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High School Preparation and Post-Secondary Educational Attainment: An Analysis of Racial/Ethnic and Gender Differences for Missouri Public High School Students

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The authors have made every effort to adhere to the guidelines for bias-free language as recommended by the American Psychological Association (APA) Style Guide. We recognize the importance of using language that is concise, accurate, and respectful, and have applied these principles throughout this work.

Abstract

This paper investigates patterns of racial/ethnic and gender gaps in post-secondary degree attainment trajectories by the levels of students' pre-college academic preparation. We follow four cohorts of Missouri public high school freshmen for five years beyond on-time graduation among White, Black, and Hispanic male and female students. A composite measure of pre-college academic preparation is constructed based on test scores, GPA, attendance, and advanced course enrollment, which we label Academic Index (AI) and split students into AI Quintiles for analysis. We find large racial/ethnic gaps in AI, with the largest difference for Black male students, who are heavily concentrated in the lowest quintile. Gender gaps in academic readiness widen during high school. College enrollment is higher for Black male and female students near the average AI and below, but this advantage completely disappears for degree completion. Hispanic-White gaps emerge earlier than that of Black-White gaps as Hispanic students are less likely to graduate from high school and attend college. An important finding is that top-performing Black and Hispanic male students have much lower rates of degree completion than other top-performing students. Also, Black-White gaps are much wider in any degree attainment than in bachelor's degree attainment, suggesting lower likelihood of completing a sub-bachelor degree among Black students. After controlling for academic preparation and the FRL status, bachelor's degree attainment among Black and Hispanic female students are similar to, or higher than, that of White female students.

Introduction

Post-secondary enrollment and educational attainment increased considerably in the US over the last several decades. Moreover, racial gaps in college enrollment between Black and Hispanic young adults and their White counterparts have narrowed since 2000, in part because college enrollment for the Black and Hispanic populations rose at a faster pace, and also because White college enrollment started declining in recent years. Specifically, between 2000 and 2021, Black 18- to 24-year-olds experienced increases in college enrollment by six percentage points from 31% to 37%, and Hispanic college enrollment of the same age group increased by eleven percentage points from 22% to 33% during this time. In comparison, college enrollment for White 18- to 24-year-olds increased from 39% to 42% between 2000 and 2010 and declined to 38% in 2021 (National Center for Education Statistics, 2023). The reduction in enrollment gaps were preceded by a narrowing of racial/ethnic gaps in high school graduation rates of 16- to 24-year-olds (National Center for Education Statistics, 2020).

By contrast, substantial racial disparities have persisted in degree completion rates. Even though degree completion rates have increased for all groups, the disparity between Black and White 25- and 29-year-olds in any degree completion has hovered around 20% for nearly two decades. The Hispanic-White degree completion gaps were 26% in 2000, 28.5% in 2010, but they began narrowing since 2010 and held steady at 20% for the last several years. Importantly, for all racial/ethnic groups, gender gaps have risen considerably since 2000, and Black males appeared to have fallen further behind other race and gender groups. For example, between 2000 and 2015, all groups, except for Black males, gained in bachelor's degree attainment. Also, for all groups, improvements in college degree completion over the last two decades among 25- and 29-year-olds were greater for females than for males (e.g., Reeves & Guyot, 2017; National

Center for Education Statistics, 2023b). The steady overall racial gap in degree completion masks growing gender gaps within the same racial/ethnic group.

College completion disparities, and the lagging performance of Black and Hispanic males, have important implications for income inequality. Educational attainment gaps are a key driver of income inequality (Goldin & Katz, 2008). Since the 1960s, wage returns to education have grown steadily and are currently higher in the U.S. than in many other developed countries (Autor, 2014; Hanushek et al., 2015). Gaps in compensation between jobs that do and do not require a college degree have also grown substantially (James, 2012), while low-skilled jobs are decreasing due to automation and offshoring (Goos, Manning, & Salomons, 2014). A recent study by Thompson (2021) finds that the explanatory power of human capital (e.g., degree attainment and test scores) for Black-White earning gaps has grown substantially over the last few decades.

This study investigates patterns of racial/ethnic and gender gaps in college enrollment and completion by the levels of students' pre-college academic preparation. Our goal is to better understand how degree attainment trajectories diverge at different transition points for students with different academic preparation. There are three potential patterns of degree completion gaps (conditional on high school academic preparation), and underlying problems and approaches to solutions depend on how the gaps emerge as students transition from high school to post-secondary education. First, similarly prepared Black and Hispanic students are less likely to enroll in college than White students, with completion rates similar among similarly prepared college enrollees. In this case, completion gaps, given academic preparation levels, stem from college access problems; therefore, equalizing access, or removing barriers to enrollment, should reduce completion gaps. This scenario is consistent with "credit constraints"

on the part of racial/ethnic minority students (Cameron & Heckman, 2001), but could reflect other factors as well.

A second scenario is that similarly prepared students have similar rates of college enrollment, while racial/ethnic completion gaps emerge among college enrollees. This suggests unique barriers faced by racial/ethnic minority students during their college years, and removing such barriers will reduce completion gaps while enrollment remains the same. Finally, it may be that Black and Hispanic students have higher college attendance rates than similarly prepared White students, while completion rates among college enrollees are lower for Black and Hispanic students. This scenario also points to the importance of addressing post-secondary factors. Here, improving support systems and reducing challenges will also reduce degree completion gaps while college enrollment remains the same, and equalizing college retention among college enrollees will reverse the gap. For the latter two scenarios, Black and Hispanic students would suffer more from the consequences of dropping out of college if completion gaps are unaddressed.

Prior research on racial disparities in college completions shows that pre-college academic readiness is the primary driver of these disparities (e.g., Fletcher & Tienda, 2010; Arcidiacono & Koedel, 2014). This highlights the importance of pre-college schooling experiences, and improving pre-college academic skills can substantially reduce degree completion gaps. Early interventions can hold promise as there are already sizable racial gaps in academic achievement when children start formal schooling (Lee & Burkam, 2002; Downey et al., 2004). Moreover, racial/ethnic achievement gaps appear to widen as children progress through schooling even after the initial levels of achievement and a host of family factors are taken into account (Jencks & Phillips, 1998; Fryer & Levitt, 2006; Quinn, 2015). These studies

highlight the role of school factors and school quality in explaining growing achievement gaps.

In contrast, fewer studies have examined how learning trajectories may widen after students enter high school. This limitation stems in part from the lack of common standardized assessments for high school students that are needed to model their growth trajectories. However, one can conceive that students who enter high school with the same academic readiness may end high school with different levels of academic readiness depending on which high school they attended, learning opportunities, or learning experience during high school. Such variation between the start and the end of high school indicates the roles that high school can play in changing the academic trajectories of students and potentially reducing racial/ethnic gaps in academic readiness before students leave high school. Importantly, prior studies also showed that non-negligible racial degree completion disparities remain among students who enter college with similar academic readiness (Arcidiacono & Koedel, 2014; Fletcher & Tienda, 2010; Merolla, 2018). This suggests that post-secondary institutions can also play a role in reducing degree completion gaps.

In this study, we investigate the patterns of post-secondary completion gaps and how degree attainment gaps emerge from high school entry through post-secondary education. We first consider how college readiness may diverge during students' high school years, and then whether the pattern of disparities may differ by the outcome (enrollment vs. completion) as well as the level of academic readiness. We reason that understanding these complex patterns of post-secondary outcome inequality can help target a particular intervention to specific student groups. Specifically, we address the following questions:

RQ1) To what extent does pre-college college readiness differ by race/ethnicity and gender at the start of high school, at the end of ninth grade, and at the end of high school? Do

pre-college academic readiness gaps grow or narrow during high school?

RQ2) How do degree attainment trajectories (high school graduation, college enrollment, and degree completion) differ by racial/ethnic and gender groups? To what extent are gaps in degree completion explained by differences in enrollment versus completion?

This study makes several contributions to the existing literature. First, we follow a cohort of 9th-grade students to avoid censoring or selection problems. Previous studies on college enrollment are often based on high school graduates, hence exclude high school dropouts (e.g., Beattie, 2002; Perna & Titus, 2005; Roderick, Nagaoka, & Coca, 2009; Posselt, Jaquette, Bielby, & Bastedo, 2012). Similarly, studies on racial gaps in bachelor's degree attainment are often based on first-time college freshmen, excluding community college entrants. These studies are not able to show when degree attainment trajectories may diverge, or do not consider racial/ethnic differences in the rate of high school graduation, post-secondary participation, and initial two-year college attendance.

