A Widening Chasm: The Divergent Paths of High- and Low-Achieving Students in Algebra I After the Pandemic

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Abstract

We follow four cohorts of students in Texas from grades 3 through 9 to identify which factors predict whether students pass the Algebra I end-of-course test by ninth grade. We find that early achievement accounts for most of the variation: racial and socioeconomic gaps in Algebra I completion trace back to differences in third-grade test scores. Because we follow students over time, we can see how the pandemic compounded existing inequalities. First, we find that the pandemic widened racial and socioeconomic gaps within each achievement level—students from disadvantaged groups who started third grade with the same test scores as their more advantaged peers fell further behind than those peers during COVID. Second, the pandemic amplified gaps between achievement levels. The lowest-scoring students in every group experienced steeper declines than their higher-scoring counterparts, with the sharpest losses concentrated among low-achieving students. In short, we find that algebra achievement gaps are rooted in early elementary school and became deeper during the pandemic. Our results underscore the importance of targeting resources to early elementary math instruction, especially for low-achieving students.

1. Introduction

Math achievement in K–12 shapes students' academic and career trajectories. Algebra is an especially critical gateway: it represents the first step in the sequence of college-preparatory math courses, such as Geometry, Algebra II, Precalculus, and Calculus (Adelman, 2006; Stein et al., 2011). Completing these advanced courses is associated with increased high school graduation rates (Bryant & Knudson, 2024; James, 2013), higher college enrollment (Long et al., 2012), and better labor market prospects (Rose & Betts, 2004). Failure to complete Algebra I by ninth grade is likely to limit students' pathways to selective colleges and technical careers, significantly limiting their opportunities for high-paying jobs later in life.

Because success in algebra is so important, nearly all states require students to pass multiple math courses to graduate from high school. As of 2018, for example, 46 states and the District of Columbia required students to complete at least three math credits to graduate. These credits typically included Algebra I and subsequent courses (NCES, 2018). Texas—the site of this study—requires students to complete Algebra I and pass an end-of-course algebra exam to qualify for a high school diploma (Texas Education Code §28.025).

As is true for many education outcomes, there are large student subgroup gaps in passing Algebra I in Texas: Black students, Hispanic students, and students facing economic disadvantages are less likely to pass Algebra I compared to their more advantaged peers (Texas Education Agency, 2023).[1] These gaps in Texas reflect the nation as a whole, as historically underserved students experience lower pass rates than their White and higher-income peers (Huffaker, 2025).

Disparities in algebra access and achievement are arguably the product of a complex set of factors working and interacting at multiple levels, from how well students are prepared when they reach middle school, to the routines schools use to place students in algebra (e.g., parent recommendations), parent information, and differences in school resources. Recent research has

[1] In 2023–24, 29% of Black, 37% of Hispanic, 56% of White, and 83% of Asian students scored at Meets Grade Level or Above on Algebra I EOC exam.

shown academic achievement disparities among high schoolers generally trace back to early elementary school (Austin et al., 2023). But the extent to which early achievement particularly drives success in algebra is not clear. Aggregating math and ELA achievement may obscure the specific early predictors of algebra success, leaving schools without clear guidance on which students to target for early intervention, at what grade levels, or in which areas.

To learn more about the early roots of disparities specific to algebra, we follow four cohorts of students in Texas from grades 3 through 9 to identify factors that predict Algebra I success by ninth grade. Consistent with studies of academic mobility (Austin et al., 2023; Goldhaber et al., 2025), we find that early achievement accounts for most of the variation in algebra outcomes. Because we follow students over time, we also can see how the COVID-19 pandemic compounded existing gaps.[2] Two COVID-related findings stand out. First, the pandemic widened racial and socioeconomic gaps *within* each achievement level—students from disadvantaged groups who started third grade with the same test scores as their more advantaged peers fell further behind. Second, the pandemic amplified gaps *between* achievement levels. The lowest-scoring students in every group experienced steeper declines than their higher-scoring counterparts, with the sharpest losses concentrated among low-achieving students. In short, we find that algebra achievement gaps are rooted in early elementary school and became deeper during the pandemic.

2. Background and Prior Research

Algebra I occupies a central place in U.S. mathematics education policy, serving as a gateway to advanced coursework, college admissions, and STEM careers. Because students who complete Algebra I by the end of eighth grade gain access to a more expansive high school math sequence — potentially reaching calculus before graduation — policymakers have long debated

[2] Algebra I scores across Texas remain below pre-pandemic levels, with low-income students scoring lower than their more affluent peers (Xia, 2024). Officials worry these persistent gaps will limit students' access to STEM fields and careers, particularly in the under-resourced districts that are least equipped to provide intervention and support.

both when students should take the course and how many students should be accelerated into it. These debates have intensified in recent decades as advocates framed early Algebra I access as an equity issue, arguing that tracking practices systematically excluded Black, Hispanic, and low-income students from advanced math pathways (Clotfelter et al., 2015).

Evidence from two prominent policy experiments illustrates the complexity of these tradeoffs. In North Carolina, researchers studied the effects of policies across the 10 largest districts that pushed more students—including those in the bottom half of the prior achievement distribution—into eighth-grade Algebra I. Clotfelter, Ladd, and Vigdor (2015) found negative effects for students in the bottom 60% of prior achievement, suggesting that accelerating underprepared students into Algebra I without adequate supports can backfire. In San Francisco, the district took the opposite approach in 2014, eliminating eighth-grade Algebra I entirely and requiring all students to wait until ninth grade — a policy intended to promote equity by ending tracking. Huffaker et al. (2025) found that participation in Advanced Placement math initially fell by roughly 15 percentage points, driven largely by declines in AP Calculus, and that large ethnoracial gaps in advanced math course-taking persisted. The school board ultimately voted to restore eighth-grade Algebra I in 2026. Together, these cases suggest that neither universal acceleration nor universal delay reliably advances equity, and that the *preparation* students bring to Algebra I and the *timing* of the course—the focus of the present study—are both consequential.

Evidence and intuition suggest that students' middle and high school performance depends greatly on their earlier schooling experiences. As noted earlier, a recent strand of research focused on "academic mobility" examines how much early achievement determines later outcomes and whether schools can alter student trajectories once established (Austin et al., 2023; Goldhaber et al., 2025). By contextualizing the timing of when disparities in achievement arise, these studies suggest when interventions to narrow gaps might be most productive.

