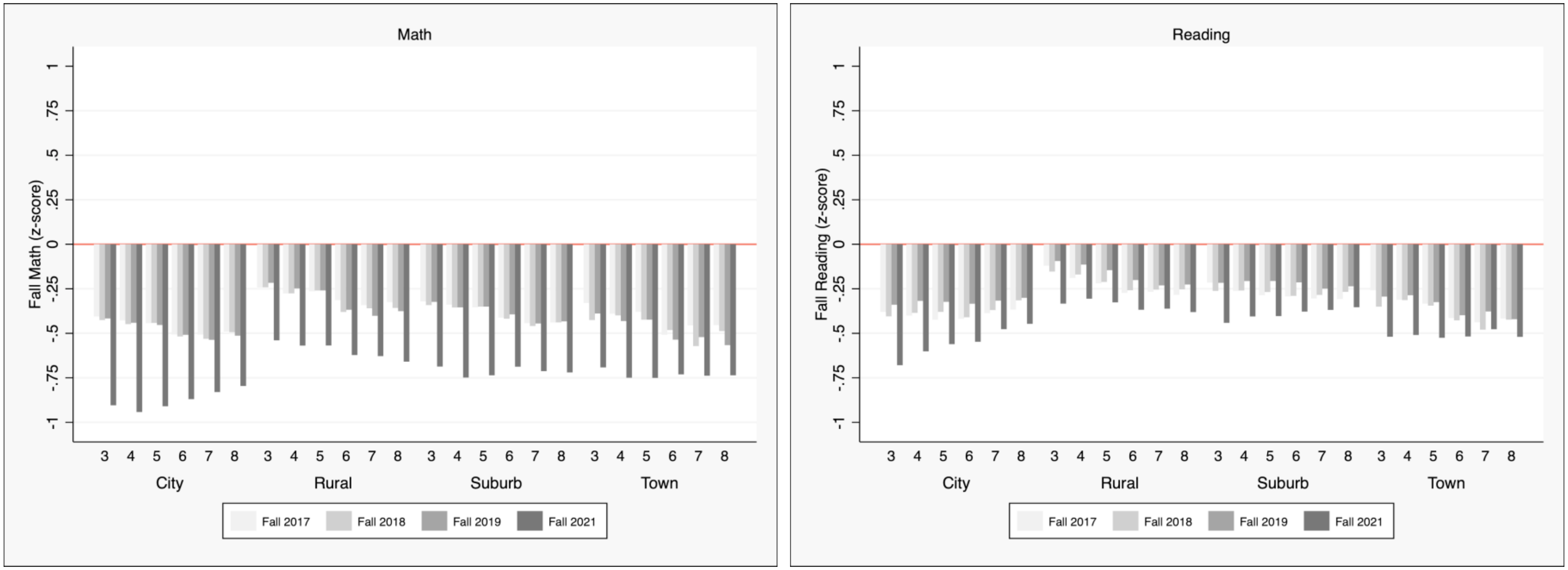
Note: Low poverty schools have less than 25% of students eligible for free or reduced-price lunch; Mid-poverty schools have 25-75% of students eligible for free or reduced-price lunch; and high poverty schools have more than 75% of students eligible for free or reduced-price lunch; this figure shows distribution of math and reading test scores for students who identify as a race other than Asian, Black, Hispanic, or White.

Figure A12: Trends in Median Math and Reading Achievement for Asian Students by School Urbanicity and Grade (2017-2021)



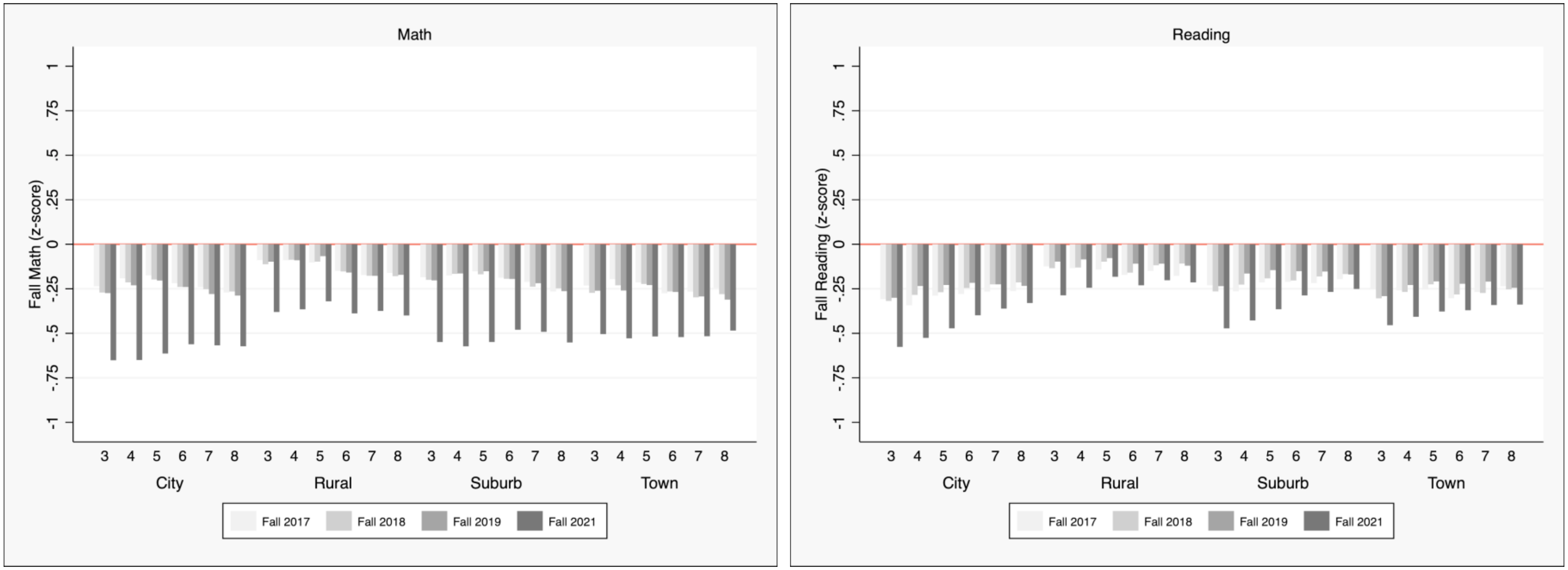
Note: Urbanicity categories are defined according to the Congressional District Code (CDC). For more information, see https://nces.ed.gov/ccd/pdf/INsc09101a.pdf; city refers to territories inside an urbanized area and inside a principal city; rural refers to a census-defined rural territory that is not in an urbanized area or urban cluster; suburb refers to a territory outside a principal city and inside an urbanized area; and town refers to a territory inside an urban cluster that is at least 10 miles from an urbanized area.

Figure A13: Trends in Median Math and Reading Achievement for Black Students by School Urbanicity and Grade in (2017-2021)



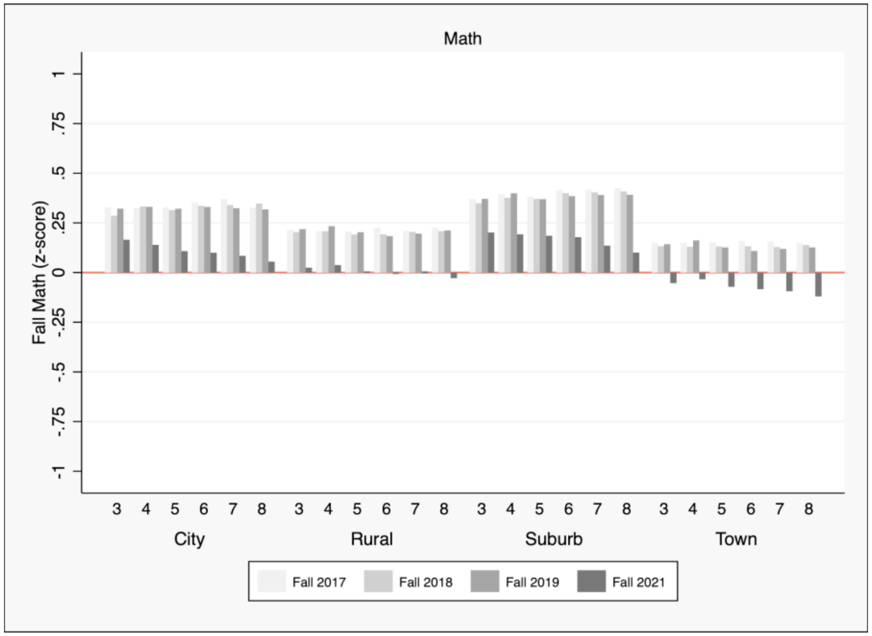
Note: Urbanicity categories are defined according to the Congressional District Code (CDC). For more information, see https://nces.ed.gov/ccd/pdf/INsc09101a.pdf; city refers to territories inside an urbanized area and inside a principal city; rural refers to a census-defined rural territory that is not in an urbanized area or urban cluster; suburb refers to a territory outside a principal city and inside an urbanized area; and town refers to a territory inside an urban cluster that is at least 10 miles from an urbanized area.