There are additional limitations in studies that exclude community college students. Community college is an important part of the post-secondary education sector, enrolling nearly one-half of all undergraduate students in the public sector (Mountjoy, 2022). It provides not only alternative pathways to four-year degrees, but also sub-bachelor credentials or degrees that may matter to labor market outcomes for those who would not have otherwise attended college (Mountjoy, 2022). Thus, if initial enrollment in four-year versus two-year institutions differs by races/ethnicities, bias could arise if we do not consider students who first enrolled in a community college. Moreover, these studies are not able to examine racial/ethnic gaps in all post-secondary degrees or credentials.

Likewise, previous studies based on public post-secondary administrative data do not

include those who initially enrolled in private or out-of-state colleges. These exclusions are also problematic if such choices of college differ by race and gender (as they do in Missouri). Finally, many studies focus on average racial/ethnic gaps, which mask important group differences, such as race/ethnicity-by-gender or pre-college achievement levels.

This study follows entire cohorts of first-time ninth-grade students in Missouri for five years after on-time high school graduation, including those who first attended two-year institutions. We construct a composite measure of college readiness, termed Academic Index (AI), and students are divided into quintiles of AI for the analysis of post-secondary outcomes. Our results first show a large difference in pre-college academic readiness across race/ethnic-gender groups with females having higher readiness than their male counterparts of the same race/ethnicity. The between-group differences appear to widen, and males, in particular, fall further behind during high school years.

The pattern of results on post-secondary outcomes depends on students' academic readiness. Among the top performing students who are in the top AI quintile White females, our reference group, exceed all other groups in all post-secondary outcomes. For students in lower quintiles, White males are slightly more likely to graduate from high school than White females with similar readiness, but among high graduates, they are less likely to enroll in college. College enrollment rates are also lower for Hispanic males and females than for White females, and this is partially explained by their lower high school graduation rates. In comparison, college enrollment rates are higher for male and female Black students, and this primarily comes from the lower end of the academic preparation distribution. However, this advantage completely disappears for college degree completion.

Another important finding is that the top performing Black and Hispanic males have

substantially lower college completion rates than similarly prepared White students, and the sizable gap remains after controlling for the low-income status. In contrast, for females with similar academic readiness and the low-income status, bachelor's degree completion rates are similar between Hispanic and White females and higher for Black females. Lastly, we also find greater Black-White degree completions gaps than their gaps in bachelor's degree completion. This highlights the importance of including community college enrollees in the analysis.

The remainder of this paper is organized as follows: The next section provides a brief literature review on gaps in post-secondary enrollment and attainment by race/ethnicity and gender. We then discuss our data and methods, followed by the findings of our analyses. We conclude with a summary of findings and implications for policy and future research.

Literature Review on College Enrollment and Completion

Between 1970 to 2000, an increasing proportion of young adults attended college. However, among *college attendees*, degree completion rates declined during the same time (Bound, Lovenheim, & Turner, 2010). To explain this decline, Bound, et al. (2010) examined the change in the characteristics of college attendees using two nationally representative samples of high school cohorts (high school classes of 1972 and 1992). They found that academically weaker students were increasingly entering post-secondary education. However, importantly, declines in institutional resources played a larger role in lower college completion rates for later cohorts.

In a study of college enrollment patterns over time by race, Backer, Klask, and Reardon (2018) found narrowing Black-White and Hispanic-White differences in college selectivity

among the population of 18-year-olds between 1986 and 2014. This study includes not enrolling in college as a choice, and the narrowing total selectivity gap is driven by growth in college enrollment rates among racial/ethnic minority students. In addition, this, in part, stems from narrowing racial gaps in high school graduation. However, among students who attend degree granting institutions, Black-White selectivity gaps are growing as fewer Black students are entering more selective colleges and greater fractions of Black students attend non-selective institutions. In contrast, the Hispanic-White college selectivity gap among college enrollees remained stable for the thirty years of the study period (Backer et al., 2018).

However, when the researchers controlled for students' pre-college characteristics, different patterns emerged. Numerous studies have demonstrated that Black students have higher college enrollment rates, conditioning on such pre-college characteristics as family socioeconomic backgrounds and high school achievement (Kane & Spizman, 1994; Rivkin 1995; Cameron & Heckman, 2001; Bennett & Lutz, 2009; Davis, & Otto, 2016; Eller & DiPrete, 2018). This "advantage" among Black students was larger for selective four-year college enrollment than that for less selective college enrollment, or Historically Black Colleges and Universities (HBCU) enrollment (Benenett & Xie, 2003). Moreover, in some studies, the advantage was only found among low-income students (Black & Sufi, 2002; Benenett & Xie, 2003). Similar pattens of advantage are reported for Hispanic students (Jasinski, 2000; Alon & Tienda, 2005; Mangino, 2010).

However, this college enrollment advantage among Black and Hispanic students does not translate into higher college completion rates among these students. Prior studies on college completion show sizable overall gaps in bachelor's degree completion by race. While much of this gap is explained by pre-college characteristics, non-negligible completion gaps remain after

controlling for academic skills upon college entry. Much of the remaining difference seems to come from which college students attend (i.e., between-college differences), and not the process within the same college. For example, Flores, Park, and Baker (2017), using public higher education data in Texas showed that 61% of four-year degree attainment gaps are due to pre-college characteristics and 35% is explained by postsecondary factors (the percentage of tenured faculty members, the faculty-to-student ratio, full-time-equivalent enrollment, per-pupil instructional expenditures, and whether the institution was designated an Hispanic Serving Institution (HSI) or HBCU).

Similarly, analyzing the data on all first-time full-time college students attending Missouri public four-year institutions across multiple cohorts, Arcidiacono and Koedel (2014) found most racial college completion gaps are explained by pre-college student demographic and academic characteristics and high school quality. This indicates college choice matters to some extent. Similarly, Fletcher and Tienda (2010) analyzed racial gaps in post-secondary outcomes (GPA and bachelor's degree attainment) using data on students who enrolled in two selective and two less selective public colleges in Texas.[1] Their findings show, in each college, racial/ethnic gaps in graduation rates are reduced considerably, but not eliminated, after controlling for high school achievement levels and high school characteristics.

On one hand, these studies point to the importance of pre-college academic preparation to explain the overall racial/ethnic degree completion gaps, and this suggests that narrowing pre-college gaps in academic readiness can substantially narrow the overall degree attainment gaps. On the other hand, the national trends do show the narrowing of racial gaps in test scores over time (e.g., Reardon & Portia, 2016). For example, the results of the National Assessment of Educational Progress (NEAP) show that racial gaps in academic achievement have narrowed for

the last forty years (Center for Education Policy Analysis, 2023). More recently, the greater progress in the NEAP performance was made by Black and Hispanic students than White students after 2000, and yet, college completion gaps do not appear to be narrowing in subsequent years as one might expect from improvements in pre-college academic skills (despite the fact that college enrollment gaps are narrowing). This calls for a closer investigation regarding how academic trajectories diverge from high school and post-secondary years.

This study contributes to the literature by addressing two limitations in prior studies examining college completion. As mentioned earlier, the first limitation is sample selection or censoring. While the college enrollment advantage of racial/ethnic minority students, given high school achievement, is well documented, many studies on college completion rely on college administrative data and only include those who enrolled in four-year public institutions and examine four-year degree attainment. These studies fail to show how the gaps may diverge as students move from high school to post-secondary education and also ignore community college enrollment. Second, while most prior studies focus on average racial gaps, educational trajectories differ considerably among race/ethnicity-by-gender groups. Moreover, the size of these gaps tends to depend on high school achievement levels.