Across multiple states, this literature reveals that third-grade achievement strongly predicts high school performance.[3] Third-grade test scores, for example, correlate with high school outcomes (.75 or higher) (Austin et al., 2023). Studies of academic mobility establish the persistence of early achievement gaps, but they often focus on combined math and English language arts (ELA) performance rather than math or algebra pathways. However, a complementary literature in educational psychology does focus on prior math skills that predict algebra success. Siegler et al. (2012), for example, find that elementary students' knowledge of fractions and division predicts later algebra achievement. Likewise, Liang et al. (2018) show that seventh graders who understand rational numbers perform better in eighth-grade algebra. Some studies trace these connections even earlier: preschool counting and addition skills, for example, have been shown to predict math achievement through age 15 (Watts et al., 2014). While the educational psychology literature usefully identifies developmental building blocks for algebra learning, it often relies on specialized assessments (such as the Woodcock-Johnson-Revised) administered to small samples in controlled settings. Beyond raising questions about generalizability, much of this literature tends to overlook school-based factors (e.g., teacher qualifications) that may play an important role in shaping math outcomes.

Beyond student and school-based drivers of achievement, exogenous shocks like Hurricane Katrina or COVID-19 may also influence students' academic trajectories. The COVID-19 pandemic, for example, widened achievement gaps, particularly in mathematics and

[3] Admittedly, the focus on third grade in the literature often stems from data constraints: although achievement gaps may take root earlier in students' schooling, standardized testing in administrative datasets typically begins in third grade.

for lower-performing students (Goldhaber et al., 2024). While students have made modest gains in math between 2022 and 2024, recovery in ELA has been more limited; in both cases, historically underserved students and low performers are regaining ground more slowly (Dorn et al., 2021; Kuhfeld & Lewis, 2025).

To sum up, prior research suggests early achievement may strongly predict algebra outcomes, and that COVID-19 disrupted learning with unequal effects. But it is less clear how early, contextualized school experiences specifically predict later algebra outcomes and the extent to which these relationships were impacted by COVID, raising questions about whether interventions based on studies of overall academic achievement would translate to algebra success.

We address this gap by following four cohorts of Texas students from third grade through ninth, tracking them through both typical schooling and the pandemic disruption. This design allows us to identify which early factors predict Algebra I passage using state assessments and controlling for a range of contextual variables, examine whether COVID altered the relationship between early achievement and algebra outcomes, and determine whether the pandemic's impact varied by students' initial achievement levels and demographic backgrounds. Unlike prior academic mobility studies, we focus specifically on math and algebra trajectories. Unlike educational psychology studies, we use larger samples, use state assessments, and account for school-level factors. And unlike most COVID learning loss research, we examine a specific consequential outcome—Algebra I completion—rather than general achievement.

3. Data and Samples

We construct a longitudinal dataset using administrative testing, course-taking, and staffing records for students in Texas public schools from 2014 to 2024. Our data sources include student and teacher data from the Texas Education Agency (TEA), and educator certification records from the State Board for Educator Certification (SBEC). We compile math and reading assessment data for end-of-grade (EOG) testing in grades 3-8, along with end-of-course (EOC) exams in Algebra I. We keep the score on the first attempt and standardize all test scores by test (grade or subject) and year. For the main outcome of interest, passing Algebra I EOC exam by ninth grade, we consider a student to have passed if they passed the Algebra I EOC exam or any of the alternate exams by ninth grade.[4]

We link student course-taking data with teacher assignment records to create a merged student-teacher dataset. Because the quality of teachers that students have been exposed to potentially predicts student success in Algebra I, we construct several measures of teacher quality. For each of these measures, we construct two predictors. One is based on the sample average for a student's math teachers in the years before Algebra I, and the other on the sample average for a student's math teachers in the year in which they first took Algebra I. For example, for a student first taking Algebra I in ninth grade, we would construct the share of novice math teachers in grades 3–8 and in grade 9. We construct these separate measures for novice teachers (two or fewer years of experience), value-added, and certification type. To construct value-added, we follow Chetty et al. (2014) and construct leave-one-out measures of value-added that use data from years other than when a student was exposed to a given teacher.

Because we are interested in the extent to which early math achievement predicts Algebra I success, our main sample contains students who were enrolled continuously in Texas public schools from grades 3 through 9. **Table 1** compares demographic and academic characteristics

[4] In Texas, all high school students are required to pass the Algebra I State of Texas Assessments of Academic Readiness (STAAR) End-of-Course (EOC) exam to graduate. Students with learning differences may qualify for alternate assessments under state guidelines. If a student does not pass the Algebra I EOC exam on their first attempt, they are permitted to retake the exam during any of the three annual testing windows: fall, spring, and summer (Texas Education Agency, 2024a). Texas districts are required to offer accelerated instruction and support until the student meets this requirement (Texas Education Agency, 2024b).

between the larger baseline third-grade sample and the restricted longitudinal sample of students observed through grades 3–9. The restricted sample serves as the analytic sample for all subsequent analyses, and is broadly similar in composition to the baseline population, but shows modest differences in subgroup representation. Hispanic students compose a slightly larger share of the restricted cohort, while most of the other subgroups are slightly underrepresented. Average third-grade math scores are marginally higher among students present continuously through grade 9, suggesting that the analytic sample may disproportionately include higher-performing students who are more consistently enrolled.

4. Methods

We examine the relative predictiveness of potential contributing factors to students' Algebra I outcomes using a simple regression framework. The contributing factors we examine include students' socioeconomic status and race, along with several measures of students' early math experiences. These include: (a) their math score on the state standardized test in third grade; (b) their school mobility, as measured by whether they attended four or more schools in grades 3–9 (i.e., more than the typical three schools experienced by the usual elementary to middle to high school transitions); (c) measures of teacher quality prior to Algebra I; and (d) measures of teacher quality in Algebra I. We add these factors to the model sequentially to understand how each predicts student outcomes, conditional on student socioeconomic status or race, as well as combined to understand their collective predictiveness.