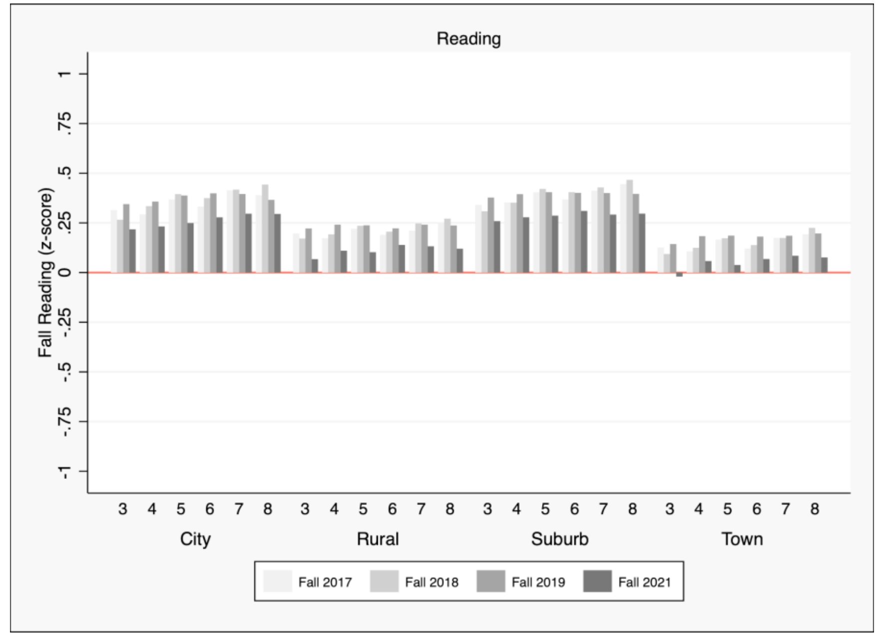
Figure A14: Trends in Median Math and Reading Achievement for Hispanic Students by School Urbanicity and Grade in (2017-2021)



Note: Urbanicity categories are defined according to the Congressional District Code (CDC). For more information, see https://nces.ed.gov/ccd/pdf/INsc09101a.pdf; city refers to territories inside an urbanized area and inside a principal city; rural refers to a census-defined rural territory that is not in an urbanized area or urban cluster; suburb refers to a territory outside a principal city and inside an urbanized area; and town refers to a territory inside an urban cluster that is at least 10 miles from an urbanized area.

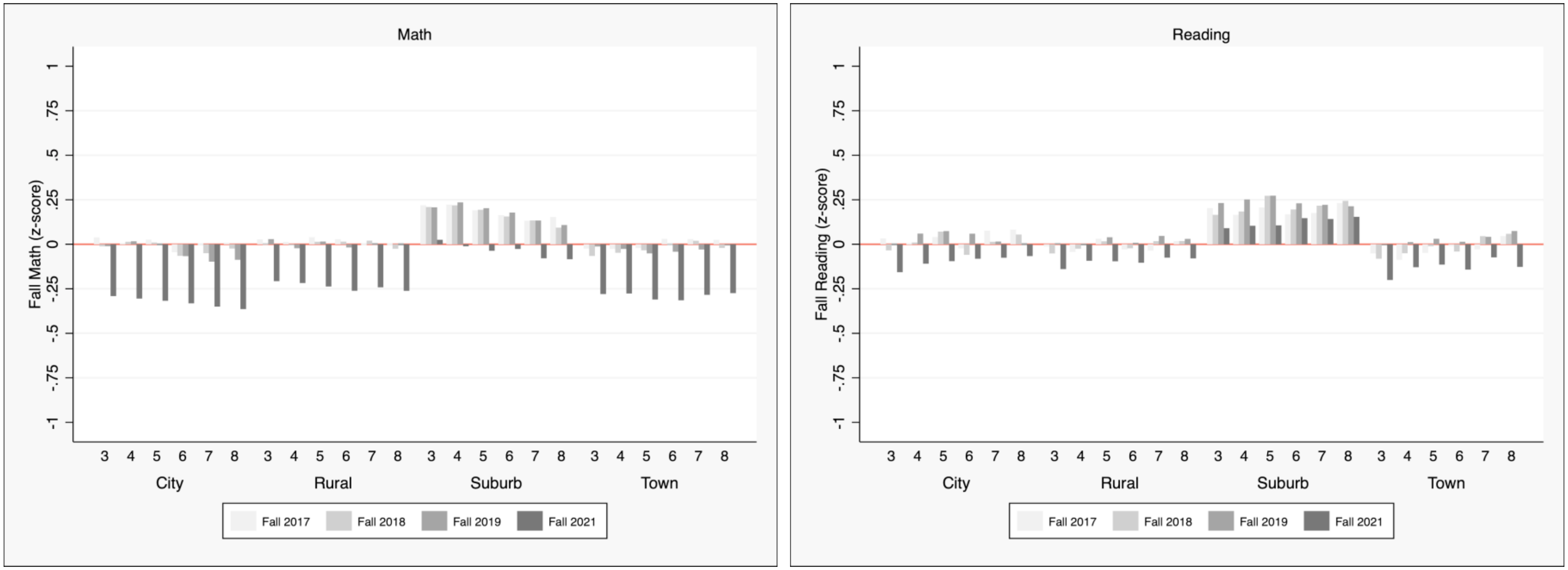
Figure A15: Trends in Median Math and Reading Achievement for White Students by School Urbanicity and Grade in (2017-2021)





Note: Urbanicity categories are defined according to the Congressional District Code (CDC). For more information, see https://nces.ed.gov/ccd/pdf/INsc09101a.pdf; city refers to territories inside an urbanized area and inside a principal city; rural refers to a census-defined rural territory that is not in an urbanized area or urban cluster; suburb refers to a territory outside a principal city and inside an urbanized area; and town refers to a territory inside an urban cluster that is at least 10 miles from an urbanized area.

Figure A16: Trends in Median Math and Reading Achievement for Other Students by School Urbanicity and Grade in (2017-2021)



Note: Urbanicity categories are defined according to the Congressional District Code (CDC). For more information, see https://nces.ed.gov/ccd/pdf/INsc09101a.pdf; city refers to territories inside an urbanized area and inside a principal city; rural refers to a census-defined rural territory that is not in an urbanized area or urban cluster; suburb refers to a territory outside a principal city and inside an urbanized area; and town refers to a territory inside an urban cluster that is at least 10 miles from an urbanized area; this figure shows distribution of math and reading test scores for students who identify as a race other than Asian, Black, Hispanic, or White.

Figure A17: Distributional Differences in Achievement Levels for Asian Students in Elementary Grades, from Fall 2019 and 2021

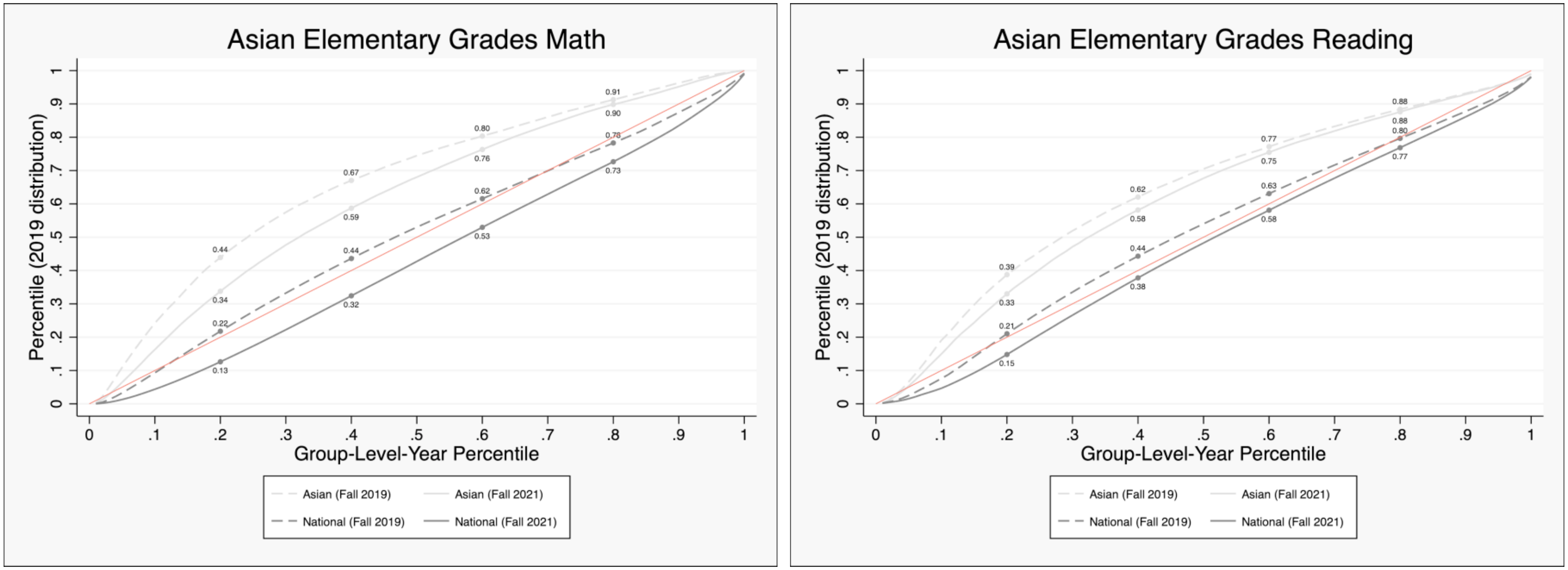
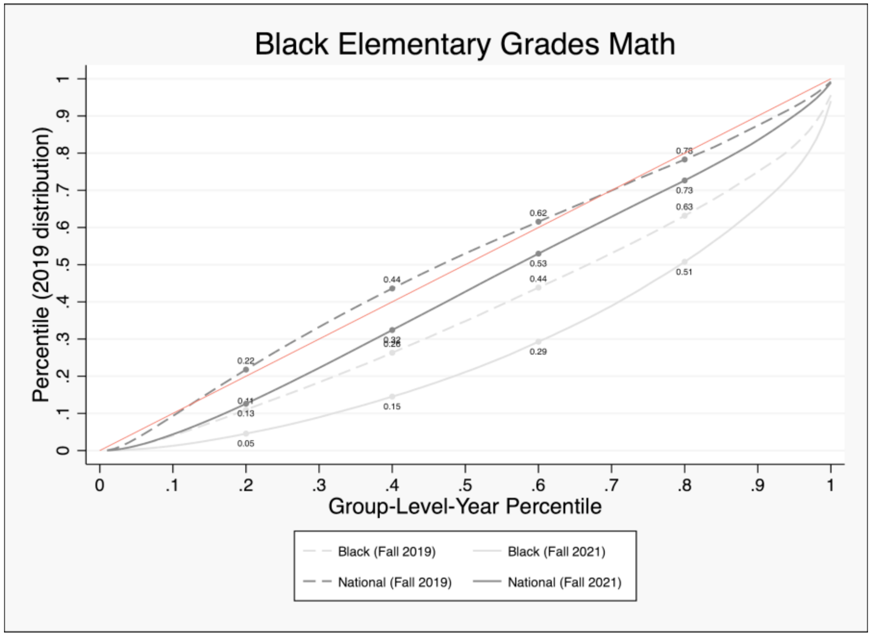