These limitations often arise from the limitations of the data. There are generally two types of data that are utilized to investigate degree completion patterns. One type of data is college administrative data, which does not contain information about students who did not enroll in the particular colleges under study. These studies can only examine a bachelor's degree completion based on students who first entered these four-year colleges. This ignores systematic differences by race in college enrollment patterns. In contrast, studies using national surveys avoid censoring problems as they follow birth cohorts or high school cohorts over time. This

allows researchers to investigate how or when post-secondary trajectories may diverge. For example, Merolla (2018) used the Educational Longitudinal Study (ELS) with a sample of a 10th-grade cohort and investigated bachelor's degree completion gaps among Black, Hispanic, and White students. This study finds that for Hispanic students the divergence in the trajectories, relative to White students, begins early as they are less likely to graduate from high school and enter a four-year institution. In comparison, the divergence for Black students happens after entering college, and college factors (e.g., financial factors, such as loans, scholarships, and having fulltime jobs, being a transfer student, college selectivity, faculty mentorship, etc.) contribute to the gap in bachelor's degree completion.

A limitation of the national survey data includes not having large enough sample sizes to conduct subgroup analyses by race, gender, and pre-college achievement levels. We consider the dimension of gender as the extant studies highlight growing gender gaps in post-secondary enrollment and degree completion (Peter & Horn, 2005; DiPrete & Buchmann, 2013), and this pattern may not be the same across racial/ethnic groups or achievement distributions. Lastly, the national survey data do not allow researchers to eliminate the contribution of all high school factors to degree completion, which can be addressed by the state longitudinal data.

Data and Method

The data for this study are based on the State Longitudinal Data System from the Missouri Department of Elementary and Secondary Education (DESE). We use four cohorts of first-time 9th-grade students who began public high school in Fall 2009, 2010, 2011, and 2012. There are approximately 70,000 students per cohort attending 520 high schools. The analytic sample is restricted to White, Black, and Hispanic students. The three racial/ethnic groups

constitute 96.1% of the total first-time 9th-grade students with the total sample size of 264,814 students. The racial/ethnic composition of the analytic sample is 78.81% White, 16.95% Black, and 4.24% Hispanic and 52.74% of students qualified for free or reduced lunch during high school.

The DESE data contain the following information: student high school enrollment and graduation status; demographic characteristics (e.g., gender[2], free/reduced lunch status, and race/ethnicity); 8th-grade Missouri Assessment Program (MAP) scores in mathematics, science, and communication arts; 10th-grade through 12th-grade GPAs[3]; End of Course Exams in Algebra I, English II, Biology I, and Government (required for high school graduation) and the date of the exam taken; year attendance rates from 9th through 12th grades, and ACT scores. High school student data are linked to five years of the National Student Clearinghouse (NSC) data following expected on-time high school graduation[4]. NSC data provide information on college enrollment (e.g., start and end date, full-time or half-time status, majors), institution types (e.g., two-year vs. four-year and private vs. public), and degree completion.

The outcome variables for this study are: whether students graduated from high school; enrolled in college within six months of high school graduation; attained any post-secondary degree or certificate by the 5th year of college following four-year high school graduation; and attained a bachelor's degree or higher by the 5th year of college.[5] The average outcomes of the six groups differ considerably (Table 1). For example, on average, White females are most likely to attend college and complete any degrees (56.0% and 34.0%, respectively, of the 9th-grade population), and Black and Hispanic males are least likely to do so (respectively, 30.0% and 32.0% attend college and 6.8% and 13.2% complete any degree). Within racial groups, female students are more likely to attend college and earn degrees than male students. Regarding student

characteristics, Black students have higher rates of FRL-eligibility (84.0% vs. 44.9% for White students) and are more likely to attend schools in urban areas with more racial minorities and FRL-eligible students. Descriptive statistics are provided in Table 1.

Table 1 about here

Measures of pre-college academic preparation (Academic Index)

A pre-college academic indicator used in this study is the academic index (AI), a composite measure of academic preparedness for college for student *i*. Specifically, the AI is a student's predicted probability of earning a four-year degree (within five years of expected high school graduation, denoted as *D*), given pre-college academic performance. This is similar to the measure in Arcidiacono and Koedel (2014) who used ACT scores and high school class rank to construct the index. In contrast, our study has a more comprehensive set of predictors, including various standardized test scores, attendance rates, GPAs, and credits earned in math and science, including advanced courses.

The statistical model for the AI is written as:

$$P(D = 1)_i = \gamma_0 + \gamma_1 X_i + e_i \quad (1)$$

where *X* represents student academic predictors, and e_i is the student error terms.

Equation 1 is estimated via a logit model across all 9th-grade cohorts, at three different time points in secondary education: prior to high school entry, the end of ninth grade, and at the end of high school. First, to capture academic readiness at high school entry (AI8), the model includes pre-high school academic achievement (8th-grade MAP scores in mathematics, science, and communication arts and whether students took and passed Algebra in 8th grade). Second, AI

at the end of ninth grade (AI9) is constructed by including these 8th-grade (AI8) predictors and 9th-grade GPA and attendance rate (AI9). Finally, academic readiness at the end of high school (AI12) is measured by a full set of academic variables through Grade 12. Along with the variables in AI8 and AI9, AI12 includes grade-specific GPAs from 10th through 12th grades; ACT English and mathematics sub-scores; the number of credits earned in mathematics and science in 11th grade and 12th grade; and the number of Advanced Placement (AP) courses in grades 11 and 12 [6].

Handling of Missing data

In our data, 71.6% of students had complete data. Most of the missing data comes from 8th-grade MAP scores, which is available only those who attended a Missouri public middle school. All of the analyses are conducted in two ways: 1) analyses using only complete cases and 2) analyses using multiple imputation for incomplete data. For the latter, missing data were only imputed for students' continuous academic achievement measures (e.g., standardized MAP scores, ACT sub-scores, End-of-Course assessments, and yearly GPAs). Assuming these variables are Missing at Random (MAR) given covariates and are characterized by an arbitrary missing data pattern, missing data were multiply imputed via the Markov Chains Monte Carlo (MCMC) option in SAS's PROC MI command. Given this imputation method assumes multivariate normality of input variables, this method was most suitable for the missing data in this study. The results reported here are based on the analysis using multiple imputation. The results from the Complete Case Analysis (CCA) are similar and available upon request.

Analytic strategies

To reiterate, our first question asks the degree to which pre-college academic readiness differs by race and gender at high school entry, the end of ninth grade, and the end of high school. This question is addressed through descriptive statistics. We are also interested in understanding whether academic readiness gaps widen or narrow during high school. We address this question descriptively as well by comparing the relationship between the AI8 percentile ranks and the subsequent percentile ranks across racial and gender groups. Specifically, for students who are at the same percentile rank upon high school entry, we examine how their subsequent percentile ranking changed for each race/ethnicity-by-gender group to illustrate how their rank relative to the entire distribution changed during high school. If racial and gender gaps in academic readiness widen during high school, we will see that the ranking will diverge over time.[7]

Our second research question asks how degree attainment trajectories (high school graduation, college enrollment, and degree completion) differ by race/ethnicity-by-gender groups. We analyze race/ethnicity-by-gender gaps by AI quintiles to see how the pattern of outcome gaps varies by pre-college academic preparation levels. We first estimate the following unconditional model for each academic outcome for student *i* in cohort *c* and school *j*;

$$Y_{ic} = \beta_1(AIQuintile_i) + \beta_2(RG_i * AIQuintile_i) + \beta_3(Coh_c) + \varepsilon_i \,, \qquad (2)$$

where *RG* is a set of race/ethnicity-by-gender group indicators with White females being the reference group; $AIQuintile_i$ is a vector of AI quintile indicators; and Coh_c is a vector of cohort fixed effects. The parameter of interest is the coefficient vector β_2 which represents the difference in the average outcome for each of the AI quintiles by the race/ethnicity-by-gender

groups relative to the outcome of White females. For the analysis of high school graduation, we first compare how this outcome differs among students with the same readiness at the end of 9th-grade, using 9th-grade AI as a covariate. We then compare students with the same 12th-grade AI. For college outcomes, comparisons are made among students who have similar readiness at the end of high school (i.e., AI12).

The next model adds an indicator for free or reduced lunch (FRL) eligibility, and we then add school fixed effects to see the degree to which the unconditional outcome difference is explained by these factors. School fixed effects control for all time-invariant between-school differences that are associated with the outcome, thus, providing the average within-school estimates of outcome differences by groups.