Specifically, we estimate the following general model:

$$Y_{ic} = FRL_i + \theta_i + \gamma_c + \epsilon_i \tag{1}$$

Here, Y_i is a binary variable indicating that student i in cohort c passes the Algebra I EOC exam by the end of ninth grade. FRL_i is an indicator for free and reduced-price lunch (FRL) eligibility. θ_i is the set of variables reflecting the early math experiences of students described above. We include cohort fixed effects (γ_c) to control for any student invariable time trends and estimate the model as a linear probability model. We also estimate versions of the model that control for students' race, rather than FRL status.

5. Results

5.1 Descriptive Evidence on Early and Later Math Outcomes

Table 2 presents summary statistics describing student demographics, prior academic preparation, and Algebra I outcomes across socioeconomic and racial/ethnic groups. Over half of students in the sample are identified as economically disadvantaged (eligible for FRL), with particularly high shares among Black (73.4%) and Hispanic (78.7%) students. FRL students have lower third-grade math scores than their non-FRL peers (-0.14 compared to 0.45), as do Black and Hispanic students (-0.27 and -0.05, respectively) in comparison to White students (0.38). These early disparities carry forward into secondary coursework. For example, FRL and under-represented minority students (i.e., Black and Hispanic, or URM) are less likely to take Algebra I by grade 8, have lower EOC exam pass rates by grade 9, and earn lower standardized Algebra I scores overall. For example, nearly every student enrolls in Algebra I and takes the Algebra I EOC exam by the end of ninth grade. However, only 48% of FRL students pass the Algebra I EOC exam by the end of ninth grade, compared to 71% of non-FRL students. There are even larger disparities across racial groups, where 85% of Asian students and 45% of Black students pass the Algebra I EOC exam by the end of ninth grade.

Teacher assignment patterns are consistent with these disparities, as students from historically underserved groups are more often taught by novice or alternatively certified teachers and less likely to have experienced teachers with higher measured value-added. Together, these descriptive results indicate that disadvantaged groups enter third grade with lower initial achievement but are also subsequently exposed to less advantageous educational environments as they progress towards algebra.

To flesh out the relationship between early and later math performance, we plot various later student math outcomes against their percentile on their third-grade standardized test score in math. **Figure 1** presents binned scatter plots showing the relationship between students' third-grade math achievement percentiles and later math outcomes in Texas: students' passage of the Algebra I EOC exam by eighth and ninth grade, their Algebra I EOC exam standardized test score, and their math score in seventh grade, which for nearly all students is 1 or 2 years before Algebra I. The overall pattern reveals a strong positive relationship between third-grade test scores and later math outcomes, with higher early math achievement consistently associated with stronger subsequent performance. In addition, these relationships look similar regardless of outcome, suggesting that the predictiveness of third-grade test scores remains strong even as more time passes between third grade and the outcome of interest. For example, the relationship between third-grade scores and seventh-grade scores displays a similar pattern to the relationship between third-grade scores and Algebra I scores. In results available from the authors, the same plots disaggregated by student subgroup show that the predictive power of third-grade math performance remains even when conditional on socioeconomic status and race.

Figure 2 displays the relationship between third-grade math percentile and the rate at which students pass the Algebra I EOC exam by ninth grade separately for FRL and non-FRL students in pre- and post-pandemic time periods. We categorize pre-pandemic students as those who were in ninth grade in 2018 or 2019, and post-pandemic students as those who were in ninth grade in 2023 or 2024.[5] At all points in the distribution of prior achievement, for both FRL and

[5] We exclude cohorts between these ranges because their Algebra I testing was disrupted by the pandemic, so their rates of Algebra I EOC exam passage by ninth grade are not comparable to other cohorts.

non-FRL students, Algebra I pass rates declined following the onset of the pandemic. For example, at the 60th percentile of grade 3 math scores, about 80% of non-FRL and 75% of FRL students passed Algebra I by ninth grade before the pandemic. After the pandemic, these numbers dropped to about 75% and 60%, respectively. This also illustrates that the disparity in Algebra I passage rates between FRL and non-FRL students expanded notably post-pandemic, particularly for students in the middle to upper portions of the third-grade achievement distribution. Comparable figures broken out for URM and non-URM students show similar post-pandemic increases in disparities across racial lines (see Appendix **Figure A1**).

In **Figure 3**, we additionally compare outcomes for FRL and non-FRL students at the cohort level, where cohorts are defined by the school year in which students were in third grade. Compared with post-pandemic cohorts, pre-pandemic cohorts had higher Algebra I EOC exam pass rates across the third-grade achievement distribution and smaller FRL and URM gaps. The pandemic interrupted this momentum, with recovery remaining incomplete through the most recent cohorts. These results align with national evidence documenting disproportionate learning losses for low-income, Black, and Hispanic students (Goldhaber et al., 2022; Dorn et al., 2021), indicating that Texas followed similar post-pandemic patterns of widening inequality in math achievement.

Figure 4 shows Algebra I EOC exam pass rates by third-grade achievement decile across cohorts and subgroups as in Goldhaber et al. (2025). Figure 4a presents trends by race, while Figure 4b compares outcomes by FRL status. Across all cohorts, Algebra I completion rates by grade 9 increase with prior achievement, but the differences between deciles changed following the pandemic. The lowest and middle achieving students saw the largest drops in Algebra I passage post-pandemic, while the top achieving students saw only minor declines (among Black and Hispanic students, or among FRL students) or no declines at all (among Asian and White students, or among non-FRL students). These patterns indicate that pandemic-related disruptions deepened existing inequities among those already most at risk.

5.2 Regression Results

The summary statistics in Table 2 suggest that disparities in Algebra I EOC exam passage rates could be driven by both incoming skills (grade 3 achievement) and exposure to less favorable educational environments. To further explore gaps in outcomes across student groups, we run regressions to assess which factors best explain these gaps. Results are shown in **Table 3**, which presents regression results examining predictors of Algebra I EOC exam pass rates.

