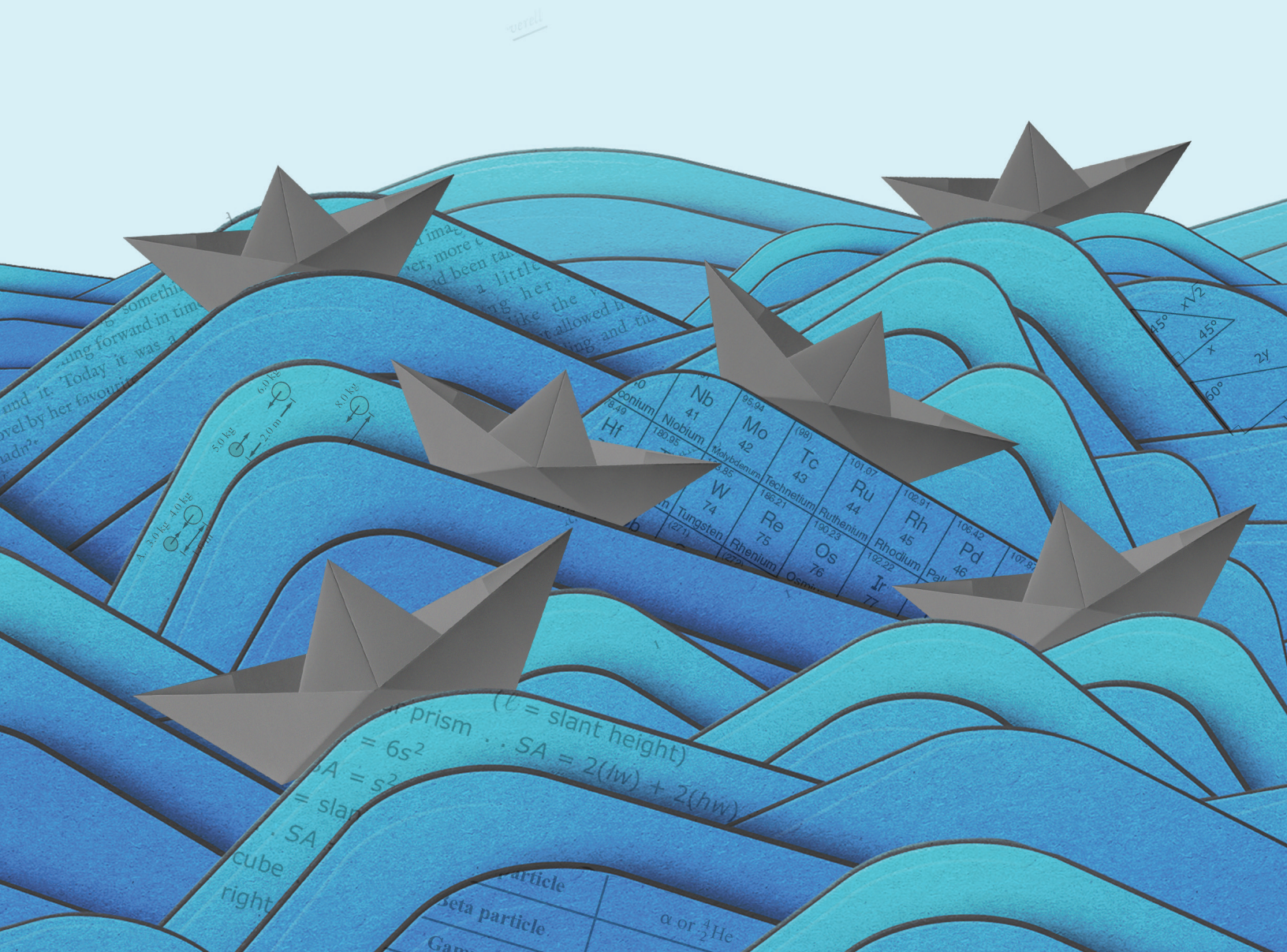


LIFTING ALL BOATS?

Accomplishments and Challenges from 20 Years of Education Reform in Massachusetts

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About the Project

Educational Opportunity in Massachusetts

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Educational Opportunity in Massachusetts is a research-practice partnership between researchers at Brown and Harvard Universities and the Massachusetts Department of Elementary and Secondary Education. We study the broad effects of educational reform in the Commonwealth and the ways that the public K–12 and higher education systems promote and constrain opportunity for students from all backgrounds. Using integrated data from several state agencies, we follow students' progress through the educational pipeline and entry into the labor force. Our work focuses on educational inequality and the consequences of standards-based reform.

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EXECUTIVE SUMMARY

Since the passage of the **Massachusetts Education Reform Act in 1993**, the Commonwealth has been seen as a national leader in education reform. The legislation introduced statewide learning standards and the Massachusetts Comprehensive Assessment System (MCAS) tests, and provided large increases in funding for K-12 education. We explore the high school experiences, post-secondary educational attainments, and labor market earnings of Massachusetts public school students since the early 2000s, when MERA was fully implemented.

New state-level initiatives, including the passage of the Student Opportunity Act in 2019 and the introduction of the Next-Generation MCAS tests, aim to advance the state's goal of providing all students with the skills and knowledge to thrive in today's complex and changing society. The COVID-19 pandemic has increased awareness of the dramatic inequalities in students' opportunities and schools' resources and underscores the need to re-envision the role of public schools in promoting equity. Doing so requires a robust consideration of the progress of public education in the Commonwealth over the past several decades.

WE HIGHLIGHT FIVE KEY FINDINGS:

1. **MCAS scores predict later outcomes.** PG 7–12

Scores on the grade 10 MCAS examinations – the last required MCAS test in high school and the only one with high-stakes consequences for students – predict longer-term educational attainments and labor market success, above and beyond typical markers of student advantage. For example, among demographically similar students who attended the same high school and have the same level of ultimate educational attainment, those with higher MCAS mathematics scores go on to have much higher average earnings than those with lower scores.

2. **Educational attainments have risen over time.** PG 16

Since the early 2000s, average educational attainments have increased substantially overall and for key student groups, including English learners (ELs), low-income students, and those of different races/ethnicities. For instance, seven years after taking the 2011 grade 10 MCAS tests, 42% of students in the 2011 test-taking cohort had graduated from a four-year college compared to 32% of test-takers in 2003. These gains came despite demographic shifts that included large increases in the proportions of low-income students and English learners.

3. Gaps by income and race/ethnicity in four-year college completion have widened. PG 19

While income-based gaps in the Commonwealth's high school graduation and college-going rates have narrowed over time, the gap in four-year college graduation rates has widened in recent years. These patterns reflect national trends but are cause for concern given the large earnings premium associated with a bachelor's degree.

4. Gaps in attainments exist even for students with the same MCAS scores. PG 22

The educational attainments of low-income students (as well as English learners, Black students, and Hispanic students) are lower, on average, than those of higher-income students with the same MCAS scores. For example, at the state median score (50th percentile) on the 2011 MCAS math examinations, about half of higher-income students graduated from a four-year college within 7 years, compared to approximately 25% of low-income students.

5. Earnings gaps are much smaller for students with the same MCAS scores and attainments. PG 18

There are large gaps between the average later earnings of students across lines of socioeconomic difference. For example, students who grew up in a higher-income family and who took the 10th grade MCAS in 2003-05 had median earnings of \$50,000 in 2019, at approximately age 30. In contrast, low-income students in this cohort earned 31% less, or about \$38,000. Two-thirds of this gap is accounted for by differences in students' 10th grade test scores and educational attainments. If we compare students who have the same 10th grade MCAS scores and same educational attainments, the gap in annual earnings between students from low-income families and those from higher-income families is only 10%.

IMPLICATIONS

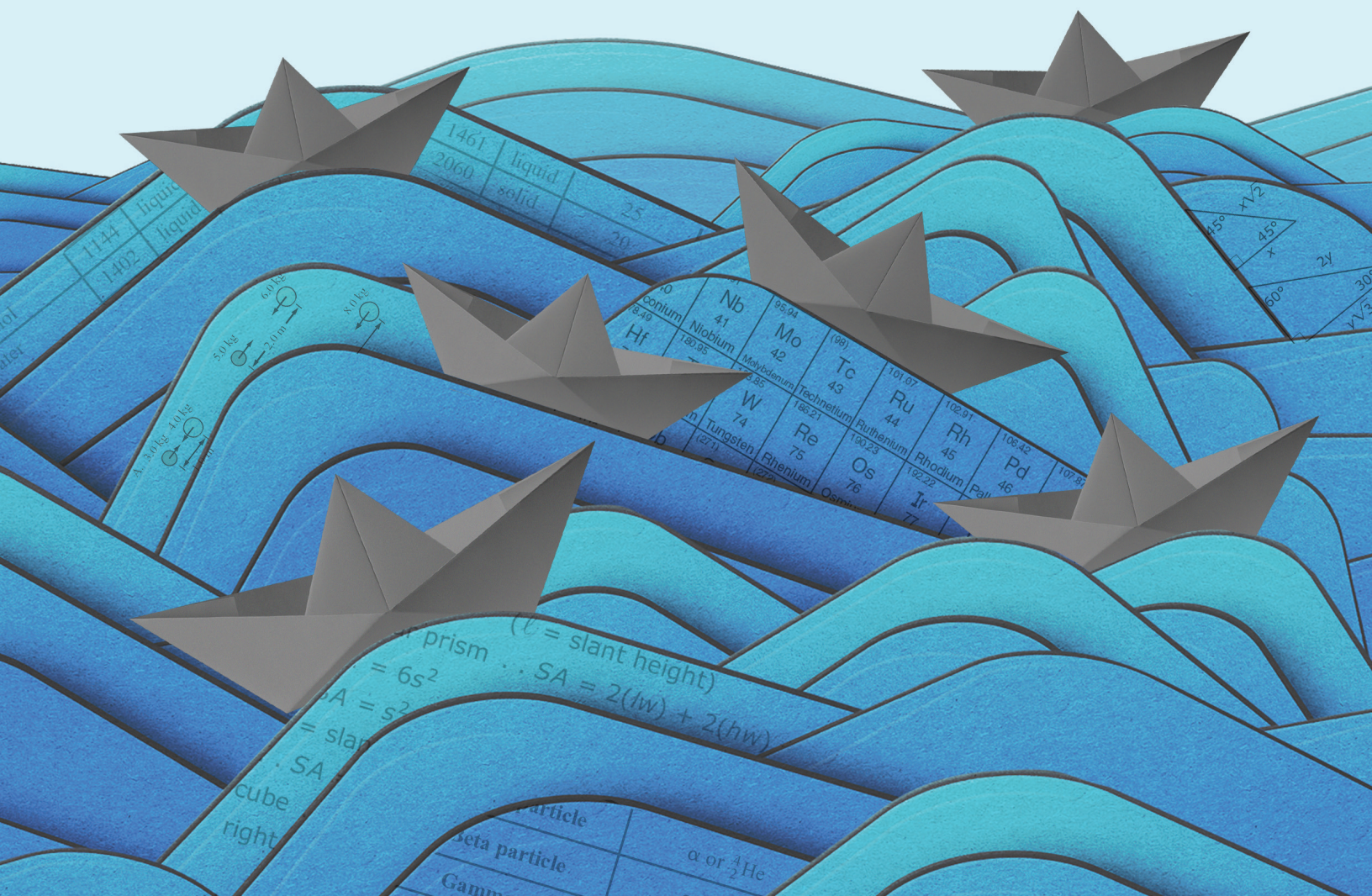
Taken together, our findings suggest that the public education system in the Commonwealth has made substantial progress over the past two decades but has a long way to go in equalizing opportunities for students from key subgroups. We find inequalities at all points in the Commonwealth's educational pipeline. Closing gaps in high school performance and postsecondary educational attainments could dramatically reduce current levels of income inequality.