All analyses are first conducted using all 9th-grade students. We repeat these analyses using high school graduates for the college enrollment outcome and college enrollees for the degree completion outcomes to see the extent to which the results are sensitive to which student populations are included in the analysis (i.e., censoring). This also allows us to understand the extent to which the outcome gaps among the 9th-grade cohort are explained by subsequent outcomes (e.g., the extent to which overall college enrollment gaps are explained by the difference in high school graduation).

Results

In Table 2, we first report descriptive statistics on students' outcomes by the Academic Index (AI) quintile measured at three different time points (AI8, AI9, and AI12). Here we also report the relationship between educational outcomes and AI population quintiles in odd ratios at the bottom of Table 1, comparing the top quintile to the bottom and middle quintiles. The results

show, not surprisingly, educational attainment rises as we move from Q1 to Q5. For example, in the first panel, which presents the 8th grade measure (AI8), we see that the high school graduation rate of Q5 students is 40 percent higher than for Q1 students yielding an odds ratio of 1.4. This odds ratio jumps to 4.2 for college attendance,14.2 for earning any degree, and 34.0 for earning a bachelor's degree. AI9 includes all of the information in AI8 in addition to 9th grade GPA and attendance. The odds ratios for post-secondary education jump sharply to 7.6 for college attendance, 4.1 for degree completion, and 102.2 for bachelor's degree completion. This clearly indicates the additional predictive power of 9th-grade grades and attendance, over and above pre-high school test scores. The predictive power rises still further when we augment the information in AI9 with high school grades, attendance, mathematics and science course taking, and ACT score information. A12 is a strong predictor of post-secondary achievement. The Q5/Q1 odds ratios for college attendance, degree completion, and bachelor's degree are 16.0, 104.4, and 346.6, respectively.

Table 2 about here

Race/Ethnicity-by-gender difference in academic preparation levels (RQ1)

Table 2 establishes the strong relationship between post-secondary attainment and our AI measures as students enter and progress through high school. Table 3 reports the distribution of AI quintiles within race/ethnicity-by-gender groups, and a few patterns emerge. First, White females and males are more likely to be represented in higher quintiles than lower quintiles, while the opposite is the case for Black and Hispanic students. The distribution for Black males is particularly striking, with 47.8 percent in quintile 1, but only 4.7 percent in quintile 5. Within

each racial/ethnic group, female preparation exceeds that of males. A second notable pattern is the deterioration of the relative position of males as they progress through high school. For example, Black females in the top quintile increases from 6.44 to 7.74 percent going from AI8 to AI12. Hispanic females also increase from 12.57 to 14.75 percent over the same range. By contrast, the Black male share in the top AI quintile falls from 4.71 to 3.08 percent and Hispanic males drop from 11.59 to 8.93 between 8th and 12th grade.

Table 3 about here

Figure 1 shows this pattern graphically by displaying the relationship between percentile ranks at high school entry (AI8) and those at the end of 9th-grade (top panel) as well as the relationship between AI8 ranks and ranks at the end of high school (AI12). White females are used as a reference group, and the overlapping group's lines indicate that their relative standings remained the same between the two grade levels compared. However, if any group's line falls below that of another group, it means that their relative position has deteriorated.

(Figures 1 and 2 about here)

We see that, as compared to White females, the gaps in academic readiness grow over time for all groups, and the ranking for males become progressively lower, especially among Black male students. However, once we condition on academic readiness at the end of 9th-grade, the gap in AI12 becomes much smaller for females (Figure 2). This implies that for students with the same AI8, which is predicted primarily by 8th-grade test scores (and taking and passing

algebra in 8th grade), Black and Hispanic females on average have lower GPAs in ninth grade. Course grades are often regarded as better predictors of later outcomes, including high school graduation and post-secondary outcomes (Allensworth & Easton, 2007; Geiser & Santelices, 2007; Easton, Johnson, & Sartain, 2017; Allensworth & Clark, 2020). Thus, comparing students with the same 8th-grade test scores and same 9th-grade GPA, academic readiness at the end of high school is relatively similar among females.

By contrast, the relative positions of male groups appear to fall further behind even after controlling for 9th-grade GPA, although White males who are top performers at the end of 9th grade share similar ranking at the end of high school as their White female peers. Again, 9th-grade GPA is much lower for males than females among students with the same 8th-grade test scores, and this explains lower ranking among males in ninth grade among students with the same AI8. The remaining gap at the end of high school, conditioning on AI9, implies that academic experience and performance after 9th grade are worse for males than for White females who are academically similar at the end of 9th-grade.

Race/Ethnicity-by-Gender gaps in high school and post-secondary outcomes (RQ2).

High School Graduation

The top panel of Table 4 compares the average high school graduation rates across racial and gender groups within quintiles of Grade 9 academic readiness (AI9), with White females as the reference group (first column). In general, White males are slightly more likely to graduate from high school than White females who are similarly prepared at the end of Grade 9 (except for Quintile 5, whose graduation rates do not differ from the White female average). White male advantage is also observed when comparisons are based on 12th grade academic readiness

(bottom panel), and the magnitude of the gaps in the lower quintiles of the 12th-grade AI are much larger than the gap in those of the 9th-grade AI. For example, White male graduation rates in Quintile 2 of the 12th-grade AI are 10 percentage points higher than that of White females (SE=.005), as compared to 3.6 percentage points higher for White males in Quintile 2 of the 9th-grade AI.

Black females and males are also more likely to graduate from high school than White females in the bottom two quintiles of 9th-grade readiness, but among those who are more academically ready, Black graduation rates are lower than those of White students. At the end of high school (bottom panel), top performing Black students of both genders have similar graduation rates as top performing White females, while graduation rates in the bottom 2 quintiles are higher for Black students by nearly 10 percentage points or greater. For Hispanic students, those with 9th-grade readiness in the bottom two quintiles have similar likelihood of high school graduation as White females, but higher performing Hispanic students are less likely to graduate. These differences become smaller, or eliminated, among students who reached the same academic readiness at Grade 12.

Table 4 about here

The FRL status and school characteristics systematically differ by race/ethnicity, and they may explain or accentuate the unconditional gaps observed earlier. Adding FRL eligibility appears to have little impact on the race/ethnic-gender coefficients after controlling for AI12 as they remained similar to the coefficients from unconditional model (Table 5, "FRL" column). This may imply that AI12 reflects the difference in the FRL status. However, after controlling

for school fixed effects, the race/ethnicity-by-gender coefficients became more positive for students in lower-quintiles. In higher quintiles where we observed lower graduation rates for Black and Hispanic students, some of these gaps are explained by school factors. The pattern of results suggests Black and Hispanic students tend to attend high schools with lower graduation rates.

Table 5 about here

College Enrollment

Table 6 compares college enrollment by academic readiness at the end of high school (AI12) for the 9th-grade population (top panel) and for high school graduates (bottom panel). First, of the 9th-grade population, few students in the bottom quintile attend college, and in this quintile, college attendance rates are higher for Black females and males by, 4.7 and 2.7 percentage points, respectively, than those for White females.

For White males, even though they are more likely to graduate from high school than White females, especially among students in lower AI12 quintiles, their college going rates tend to be lower than those of White females. This indicates that, once graduating from high school, White males are less likely to attend college. This is shown in the bottom panel based on high school graduates where White males display lower college enrollment rates in all quintiles. The same pattern of results is found for Hispanic males in the bottom quintile.

By contrast, Black students of both genders attend college at a higher rate than White females, except for the top performing Black students who are less likely to attend college than White females. The enrollment advantage for Black students is particularly large in the second

and third quintiles (more than 10 percentage points). Also, the magnitude of the gaps is similar regardless of the populations being compared (all 9th-grade students or high school graduates). Thus, higher high school graduation rates for Black students do not explain their higher college enrollment rates as compared to White students.

Table 6 about here

Once we control for the FRL status, which is negatively related to college enrollment, the lower college going rates of the top quintile among Black students are reduced, while the enrollment advantage observed for students in quintiles 1 through 4 becomes even larger (Table 7). Adding school fixed effects tends to move the estimate slightly downward, suggesting that schools enrolling higher proportion of Black students are more likely to send their students to college.