Column 1 shows results for the base model that only includes FRL status. A student's socioeconomic status is highly predictive of their Algebra I outcomes—FRL students are 22.5 percentage points less likely than non-FRL students to pass the Algebra I EOC exam by the end of ninth grade. Column 2 shows the results when students' third-grade math scores are added in as a control. While the coefficient on FRL status is still statistically significant, it decreases in magnitude substantially once early math performance is included, suggesting that differences in early math proficiency explain a large share of later Algebra I disparities. Columns 3, 4, and 5 show results from models that include controls for school mobility, teacher quality prior to Algebra I, and teacher quality in Algebra I, respectively. Notably, none of these sets of contributing factors affect the coefficient on FRL as much as the inclusion of third-grade test scores (although the quality of Pre-Algebra I teachers does reduce the magnitude of the FRL coefficient by approximately 10%). Indeed, a one-standard-deviation increase in third-grade test scores is associated with a 21-percentage-point increased probability of passing Algebra I. Columns 6 (fixed effects for third-grade school) and 7 (fixed effects for each math teacher between grades 3 and 8) show results for models where all sets of predictors are included. All coefficients remain statistically significant (with the exception of the certified status of teachers in Algebra I). When including third-grade school fixed effects, even when conditional on all the additional contributing factors we measure, the association between students' math score in third grade and their eventual passing of Algebra I, and the relationship between their FRL status and passing Algebra I, is largely unchanged between columns 2 and 6.[6] A different story emerges when including individual teacher effects in grades 3 through 8.[7] In particular, the coefficient on FRL status decreases from -0.094 to -0.051 when replacing school fixed effects with teacher indicators. This decrease of 46% is extremely similar to the 43% reported by the Goldhaber et al. (2022) study of the relationship between third-grade and eighth-grade math achievement.

Table 4 is comparable to Table 3 but instead reports results from regressions controlling for student race, rather than FRL status (where White students is the reference group). The base model in column 1 shows significant gaps in Algebra I performance across racial groups, with Asian students outperforming their peers and Black and Hispanic students showing lower EOC exam pass rates. When third-grade math scores are added to the model, the racial differences in Algebra I outcomes shrink considerably, indicating that much of the cross-race variation in Algebra I success reflects earlier differences in math achievement. Similar to the results shown in Table 3, conditioning on third-grade math performance reduces the magnitude of the coefficients on student race more than any of the other sets of determining factors, underscoring the role of early academic achievement in shaping later opportunities and outcomes in mathematics. In

[6] Consistent with this pattern, a formal variance decomposition into between districts, across schools within districts, and within schools finds that the vast majority of variation in both Algebra I test scores and pass rates is within schools.
[7] The sample size for this specification decreases because the sample retains students who were linked to exactly 1 teacher in math in each of grades 3 through 8.

addition, as with Table 3, the addition of grade 3 through 8 teacher indicators adds additional explanatory power above third-grade math scores and third-grade school attended, decreasing the coefficients on African American and Hispanic from -0.050 and -0.039 to -0.026 and -0.012, respectively.

To directly quantify how much of the difference in Algebra I success between more and less advantaged students can be attributable to their observable early math experiences, we use the Oaxaca–Blinder decomposition. **Table 5** reports results of this decomposition of the gap in Algebra I EOC exam pass rates between FRL and non-FRL students. The decomposition separates the overall performance gap into two components: (a) differences in observable characteristics (endowments) and (b) differences in returns to those characteristics (coefficients). Consistent with earlier regression findings, most of the explained portion reflects disparities in prior achievement, particularly third-grade math scores, which account for the largest share of endowments (0.128). Other factors, such as school mobility and teacher value-added measures, contribute minimally. Overall, about 56% of the FRL–non-FRL gap is explained by observed characteristics, with the remainder attributed to differences in coefficients. These results reinforce that socioeconomic gaps in Algebra I outcomes largely stem from early skill differences—which encompass a range of factors, including early school experiences prior to third grade, family background, neighborhoods, and other factors—rather than middle school course-taking or teacher assignment patterns, underscoring the importance of strengthening foundational math skills in the early grades.

6. Discussion and Conclusion

Using a detailed, statewide administrative dataset in Texas, we examined the academic trajectories of over 1.7 million students from early elementary school through ninth grade to identify factors that predict whether students pass their Algebra I end-of-course test. Because our data span the decade between 2014 and 2024, we were also able to see how students' trajectories shifted before and after the pandemic.

Consistent with general research on academic mobility, we find early academic achievement accounts for most of the variation in algebra outcomes. We found that a one-standard-deviation increase in third-grade test scores is associated with a 21-percentage-point increase in the probability of passing Algebra I. Indeed, much of the variation in Algebra I success reflects earlier differences in math achievement, above and beyond differences related to social and economic disadvantage. Also consistent with prior research on the educational impact of COVID-19, we find that racial and socioeconomic gaps widened both within and between achievement levels. Achievement gaps that were already rooted in early elementary school deepened during the pandemic.

These patterns raise important questions about when and how to intervene to address math disparities. As noted in the introduction, math achievement—especially in algebra—has significant implications for students' academic and career trajectories. Left unaddressed, racial, ethnic, and socioeconomic gaps in algebra completion will reinforce inequitable access to college-preparatory coursework and the opportunities that follow. While policies targeting middle and high school math achievement are important—such as automatically enrolling higher-achieving students in advanced courses—they may come too late for many students. Our results reinforce the need to act earlier. Effective early intervention, however, may require more than just identifying and helping struggling students. Aligned curricula across grade levels, professional development that helps teachers build students' procedural skills and conceptual understanding, and systems for tracking whether supports are working as students progress through school may all also be necessary. Recent evidence from national surveys (Covelli et al.,

2024) also reinforces the idea that improving algebra outcomes is a multifaceted project. Besides earlier disparities, other issues can make it harder for students to succeed in math, including unequal access to qualified math teachers and grade-level instruction, limited access to courses beyond algebra, and subjective algebra placement practices. Indeed, when we accounted for the influence of individual teachers in this study, the gap between low-income students and their peers shrank, suggesting a link between unequal access to teacher quality and the performance of lower-income students.

Looking ahead, future research might build on prior research from different disciplines to identify both the specific early math skills that matter most and to measure them reliably at scale and in context. This could provide schools clearer guidance on when and how to prepare elementary students for later success. Future research should also examine policy-amenable factors that span the system (e.g., teachers and curricular alignment) as well as follow students beyond ninth grade to clarify a fuller picture of the drivers and consequences of algebra achievement. As a recent report on America's math crisis noted, "low math achievement in school has a lifetime of consequences." Although math achievement problems can appear acute in middle and high school, our paper reinforces the idea that addressing disparities in math achievement requires starting much earlier by helping elementary students—and their teachers—build a foundation for future success.