Both the state's public K-12 and higher education systems need to work to ensure that students who want to pursue post-secondary education have

access to college, enter college ready to succeed, and receive the supports necessary during college to leave with a valuable credential. For K-12, improved MCAS scores should follow from better educational opportunities and increases in critical skills. This requires that all students experience high-quality instruction designed to achieve student mastery of core academic and social skills, as opposed to test-taking strategies. For higher education, we note that in-state public colleges have a critical role to play in equipping low-income students with the skills and educational credentials to succeed in the labor market.

INTRODUCTION

It has been almost three decades since the passage of the path-breaking **Massachusetts Educational Reform Act (MERA) of 1993**. This legislation brought standards-based educational reforms to the Commonwealth with the goal of providing all students with the skills and knowledge to thrive in today's complex and changing society. The state articulated learning standards that defined what students should learn in each grade and subject and held schools and school districts accountable for their progress towards meeting these standards via the Massachusetts Comprehensive Assessment System (MCAS). These learning standards and tests are designed to ensure that students leave the K-12 system with the skills and capacities necessary to thrive in the labor market and/or in further education. In exchange for increased accountability, the state increased funding substantially. Net of inflation, real expenditures per student from all sources, including local tax revenues, increased by 66% between 1993 and 2016 in Massachusetts, compared to a 38% increase in the nation as a whole.



By many counts, this investment has paid off. Massachusetts now sits at the top of the nation in test scores, and states across the country have sought to emulate the Commonwealth's education system. However, there are important questions about the long-term impacts of these reforms—overall and for certain groups of students.

Among the many goals for public K-12 and post-secondary education in the Commonwealth, two are particularly relevant here. The first is that all students acquire the skills and credentials they will need to thrive in a changing economy. The second is that education contribute to “leveling the playing field” among students who enter school with widely varying advantages and disadvantages. As Horace Mann, the Commonwealth's first Secretary of Education, stated in 1848: “Education, then, beyond all other devices of human origin, is the great equalizer of the conditions of men—the balance-wheel of the social machinery.”¹ Yet recent reports have highlighted critical gaps in educational outcomes for low-income students, Black and Hispanic students, students with disabilities, and English learners.²

In this report, we use longitudinal data to explore trends and patterns in the high school experiences, post-secondary educational attainments, and labor market earnings of Massachusetts public school students since the early 2000s. We examine whether educational outcomes have improved on average and for specific groups of students, including English learners (ELs), low-income students, and those of different races/ethnicities, and whether educational outcomes have equalized along these lines of difference.

WE HIGHLIGHT FIVE KEY FINDINGS:

High school MCAS test scores predict success in the labor market and are important early indicators of long-run outcomes.

Educational attainments have risen substantially over the past two decades.

Across many lines of difference, inequality in high school graduation and college enrollment rates has narrowed, but gaps in college completion have widened.

There are striking gaps by family income and race/ethnicity in educational attainments among students with the same MCAS scores.

Academic skills and educational attainments explain much of the gap in later average earnings between students who grew up in low-income and higher-income families.

The time is ripe to examine the role of education in Massachusetts for several reasons. First, the COVID-19 pandemic has brought into stark relief several realities about public schooling in the Commonwealth and elevated the role of in-person schooling in the public's eyes. The pivotal role of schools and teachers has become clearer than ever. The pandemic has also increased awareness of the dramatic inequalities across the Commonwealth in students' opportunities and schools' resources. While this COVID-19 crisis presents unprecedented challenges, it also affords an opportunity to re-envision the role of public schools in promoting equity. Doing so requires a robust consideration of the long-term progress of public education in the Commonwealth over the past several decades.

Second, the passage of the Student Opportunity Act in November 2019 makes this an especially important time to examine recent trends in student outcomes. The new legislation continues in the spirit of the 1993 law and promises to inject substantial new resources

into the state's system and ameliorate inequities in funding across public school districts. The state has also introduced Next-Generation MCAS tests, which seek to measure students' readiness for college and careers. It is currently debating future graduation standards in the Commonwealth and updates to its policy, dating from the class of 2003, that all students must demonstrate content mastery on the high school MCAS examinations in order to earn a diploma.

Finally, the state's investments in data infrastructure mean that, for the first time, we can examine how students' experiences in the Massachusetts public school system relate to markers of success in adulthood. Longitudinal data from several state agencies and the National Student Clearinghouse allow us to track students from their enrollment in the public K-12 system through college and into the state's labor force. We are able to analyze a wide range of outcomes, including in-state earnings at age 30 for students who were in high school during the early 2000s.

WE DIVIDE THIS REPORT INTO THREE SECTIONS.

First, we describe the economic and demographic context of educational reform efforts in Massachusetts over the past few decades.

Second, we present evidence on how well 10th grade MCAS test scores predict long-term outcomes.

Third, we document how academic skills and educational attainments have evolved over the past two decades in Massachusetts, including the trends for all students and whether inequality between key subgroups has grown or declined.

CONTEXT



The combination of academic and social skills is more important to labor market success than was the case several decades ago. The Massachusetts public high school student population is now more diverse and less advantaged, on average, than it was two decades ago.

The state’s education system operates within a broader economic and social/demographic context that provides important background for this report. Assessing progress thus requires a careful consideration of how these two elements have changed in recent years.

There are two critical economic changes over the past two decades that bear directly on our analysis of the state’s educational system. First, changes in the economy, brought about by computer-based technological changes and increasing globalization of the production of goods and services, have altered the skills workers need to earn a decent living. Economists have documented the increasing importance of a combination of academic skills—including reading and mathematics—and social skills for labor market success.³ While scholars define “social skills” differently, they include the ability to work productively in groups with people from different backgrounds, reliability, persistence in the face of challenges, listening, cooperating, negotiating, and communicating effectively.⁴ Recent research has documented that teachers and schools affect not only the academic skills students master, but also the social skills they develop.⁵

While MCAS tests assess students’ academic skills, they do not measure most dimensions of social skills. This asymmetry creates a problem in assessing the progress of Massachusetts public education. It is possible that accountability tied to MCAS tests has led some schools to respond in ways that do not develop useful academic and social skills, for example by narrowing the curriculum or focusing on test-taking strategies. We return to this point later.

The second key economic change relevant to our analysis is a substantial increase in income inequality among Massachusetts households. Between 1980 and 2011, the average income of high-income households grew five times faster than that of low-income households.⁶ Indeed, in 2015, income inequality among Massachusetts families was 6th highest among the 50 states.⁷ Children from low-income families are much more likely to enter school with health and learning

MA public high schools are serving more low-income students and English learners

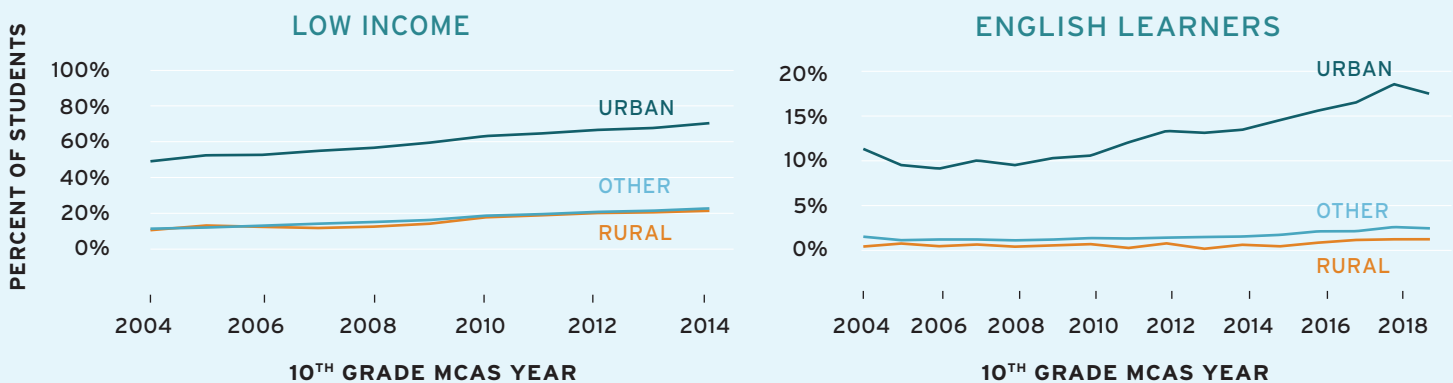


FIGURE 1
Proportion of 10th grade MCAS test-takers who are low-income (left) or English learners (right) by district type, 2004-19

NOTE

Massachusetts recently changed how it identifies low-income students. As a result, we focus on trends in family income before 2015.

challenges than children from higher-income families, who benefit from substantial and growing levels of spending on enrichment activities by their parents.⁸

These economic patterns have interacted with important demographic trends in the Commonwealth over the past two decades to change fundamentally the enterprise of public education in Massachusetts. The state's public school student population is now more diverse and less advantaged, on average, than it was two decades ago. For example, the percentage of Massachusetts public school students designated as English learners more than doubled between 2003 and 2018, from 6 to 14 percent. Serving English learners well requires extra expenditures to pay for additional services and support. Similarly, the proportion of the Massachusetts public school student population living in low-income families—defined as those that qualify for free- or reduced-price lunch—increased from 23 percent in 2003 to 37 percent in 2014. Since then, the percentage has declined somewhat as recovery from the Great Recession improved job opportunities.

The state's low-income families with children are increasingly clustered in neighborhoods with other low-income families.⁹ Since most children attend a school close to their home, this contributes to a high level of school segregation by income.¹⁰

DATA WE USE

The Massachusetts Department of Elementary and Secondary Education maintains a comprehensive database that tracks students longitudinally beginning in the early 2000s. Every record contains each student's MCAS scores, demographic characteristics, and K-12 enrollment/graduation status. We link this information to data about students' college enrollment, college success (i.e., remediation and grades), college graduation, and labor market earnings. For college outcomes, we use data from both the National Student Clearinghouse and the state Department of Higher Education. For labor market outcomes, we use Massachusetts unemployment insurance data.

We focus on **first-time 10th grade test-takers** throughout the report. When we say 2004 test-takers, for example, we mean students who took the test in that year for the first time, not as a retest. This means that our estimates of student performance on the test may not line up precisely with state reports on all test-takers. More importantly, we do not include in our analyses either students who dropped out of Massachusetts public schools before they would have taken the grade 10 MCAS or students who

This is problematic because research shows that children from low-income families fare better in terms of educational attainments and adult earnings when they grow up in mixed-income neighborhoods and attend mixed-income schools.¹¹

Demographic shifts are not occurring evenly across the Commonwealth. Instead, they are concentrated in urban districts. For example, the proportion of low-income 10th graders is much higher and has grown more rapidly in the state's urban school districts than in other districts. The same is true for the proportion of students who are English learners in 10th grade.

Figure 1 displays these patterns.

These demographic trends in Massachusetts have posed growing challenges for the Commonwealth's public school system. It is important to keep these trends in mind in interpreting the achievement and educational attainments of the state's public school students. For example, these compositional shifts could make trends in outcomes over time flat even if outcomes for each subgroup are increasing. Furthermore, the impacts of these changes are disproportionately affecting a subset of districts, a key challenge that the Student Opportunity Act is designed to address.

entered the system in 11th or 12th grade. For our analyses of earnings, we focus on students who took the test between 2003 and 2005; these students are in their early 30s in 2019. For analyses of educational attainments, we focus on 2011 test-takers as this is the most recent year we can examine. We find quite similar patterns across years.

Many of the analyses in the report present simple patterns in data—for example, the percentage of students in each year who graduate from high school. In some places, we report the results of more complex analyses that statistically control for a variety of factors. In these cases, we include a footnote explaining our analysis in more detail. We should note that all of the research presented here is **descriptive** in nature. We cannot make causal claims about the relationships we present. For example, while we document that students with higher MCAS scores have better earnings, we cannot conclude that raising MCAS scores definitively causes higher earnings.