Among Hispanic students, our earlier results showed that students with middle to higher academic readiness are less likely to attend college overall than White females (Table 6), and this is only partially explained by their lower rates of high school graduation. In quintiles where we observed lower high school graduation rates for Hispanic students (Quintiles 3 and 4 for females and Quintile 4 and 5 for males), college enrollment gaps in these quintiles are somewhat smaller for high school grades than for the 9th-grade population. The remaining gaps are further reduced after controlling for students' FRL status. However, after controlling for school fixed effects, these coefficients moved downward, indicating greater gaps for White females. This suggests, as is the case for Black students, that schools attended by Hispanic students are more likely to send their students to college.

Table 7 about here

Any Degree Completion

Of the total 9th-grade population, the rate of completing any degree is very low for students with low academic readiness (Table 8). The estimated five-year college completion rates of White females in the bottom quintile are near zero, and only 11 percent of students in the middle quartile obtain any degree. Between-group variation is also negligible among these students. By contrast, for students with higher academic readiness, we see substantial degree completion gaps, with White females outperforming all other groups. The magnitude of the gap is particularly large for Black males (Est= -.223, SE=.022) and Black females (Est=-.143, SE=.018) as well as for Hispanic males (Est= -.18.5, SE=.026) as compared to that for Hispanic females (Est=-.099, SE=.019) and White males (Est=-.077, SE=.005).

Even though college completion is similar across students with middle and lower academic readiness, our results illustrate how post-secondary trajectories differ by group. For White males, recall that their college enrollment rates are generally lower than White females, but they have similar college completion rates in the bottom three quintiles (or slightly higher in the second quintile). This indicates that these middle- and low-achieving White males, once enrolled in college, are more likely to complete a degree. This is shown in the result of college enrollees (Table 8, bottom panel). By contrast, Black males and females are much more likely to attend college, especially in the second and third quintiles, and yet their college completion rates are similar overall. They thus appear to lose ground once in college. The bottom panel of Table 8 shows that Black college enrollees leave college without a degree at higher rates than White

females. In comparison, college going behavior and any degree completion for middle and lower achieving Hispanic students are relatively similar to that of White females.

Table 8 about here

For students with higher levels of academic readiness (Quintiles 4 and 5), all groups underperform White females. The FRL status reduces these gaps substantially, or eliminates them, for many groups (Table 9). For example, any degree completion gap between Black and White females in Quintile 3 was reduced from -0.046 to -0.12 (n.s.) and for Quintiles 4 and 5, the gap was reduced by more than half. Similarly, the FRL eliminates college completion gaps for Hispanic females in Quintiles 4 and 5 and Hispanic males Quintile 4. Specifically, the Hispanic and White female degree completion gaps were reduced from -0.071 to -0.029 (n.s.) for Quintile 4 and from -0.063 to -0.016 (n.s.) for Quintile 5, while the Hispanic male and White female gap in Quintile 5 was reduced from -0.54 to -0.016 (n.s.). We also note that among the highest-performing college enrollees, Black and Hispanic males have much lower degree completion rates regardless of the population being compared and substantial gaps remain even after controlling for FRL or high school characteristics through school fixed effects.

Table 9 about here

Bachelor's Degree Completion

Of the 9th grade population (Table 10, top panel), very few students complete a bachelor's degree within 5 years if their academic readiness is at or below the 60th percentile.

There are few race/ethnicity-by-gender differences in bachelor's degree attainment among these students, with an exception that Black students are slightly more likely to complete a four-year degree (between 0.5 to 2.4 percentage points with SE=.002). In Quintile 4, Black males and females are equally likely to obtain a bachelor's degree as White females, while White males, Hispanic females, and Hispanic males are less likely to complete a four-year degree. For White and Hispanic male students, this appears to be explained by their lower rate of college attendance as their bachelor's degree completion is smaller and no longer significant among college enrollees (Table 10, bottom panel). Of the most academically ready students (Quintile 5), White females outperform all the other high performing groups. The magnitude of the gap is substantial for Black and Hispanic students, and males in particular. Specifically, the difference in bachelor's degree attainment from White females is -0.047 for White males, -0.095 and -0.81 for Hispanic and Black females, respectively, and -0.169 and -0.131 for Black and Hispanic males.

Table 10 about here

The pattern of results changes dramatically when we control for FRL status. The bachelor's degree completion gaps among the top performing student are eliminated completely for Black females and reduced by half for Black males. For students in lower quintiles, Black bachelor's degree completion rates of both genders surpass that of White females. Similarly, lower completion rates we observed for Hispanic females are eliminated and the gap between Hispanic males and White females is also smaller when the FRL status is taken into account. Gender gaps remained large for students in the top quintile, especially for Black and Hispanic males. These coefficients slightly move downwards by adding school fixed effects, suggesting

that Black and Hispanic students who earn a bachelor's degree attend particular types of schools with more students who will later attain a degree. This is contrasted to our earlier result of high school graduation where adding school fixed moved their coefficients upward. It may be that these high schools have tougher graduation standards, while the graduates of these high schools are more likely to complete a college degree.

Table 11 about here

Discussion and Conclusion

This paper provides a detailed descriptive analysis of racial/ethnic gaps in degree attainment trajectories based on the data for Missouri public high school students. Our study differs from previous studies on this topic in three important ways. First, while many prior studies relied on the data of college enrollees at four-year institutions, we tracked 9th-grade students through high school and into post-secondary education. Second, most studies on racial/ethnic gaps in college completion examined average gaps in bachelor's degree attainment. In contrast, this study depicts much more complex patterns of post-secondary gaps across race/ethnicity-by-gender groups as well as a college readiness measure, which we label Academic Index (AI). Finally, by including students who first enrolled in community colleges, this study provides a fuller picture of post-secondary degree completion, since initial college choice differences considerably across our race and gender groups.

The measure of academic readiness is a strong predictor of degree attainment, and as in prior studies, this is the most significant factor explaining degree attainment disparities. Our data shows, of all Missouri 9th-grade students, less than a quarter attain any degree within five years

after first enrolling in college and less than 20 percent of all 9th-grade students earn a bachelor's degree during the same period. The degree attainment rates for the top AI12 quintile are considerably higher, reaching nearly 70 percent for any degree and 60 percent for a bachelor's degree. The likelihood of being in the top quartile in AI12 is much lower for Black males (3.08%), Black females (7.74%), and Hispanic males (8.93%).

Another important finding is that gaps in academic preparation appear to widen during high school. Academic readiness at the end of high school is strongly related to academic skills when students start high school. However, academic trajectories appear to diverge for students with the same readiness at high school entry, and in particular, gender gaps continue to widen after 9th-grade. Potential factors that contribute to this widening gap include course grades, attendance, mathematics and science course enrollment and performance later in high school, and ACT scores. For Black and Hispanic female students, once taking into account 9th-grade GPA and attendance, their standing in academic readiness at the end of high school is similar to that of White female students. However, for male students, their academic standing across each race/ethnicity falls behind their female peers throughout high school years. These findings indicate the importance of the role that high school can play in redirecting students' trajectories to reduce the current gaps.

To narrow degree attainment gaps for Black students, given pre-college academic preparation, college enrollment is not an issue as they are more likely to attend college. This finding is consistent with extant research (Kane & Spizman, 1994; Rivkin, 1995; Cameron & Heckman, 2001; Bennett & Lutz, 2009; Davis & Otto, 2016; Eller & DiPrete, 2018). For Hispanic students, degree attainment gaps can be narrowed by increasing high school graduation and college enrollment if completion rates remain the same for college enrollees. This pattern of

results is similar to that of Merolla (2018) who, using the national survey data, shows that the average post-secondary trajectory diverges after college entry for Black students and earlier for Hispanic students.

Finally, to reduce degree-attainment gaps between White, Black, and Hispanic students, addressing factors associated with poverty appears to be critical. We find that after conditioning on the FRL status, a rough measure of poverty, bachelor's degree attainment rates are higher for Black females than White females, no significant difference is found between Hispanic females and White females, and the magnitude of the gaps for Black and Hispanic males are smaller. Financial barriers of higher education are noted elsewhere (e.g., Heller, 2013; Goldrick-Rab, Kelchen, Harris, & Benson, 2016; Lovenheim, 2017; Dynarski, Page, & Scott-Clayton, 2022), and this includes difficulty in paying tuition, food and housing insecurity, and balancing work and school. Also, institutional resources and college choice are another factors as low-income students are more likely to attend a college with lower resources for students. Hoxby and Avery (2012) show that high-achieving, low-income students are much more likely to apply to resource-poor, non-selective, and/or two-year institutions, and such students tend to come from high schools in small districts with few options for alternative high schools.