Figure A18: Distributional Differences in Achievement Levels for Black Students in Elementary Grades, from Fall 2019 and 2021



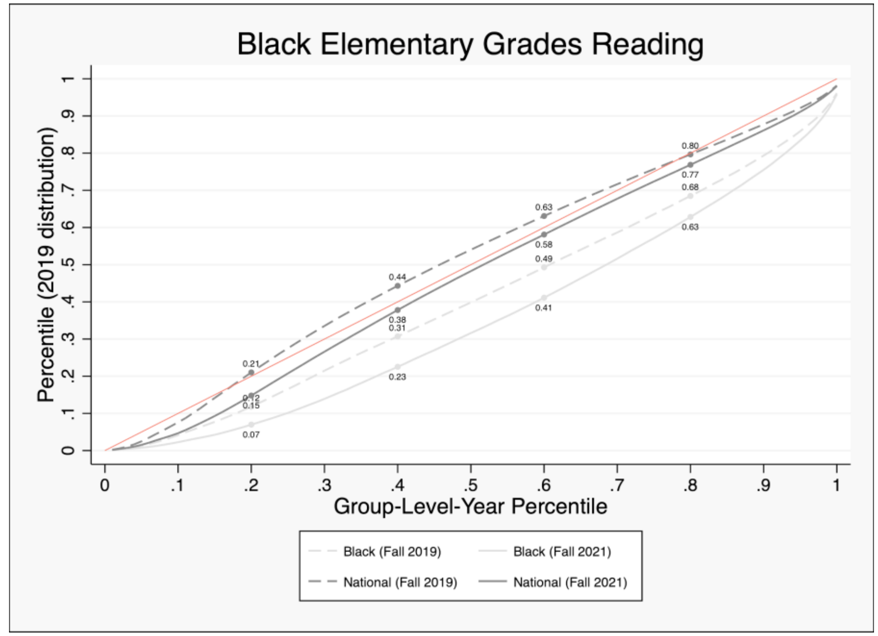
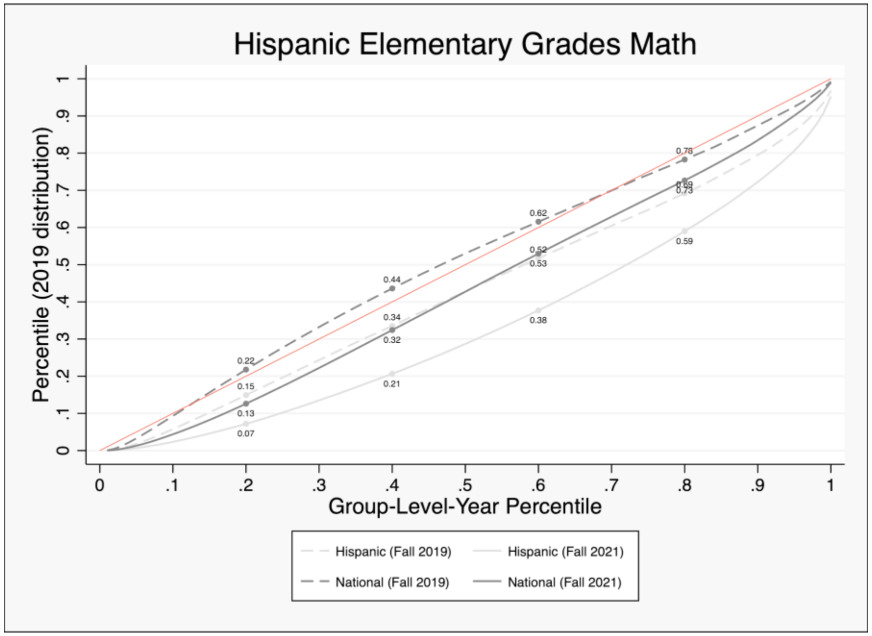


Figure A19: Distributional Differences in Achievement Levels for Hispanic Students in Elementary Grades, from Fall 2019 and 2021



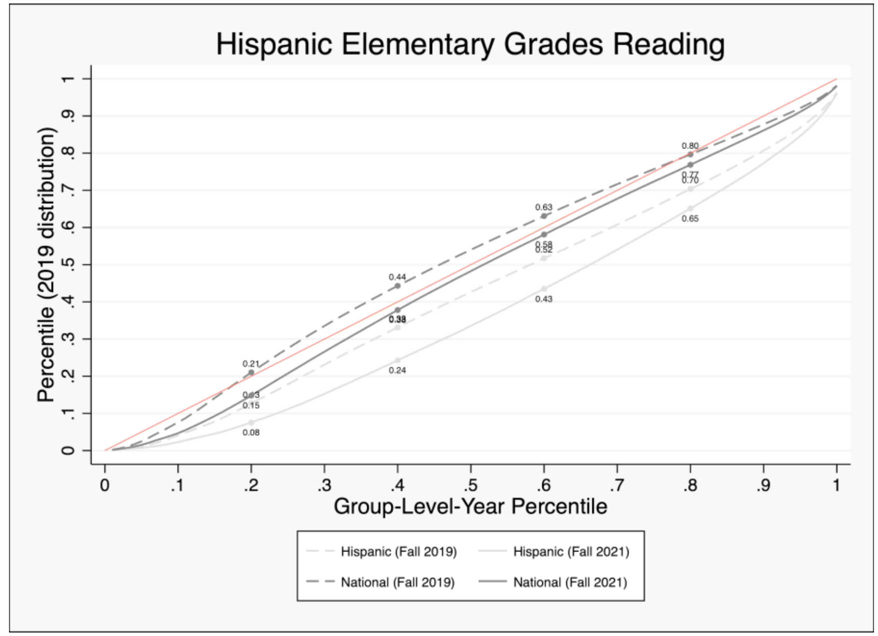


Figure A20: Distributional Differences in Achievement Levels for White Students in Elementary Grades, from Fall 2019 and 2021

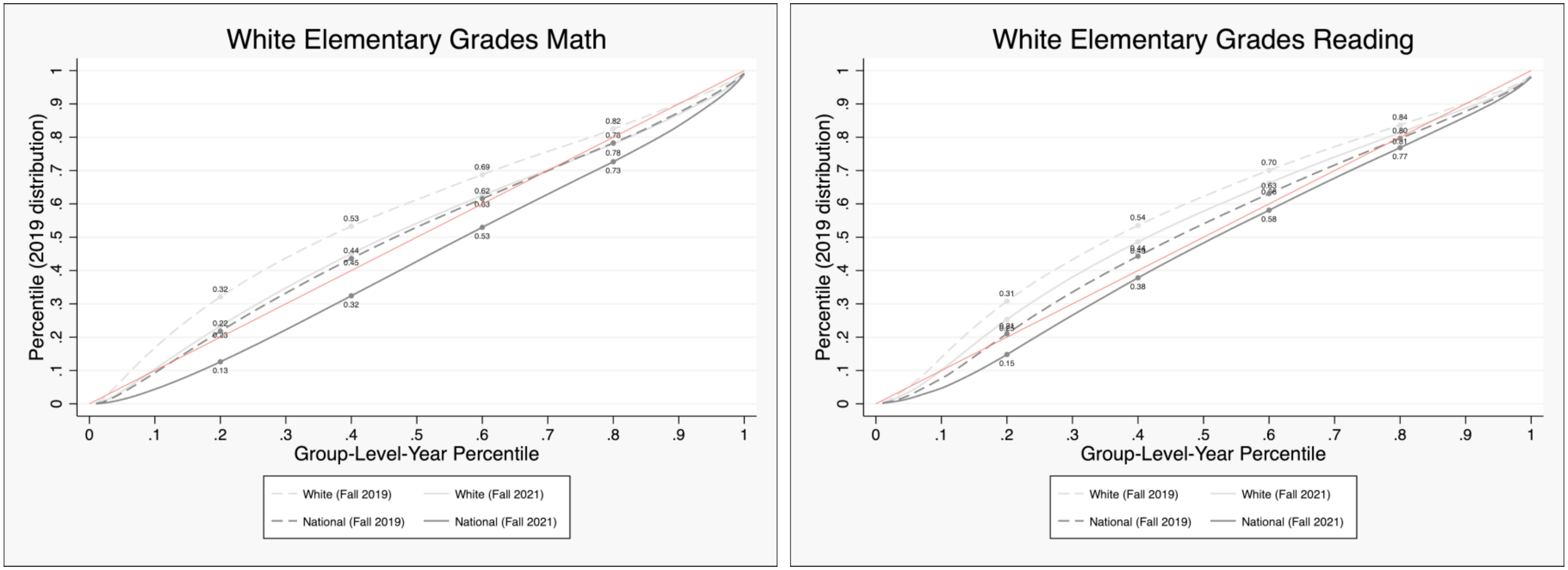
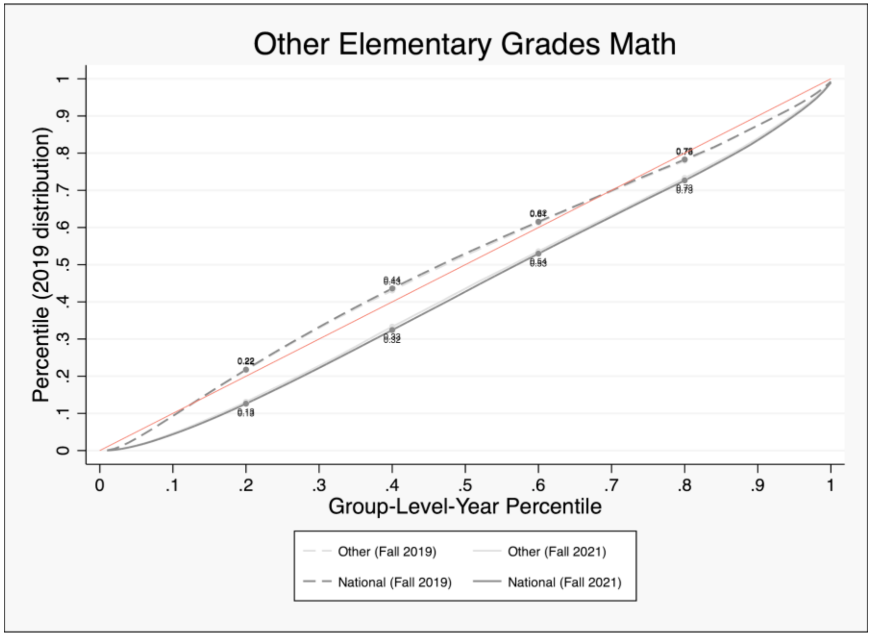
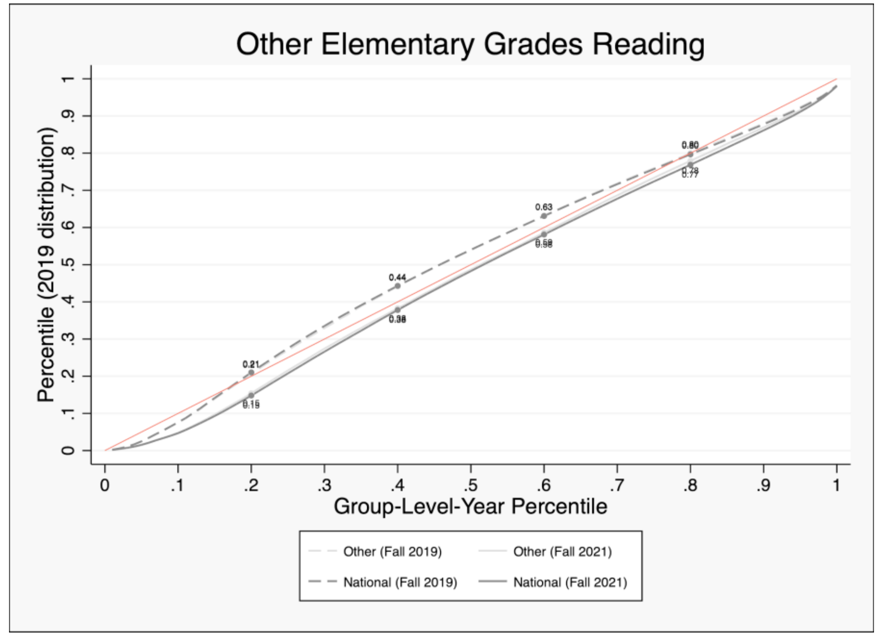