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Tables and Figures

Table 1. Comparison of Baseline and Restricted Analytics Samples

	Baseline Third Grade Sample	Restricted Grades 3–9
Asian (%)	0.049	0.044
Black (%)	0.134	0.104
Hispanic (%)	0.499	0.539
Other (%)	0.031	0.025
White (%)	0.287	0.287
Free/Reduced-Price Lunch (%)	0.619	0.593
Special Education Services (%)	0.082	0.054
Math score	-0.01	0.099
(SD)	0.997	0.982
Observations	6,530,574	1,721,618

Table 2. Summary Statistics for Student Characteristics and Algebra I Outcomes

	Overall	FRL	Non-FRL	Asian	Black	Hispanic	White	Other
Student Characteristics								
FRL	59.31%	100.00%	0.00%	26.14%	73.12%	78.65%	24.59%	42.21%
Special education	7.09%	8.25%	5.40%	2.97%	9.07%	7.29%	6.62%	7.14%
Gifted	12.74%	8.49%	18.94%	30.31%	7.09%	10.19%	16.62%	15.69%
LEP	26.72%	39.87%	7.54%	35.21%	2.83%	44.90%	1.79%	5.83%
4+ schools attended grades 3–9	44.81%	47.54%	40.83%	36.73%	58.54%	43.13%	44.02%	47.08%
Math Trajectory								
Took ALG1 by grade 8	34.07%	24.79%	47.59%	73.82%	23.23%	28.98%	40.98%	39.59%
Took ALG1 by grade 9	99.19%	98.97%	99.51%	98.99%	99.22%	98.97%	99.58%	99.46%
Took ALG1 EOC by grade 8	32.69%	23.83%	45.67%	69.37%	22.46%	27.88%	39.33%	37.88%
Passed ALG1 EOC by grade 8	26.84%	17.21%	40.96%	66.55%	16.82%	20.71%	35.35%	32.91%
Took ALG1 EOC by grade 9	96.90%	96.69%	97.20%	94.88%	96.68%	97.09%	96.94%	96.66%
Passed ALG1 EOC by grade 9	58.13%	48.86%	71.70%	85.64%	45.90%	53.01%	67.58%	62.43%
Grade 3 EOG math score	0.099	-0.142	0.451	0.879	-0.272	-0.050	0.380	0.257
Algebra I score	0.135	-0.110	0.490	1.302	-0.166	-0.022	0.350	0.271
Teacher Characteristics Prior to Algebra I								
Standard cert	62.55%	57.74%	69.55%	69.36%	58.17%	57.80%	71.50%	68.32%
Alt cert	32.42%	36.44%	26.55%	27.25%	37.03%	36.01%	25.17%	28.19%
Permit (not cert)	4.33%	4.93%	3.46%	2.86%	3.65%	5.37%	2.98%	2.97%
Math VA	0.020	0.010	0.033	0.048	0.008	0.014	0.031	0.024
Novice teacher	21.04%	23.42%	17.58%	19.37%	25.41%	22.46%	17.19%	19.61%
Teacher Characteristics in Algebra I								
Standard cert	58.99%	55.15%	64.54%	63.75%	54.20%	55.62%	65.89%	63.14%
Alt cert	34.96%	37.91%	30.72%	32.88%	39.51%	37.49%	29.19%	32.17%
Permit (not cert)	4.01%	4.34%	3.53%	2.24%	3.39%	4.48%	3.68%	3.25%
Certified in math	93.59%	92.42%	95.27%	95.05%	92.17%	92.85%	95.16%	94.73%
Math VA	-0.007	-0.003	-0.012	-0.001	-0.016	0.000	-0.015	-0.016
Novice teacher	20.08%	22.95%	15.93%	14.30%	24.84%	22.07%	15.73%	18.06%
Observations	1721618	1021080	700538	75866	179504	928338	494780	43130

Table 3. Early Math Experiences and Algebra I Success by FRL Status

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
FRL status	-0.225***	-0.103***	-0.220***	-0.200***	-0.220***	-0.094***	-0.051***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Math score in grade 3		0.210***				0.196***	0.151***
		(0.000)				(0.000)	(0.001)
4+ schools attended			-0.061***			-0.041***	-0.033***
			(0.001)			(0.001)	(0.002)
Teacher VA before Algebra I				0.874***		0.420***	0.037
				(0.006)		(0.006)	(0.022)
% standard cert teachers before Algebra I				0.036***		0.000	0.006
				(0.002)		(0.002)	(0.007)
Alg1 teacher VA					0.486***	0.425***	0.393***
					(0.003)	(0.003)	(0.005)
Alg1 tch standard cert					0.014***	0.006***	0.011***
					(0.001)	(0.001)	(0.002)
Alg1 tch cert					0.066***	0.044***	0.034***
					(0.002)	(0.002)	(0.004)
Constant	0.737***	0.645***	0.762***	0.683***	0.690***	0.625***	0.628***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.003)	(0.003)	(0.006)
Observations	978,911	978,911	978,911	978,570	871,413	871,343	656,583
R-squared	0.064	0.228	0.068	0.085	0.090	0.251	0.414
Grade 3 school FE						Yes	
Grades 3–8 teacher FE							Yes

Note. Each column presents estimates from separate linear regressions of students' Algebra I end-of-course (EOC) exam pass rates on indicators for socioeconomic group status. All models include cohort fixed effects for students' third-grade school year and use robust standard errors. Subsequently, we add controls for students' third-grade math achievement, school mobility, teacher value-added, school fixed effects, and measures of teacher certification and assignment before and during Algebra I.