Another critical finding of this study is that the most academically ready Black and Hispanic male students are much less likely to attain a bachelor's degree than their peers in other race/ethnicity-by-gender groups. For Hispanic male students, this is only partially explained by their lower college enrollment rates, but for both groups, substantial gaps remain among college enrollees and after controlling for the poverty status. This suggests the importance of providing greater support for these students to remove the barriers to degree completion.

Finally, for Black students, the gaps in any degree completion appear to be larger than the

gaps in bachelor's degree completion. This suggests that Black students are less likely to complete sub-bachelor's degrees, a finding that could not be revealed in studies that excluded community college students. We speculate that this is partly explained by the difference in the initial college choice. Our data show that community college enrollment rates are much lower for Black males and females than all other groups with similar academic readiness. This likely prevents them from attaining any credentials below a bachelor's degree. The issue of college choice in explaining degree completion gaps is a topic for future research.

A limitation of this study is that it is based on administrative data from a single state. Thus, the question remains as to whether these results are generalizable outside of Missouri. Missouri has two large metro areas, with large shares of high poverty and racial minorities students enrolled in public schools. Although parts of the findings of this study are replicated in studies using administrative data from other states, or national surveys, we are aware of no other studies that fully replicate this one (particularly starting with a 9th grade high school cohort). However, many other states have developed these types of longitudinal P20 student data files, so replication in other states is feasible and desirable.

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[1] The four institutions in Fletcher and Tienda (2010) are University of Texas at Austin, Texas A&M, Texas Tech, and University of Texas at San Antonio, and they are classified as, respectively, very competitive, highly competitive, competitive, and noncompetitive on Barron's 1996 clarification.

[2] The DESE's Missouri Student Information System (MOSIS) manual specifies the gender code as "Male" and "Female." We examine gender gaps to the extent that the state administrative data allow.

[3] DESE administrative data only provide 10th- and 11th-grade GPAs that were reported by the school to DESE. We calculated 11th- and 12th-grade GPAs using student Course Completion data.

[4] The NSC data cover more than 97 percent of all students in both public and private U.S. institutions (National Student Clearinghouse, 2023).

[5] Currently, DESE links high school student data up to the fifth year of high school graduation through NSC for all cohorts.

[6] The correct prediction rate of AI12 for a bachelors' degree completion is 90.7% using the data set with imputed values and 88.5% using students with complete data (i.e., listwise deletion/CCA).

Table 1: Descriptive Statistics

	All	WF	WM	BF	BM	HF	HM
MAP Math	0.000	0.166	0.146	-0.595	-0.699	-0.189	-0.205
	(1.000)	(0.898)	(0.977)	(0.9704)	(1.027)	(0.916)	(0.988)
MAP Science	0.000	0.161	0.213	-0.745	-0.810	-0.290	-0.216
	(1.000)	(0.863)	(0.945)	(0.956)	(1.069)	(0.908)	(0.992)
MAP ELA	0.000	0.276	0.010	-0.404	-0.729	-0.101	-0.312
	(1.000)	(0.879)	(0.986)	(0.939)	(1.086)	(0.920)	(1.016)
Taking Algebra in	0.182	0.220	0.186	0.116	0.085	0.150	0.125
Grade 8	(0.386)	(0.414)	(0.389)	(0.320)	(0.278)	(0.357)	(0.331)
FRL	0.533	0.450	0.454	0.847	0.838	0.740	0.747
	(0.498)	(0.497)	(0.498)	(0.359)	(0.367)	(0.438)	(0.435)
Attendance rate							
Grade 9	93.589	94.292	94.232	91.155	90.644	92.344	92.368
	(8.669)	(7.349)	(7.996)	(10.764)	(11.851)	(9.981)	(10.901)
Grade 10	91.737	92.292	92.569	89.109	89.057	89.831	89.925
	(10.707)	(9.744)	(10.300)	(12.280)	(12.891)	(11.534)	(12.689)
Grade 11	90.557	91.260	91.342	87.966	87.581	88.425	88.321
	(11.021)	(10.062)	(10.591)	(12.487)	(13.229)	(12.114)	(13.131)
Grade 12	91.737	92.292	92.569	89.109	89.057	89.831	89.925
	(10.707)	(9.744)	(10.300)	(12.280)	(12.891)	(11.534)	(12.689)
GPA							
Grade 9	2.704	3.019	2.679	2.300	1.956	2.692	2.398
	(0.955)	(0.851)	(0.923)	(0.944)	(0.930)	(0.913)	(0.956)
Grade 10	2.660	2.980	2.620	2.310	1.950	2.620	2.300
	(0.98)	(0.88)	(0.95)	(0.95)	(0.94)	(0.94)	(0.99)
Grade 11	2.640	2.960	2.590	2.310	1.920	2.610	2.280
	(1.01)	(0.91)	(0.99)	(0.99)	(0.98)	(0.97)	(1.02)
Grade 12	2.830	3.160	2.780	2.490	2.080	2.790	2.430
	(0.99)	(0.87)	(0.97)	(0.97)	(0.98)	(0.95)	(1.01)
Math Credits Enrolled							
Grade 11	0.750	0.803	0.759	0.659	0.591	0.718	0.693
	(0.502)	(0.476)	(0.500)	(0.521)	(0.537)	(0.536)	(0.544)
Grade 12	0.783	0.858	0.777	0.692	0.603	0.761	0.714
	(0.592)	(0.595)	(0.589)	(0.568)	(0.556)	(0.611)	(0.595)
Science Credits Enrolled							
Grade 11	0.477	0.507	0.466	0.476	0.425	0.444	0.433
	(0.529)	(0.522)	(0.529)	(0.539)	(0.529)	(0.532)	(0.553)
Grade 12	0.453	0.506	0.449	0.394	0.333	0.416	0.385
	(0.627)	(0.657)	(0.626)	(0.573)	(0.521)	(0.624)	(0.609)
AP Credits Enrolled							
Grade 11	0.323	0.427	0.295	0.221	0.115	0.367	0.260
	(0.856)	(0.969)	(0.823)	(0.684)	(0.509)	(0.897)	(0.798)
Grade 12	0.488	0.636	0.456	0.328	0.184	0.507	0.373
	(1.024)	(1.137)	(1.000)	(0.837)	(0.603)	(1.085)	(0.946)

Table 1: Descriptive Statistics (continued)

	All	WF	WM	BF	BM	HF	HM
ACT English scores	18.120	19.930	18.430	14.650	13.280	16.860	15.850
	(6.65)	(6.35)	(6.51)	(5.66)	(5.76)	(5.93)	(6.08)
ACT Math scores	18.610	19.390	19.450	15.550	15.090	17.350	17.360
	(5.27)	(4.88)	(5.46)	(4.14)	(4.53)	(4.42)	(4.97)
Total N	264,814	100,452	106,581	22,635	23,816	5,462	5,868
	100%	37.93%	40.25%	8.55%	8.99%	2.06%	2.22%

Note: WF=White Female, WM = White Male, BF = Black Female, BM = Black Male, HF = Hispanic Female, HM = Hispanic Male.
Standard deviations are in parentheses.