Figure A21: Distributional Differences in Achievement Levels for Other Students in Elementary Grades, from Fall 2019 and 2021





Note: This figure shows distributional differences in achievement levels for students who identify as a race other than Asian, Black, Hispanic, or White.

Figure A22: Distributional Differences in Achievement Levels for Asian Students in Middle Grades, from Fall 2019 and 2021

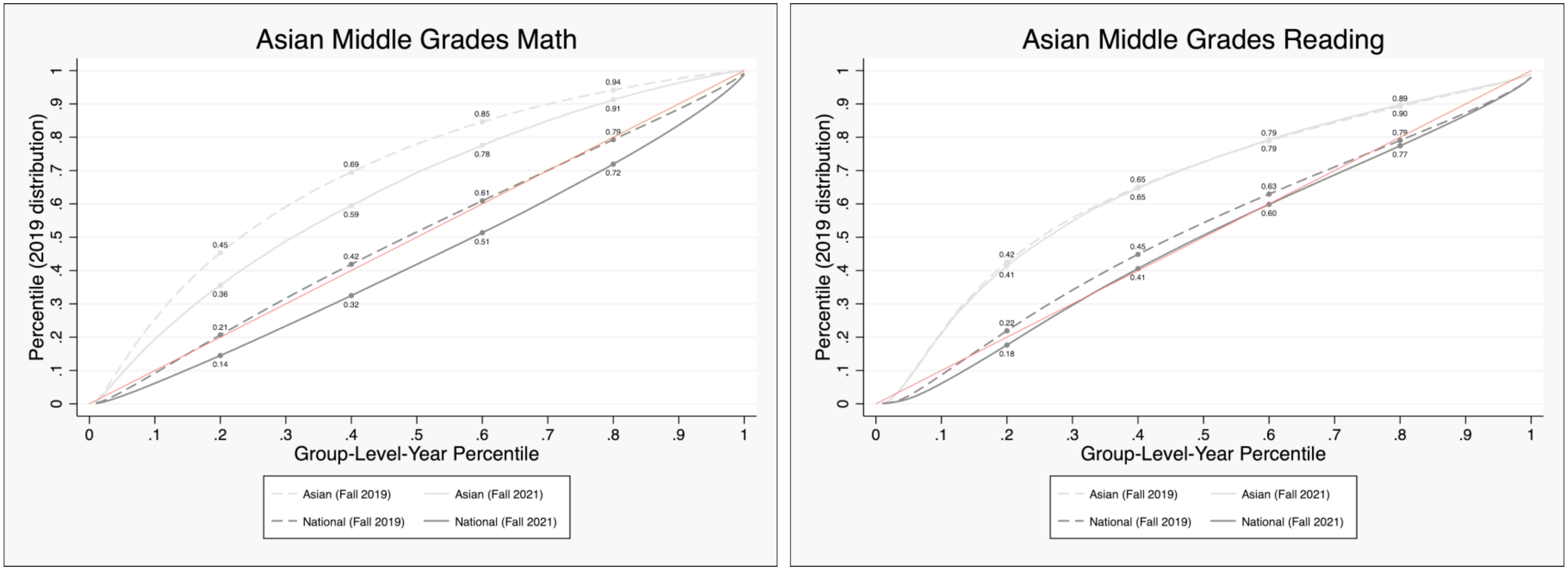


Figure A23: Distributional Differences in Achievement Levels for Black Students in Middle Grades, from Fall 2019 and 2021

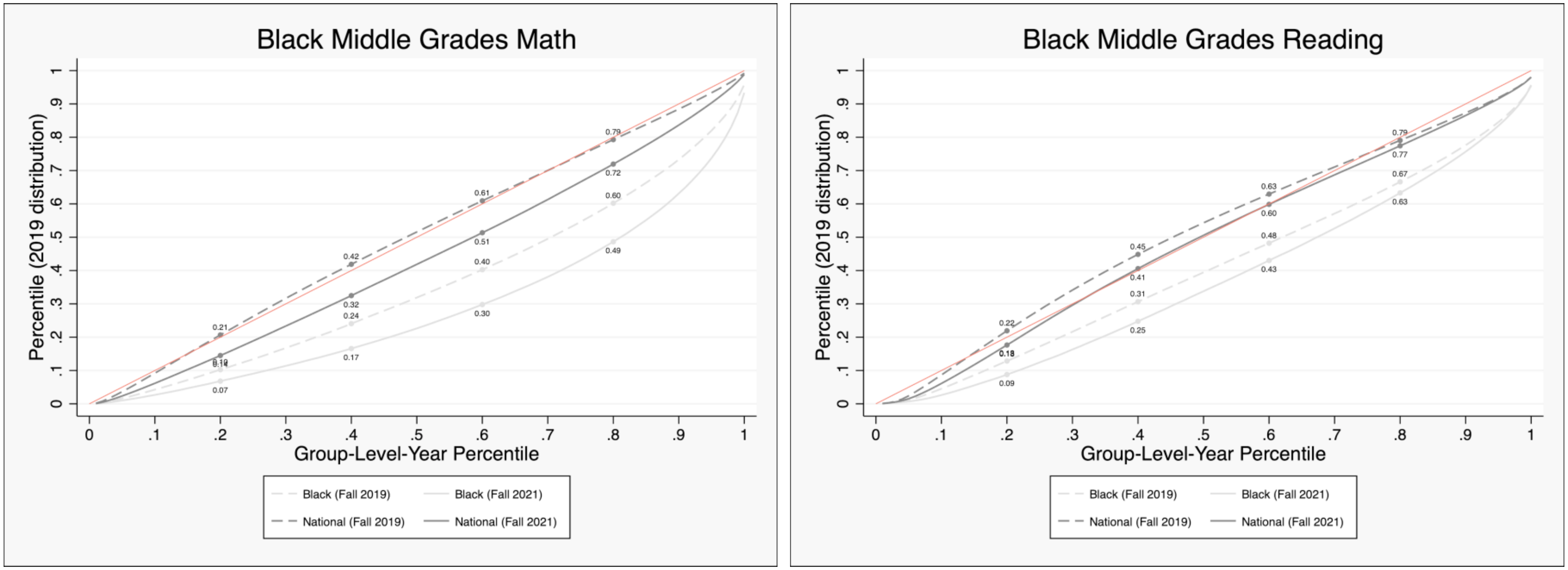
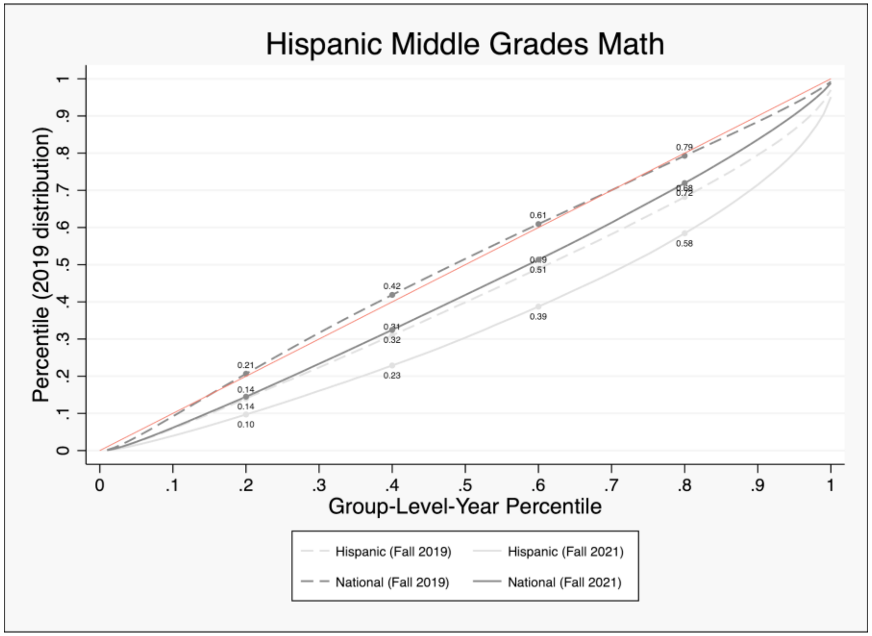