SECTION TWO

MCAS SCORES AND LONG-TERM OUTCOMES



MCAS scores predict long-term outcomes, above and beyond educational attainments and other markers of student advantage.

Massachusetts has invested heavily in the MCAS assessments over the past two decades. Not only are these tests a focus of the state’s school accountability system, students must also pass the grade 10 examinations to receive a high school diploma. There is substantial evidence on the content validity of these tests, showing that MCAS tests are well aligned to the state’s curricular frameworks.¹² However, critics assert that MCAS scores are error-prone and simply reflect students’ socioeconomic status or exposure to test preparation. We examine the critical question of how well the scores on these tests predict students’ later success in college or the workforce.

MCAS scores are strong early indicators of college and career readiness for Massachusetts students. Students with higher 10th grade MCAS scores are more likely than those with lower scores to graduate from high school, enroll in college, and graduate from college. They also have higher labor market earnings, on average.

Figure 2 shows the percentage of students scoring at each percentile of the MCAS mathematics score distribution who complete particular levels of

education.¹³ We include the results both for 2003–05 test-takers—the early MCAS years we use in our earnings analysis—and for those in 2011, the most recent year available to measure college graduation. The patterns are quite similar, suggesting that changes in the test over time have not affected how well scores predict outcomes. In 2011, 89% of students at the 25th percentile of the test distribution graduated from high school, compared to 97% at the 75th percentile. Similarly, only 19% of students at the 25th percentile

MCAS scores predict high school and college outcomes

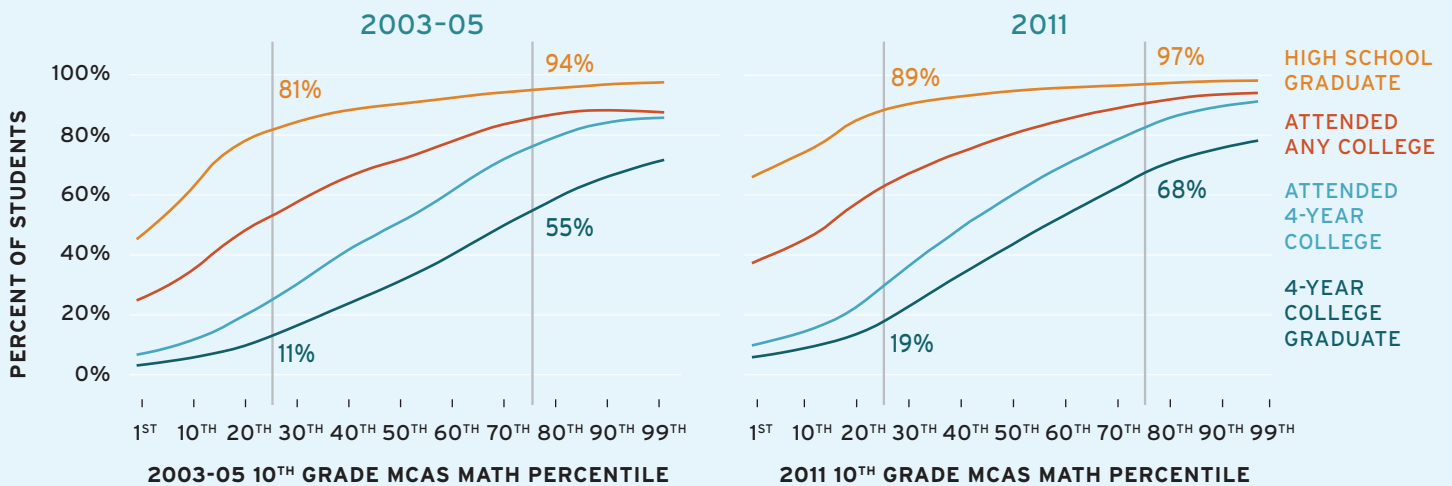


FIGURE 2
High school and college outcomes by MCAS math performance level
(2003-05 (left panel) and 2011 (right panel) first-time 10th grade test-takers)

NOTE

Attainments are measured as follows: high school graduation within 3 years of first taking the 10th grade MCAS, college attendance within 4 years of first taking the 10th grade MCAS, and college graduation within 7 years of first taking the 10th grade MCAS.

graduated from a four-year college, compared to 68% at the 75th percentile. We see quite similar patterns in ELA.

Tenth grade MCAS scores from 2003-05 also predict labor market earnings. We illustrate this pattern descriptively in *Figure 3*, which displays median 2019 earnings (when individuals are about 30 years of age) by MCAS score percentile for 10th grade mathematics test-takers. For reference, an MIT study estimates that a living wage in Massachusetts translates to annual earnings of \$40,705 for individuals in a family with two working adults and two children, and \$32,157 for a single working adult with no children.¹⁴

On average, students with higher scores have higher earnings. For example, students scoring at the 75th percentile on the MCAS math exam earned \$22,342 more than students scoring at the 25th percentile, on average. The pattern in ELA is nearly identical: Students scoring at the 75th percentile on the MCAS ELA exam earned \$22,106 more than students scoring at the 25th percentile, on average.

As *Figure 3* illustrates, MCAS scores are not the only determinant of later earnings. There is considerable variation in earnings among people with the same MCAS scores. Contributing factors include differences in social skills, health, occupational opportunities and choices, and the amount of time devoted to work for pay.

These analyses rely on test scores for high school students from 15 years ago. Because earnings are quite unstable as students engage in post-secondary education through the first decade after high school graduation, we focus our analysis on earnings in 2019 when these students have reached their early 30s. However, as *Figure 2* illustrates, there are similar relationships between MCAS scores and educational attainments across years. In fact, we replicate all of the analyses we present using data from the most recent years available and find quite similar patterns. Our best interpretation is that changes in the test and test scale over time have not substantially affected how well MCAS scores predict long-term outcomes. Of course, we cannot predict how the economy and labor market

MCAS scores predict earnings at age 30

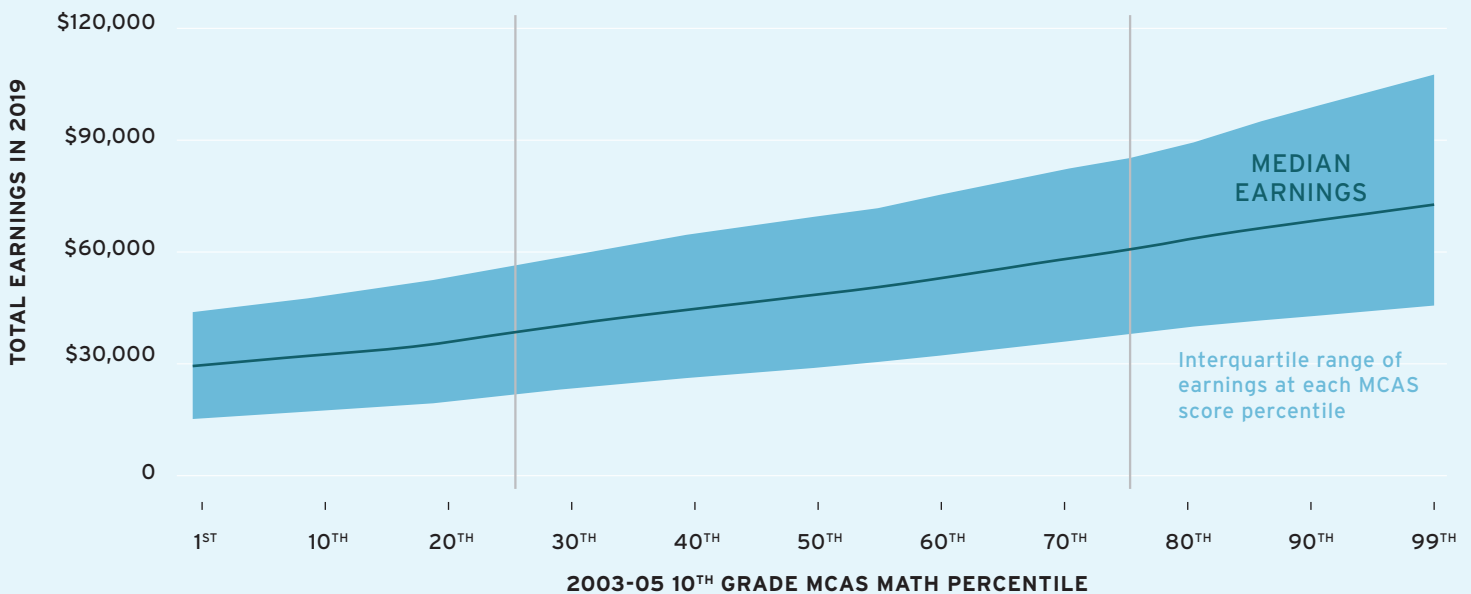


FIGURE 3
Earnings by mathematics score percentile of 2003-05 first-time 10th grade test-takers

will change by 2035, when current test-takers will be in their early 30s.

That MCAS test scores predict long-term outcomes for students is reassuring but expected, given the relationship between these scores and other forms of student advantage. The key question is whether the mathematics and English language skills assessed by the MCAS pay off later in the labor market. We cannot answer this question definitively. However, we present three pieces of relevant evidence. In essence,

Comparing students' performances in first college math class

One important question is whether MCAS scores are useful signals of college readiness. We look at Massachusetts public school students who enroll in a mathematics course during their first year in one of the nine in-state public universities other than the University of Massachusetts, as these are the only students for whom we have the relevant data. We examine whether they earn credit towards graduation in their first college math course. There are two reasons

we compare students who are similar on a wide range of observable characteristics, such as demographics and high school grades, but who have *different* MCAS scores. We show that MCAS scores predict post-secondary success and earnings even among students with very similar observed characteristics. We note that these analyses are purely descriptive and do not necessarily reflect causal relationships between MCAS scores and later outcomes.

why students may not earn credit towards graduation—they are assigned to a “developmental” (remedial, non-credit-bearing) course, or they fail their credit-bearing course.

We compare students with the same demographic profiles (family income, race/ethnicity, gender, disability status, and English learner status) and same high school GPAs, who attended the same high school,

DATA LIMITATIONS

Educational Attainments

Our data on long-term educational attainments have two limitations. First, we currently are able to **track college outcomes consistently for only 7 years after students take the 10th grade test**. The figures we present thus reflect underestimates of ultimate attainments. For cohorts for which we can track students longer, we see that more students do indeed graduate from both two-year and four-year colleges after the period covered by our data. For example, among 2003 test-takers we see that four-year college graduation rates increased by 5 percentage points if we examined students 9 years after they took the MCAS, rather than 7 years. However, while the levels of attainments are different, we see quite consistent patterns in the trends and gaps we explore if we track students for longer periods of time.

Second, we cannot track college completion for students in the most recent high school cohorts because they have not yet finished college. Thus, we do not report college completion rates for students who first took the grade 10 MCAS examinations in 2012 or later.

Earnings

Our data on earnings have several limitations. First, we only observe earnings in Massachusetts. Estimates suggest that 70% of students who grew up in Massachusetts remain living in the same commuting zone in their early 30s; those that leave the commuting zone have only slightly higher earnings.* Second, we do not observe earnings of workers who are self-employed, work for the federal government, or whose employers do not report employees' earnings to the state Unemployment Insurance system. Estimates from the American Community Survey suggest that 12% of Massachusetts earners in their early 30s have some self-employment income. Third, we cannot determine whether earnings represent full-time work. These limitations have important implications for our analysis, namely:

- We cannot estimate accurately the employment rate for any group.
- We may be somewhat understating the average earnings of groups that are especially likely to leave the state.