Table 2. Outcomes by Academic Index (AI) Quintiles

Grade 8 (AI8)

	HS Grad		Attend College		Any Deg		Bachelor's Deg	
Quintile	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1	.643	.479	.180	.384	.037	.190	.014	.116
2	.769	.421	.334	.472	.110	.313	.055	.227
3	.835	.371	.467	.499	.207	.405	.126	.332
4	.880	.325	.599	.492	.328	.469	.235	.424
5	.923	.267	.751	.433	.532	.499	.464	.499
All	.809	.393	.463	.499	.241	.428	.177	.382
Odds Ratio								
Q5/Q1	1.434	.005	4.171	.040	14.225	.314	33.972	1.219
Q5/Q3	1.105	.003	1.606	.009	2.566	.250	3.669	.046

Grade 9 (AI9)

	HS Grad		Attend College		Any Deg		Bachelor's Deg	
Quintile	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1	.527	.499	.106	.308	.015	.122	.005	.072
2	.796	.403	.283	.450	.064	.246	.027	.162
3	.870	.337	.476	.499	.171	.376	.092	.289
4	.913	.281	.655	.476	.353	.478	.238	.426
5	.947	.224	.805	.396	.613	.487	.532	.499
All	.809	.393	.463	.499	.241	.428	.177	.382
Odds Ratio								
Q5/Q1	1.800	.008	7.589	.095	4.754	1.453	102.156	6.149
Q5/Q3	1.089	.002	1.693	.009	3.595	.035	5.787	.083

Grade 12 (AI12)

	HS Grad		Attend College		Any Deg		Bachelor's Deg	
Quintile	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1	.422	.494	.055	.229	.007	.081	.002	.042
2	.799	.401	.226	.418	.036	.185	.010	.097
3	.893	.309	.459	.498	.124	.329	.051	.220
4	.946	.225	.703	.457	.359	.480	.227	.419
5	.994	.074	.883	.321	.692	.462	.606	.489
All	.809	.393	.463	.499	.241	.428	.177	.382
Odds Ratio								
Q5/Q1	2.354	.119	15.970	.286	104.37	5.540	346.59	35.620
Q5/Q3	1.114	.002	1.925	.009	5.573	.064	11.868	.217

Table 3. Percent of Students in AI Quintiles by Race/Ethnicity-Gender Groups

Grade 8 (AI8)

Quintile	WF	WM	BF	BM	HF	HM
1	12.21	16.76	39.33	47.80	23.91	28.09
2	18.39	19.07	25.94	23.71	24.26	23.95
3	21.21	21.10	16.65	14.29	21.58	19.91
4	23.32	21.42	11.64	9.49	17.68	16.46
5	24.87	21.65	6.44	4.71	12.57	11.59

Grade 9 (AI9)

Quintile	WF	WM	BF	BM	HF	HM
1	11.47	18.41	36.10	48.36	21.49	28.79
2	16.06	21.25	24.89	25.29	22.63	24.42
3	19.84	21.40	18.48	14.70	21.60	21.58
4	24.27	2.14	13.36	8.19	2.12	15.64
5	28.36	18.79	7.17	3.47	14.16	9.58

Grade 12 (AI12)

Quintile	WF	WM	BF	BM	HF	HM
1	11.55	19.94	31.14	45.71	21.31	23.97
2	14.96	21.48	25.58	27.02	22.50	24.55
3	19.18	21.51	2.74	15.76	21.66	22.62
4	24.64	19.64	14.80	8.43	19.79	14.92
5	29.66	17.42	7.74	3.08	14.75	8.93
N	100,391	106,499	22,612	23,772	5,458	5,857

Note: WF=White Female, WM = White Male, BF = Black Female, BM = Black Male, HF = Hispanic Female, HM = Hispanic Male.

Table 4. Unconditional Race/Ethnicity-by-Gender Gaps in High School Graduation by AI quintiles

	High School Graduation: All students (AI9)					
	Intercept (WF)	WM	BF	BM	HF	HM
Q1	.487	.024***	.106***	.038*	-.015	-.034
	(.009)	(.007)	(.016)	(.017)	(.021)	(.024)
Q2	.765	.036***	.055***	.031**	-.021	.005
	(.007)	(.004)	(.011)	(.011)	(.015)	(.013)
Q3	.856	.026***	-.004	-.032**	-.07***	-.055***
	(.005)	(.003)	(.009)	(.011)	(.016)	(.014)
Q4	.91	.009**	-.035***	-.079***	-.059***	-.048***
	(.004)	(.003)	(.01)	(.013)	(.015)	(.013)
Q5	.946	-.002	-.044***	-.066***	-.042**	-.077***
	(.003)	(.002)	(.009)	(.013)	(.013)	(.015)

	High School Graduation: All students (AI12)					
	Intercept (WF)	WM	BF	BM	HF	HM
Q1	.357	.065***	.124***	.095***	.009	.044*
	(.009)	(.007)	(.015)	(.016)	(.018)	(.021)
Q2	.73	.102***	.095***	.095***	-.02	.037**
	(.007)	(.005)	(.011)	(.011)	(.019)	(.014)
Q3	.863	.046***	.019*	.013	-.039*	-.017
	(.004)	(.003)	(.009)	(.01)	(.017)	(.014)
Q4	.935	.011***	.006	-.004	-.031**	-.023*
	(.003)	(.002)	(.005)	(.007)	(.011)	(.01)
Q5	.988	-.001	-.007*	-.002	-.004	-.014*
	(.002)	(.001)	(.003)	(.003)	(.004)	(.006)

Note: WF=White Female, WM = White Male, BF = Black Female, BM = Black Male, HF = Hispanic Female, HM = Hispanic Male.
Standard errors are in parentheses.
*<.05. **<.01. ***<.001

Table 5. Conditional Race/Ethnicity-by-Gender Gaps in High School Graduation by AI quintiles (AI12)

	High School Graduation: All students (AI12)										
	Intercept (WF)	WM		BF		BM		HF		HM	
		FRL	FRL/FE	FRL	FRL/FE	FRL	FRL/FE	FRL	FRL/FE	FRL	FRL/FE
Q1	.4	.062***	.063***	.131***	.169***	.101***	.136***	.013	.043***	.047**	.079***
	(.013)	(.006)	(.004)	(.015)	(.005)	(.016)	(.005)	(.018)	(.01)	(.021)	(.009)
Q2	.721	.103***	.104***	.092***	.108***	.092***	.109***	-.022	-.001	.035**	.051***
	(.01)	(.005)	(.003)	(.011)	(.005)	(.011)	(.005)	(.019)	(.01)	(.014)	(.009)
Q3	.85	.048***	.049***	.012	.021***	.007	.018***	-.045***	-.025**	-.021	-.002
	(.006)	(.003)	(.003)	(.009)	(.006)	(.01)	(.006)	(.017)	(.01)	(.014)	(.01)
Q4	.93	.012***	.013***	.002	.004	-.008	-.004	-.034***	-.022**	-.026***	-.017
	(.003)	(.002)	(.003)	(.006)	(.006)	(.007)	(.008)	(.012)	(.01)	(.01)	(.012)
Q5	.988	-.001	-.001	-.007**	-.003	-.002	.003	-.004	.003	-.014**	-.001
	(.002)	(.001)	(.003)	(.003)	(.009)	(.003)	(.012)	(.004)	(.012)	(.006)	(.014)

Note: WF=White Female, WM = White Male, BF = Black Female, BM = Black Male, HF = Hispanic Female, HM = Hispanic Male.

Standard errors are in parentheses.

*<.05. **<.01. ***<.001

Table 6. Unconditional Race/Ethnicity-by-Gender Gaps in College Enrollment by AI quintiles (AI12)

	College Enrollment: All students (AI12)					
	Intercept (WF)	WM	BF	BM	HF	HM
Q1	.033	-.009**	.047***	.027***	.005	-.005
	(.003)	(.003)	(.006)	(.005)	(.007)	(.005)
Q2	.187	-.01*	.142***	.138***	-.015	.01
	(.005)	(.004)	(.013)	(.012)	(.014)	(.012)
Q3	.436	-.018**	.106***	.112***	-.046**	-.021
	(.006)	(.006)	(.015)	(.015)	(.016)	(.016)
Q4	.696	-.023***	.022*	.015	-.087***	-.092***
	(.005)	(.005)	(.01)	(.013)	(.016)	(.018)
Q5	.876	-.013***	-.022*	-.054***	-.089***	-.067***
	(.003)	(.003)	(.01)	(.013)	(.015)	(.017)

	College Enrollment: High School Graduates (AI12)					
	Intercept (WF)	WM	BF	BM	HF	HM
Q1	.113	-.04***	.062***	.031**	.012	-.028*
	(.007)	(.007)	(.009)	(.01)	(.018)	(.012)
Q2	.255	-.045***	.14***	.134***	-.013	0
	(.006)	(.006)	(.014)	(.012)	(.019)	(.015)
Q3	.5	-.045***	.108***	.119***	-.03~	-.014
	(.007)	(.006)	(.015)	(.014)	(.016)	(.018)
Q4	.737	-.033***	.019*	.019~	-.07***	-.082***
	(.005)	(.005)	(.009)	(.012)	(.016)	(.019)
Q5	.877	-.013***	-.017*	-.053***	-.087***	-.056**
	(.003)	(.003)	(.009)	(.013)	(.015)	(.017)