Figure A24: Distributional Differences in Achievement Levels for Hispanic Students in Middle Grades, from Fall 2019 and 2021



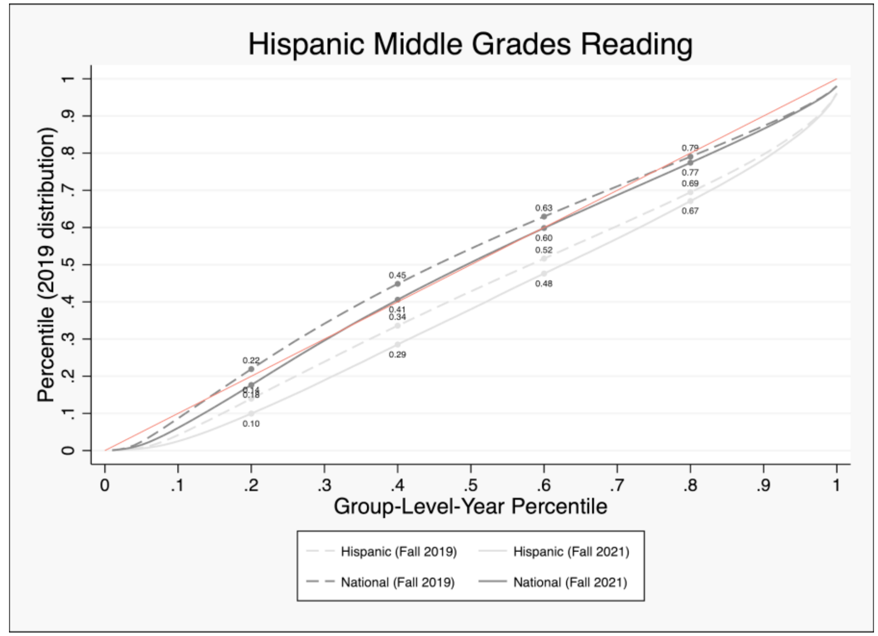
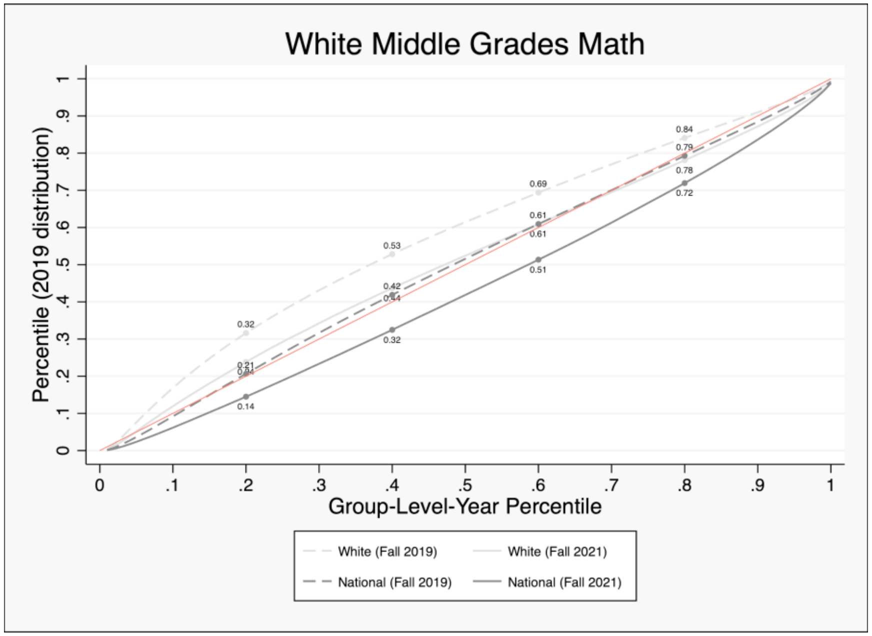


Figure A25: Distributional Differences in Achievement Levels for White Students in Middle Grades, from Fall 2019 and 2021



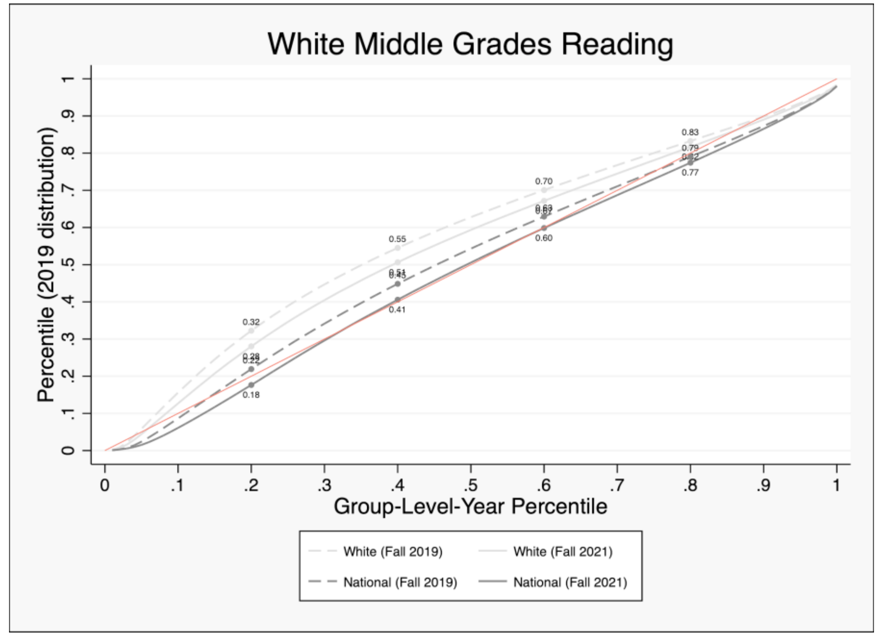
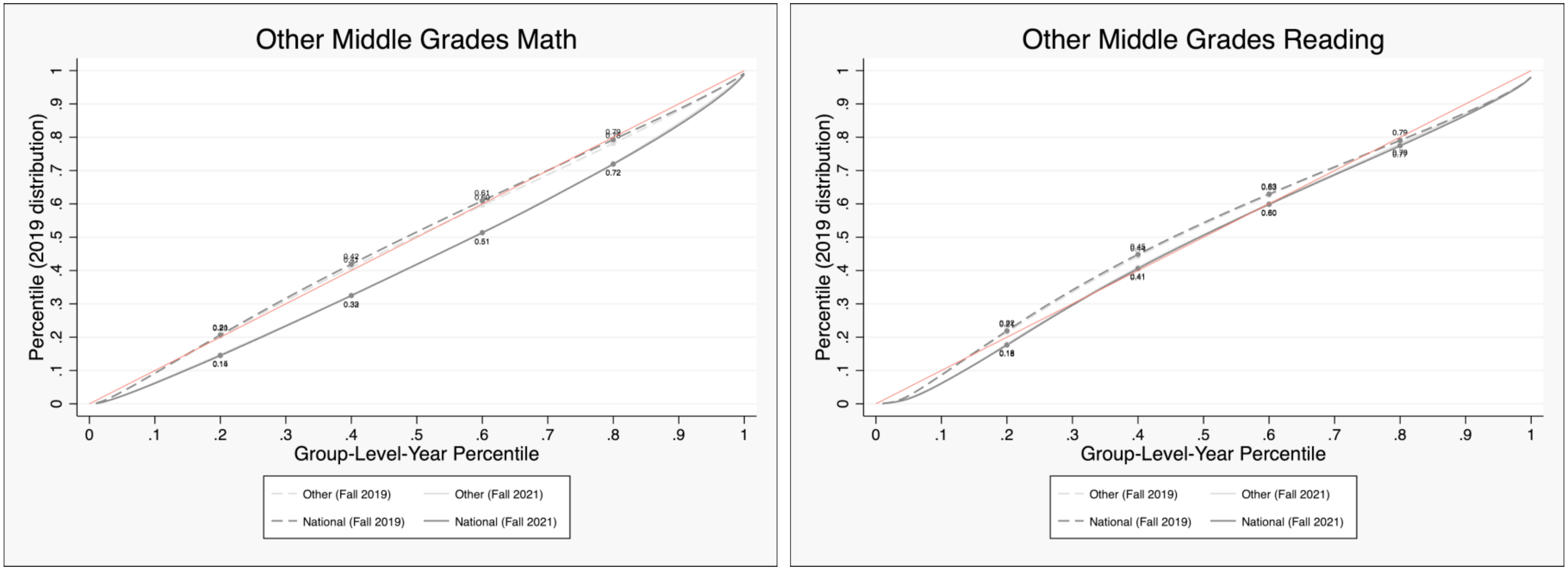


Figure A26: Distributional Differences in Achievement Levels for Other Students in Middle Grades, from Fall 2019 and 2021



Note: This figure shows distributional differences in achievement levels for students who identify as a race other than Asian, Black, Hispanic, or White.