Table 4. Early Math Experiences and Algebra I Success by Race

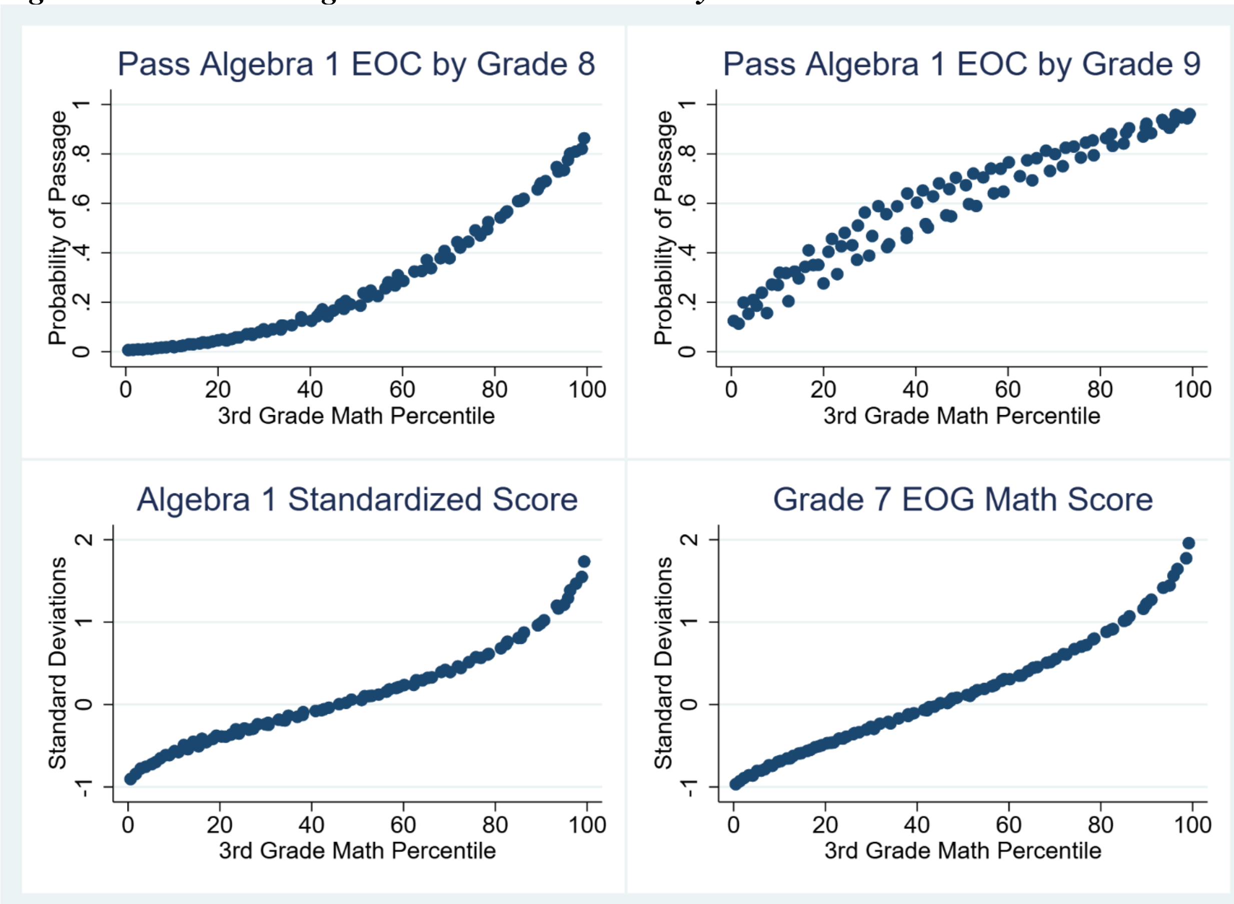
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Asian	0.212***	0.106***	0.207***	0.196***	0.195***	0.087***	0.053***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
African American	-0.207***	-0.069***	-0.197***	-0.179***	-0.196***	-0.050***	-0.026***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Hispanic	-0.134***	-0.043***	-0.134***	-0.110***	-0.134***	-0.039***	-0.012***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Other	-0.037***	-0.009***	-0.035***	-0.029***	-0.032***	-0.002	-0.001
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Math score in grade 3		0.215***				0.201***	0.151***
		(0.000)				(0.000)	(0.001)
4+ schools attended			-0.065***			-0.043***	-0.035***
			(0.001)			(0.001)	(0.002)
Teacher VA before Algebra I				0.912***		0.443***	0.032
				(0.006)		(0.006)	(0.022)
% standard cert teachers before Algebra I				0.062***		0.017***	0.007
				(0.002)		(0.002)	(0.007)
Alg1 teacher VA					0.480***	0.420***	0.393***
					(0.003)	(0.003)	(0.005)
Alg1 tch standard cert					0.018***	0.008***	0.011***
					(0.001)	(0.001)	(0.002)
Alg1 tch cert					0.073***	0.047***	0.034***
					(0.003)	(0.002)	(0.004)
Constant	0.689***	0.609***	0.718***	0.617***	0.634***	0.578***	0.605***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.003)	(0.003)	(0.006)
Observations	978,911	978,911	978,911	978,570	871,413	871,343	656,583
R-squared	0.051	0.223	0.055	0.074	0.075	0.246	0.414
Grade 3 school FE						Yes	
Grades 3–8 teacher FE							Yes

Note. Each column presents estimates from separate linear regressions of students' Algebra I end-of-course (EOC) exam pass rates on indicators for racial/ethnic group status. All models include cohort fixed effects for students' third-grade school year and use robust standard errors. Subsequently, we add controls for students' third-grade math achievement, school mobility, teacher value-added, school fixed effects, and measures of teacher certification and assignment before and during Algebra I.

Table 5. Oaxaca Decomposition Estimates for Gaps in Algebra I Passing Rates, FRL Versus Non-FRL Students