* Calculation from the Opportunity Atlas (<https://www.opportunityatlas.org>)

and who enrolled in the same college. We focus on students who took the test in 2011, although we see similar patterns in earlier years. We wanted to learn whether those with higher MCAS scores were more likely to earn credit toward graduation in their first college mathematics course than students with lower scores.

We see that this is the case. For example, if we compare students with similar demographics who have a 3.0 GPA from the same high school and who attend the same college, the average student scoring at the

75th percentile in 10th grade is 13 percentage points more likely to earn credit than the average student scoring at the 50th percentile. Given that 61% of students with a 3.0 GPA who score at the 50th percentile on the 10th grade MCAS math exam earn credit towards graduation, this is a sizable difference. This pattern holds for students with high GPAs and low GPAs. MCAS scores predict college success, even for students with the same demographic profile who attended the same high school and had the same GPA.¹⁵

Comparing students' earnings at age 30

Above, we showed that students with higher MCAS scores went on to earn substantially more, on average. Of course, students with higher MCAS scores may also have many advantages unrelated to the academic skills they have developed that lead to higher average earnings as adults. For example, students from relatively affluent families may have access to financial resources to support further education, social capital, networks, job or internship experiences, and opportunities—both in and out of school—to develop the types of social skills rewarded in the labor market. Most critically, students from wealthier families are more likely to complete college than students from lower-income families who have the same MCAS scores (*see Section 3*).

Here, we compare the earnings of demographically similar students who attended the same high school and have the same level of ultimate educational attainment. *Figure 4* shows that, even among these students, those with higher MCAS mathematics scores have much

higher earnings, on average, than those with lower scores. We see similar patterns in ELA, although the relationships are not quite as steep. Note that the lines are of different lengths because we only plot each curve within the range of the relevant data; in other words, there are very few high school dropouts with very high MCAS scores and few four-year college graduates with very low scores.

Among four-year college graduates, earnings for a student scoring at the 75th percentile on the MCAS mathematics test are 33% higher, on average, than those for a demographically similar student from the same high school who scored at the 25th percentile. This represents a difference of approximately \$18,000. This same pattern holds across different levels of educational attainment: students with higher MCAS scores earn more than students with lower scores, on average, even after adjusting for differences in educational attainment, demographics, and high school

MCAS TESTING IN MASSACHUSETTS

We focus on student scores on the 10th grade MCAS assessments. These tests were first given in 1998. Beginning with the high school graduating class of 2003, the 10th grade MCAS math and ELA assessments have functioned as high school exit exams. Students received a scaled score and a performance label of Failing, Needs Improvement, Proficient, or Advanced. These scores are used for what is known in the state as “competency determination”—ensuring that all high school graduates have demonstrated competency in core academic subjects. The state determined

that passing the competency determination standard required a score in the Needs Improvement range. Students who do not pass the test have multiple chances to retest and pass before graduation. For the class of 2010, the state added an end-of-course test in science. It also required students who met the “passing” standards but had not achieved the Proficient level to undertake an Educational Proficiency Plan to articulate a plan of study in grades 11 and 12. The aim was to ensure that students achieve proficiency on state standards.

MCAS scores predict earnings among similar students with the same education level

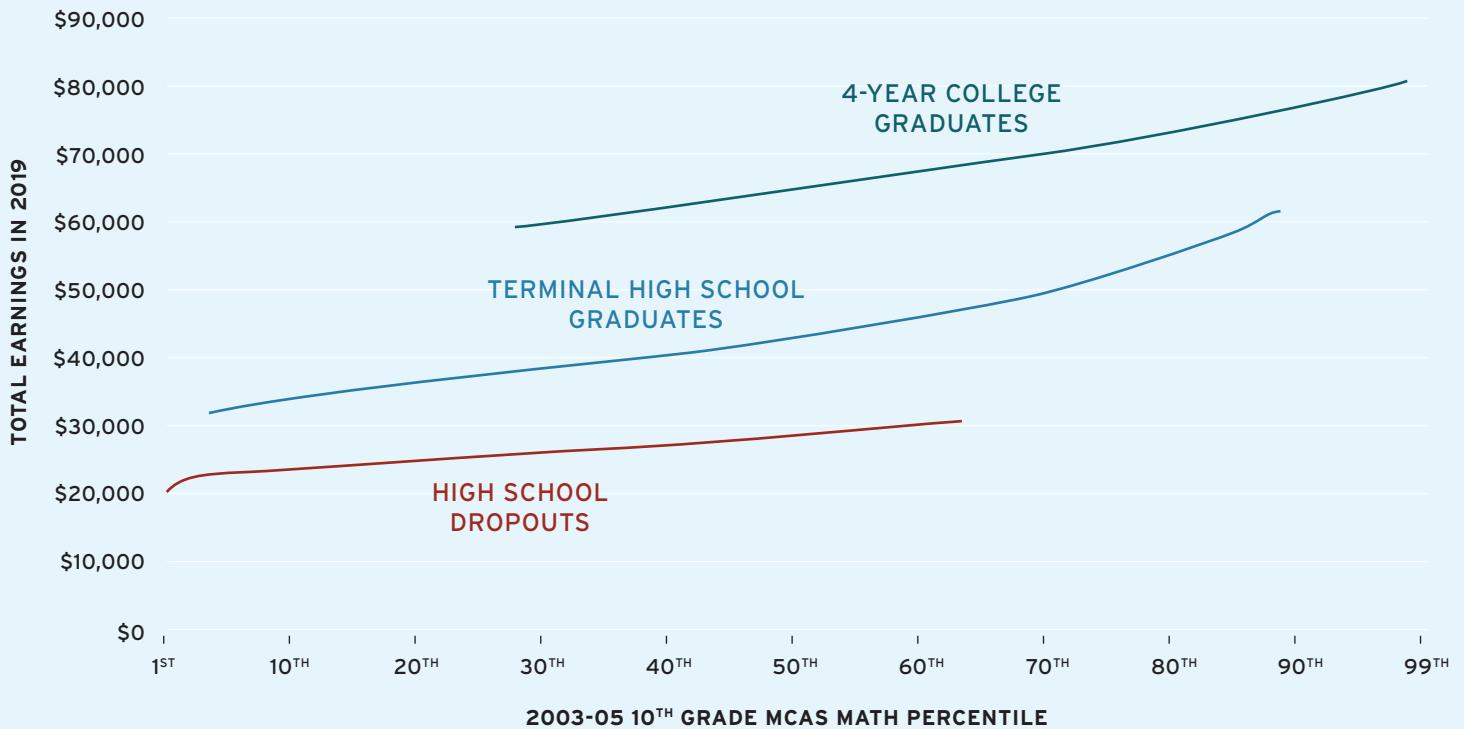


FIGURE 4
Estimated average annual earnings by MCAS mathematics score and educational attainment for demographically similar students who attended the same high school

NOTE

We model log earnings in 2019 as a cubic function of standardized raw MCAS mathematics test scores, student demographics, and high school fixed effects. We also include indicators for the students’ ultimate educational attainment 7 years after taking the test and interact these with the cubic function of test scores. Note that students’ attainments may continue to change over time; as such, our estimates of the differences may be understated. We plot from the 5th to the 95th percentile of the MCAS score distribution within each attainment level relative to the median earnings for terminal high school graduates.

attended. Importantly, while MCAS scores predict earnings across all levels of attainment, the relationship is shallowest for high school dropouts. This implies that the cost of dropping out of high school is larger for students with stronger academic skills.

While this pattern holds within all key demographic groups that we examine, the MCAS-earnings relationship is less steep for low-income students than for higher-income students. For example, moving from the 25th to the 75th percentile of the MCAS math

test distribution is associated with a 53% difference in earnings for low-income students, but a 61% difference for higher-income students. As we show in section 3, a key explanation is that students from low-income families are less likely to earn a four-year college degree than students from higher-income families who have the same MCAS scores.

The role of 10th grade MCAS scores for students with the same 8th grade scores

Finally, we compare the earnings of students who have *the same* 8th grade MCAS scores and demographic characteristics, but *different* 10th grade MCAS scores. We can see 8th grade test scores as encompassing the set of skills and opportunities students have had entering high school. Thus, differences in 10th grade scores for students with the same 8th grade scores should reflect differences in test performance as a result of the learning that occurs between those two grades.¹⁶

Among demographically similar students with the same 8th grade MCAS math score, those with higher 10th grade math scores have much higher earnings, on average, than those with lower 10th grade math scores. For example, if we compare two demographically similar students who scored at the state average in 8th grade, a student whose 10th grade math score was at the 75th percentile had annual earnings that are 22% greater (\$10,903), on average, than another student whose 10th grade score remained at the state average. A student who fell to the 25th percentile in 10th grade had earnings that were 15% lower (\$7,574), on average. Changes this dramatic are not

uncommon—nearly 1,000 students each year who scored near the median in 8th grade have scores above the 75th percentile in 10th grade. Improved MCAS scores between 8th and 10th grade translate into higher earnings across all levels of 8th grade scores and with controls for students' scores in both 7th and 8th grades.¹⁷ We also find similar patterns on the ELA test.

Again, our analyses primarily rely on test score data from 2003 to 2005.¹⁸ We conduct the same analysis using more recent cohorts, focusing on educational attainments. We find that improvements in test scores from 8th to 10th grade predict college enrollment and four-year college graduation in more recent years just as well as they did for the 2003-05 cohorts.

Taken together, these three analyses serve as strong evidence that, for any given cohort, MCAS scores are important predictors of labor market outcomes above and beyond other measures of student advantage (such as 8th grade test scores, high school GPAs, or educational attainments).

Among students with the same 8th grade MCAS math score, those with higher 10th grade math scores have much higher earnings, on average, than those with lower 10th grade math scores.

TRENDS IN EDUCATIONAL SKILLS AND ATTAINMENTS



Educational attainments have risen dramatically over the past two decades. Across many lines of difference, inequality in high school graduation and college enrollment rates has narrowed, but gaps in college completion have widened. There are striking gaps in educational attainments among students with similar academic skills. Academic skills and educational attainments explain two-thirds of the gap in future earnings between students who grow up in low-income and higher-income families.

In this section, we discuss two key questions about trends over time in the Commonwealth's educational outcomes. The first is whether these outcomes have improved on average and for specific groups of students, including English learners (ELs), low-income students, and those of different races/ethnicities. We examine trends in MCAS scores and the issues with interpreting those trends, as well as changes in educational attainments. The second question is whether educational outcomes have equalized along lines of difference in family income, race/ethnicity, and language proficiency. We report on opportunity gaps and describe the mixed progress on this front.

10th grade MCAS scores have increased

That test scores for 10th graders have increased over the past 15 years is quite clear. Among students who first took the 10th grade MCAS mathematics examination in 2003, 19% failed, but only 7% of those who first took the exam in 2018 did so. Similarly, the percentage of

students who achieved scores of Proficient or Advanced has increased. In 2018, 79% of 10th graders scored Proficient or better in math and 92% in ELA, compared to 52% and 61%, respectively, in 2003 (see *Figure 5*).

Academic skill levels did not increase as much as MCAS scores

These substantial increases in test scores could reflect a true change in the academic skills of students in the state. However, they could also stem from scale drift, a technical problem with test construction and linking of MCAS scores across years. The Massachusetts Department of Elementary and Secondary Education identified issues of scale drift in early MCAS years and made changes in their linking procedures in 2014 to resolve this issue.¹⁹ Or, the MCAS improvements could arise from score inflation, where test scores increase without improvements in underlying skills because, for example, of teaching to the test. Both of these issues would result in a score in 2018 not reflecting the same level of underlying academic skill as the same score in 2003. Because of known issues with scale drift on the MCAS and research documenting score inflation in high-stakes testing regimes, it is difficult to make definitive judgments about improvements in the academic skills of Massachusetts 10th graders over time.