Table A1: Math and Reading MAP Growth Scores by Grade and Term

	Fall 2017		Fall 2018		Fall 2019		Fall 2021	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
math								
grade								
1	160.2	(12.7)			160.5	(12.8)		
2	175.8	(13.7)			175.8	(13.8)		
3	189.1	(13.5)	188.7	(13.7)	189.0	(13.7)	185.4	(14.9)
4	201.1	(14.1)	200.9	(14.3)	200.9	(14.4)	196.9	(15.5)
5	210.6	(15.5)	210.4	(15.6)	210.2	(15.7)	206.1	(16.5)
6	215.4	(15.8)	215.2	(15.6)	215.2	(15.4)	211.7	(15.9)
7	222.2	(17.5)	222.0	(17.3)	221.8	(17.2)	217.9	(17.1)
8	227.6	(18.6)	227.6	(18.4)	227.3	(18.4)	222.7	(18.0)
reading								
grade								
1	156.6	(13.1)			156.4	(13.1)		
2	172.8	(15.8)			172.5	(16.1)		
3	186.5	(16.7)	186.2	(16.7)	187.0	(16.9)	184.0	(17.9)
4	196.5	(16.9)	196.9	(16.9)	197.5	(16.8)	194.7	(17.6)
5	204.5	(17.1)	204.8	(17.0)	205.0	(16.6)	202.3	(17.4)
6	209.3	(16.8)	209.4	(17.1)	210.3	(16.3)	208.4	(16.9)
7	214.0	(17.2)	214.3	(17.3)	214.5	(16.4)	212.7	(17.0)
8	218.3	(17.4)	218.7	(17.5)	218.4	(16.6)	216.7	(17.2)

Table A2: Comparing the Analysis Sample to the Universe of K-8 Public Schools

	Achievement Sample				Growth Sample		CCD Grades 3-8
	Fall 2017	Fall 2018	Fall 2019	Fall 2021	F17 to F19	F19 to F21	2019-20
Panel A: Math							
Race (%)							
Asian	4	4	4	5	4	4	5
Black	15	16	16	16	15	15	15
Hispanic	19	19	20	20	19	20	28
White	50	50	49	48	51	50	46
Other	11	11	11	11	11	11	6
School poverty (%)							
High	24	23	24	23	25	25	27
Mid	54	54	54	54	52	52	54
Low	22	23	23	24	23	23	20
Urbanicity (%)							
City	27	27	28	27	27	27	30
Rural	20	20	19	20	20	20	20
Suburb	42	42	42	43	43	42	39
Town	11	11	11	11	11	11	11
Number of schools in sample	11334	11329	11316	11163	11283	11314	74189
Number of students in sample	3332148	3359172	3409511	3135244	2562149	2403309	22835038
Panel B: Reading							
Race (%)							
Asian	4	4	4	4	4	4	5
Black	16	16	16	16	16	16	15
Hispanic	19	19	20	20	19	19	28
White	50	49	49	49	50	50	46
Other	11	11	11	11	11	11	6
School poverty (%)							
High	24	24	24	23	26	25	27
Mid	54	54	54	54	52	53	54
Low	21	21	22	23	21	22	20
Urbanicity (%)							
City	26	27	27	27	27	26	30
Rural	20	20	20	20	20	20	20
Suburb	43	42	42	42	42	42	39
Town	11	11	11	11	11	11	11
Number of schools in sample	10972	10966	10961	10893	10901	10926	74189
Number of students in sample	2714843	2535584	3033830	2705724	2027538	1925551	22835038

Table A3: Median Math Test Scores by Race, Grade, and Year

	Race				
	Asian	Black	Hispanic	White	Other
grade					
3					
year					
Fall 2018	0.615	-0.356	-0.198	0.289	0.094
Fall 2019	0.591	-0.376	-0.222	0.267	0.068
Fall 2020	0.607	-0.362	-0.222	0.289	0.078
Fall 2021	0.467	-0.771	-0.572	0.108	-0.148
4					
year					
Fall 2018	0.679	-0.378	-0.173	0.298	0.080
Fall 2019	0.655	-0.392	-0.181	0.288	0.072
Fall 2020	0.658	-0.389	-0.188	0.308	0.082
Fall 2021	0.453	-0.822	-0.582	0.108	-0.170
5					
year					
Fall 2018	0.696	-0.391	-0.159	0.292	0.075
Fall 2019	0.697	-0.392	-0.178	0.278	0.067
Fall 2020	0.672	-0.398	-0.171	0.280	0.065
Fall 2021	0.468	-0.804	-0.556	0.086	-0.193
6					
year					
Fall 2018	0.735	-0.455	-0.207	0.313	0.051
Fall 2019	0.730	-0.471	-0.220	0.292	0.037
Fall 2020	0.745	-0.456	-0.219	0.278	0.028
Fall 2021	0.520	-0.763	-0.509	0.075	-0.210
7					
year					
Fall 2018	0.797	-0.467	-0.227	0.308	0.049
Fall 2019	0.806	-0.492	-0.245	0.292	0.035
Fall 2020	0.783	-0.486	-0.245	0.281	0.013
Fall 2021	0.514	-0.764	-0.516	0.053	-0.221
8					
year					
Fall 2018	0.766	-0.453	-0.257	0.307	0.055
Fall 2019	0.784	-0.463	-0.252	0.300	0.013
Fall 2020	0.795	-0.474	-0.271	0.285	0.008
Fall 2021	0.471	-0.751	-0.541	0.019	-0.228

Table A4: Median Reading Achievement by Race, Grade, and Year

	Race				
	Asian	Black	Hispanic	White	Other
grade					
3					
year					
Fall 2018	0.477	-0.283	-0.249	0.264	0.074
Fall 2019	0.457	-0.321	-0.274	0.233	0.030
Fall 2020	0.508	-0.268	-0.251	0.296	0.085
Fall 2021	0.433	-0.545	-0.495	0.159	-0.072
4					
year					
Fall 2018	0.477	-0.320	-0.275	0.258	0.032
Fall 2019	0.510	-0.310	-0.243	0.271	0.050
Fall 2020	0.529	-0.251	-0.186	0.314	0.106
Fall 2021	0.418	-0.491	-0.442	0.191	-0.031
5					
year					
Fall 2018	0.559	-0.344	-0.237	0.314	0.082
Fall 2019	0.590	-0.319	-0.214	0.333	0.116
Fall 2020	0.554	-0.262	-0.176	0.325	0.127
Fall 2021	0.463	-0.478	-0.393	0.196	-0.030
6					
year					
Fall 2018	0.542	-0.355	-0.244	0.279	0.044
Fall 2019	0.594	-0.352	-0.229	0.310	0.043
Fall 2020	0.592	-0.280	-0.181	0.320	0.099
Fall 2021	0.525	-0.465	-0.329	0.225	-0.018
7					
year					
Fall 2018	0.604	-0.346	-0.234	0.323	0.069
Fall 2019	0.638	-0.330	-0.200	0.341	0.087
Fall 2020	0.608	-0.285	-0.182	0.324	0.098
Fall 2021	0.582	-0.428	-0.306	0.217	-0.007
8					
year					
Fall 2018	0.626	-0.339	-0.221	0.344	0.113
Fall 2019	0.656	-0.297	-0.185	0.375	0.118
Fall 2020	0.606	-0.276	-0.196	0.315	0.095
Fall 2021	0.608	-0.412	-0.288	0.213	-0.006

Table A5: Median Math Achievement by School Urbanicity, Grade, and Year

	School Urbanicity			
	City	Rural	Suburb	Town
grade				
3				
year				
Fall 2018	-0.040	0.138	0.154	0.041
Fall 2019	-0.070	0.126	0.136	0.012
Fall 2020	-0.058	0.139	0.152	0.032
Fall 2021	-0.368	-0.075	-0.075	-0.189
4				
year				
Fall 2018	-0.029	0.131	0.190	0.042
Fall 2019	-0.035	0.132	0.174	0.024
Fall 2020	-0.036	0.152	0.183	0.043
Fall 2021	-0.374	-0.065	-0.088	-0.176
5				
year				
Fall 2018	-0.016	0.135	0.187	0.040
Fall 2019	-0.032	0.121	0.168	0.023
Fall 2020	-0.040	0.130	0.163	0.020
Fall 2021	-0.378	-0.088	-0.099	-0.213
6				
year				
Fall 2018	-0.061	0.137	0.187	0.046
Fall 2019	-0.075	0.108	0.174	0.022
Fall 2020	-0.070	0.093	0.163	-0.004
Fall 2021	-0.369	-0.111	-0.078	-0.212
7				
year				
Fall 2018	-0.034	0.122	0.174	0.056
Fall 2019	-0.067	0.118	0.151	0.025
Fall 2020	-0.093	0.101	0.144	0.007
Fall 2021	-0.367	-0.107	-0.122	-0.218
8				
year				
Fall 2018	-0.066	0.132	0.158	0.046
Fall 2019	-0.059	0.108	0.142	0.025
Fall 2020	-0.100	0.113	0.122	0.007
Fall 2021	-0.374	-0.140	-0.172	-0.228

Note: Urbanicity categories are defined according to the Congressional District Code (CDC). For more information, see https://nces.ed.gov/ccd/pdf/INsc09101a.pdf; city refers to territories inside an urbanized area and inside a principal city; rural refers to a census-defined rural territory that is not in an urbanized area or urban cluster; suburb refers to a territory outside a principal city and inside an urbanized area; and town refers to a territory inside an urban cluster that is at least 10 miles from an urbanized area.

Table A6: Median Reading Achievement by School Urbanicity, Grade, and Year

	School Urbanicity			
	City	Rural	Suburb	Town
grade				
3				
year				
Fall 2018	-0.067	0.117	0.132	0.020
Fall 2019	-0.099	0.093	0.096	-0.020
Fall 2020	-0.039	0.147	0.167	0.032
Fall 2021	-0.258	-0.015	0.004	-0.141
4				
year				
Fall 2018	-0.098	0.088	0.130	-0.006
Fall 2019	-0.052	0.110	0.133	0.004
Fall 2020	-0.002	0.158	0.188	0.066
Fall 2021	-0.211	0.029	0.031	-0.072
5				
year				
Fall 2018	-0.048	0.132	0.173	0.033
Fall 2019	-0.014	0.142	0.195	0.049
Fall 2020	0.000	0.160	0.197	0.071
Fall 2021	-0.185	0.022	0.056	-0.081
6				
year				
Fall 2018	-0.068	0.098	0.146	0.003
Fall 2019	-0.036	0.103	0.179	0.004
Fall 2020	0.022	0.136	0.199	0.067
Fall 2021	-0.140	0.044	0.100	-0.050
7				
year				
Fall 2018	0.022	0.118	0.175	0.050
Fall 2019	0.014	0.149	0.197	0.049
Fall 2020	0.012	0.147	0.193	0.080
Fall 2021	-0.100	0.047	0.093	-0.024
8				
year				
Fall 2018	0.015	0.150	0.206	0.079
Fall 2019	0.058	0.167	0.228	0.087
Fall 2020	0.007	0.145	0.185	0.084
Fall 2021	-0.087	0.034	0.092	-0.044

Note: Urbanicity categories are defined according to the Congressional District Code (CDC). For more information, see https://nces.ed.gov/ccd/pdf/INsc09101a.pdf; city refers to territories inside an urbanized area and inside a principal city; rural refers to a census-defined rural territory that is not in an urbanized area or urban cluster; suburb refers to a territory outside a principal city and inside an urbanized area; and town refers to a territory inside an urban cluster that is at least 10 miles from an urbanized area.