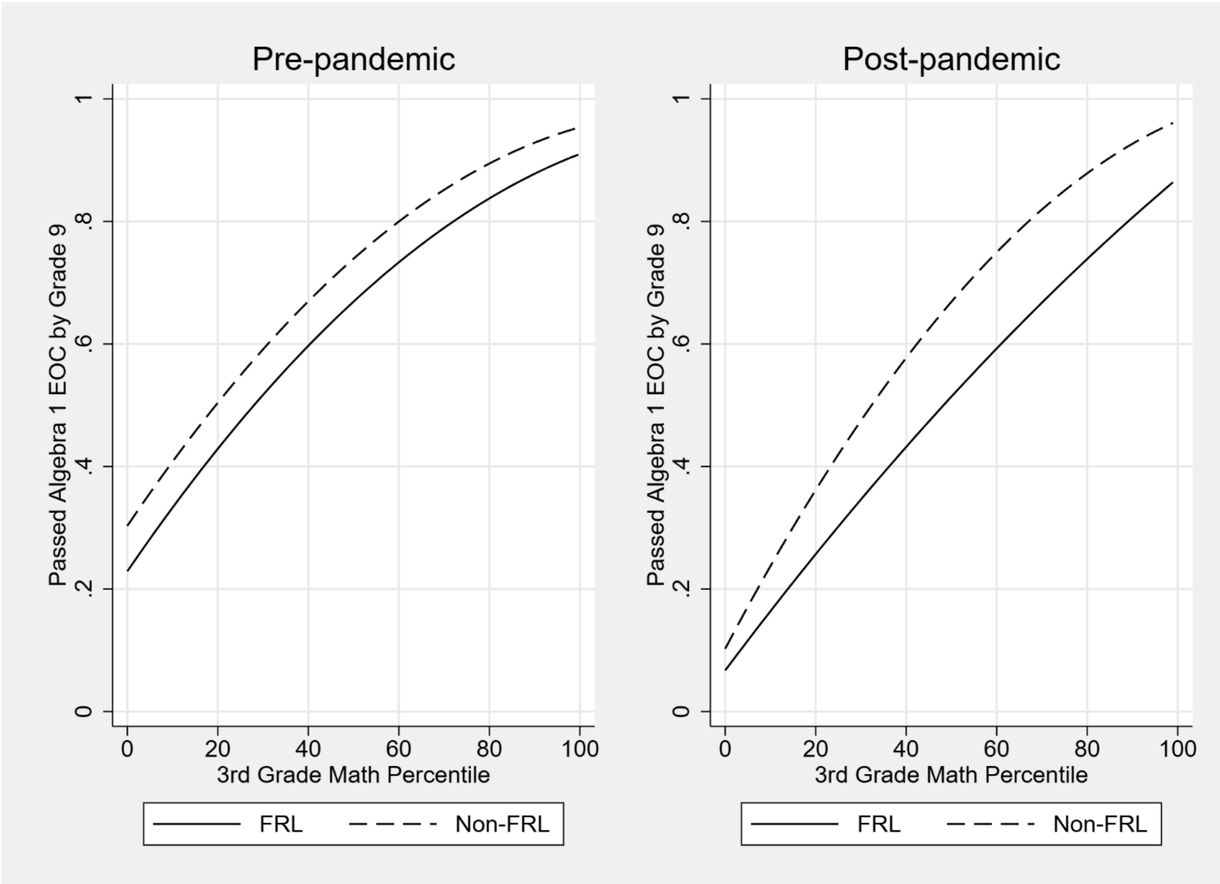
	Endowments (Explained)	**Coefficients (Unexplained)**
Overall	**0.141**	**0.110**
Math score in grade 3	0.128***	0.006***
	(0.001)	(0.000)
4 or more schools attended in grades 3–9	0.003***	0.010***
	(0.000)	(0.001)
Average teacher value added before Algebra I	0.010***	0.000
	(0.000)	(0.000)
Average of certified standard teachers before Algebra I	-0.000	0.013***
	(0.000)	(0.002)
Average teacher value added in Algebra I	-0.003***	0.001***
	(0.000)	(0.000)
Average of certified standard teachers in Algebra I	0.001***	0.001
	(0.000)	(0.001)
Average of certified math teachers in Algebra I	0.001***	-0.002
	(0.000)	(0.004)
Constant		0.332*
		(0.136)
Observations	871,343	

Figure 1. Middle and High School Math Outcomes by Third-Grade Math Percentile



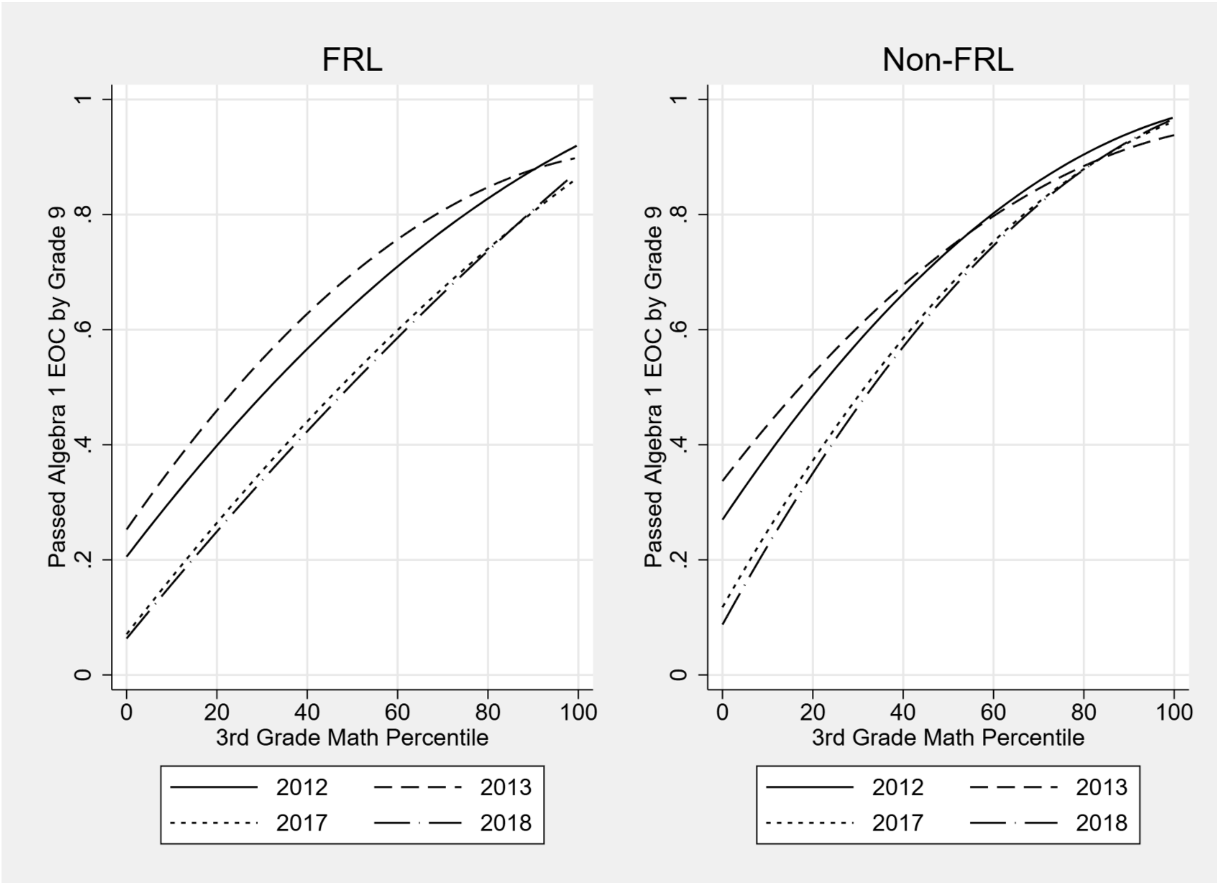
Note. Binned scatter plots show students' percentile ranks on the third-grade state standardized test in math plotted against later achievement outcomes in math.