The best available evidence comes from comparing trends in MCAS scores to the performance over time of Massachusetts students on the National Assessment of Educational Progress (NAEP), a low-stakes test with no known problems with scaling. Because the NAEP is not given in 10th grade, we use 8th grade NAEP trends as a proxy for 10th grade MCAS trends; MCAS scores from these two grade levels are highly correlated. In both ELA and mathematics, the average 8th grade NAEP scores of Massachusetts public school students increased through 2005-06 (corresponding to 10th grade test takers in 2007-08) but have remained quite flat thereafter. This suggests that the increases in average MCAS mathematics and ELA scores until approximately 2008 represented real gains in academic proficiency, while the increases since then have been almost entirely due to scale drift, score inflation, or a combination of the two.

MCAS scores have improved over time

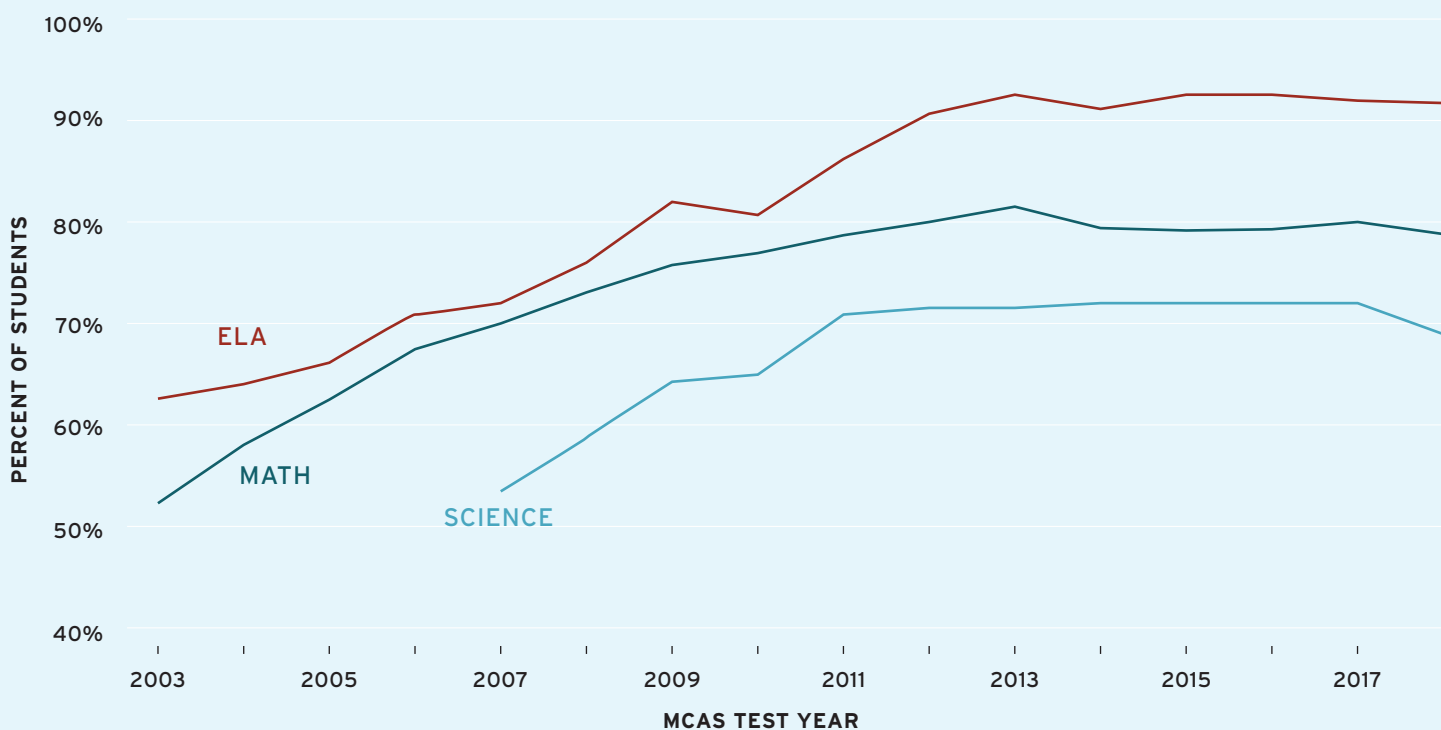


FIGURE 5
Percent of first-time 10th grade test-takers scoring proficient/advanced by MCAS subject test, 2003-18

The educational attainments of Massachusetts students are increasing

Of course, trends in test scores are only one limited measure of the success of an educational system. The educational attainments of Massachusetts public school students are another important indicator. Here the evidence is quite encouraging. Average attainments have risen appreciably, even though the state's public schools increasingly serve students from high-needs groups. For instance, among students who took the grade 10 MCAS tests in 2003, 83% graduated from high school within the next three years. The comparable figure for 2015 MCAS test-takers is 92% (see *Figure 6*).

While high school graduation is clearly an important stepping-stone to labor market success, there is reason to be wary of attributing improvements in high school graduation rates to the success of education reform. Evidence from other states suggests that, as accountability systems added high school graduation

as a criterion for performance evaluation, some high schools may have responded by lowering standards and inflating graduation rates.²⁰

As a result, and because of the large returns to post-secondary credentials, we focus our attention on college completion and find a similar upward trend. Seven years after taking the grade 10 MCAS tests, 42% of students in the 2011 test-taking cohort had graduated from a four-year college compared to 32% of those who took the test in 2003. Relatively few Massachusetts high school students earn an associate's degree or other credential from 2-year colleges within seven years of taking the MCAS. (In part, this stems both from students delaying enrollment in a Massachusetts community college until several years after high school graduation and from enrolling as part-time students.)

Educational attainments have risen over time

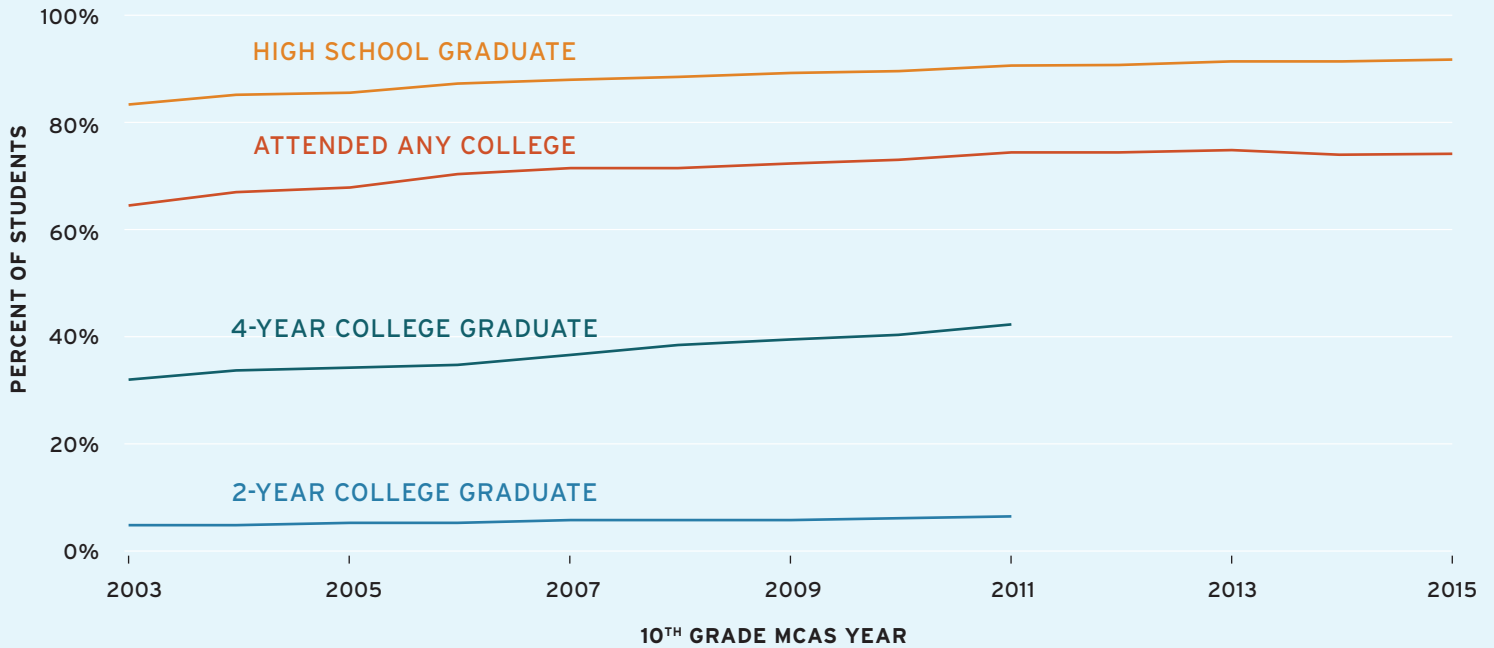


FIGURE 6
High school and college outcomes of 10th grade test-takers from 2003-15

NOTE

Among first-time 10th grade MCAS test takers. Attainments are measured as follows: high school graduation within 3 years of first taking the 10th grade MCAS, college attendance within 4 years, and college graduation within 7 years.

Educational attainments have risen for key groups

So far, we have described the average patterns for all students in the Commonwealth. However, aggregate trends may obscure differences in trends for important groups of students, including low-income students, those from different racial/ethnic groups, and students classified as English learners in 10th grade.²¹ *Figure 7* shows that educational attainments have risen for all of these groups (although the college enrollment rate for

students who were English learners as 10th graders has declined in recent years).

This consistent pattern indicates that students from a variety of backgrounds have benefited from improvements in the Massachusetts educational system. However, serious and substantial opportunity gaps remain.

Large opportunity gaps remain in Massachusetts

One measure of the progress of the state's public educational system is the extent to which gaps in educational outcomes between students from historically disadvantaged groups and other students

have decreased. These gaps are critical because academic skills and educational attainments are important predictors of long-term earnings. Students of color, those with low family incomes, and those who