Table A7: Median Math Achievement by School Poverty Level, Grade, and Year

	School Poverty Level		
	High-Poverty	Mid-Poverty	Low-Poverty
grade			
3			
year			
Fall 2018	-0.321	0.104	0.532
Fall 2019	-0.342	0.076	0.494
Fall 2020	-0.336	0.087	0.520
Fall 2021	-0.745	-0.159	0.381
4			
year			
Fall 2018	-0.329	0.105	0.537
Fall 2019	-0.346	0.094	0.525
Fall 2020	-0.337	0.106	0.535
Fall 2021	-0.788	-0.158	0.375
5			
year			
Fall 2018	-0.334	0.109	0.525
Fall 2019	-0.341	0.090	0.510
Fall 2020	-0.334	0.089	0.513
Fall 2021	-0.766	-0.185	0.363
6			
year			
Fall 2018	-0.407	0.102	0.570
Fall 2019	-0.415	0.075	0.543
Fall 2020	-0.404	0.058	0.523
Fall 2021	-0.715	-0.193	0.335
7			
year			
Fall 2018	-0.422	0.088	0.572
Fall 2019	-0.455	0.066	0.550
Fall 2020	-0.445	0.049	0.538
Fall 2021	-0.721	-0.206	0.292
8			
year			
Fall 2018	-0.431	0.074	0.574
Fall 2019	-0.427	0.055	0.561
Fall 2020	-0.456	0.041	0.546
Fall 2021	-0.697	-0.235	0.253

Note: Low-poverty schools have less than 25% of students eligible for free or reduced-price lunch; Mid-poverty schools have 25-75% of students eligible for free or reduced-price lunch; and high poverty schools have more than 75% of students eligible for free or reduced-price lunch.

Table A8: Median Reading Achievement by School Poverty Level, Grade, and Year

	School Poverty Level		
	High-Poverty	Mid-Poverty	Low-Poverty
grade			
3			
year			
Fall 2018	-0.348	0.095	0.501
Fall 2019	-0.380	0.056	0.457
Fall 2020	-0.338	0.106	0.517
Fall 2021	-0.651	-0.068	0.426
4			
year			
Fall 2018	-0.378	0.067	0.496
Fall 2019	-0.360	0.078	0.514
Fall 2020	-0.293	0.133	0.518
Fall 2021	-0.588	-0.025	0.433
5			
year			
Fall 2018	-0.375	0.109	0.559
Fall 2019	-0.352	0.123	0.569
Fall 2020	-0.294	0.133	0.539
Fall 2021	-0.554	-0.024	0.442
6			
year			
Fall 2018	-0.394	0.078	0.515
Fall 2019	-0.393	0.099	0.541
Fall 2020	-0.315	0.121	0.522
Fall 2021	-0.498	0.000	0.446
7			
year			
Fall 2018	-0.386	0.107	0.552
Fall 2019	-0.370	0.123	0.574
Fall 2020	-0.324	0.118	0.520
Fall 2021	-0.479	0.010	0.421
8			
year			
Fall 2018	-0.371	0.127	0.559
Fall 2019	-0.330	0.145	0.596
Fall 2020	-0.327	0.113	0.508
Fall 2021	-0.435	0.000	0.423

Note: Low-poverty schools have less than 25% of students eligible for free or reduced-price lunch; Mid-poverty schools have 25-75% of students eligible for free or reduced-price lunch; and high poverty schools have more than 75% of students eligible for free or reduced-price lunch.

Appendix B
Figures

Figure B1: Variation in Students' Math and Reading Growth between Fall 2019 and Fall 2021 by Students' Baseline Achievement in Grade 3

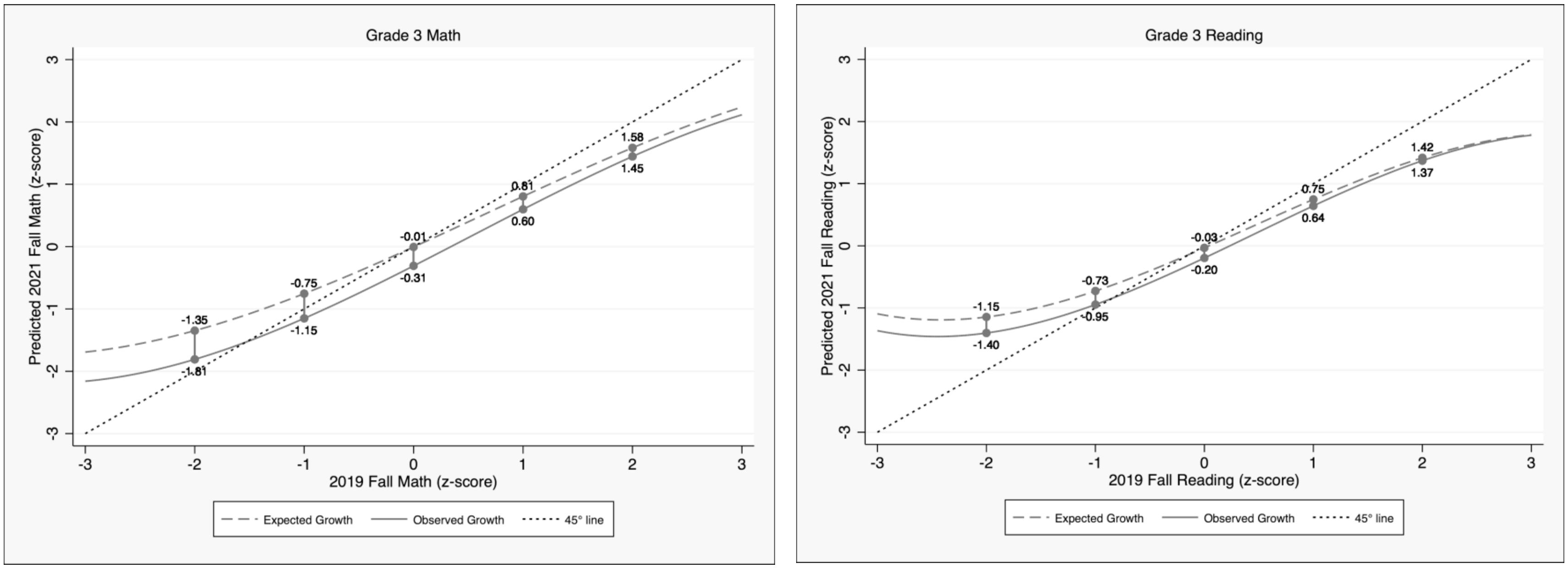


Figure B2: Variation in Students' Math and Reading Growth between Fall 2019 and Fall 2021 by Students' Baseline Achievement in Grade 4

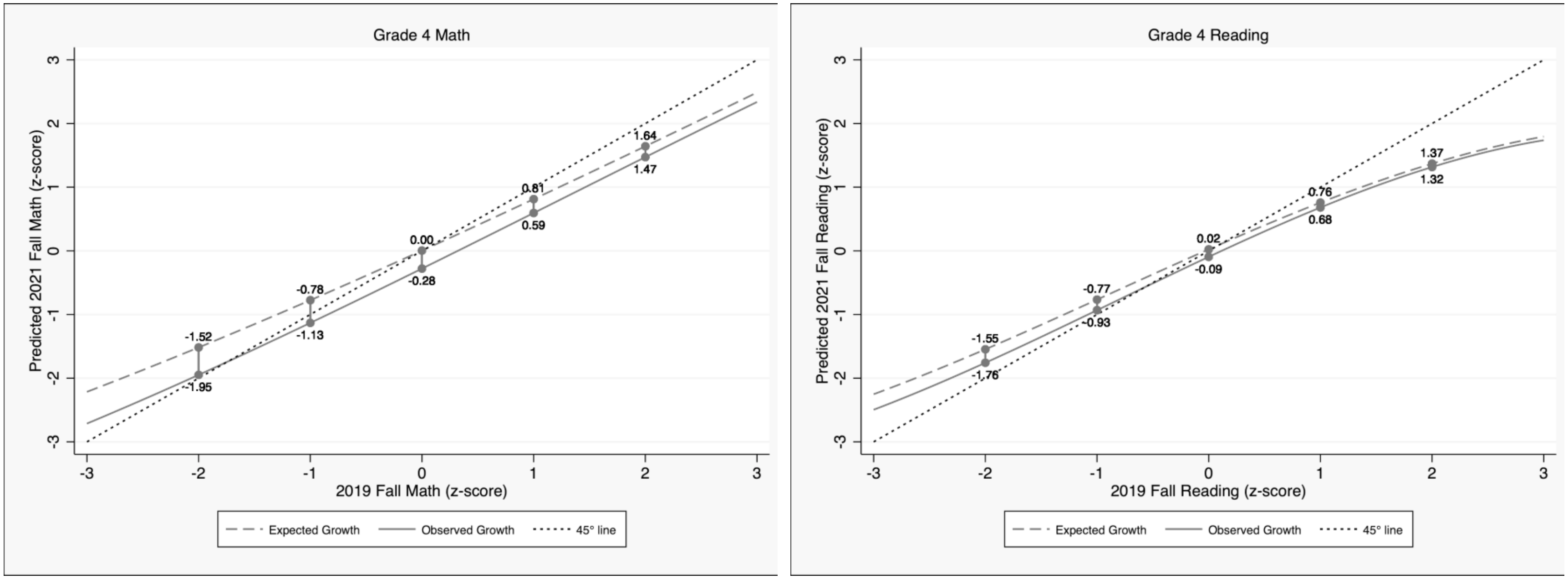
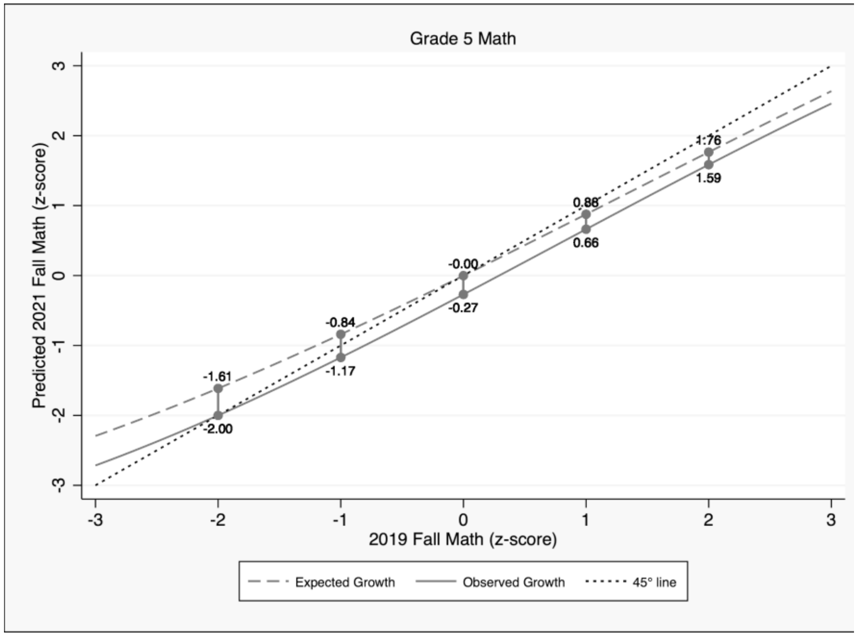