Figure 2. Pre- and Post-pandemic Algebra I Passage Rates by Third-Grade Math Percentile and FRL Status



Note. Scatter plots show relationship between third-grade math percentile and passage rates of Algebra I EOC exam by ninth grade, modeled using quadratic fit line. Figures reflect the total student population in Texas.

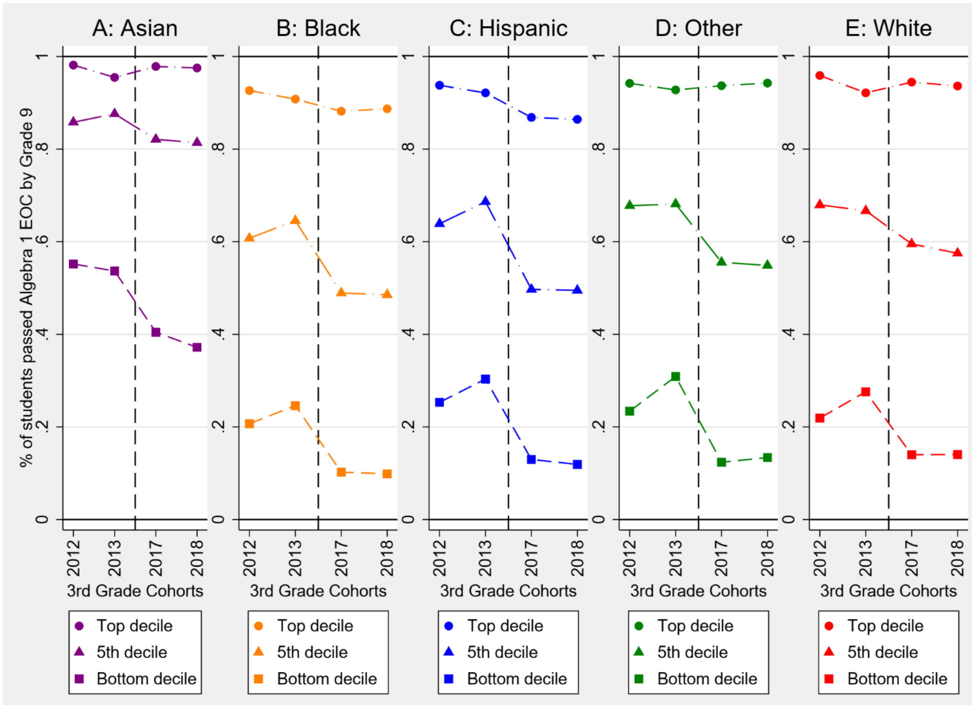
Figure 3. Cohort-Level Algebra I Passage Rates by Third-Grade Math Percentile, by FRL Status



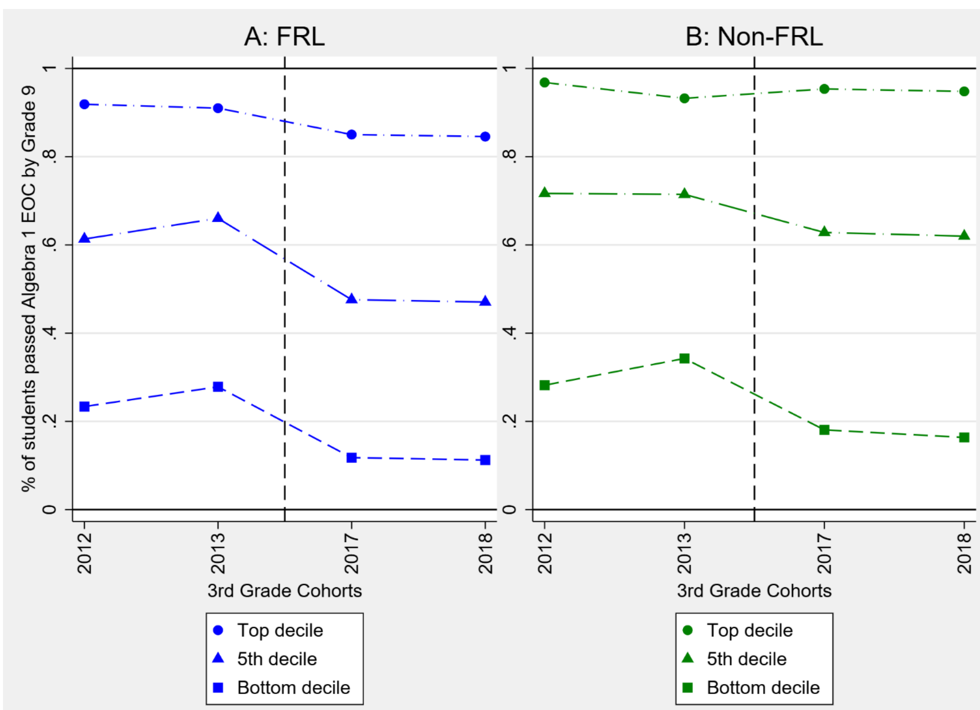
Note. Cohort labels correspond to the year in which students were in third grade.

Figure 4. Trends in Algebra I Passage Rates by Third-Grade Achievement

(a) By race



(b) By FRL status



Note. Within each panel, we show results for three selected achievement deciles in third-grade math: decile 1 (circle markers), decile 5 (diamond markers), and decile 10 (square markers).

Appendix

Figure A1. Pre- and Post-pandemic Algebra I Passage Rates, by Third-Grade Math Percentile and URM Status