Educational attainments have risen for key groups

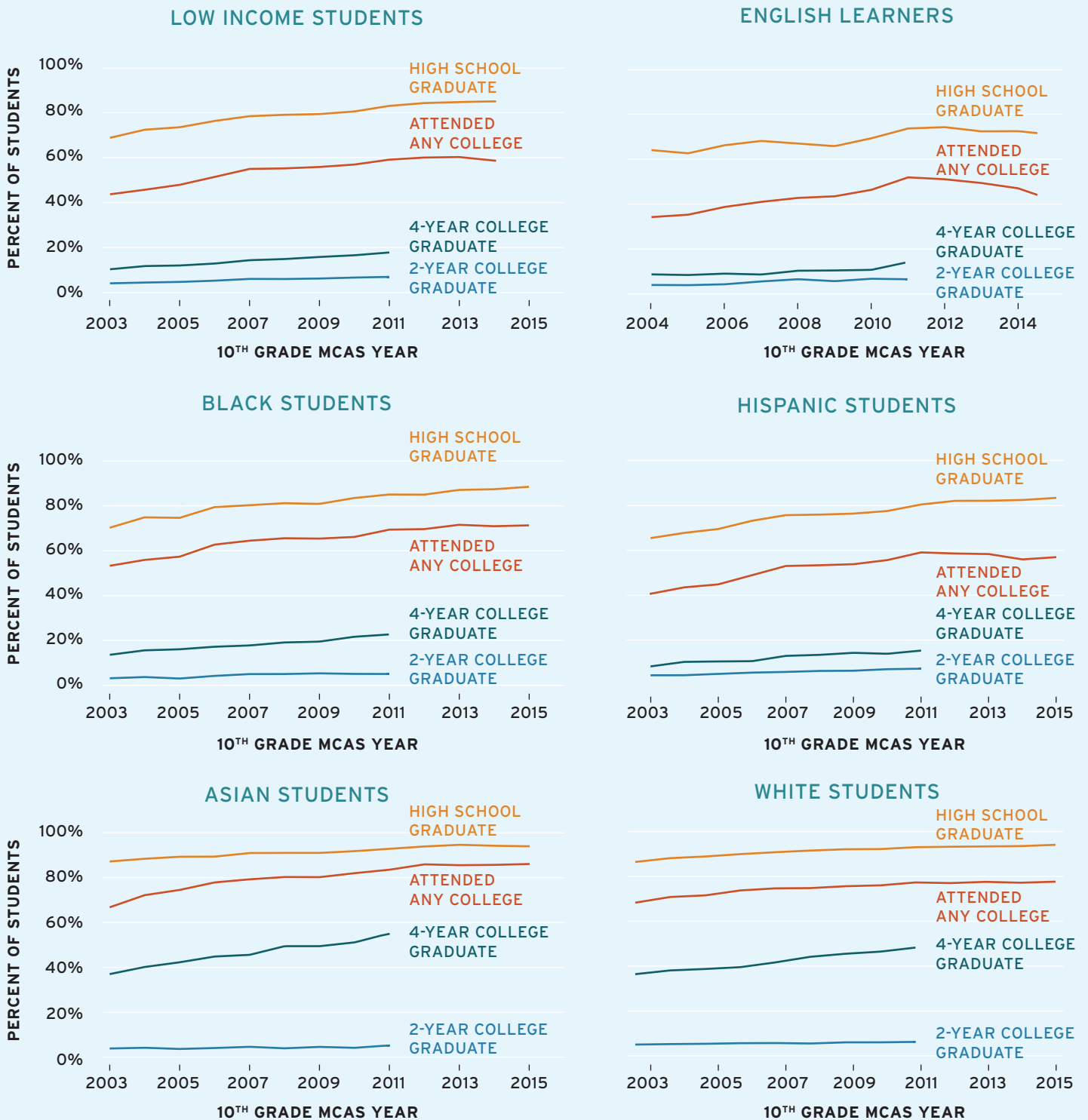


FIGURE 7
Educational attainments over time, by student group

NOTE

Among first-time 10th grade math MCAS test takers. In our analyses the “English learner” group only includes students who were currently classified as English learners in 10th grade.

are English learners as 10th graders earn substantially less on average in their early 30s than other students. For example, the median student who grew up in a higher-income family and who took the MCAS between 2003 and 2005 earned \$50,000 in 2019, while the median low-income student in this cohort earned about 30% less. We show the percentage difference in earnings in the first column of *Table 1*.

Differences in 10th grade MCAS scores explain a substantial part of this gap—differences in earnings are much smaller when we compare students with the same MCAS scores (second column). The primary reason is that MCAS scores predict earnings and some groups of students have lower MCAS scores, on

average, than others.²² However, even among students with the same MCAS scores, those from low-income families earn 16% less (about \$8,000) less than those from higher-income families. Much of the explanation is that low-income students with the same MCAS scores have, on average, lower educational attainments than higher-income students.

We see this in the third column of *Table 1*—earnings differences are largely (and in some cases completely) accounted for by differences in 10th grade MCAS scores and educational attainments. For example, if we compare students who have the same 10th grade MCAS scores and the same educational attainments, the gap in earnings between students from low-income families

Earnings gaps are largely explained by MCAS scores and educational attainments

	Earnings Gap	Gap Accounting for MCAS Scores	Gap Accounting for MCAS Scores & Attainment
Low-income/Higher income	30%	16%	10%
Black/White	31%	14%	12%
Hispanic/White	28%	6%	1%
Asian/White	-11% ^a	-4% ^a	-2% ^a
English Learner/Non-English Learner	16%	-12% ^a	-12% ^a

^a Negative numbers mean that the first group has higher earnings than the second. For example, Asian students have higher earnings than White students. Comparing students with the same MCAS scores and educational attainments, Hispanic students have higher earnings than White students, and English learners have higher earnings than non-English learners.

TABLE 1
Gaps in total 2019 earnings for 2003-05 test-takers, overall and controlling for 10th grade MCAS math and ELA test scores and educational attainment level (Median earnings = \$46,332)

NOTE

Column 1 presents the raw percentage difference. Column 2 models log earnings as a function of cubic polynomials of MCAS scores in both mathematics and ELA and includes the interaction between scores and the demographic of interest. The results in Column 3 also model log earnings as a cubic function of MCAS mathematics and ELA test scores, but we include indicators for the students' ultimate educational attainment 7 years after taking the test and interact these with the cubic function of test scores. All estimates come from 2003-05 test-takers. We find generally consistent patterns across the test-score distribution, although the EL/non-EL differences are larger for students with low MCAS scores and smaller for students with high MCAS scores.

Earnings differences are largely (and in some cases completely) accounted for by differences in 10th grade MCAS scores and educational attainments.

and those from higher-income families narrows to 10% (less than \$5,000), on average. These patterns hold across most lines of difference in the Commonwealth. In fact, students who were English learners in 10th grade earn more than their peers with similar test scores and attainments, likely because 10th grade scores for students who were English learners understated their latent academic skills.

This pattern illustrates the importance of academic skills and educational attainments in today's labor market. It also underscores the critical challenge facing Massachusetts public elementary and secondary schools in equalizing educational opportunities in the face of growing inequality in family incomes.

In the remainder of this section, we present additional evidence on trends in educational attainments and earnings gaps for students across these lines of difference.²³

Gaps in test scores and educational attainments

While test performance and educational attainments have risen for all key groups, changes in the differences *between* groups do not follow a consistent pattern. Gaps in high school graduation and college enrollment rates have narrowed over the past 15 years, while gaps in test scores have remained relatively constant and gaps in four-year college graduation have widened.

As discussed above, documenting how test score performance has changed over time is complicated by the issues of scale drift and possible score inflation present on the MCAS. However, we can examine how gaps in test scores have evolved. Gaps across most lines of difference are large and have remained quite stable over the past 15 years. For example, 81% of low-income

students scored below the median higher-income student in 2002 and in 2014. Gaps for English learners have grown modestly, and those for Black and Hispanic students have narrowed slightly. In all cases, though, English learners, Black students, and Hispanic students score substantially lower on average than their peers in both math and ELA.

While test score gaps are large and relatively unchanged over time, evidence on gaps in educational attainments is more mixed. *Figure 8* shows that the proportion of low-income test-takers graduating from high school increased by 16 percentage points between 2003 to 2014, while the analogous percentage of higher-income students increased by only 8 percentage points. This cut the income-based gap in high school graduation rates almost in half. Income-based gaps in college attendance also narrowed by 3 percentage points (not shown).

However, while the proportion of students who graduated from a four-year college increased for all groups, the income-based gap in college completion widened over this time period. The percentage of low-income students who graduated from a four-year college increased from 10% for 2003 MCAS test-takers to 18% for those who took the 10th grade MCAS in 2011. The comparable college graduation rates for higher-income students are 38% and 52%. Thus, the gap in the graduation rate widened from 28 to 34 percentage points over an eight-year period.

Table 2 shows similar patterns across other lines of difference in the Commonwealth. In virtually all cases, the gap in high school graduation has narrowed dramatically, while the gap for four-year college graduation has increased. The exceptions are the high

The income gap in four-year college graduation rates has increased

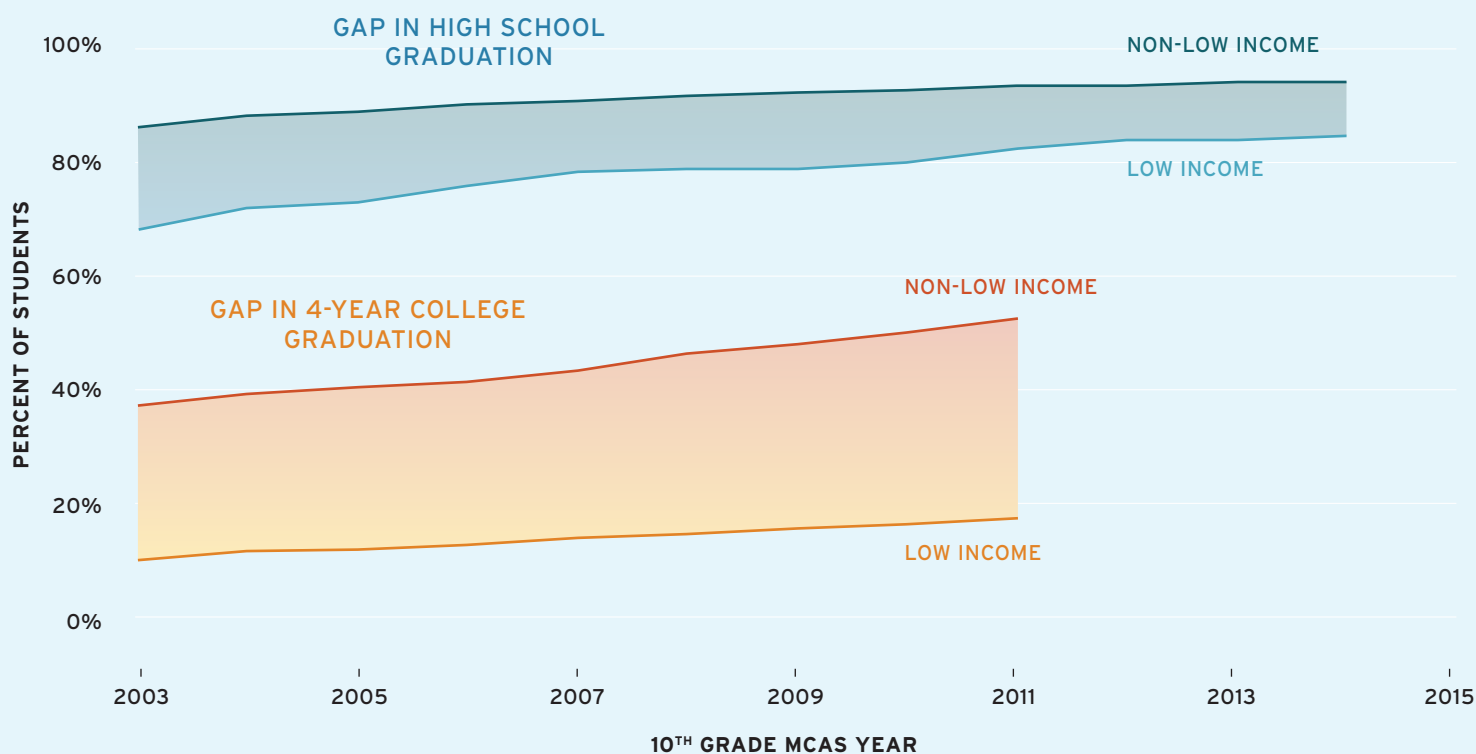


FIGURE 8
Gaps in educational attainments by family income, over time, among first-time 10th grade test-takers

school graduation gaps for English learners and for Asians vs. Whites, which both showed little change over the period in question.

Furthermore, even among students who enroll in post-secondary education, there are substantial differences in the types of institutions in which students from different groups enroll. In *Figure 9*, we show the proportion of low-income and higher-income students who enroll in different types of post-secondary institutions. Overall, private or out-of-state four-year college is the most popular option among higher-income students who pursue post-secondary education, and it has become increasingly popular over time. Among 2014 test-takers, approximately one-half

of higher-income students attended such colleges, compared to just 18% of low-income students. By contrast, approximately 26% of low-income students enrolled in a Massachusetts 2-year public college, compared to just 13% of higher-income students. For both groups, the share of students enrolling in Massachusetts two-year colleges has fallen since 2007, while enrollments in four-year colleges have increased.