Figure B3: Variation in Students' Math and Reading Growth between Fall 2019 and Fall 2021 by Students' Baseline Achievement in Grade 5



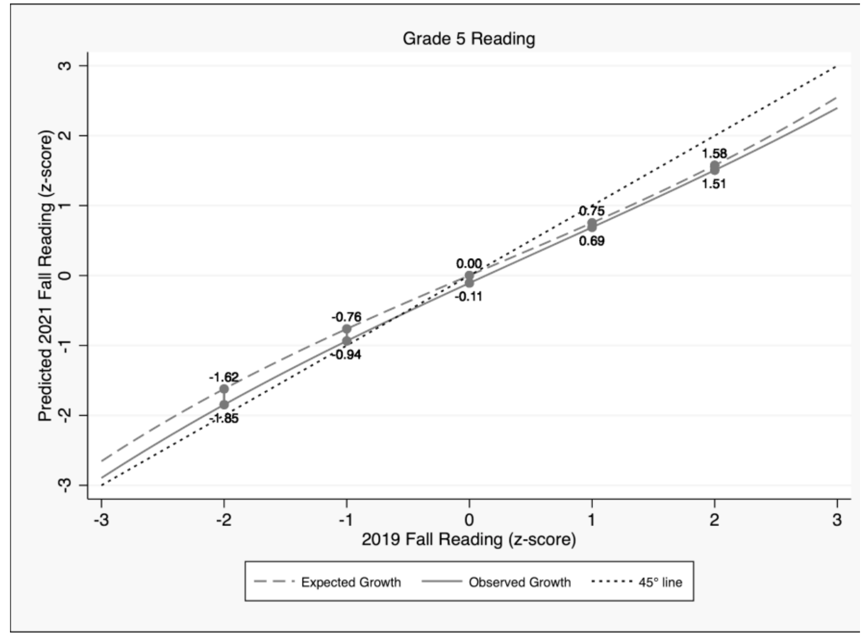


Figure B4: Variation in Students' Math and Reading Growth between Fall 2019 and Fall 2021 by Students' Baseline Achievement in Grade 6

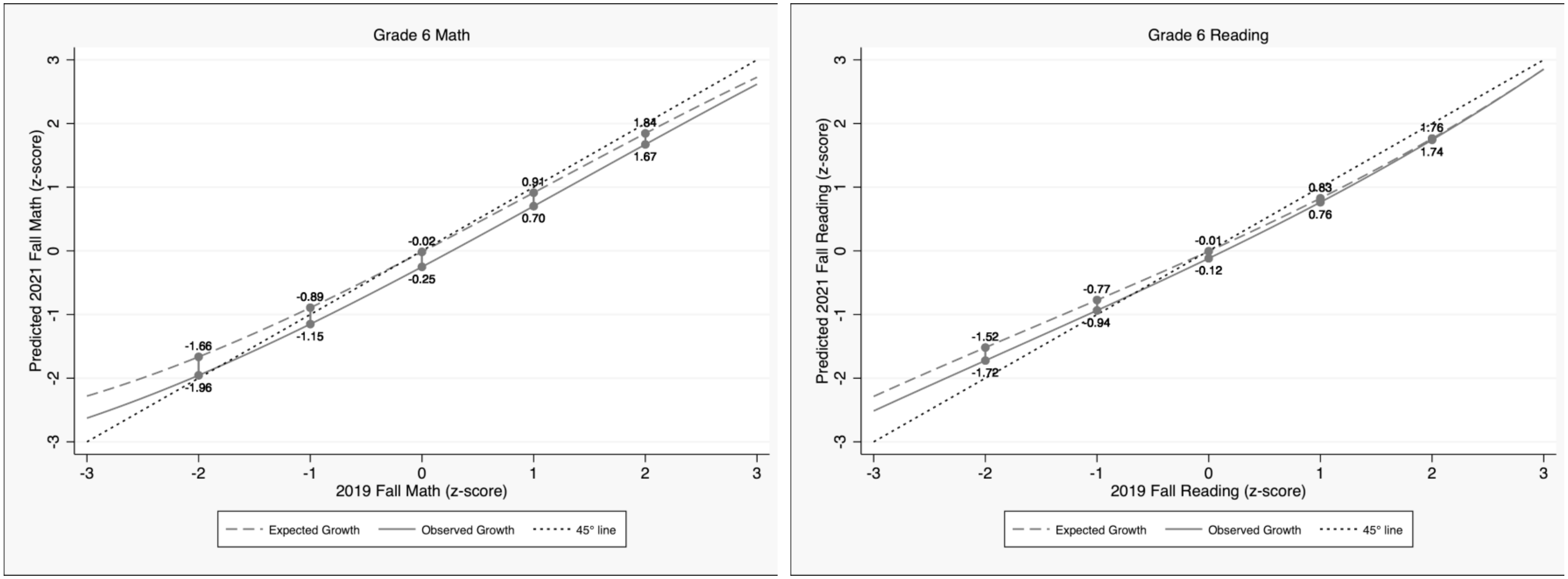


Figure B5: Variation in Students' Math and Reading Growth between Fall 2019 and Fall 2021 by Students' Baseline Achievement in Grade 7

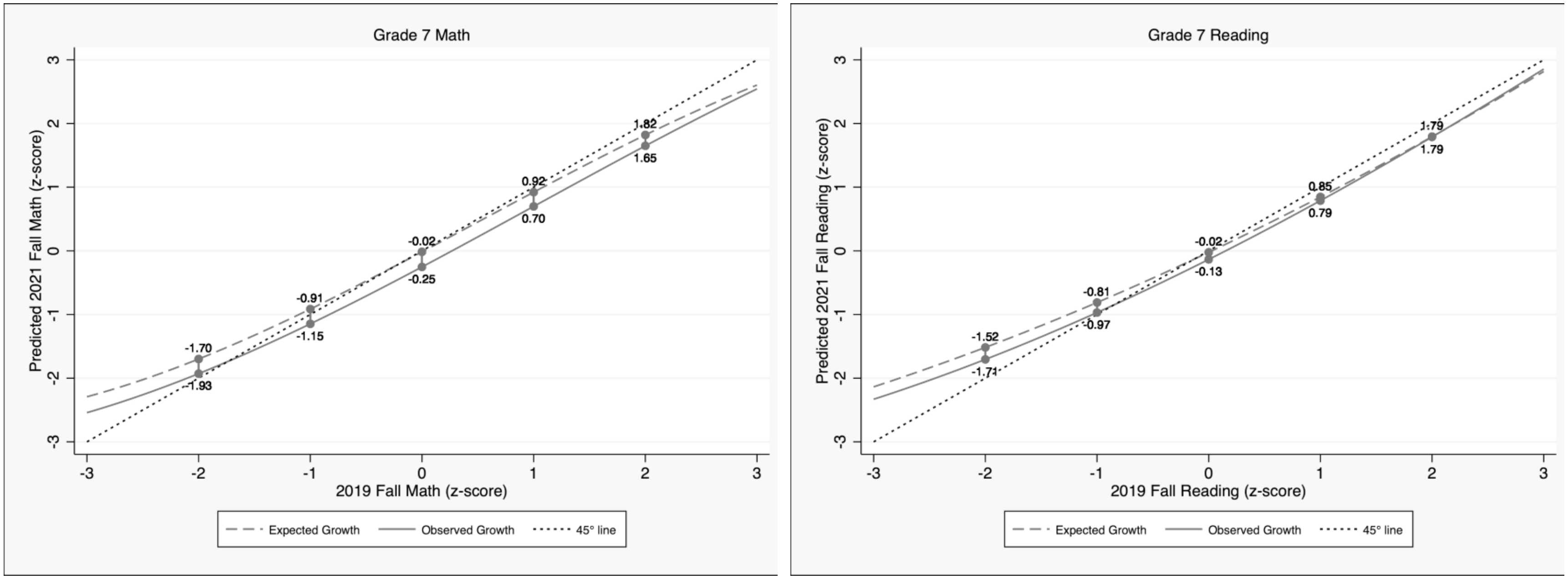


Figure B6: Variation in Students' Math and Reading Growth between Fall 2019 and Fall 2021 by Students' Baseline Achievement in Grade 8