Gaps in educational attainments for students with similar MCAS scores

The test-score gaps discussed above are a partial explanation for gaps in educational attainments, but they do not tell the whole story. There are large gaps

Trends in educational inequality are similar for key student groups

	High School Graduation		4-Year College Graduation	
	2003	2014	2003	2011
Low-income/Higher income	18	10	27	35
Black/White	16	6	23	26
Hispanic/White	21	11	28	33
Asian/White	-1 ^a	-1 ^a	-1 ^a	-7 ^a
English Learner/Non-English Learner	18	20	21	29

^a Negative numbers mean that the first group has attainments than the second. Asian students graduate from high school and college at greater rates than White students in both time periods.

TABLE 2
Percentage point gaps in educational attainments over time, by grade 10 MCAS test year.

Low-income students who enroll in college tend to go to in-state public colleges

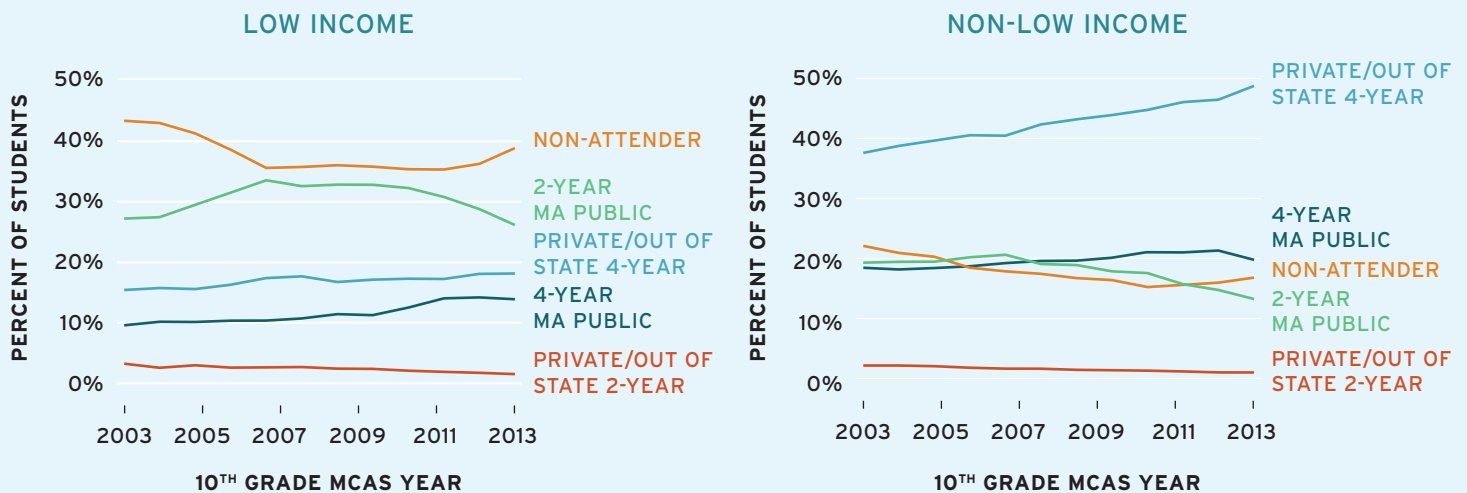


FIGURE 9
College attendance by type for first-time 10th grade test-takers, 2003-13

in educational attainments even among students with the same MCAS scores. *Figure 10* shows that students from low-income families are much less likely to earn a four-year college degree than their peers from higher-income families who performed the same on the MCAS. For example, at the state median score (50th percentile) on the 2011 MCAS math examination, about half of higher-income students graduated from a four-year college within 7 years, compared to approximately 25% of low-income students. Put another way, low-income students scoring at the 90th percentile on the MCAS test graduate from a four-year college at the same rate as higher-income students who score at the 57th percentile. These figures are identical if we compare students with similar ELA scores as well.

The equity implications of this finding are particularly troubling: students with similar academic skills in high school, as measured by the MCAS, have quite different educational attainments depending on their family income. If low-income students graduated from four-year colleges at the same rate as their higher-income peers with the same MCAS scores, more than 3,500 additional low-income students who took the test in 2011 would be four-year college graduates.

This gap results in part from substantial differences in college enrollment rates among students with the same MCAS scores. However, there are also large and persistent income-based gaps in college completion rates even among students who enroll in a four-year

Gaps in college graduation rates are large even for students with the same MCAS scores

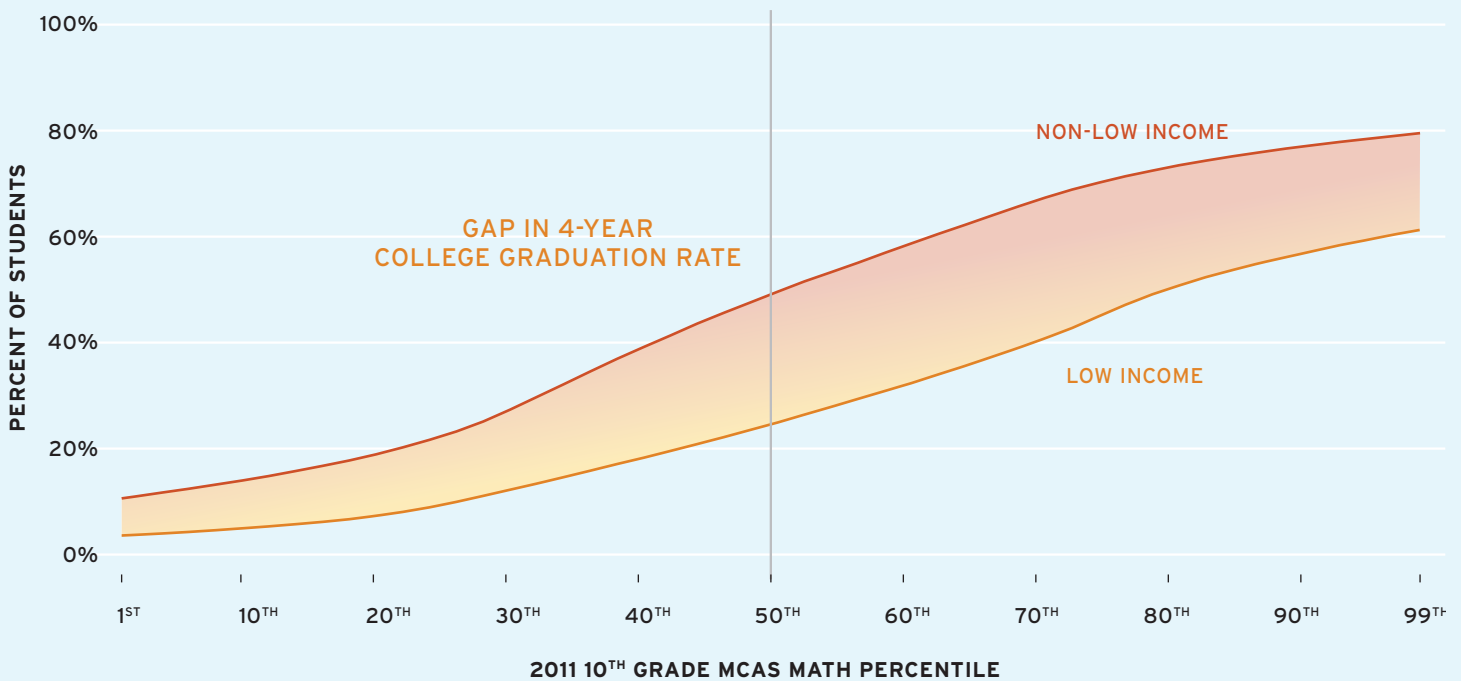


FIGURE 10
4-year college graduation by MCAS math percentile and family income, for all 10th grade test-takers in 2011

college. For example, *Figure 11* shows the gap in college graduation rates among students who enroll in a Massachusetts public four-year university. Here, for students at the median MCAS score in 2011, the gap in four-year college graduation conditional on enrollment is about 20 percentage points. Patterns are quite similar if we look at all colleges in the country.

There are several complementary explanations for this pattern. First, they may reflect students' experiences in high school. Low-income students are increasingly concentrated in schools in which most of their classmates also are living in poverty. Such schools tend to have fewer resources for college guidance and fewer students who plan to attend a four-year college.

These schools are also more likely to be at risk of sanctions because of low MCAS scores, which may lead educators to focus on increasing scores using strategies that do not promote mastery of critical academic and social skills important in college. Second, these differences may reflect students' own financial and social resources. Low-income students have, almost by definition, less access to the financial resources needed to enter and persist in the post-secondary system. They also tend to have less access to social networks that support post-secondary success. Finally, these differences may reflect students' experiences in college. Low-income students are more likely to attend colleges with fewer financial resources and less academic support than their higher-income peers.

There are similar gaps in graduation rates for students who attend in-state public 4-year colleges

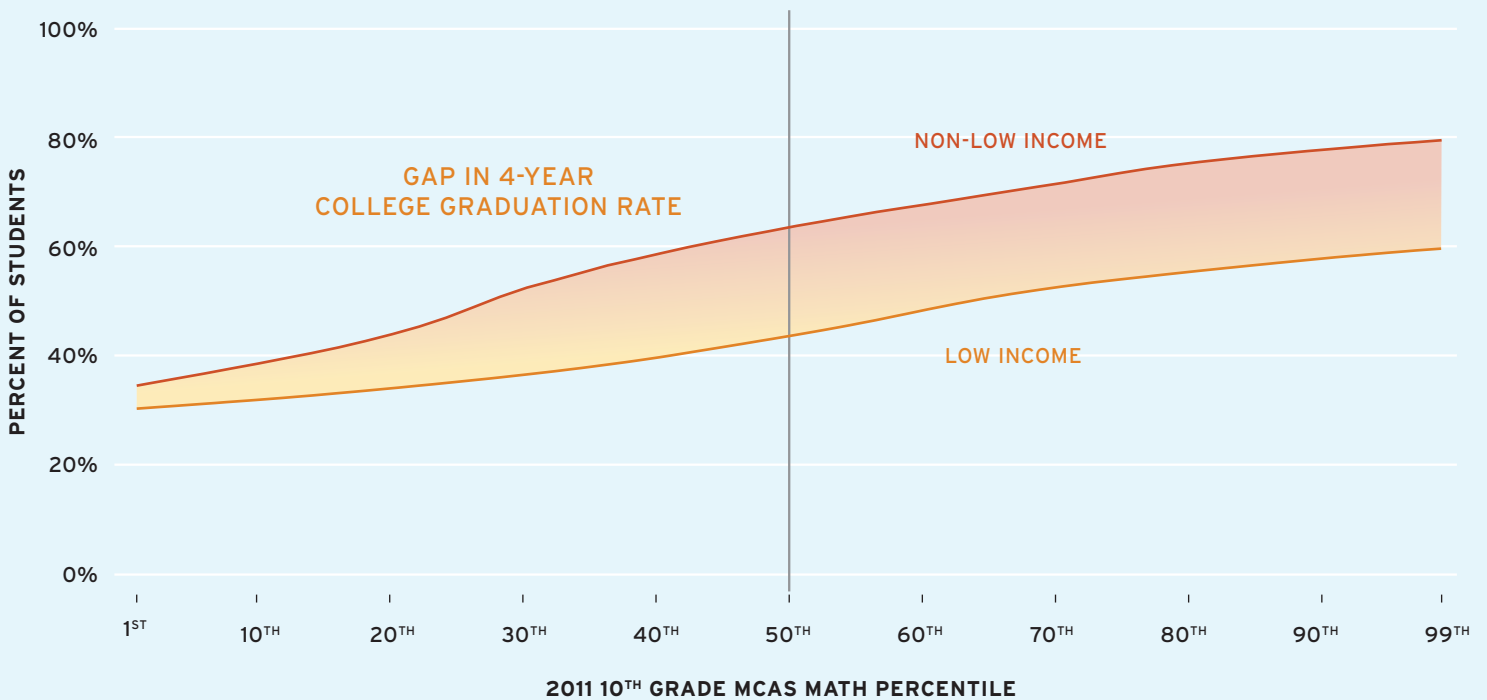


FIGURE 11
Four-year college graduation rate by MCAS math percentile and family income, for all 2011 10th grade test-takers who enrolled in a Massachusetts public four-year college

There are large gaps in four-year college graduation rates for students with the same test scores across most lines of difference

	4-Year College Enrollment	4-Year College Graduation
Low-income/Higher income	21	23
Black/White	-2 ^a	11
Hispanic/White	15	20
Asian/White	-4 ^a	0
English Learner/Non-English Learner	5	6

^a Negative numbers mean that the first group has higher earnings than the second. For example, comparing students with the same MCAS scores, Black and Asian students are more likely to enroll in a four-year college than White students.

TABLE 3
Percentage point gaps in educational attainments for students scoring at the median on the 2011 10th grade MCAS tests in ELA and mathematics

As we show in *Table 3*, patterns are generally similar across other lines of difference, although Black students are more likely to enroll in a four-year college than their White peers with similar MCAS scores (but nonetheless less likely to graduate). For example, among students who score at the median on the 10th

grade math and ELA exams, Hispanic students are 15 percentage points less likely to enroll in a four-year college and 20 percentage points less likely to graduate from a four-year college than White students.

CONCLUSION

This report contains significant good news for Massachusetts families, educators, and policymakers. Namely, the average educational attainments of the Commonwealth's public school students have increased substantially over the past 15 years. The percentages of students graduating from high school, enrolling in college, and earning four-year college degrees have all risen over time. Moreover, this pattern holds true for low-income students, English learners, and students from all of the largest racial/ethnic groups. This is important because our analysis of labor market earnings shows that the typical student who does not earn a post-secondary education credential struggles to earn a living wage in Massachusetts. Furthermore, we find strong evidence that the MCAS test itself predicts longer-term outcomes, including earnings, above and beyond typical markers of student advantage.

However, this report also strikes some cautionary notes. First, while the mathematics and English language arts skills of Massachusetts public grade 10 students appear to have increased in the 1990s and early 2000s, the best available evidence indicates they have been stagnant since then.

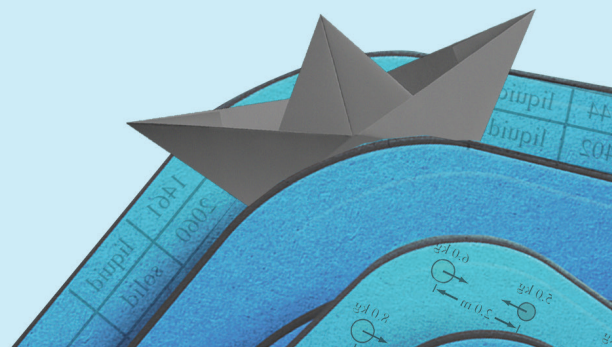
Perhaps more important, there are striking gaps in test scores, educational attainments, and earnings along lines of family income, race/ethnicity, and English learner status in the Commonwealth. Particularly troubling is that students from advantaged backgrounds are much more likely to enroll in post-secondary education and to graduate from four-year colleges than less advantaged students with identical skills, as reflected in 10th grade MCAS scores.

While gaps in high school graduation and college enrollment have narrowed somewhat, those for graduation from a four-year college or university have actually widened over the last two decades. While these patterns reflect national trends, they are cause for concern given the large and growing earnings premium associated with a bachelor's degree.

IMPLICATIONS FOR POLICYMAKING IN MASSACHUSETTS

Most critically, the results described in this report illustrate the importance of providing all Massachusetts students with the high-quality education they need to master critical academic and social skills and develop their interests and potential.

We must be clear—improved MCAS scores are not the goal, but should reflect improvements in underlying capacities and skills. As such, improved MCAS scores should follow from better educational opportunities and achievement for all students. Too much emphasis on the test, rather than the skills it is designed to measure, can result in higher scores without improving the academic and social skills of students in the Commonwealth.



Second, equalizing educational attainments along key lines of difference is critical, as there are large and growing gaps in four-year college completion rates, even among students with similar MCAS scores.²⁴

Most importantly, gaps in college graduation rates are larger than gaps in college enrollment. While college access is a challenge, it is not the only concern—there are inequalities at all points in the educational pipeline. Both the state’s public K-12 and higher education systems need to work to ensure that students who want to pursue post-secondary education have access to college, enter college ready to succeed, and receive the supports necessary during college to leave with a valuable credential. Given that the lion’s share of low-income students who enroll in college attend an in-state public college or university, these institutions should play a critical role in providing the skills and educational credentials for low-income students to succeed in the labor market.

NEXT STEPS

We will continue to partner with the Massachusetts Departments of Elementary and Secondary Education and Higher Education to explore topics of interest to the state. For example, the state is currently engaged in a discussion about the Competency Determination policy. Our ongoing analysis will focus on how previous changes in this policy affected students. We also will examine how students fare in the state’s public community colleges, the post-secondary institutions low-income students are most likely to attend, and the economic payoffs to the credentials they earn in these colleges. We are also seeking to explore the role of college quality in explaining the patterns we discuss above, differences in the relationship between earnings and both MCAS

As established in a long line of recent studies, the United States has had relatively low levels of intergenerational social mobility over the past several decades.²⁵ In Massachusetts, students who grow up in low-income families have much lower earnings in their early 30s than students from higher-income families. Most of this gap, as well as earnings gaps along other lines of difference in the Commonwealth, is explained by differences in high school test scores and educational attainments. In other words, closing the existing gaps in high school performance and postsecondary educational attainments could dramatically reduce current levels of income inequality. Our findings warrant a continued policy focus on these persistent opportunity gaps, which impact the life chances of thousands of students in the Commonwealth.

scores and educational attainments by gender, whether attending schools that improve student test scores improves long-run outcomes, and the ways in which MCAS accountability affects students’ skill development.

This report highlights the tremendous value of the integrated, longitudinal dataset in which Massachusetts has invested. However, it also surfaces new opportunities that would provide additional insight. In particular, state efforts to develop cross-agency data-sharing and increased investments in data infrastructure for expanded and enhanced unit-record data collections across all state agencies would facilitate greater insight.

NOTES

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- In fact, nationally, the per-child gap in annual spending on child enrichment, net of inflation, between families in the top and bottom quintiles of the family income distribution rose from \$3,000 per child in 1972-73 to \$8,000 in 2005-06. Duncan & Murnane (2014, p. 29). This book also explains other reasons why increasing family income inequality hinders schools' attempt to equalize learning opportunities.
- ⁹ At our request, Professor Ann Owens calculated that, between 1980 and 2016, residential segregation by income in Massachusetts rose by more than 10 percent. The estimates she provided correct for the bias resulting from being based on population samples rather than entire populations. Professor Owens has shown that the increase residential segregation by income nationally took place almost entirely among households with school-aged children. See Owens, A. (2016). Inequality in children's contexts: Income segregation of households with and without children. *American Sociological Review*, 81(3), 549-574.
- ¹⁰ We thank Professor Sean Reardon for providing us with data on school segregation by income for Massachusetts schools and districts from 1991 to 2016. These data show a quite high level of school segregation by income both among Massachusetts schools and school districts. However, the level of segregation is somewhat lower in 2016 than it was in 1991. One potential explanation is that affluent families increasingly send their children to private schools. See Murnane, R.J., & Reardon, S.F. (2018). Long-term trends in private school enrollments by family income. *AERA Open*, 4(1), 1-24.
- ¹¹ Chetty, R., Hendren, N., & Katz, L.F. (2016). The effects of exposure to better neighborhoods on children: New evidence from the Moving to Opportunity experiment. *American Economic Review*, 106(4), 855-902.
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- ¹² For more detail on the validation framework, see: Massachusetts Department of Education. (2020). *MCAS technical reports*. Retrieved May 15, 2020 from <http://www.doe.mass.edu/mcas/tech/?section=techreports>.

- ¹³ Of course, we have no evidence on the predictive power of next-Generation MCAS tests, which were taken for the first time by 10th graders in 2019. However, we expect that these next-Generation tests, which place more emphasis than their predecessor on higher-order skills, will have at least as strong a relationship with long-term outcomes.
- ¹⁴ Glasmeier, A.K. (2018). Living wage calculator. *Massachusetts Institute of Technology*. Retrieved May 15, 2020 from <https://livingwage.mit.edu/states/25>.
- ¹⁵ We model the probability of earning credit in a student's first college math course as a cubic function of both standardized raw MCAS mathematics test scores and GPAs, student demographics, high school fixed effects, and college fixed effects. We tested (and rejected) whether the relationship between MCAS test scores and outcomes varied by GPA. We compare students within the same high school because of substantial differences in GPA standards across high schools. We compare students within the same college because of differences in remediation policies and grading standards across colleges. We only include in our sample students who enroll in a college mathematics course in their first year and for whom we have data on their GPA and course outcomes. Technically, we present results for students with GPAs from 2.9 to 3.1.
- ¹⁶ We model earnings as a cubic polynomial of both 8th and 10th grade mathematics test scores and student demographic characteristics, including race, gender, disability status, English learner status, and family income. We test and reject that the relationship between 10th grade scores and earnings differs by 8th grade score. We confirm that 10th grade scores explain variation in earnings above and beyond 8th grade scores. We find similar patterns with school fixed effects, which restrict our comparisons to students in the same high school.
- ¹⁷ We can only do this analysis in more recent years because Massachusetts did not begin testing students in both 7th and 8th grade until 2006.
- ¹⁸ Note that our analysis of ELA scores in section 2.3 focuses on test-takers in 2008, the first year in which 8th grade test scores were available. Similarly, the analyses of math scores using 7th grade data are from 2009 10th graders.
- ¹⁹ For more details, see: Massachusetts Department of Elementary and Secondary Education. (2014). *2014 MCAS and MCAS-Alt technical report*. Retrieved May 15, 2020 from <http://www.mcasservicecenter.com>.
- ²⁰ Heinrich, C.J., Darling-Aduana, J., Good, A., & Cheng, H. (2019). A look inside online educational settings in high school: Promise and pitfalls for improving educational opportunities and outcomes. *American Educational Research Journal*, 56(6), 2147-2188.
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- ²¹ We do not examine students with disabilities in detail because many students with severe disabilities take an alternative MCAS assessment.
- ²² There are several reasons why controlling for MCAS score does not eliminate the predicted difference in earnings between groups. As stated above, there are many determinants of earnings beyond test scores. Furthermore, differences in MCAS scores translate into somewhat smaller differences in predicted earnings for low-income students than for those from higher-income families, and the same holds true for students of color compared to non-Hispanic White students.
- ²³ Note that these groupings are not the only important elements of students' identities and that they intersect and interact in important ways to structure students' experiences and opportunities. Here, though, in the interest of parsimony, we present results for each group separately.
- ²⁴ Of course, post-secondary education is not the only option for labor market success in Massachusetts. Some terminal high school graduates, for example, earn more than demographically similar students with four-year degrees. However, these cases are relatively rare and are primarily limited to students with strong academic skills who choose not to pursue post-secondary education. Most students with middling or low MCAS scores who do not earn post-secondary credentials struggle to earn what is necessary to support a family in the state.
- ²⁵ Chetty, R., Grusky, D., Hell, M., Hendren, N., Manduca, R., & Narang, J. (2017). The fading American dream: Trends in absolute income mobility since 1940. *Science*, 6336, 398-406.

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