Note: WF=White Female, WM = White Male, BF = Black Female, BM = Black Male, HF = Hispanic Female, HM = Hispanic Male.
Standard errors are in parentheses.
*<.05. **<.01. ***<.001

Table 7. Conditional Race/Ethnicity-by-Gender Gaps in College Enrollment by AI quintiles (AI12)

	College Enrollment: High School Graduates (AI12)										
	Intercept (WF)	WM		BF		BM		HF		HM	
		FRL	FRL/FE	FRL	FRL/FE	FRL	FRL/FE	FRL	FRL/FE	FRL	FRL/FE
Q1	.149	-.045***	-.043***	.071***	.056***	.039***	.021**	.018	.017	-.023*	-.026
	(.009)	(.007)	(.008)	(.009)	(.01)	(.01)	(.009)	(.018)	(.021)	(.012)	(.017)
Q2	.334	-.057***	-.054***	.169***	.141***	.158***	.132***	.008	.004	.018	.011
	(.008)	(.006)	(.005)	(.013)	(.008)	(.012)	(.007)	(.019)	(.014)	(.015)	(.013)
Q3	.592	-.062***	-.059***	.16***	.128***	.16***	.13***	.01	.002	.018	.014
	(.007)	(.006)	(.004)	(.013)	(.008)	(.013)	(.008)	(.015)	(.014)	(.017)	(.013)
Q4	.79	-.046***	-.046***	.074***	.036***	.064***	.03***	-.03*	-.038***	-.048***	-.055***
	(.005)	(.005)	(.004)	(.009)	(.008)	(.011)	(.01)	(.016)	(.013)	(.018)	(.015)
Q5	.888	-.015***	-.018***	.011	-.023**	-.029**	-.06***	-.066***	-.076***	-.038**	-.043**
	(.003)	(.003)	(.004)	(.009)	(.011)	(.013)	(.016)	(.014)	(.015)	(.016)	(.018)

Note: WF=White Female, WM = White Male, BF = Black Female, BM = Black Male,
HF = Hispanic Female, HM = Hispanic Male.
Standard errors are in parentheses.
*<.05. **<.01. ***<.001

Table 8. Unconditional Race/Ethnicity-by-Gender Gaps in Any Degree Attainment by AI quintiles (AI12)

	Any Degree: All Students (AI12)					
	Intercept (WF)	WM	BF	BM	HF	HM
Q1	-.005	.001	.003~	0	.001	.002
	(.002)	(.001)	(.002)	(.001)	(.003)	(.002)
Q2	.017	.015***	.008*	.007*	-.001	.008
	(.002)	(.002)	(.003)	(.003)	(.006)	(.006)
Q3	.113	.005	-.005	-.009	-.027**	0
	(.004)	(.003)	(.008)	(.007)	(.01)	(.01)
Q4	.375	-.04***	-.075***	-.113***	-.081***	-.075***
	(.007)	(.005)	(.014)	(.015)	(.016)	(.018)
Q5	.721	-.077***	-.143***	-.223***	-.099***	-.185***
	(.006)	(.005)	(.018)	(.022)	(.019)	(.026)

	Any Degree: College Enrollees (AI12)					
	Intercept (WF)	WM	BF	BM	HF	HM
Q1	.07	.04*	-.015	-.032*	-.046~	0
	(.012)	(.016)	(.015)	(.014)	(.025)	(.03)
Q2	.105	.049***	-.024**	-.026**	.008	.001
	(.007)	(.008)	(.009)	(.008)	(.023)	(.021)
Q3	.236	.018**	-.046***	-.052***	-.024	.013
	(.007)	(.006)	(.012)	(.01)	(.021)	(.02)
Q4	.504	-.037***	-.109***	-.146***	-.071**	-.054*
	(.008)	(.006)	(.017)	(.017)	(.022)	(.025)
Q5	.793	-.072***	-.146***	-.217***	-.063**	-.151***
	(.006)	(.004)	(.019)	(.022)	(.02)	(.027)

Note: WF=White Female, WM = White Male, BF = Black Female, BM = Black Male, HF = Hispanic Female, HM = Hispanic Male.
Standard errors are in parentheses.
*<.05. **<.01. ***<.001

Table 9. Conditional Race/Ethnicity-by-Gender Gaps in Any Attainment by AI quintiles (AI12)

	Any Degree Attainment: College Enrollees (AI12)										
	Intercept (WF)	WM		BF		BM		HF		HM	
		FRL	FRL/FE	FRL	FRL/FE	FRL	FRL/FE	FRL	FRL/FE	FRL	FRL/FE
Q1	.077	.038**	.037	-.012	.008	-.029**	-.017	-.044*	-.035	.002	.008
	(.015)	(.016)	(.024)	(.016)	(.026)	(.015)	(.024)	(.025)	(.058)	(.031)	(.052)
Q2	.126	.044***	.04***	-.012	.001	-.015*	-.007	.017	.026	.007	.005
	(.009)	(.008)	(.01)	(.009)	(.013)	(.008)	(.013)	(.023)	(.03)	(.021)	(.026)
Q3	.278	.006	.007	-.012	-.004	-.025**	-.017	0	-.004	.032	.025
	(.008)	(.006)	(.006)	(.011)	(.01)	(.01)	(.011)	(.02)	(.02)	(.02)	(.019)
Q4	.558	-.053***	-.053***	-.044***	-.037***	-.094***	-.091***	-.029	-.028	-.016	-.019
	(.009)	(.006)	(.005)	(.014)	(.01)	(.016)	(.012)	(.022)	(.017)	(.025)	(.019)
Q5	.82	-.079***	-.08***	-.077***	-.072***	-.159***	-.155***	-.016	-.018	-.113***	-.11***
	(.005)	(.004)	(.004)	(.016)	(.012)	(.021)	(.018)	(.019)	(.017)	(.023)	(.021)

Note: WF=White Female, WM = White Male, BF = Black Female, BM = Black Male,
HF = Hispanic Female, HM = Hispanic Male.
Standard errors are in parentheses.
*<.05. **<.01. ***<.001

Table 10. Unconditional Race/Ethnicity-by-Gender Gaps in Bachelor's Attainment by AI quintiles (AI12)

	Bachelor's Degree: All Students (AI12)					
	Intercept (WF)	WM	BF	BM	HF	HM
Q1	-.01	0	.001	0	-.001	-.002**
	(.002)	(.001)	(.001)	(.001)	(.001)	(.001)
Q2	-.004	.001	.009***	.005**	0	-.003
	(.002)	(.001)	(.002)	(.002)	(.003)	(.002)
Q3	.037	-.003	.024***	.018***	-.003	-.007
	(.003)	(.002)	(.006)	(.005)	(.007)	(.006)
Q4	.221	-.014***	.012	-.02	-.065***	-.043**
	(.008)	(.004)	(.014)	(.014)	(.013)	(.015)
Q5	.624	-.052***	-.096***	-.175***	-.117***	-.163***
	(.009)	(.005)	(.018)	(.022)	(.021)	(.026)
	Bachelor's Degree: College Enrollees (AI12)					
	Intercept (WF)	WM	BF	BM	HF	HM
Q1	.014	.009	-.01	-.016*	-.031***	-.016
	(.008)	(.01)	(.01)	(.008)	(.008)	(.015)
Q2	.021	.006	.008	.002	.005	-.012
	(.005)	(.005)	(.006)	(.006)	(.012)	(.01)
Q3	.088	-.001	.022*	.013	.006	-.007
	(.006)	(.004)	(.009)	(.009)	(.016)	(.014)
Q4	.302	-.009	.007	-.033*	-.065***	-.027
	(.011)	(.006)	(.018)	(.016)	(.019)	(.021)
Q5	.685	-.047***	-.095***	-.169***	-.081***	-.131***
	(.009)	(.005)	(.018)	(.023)	(.023)	(.028)

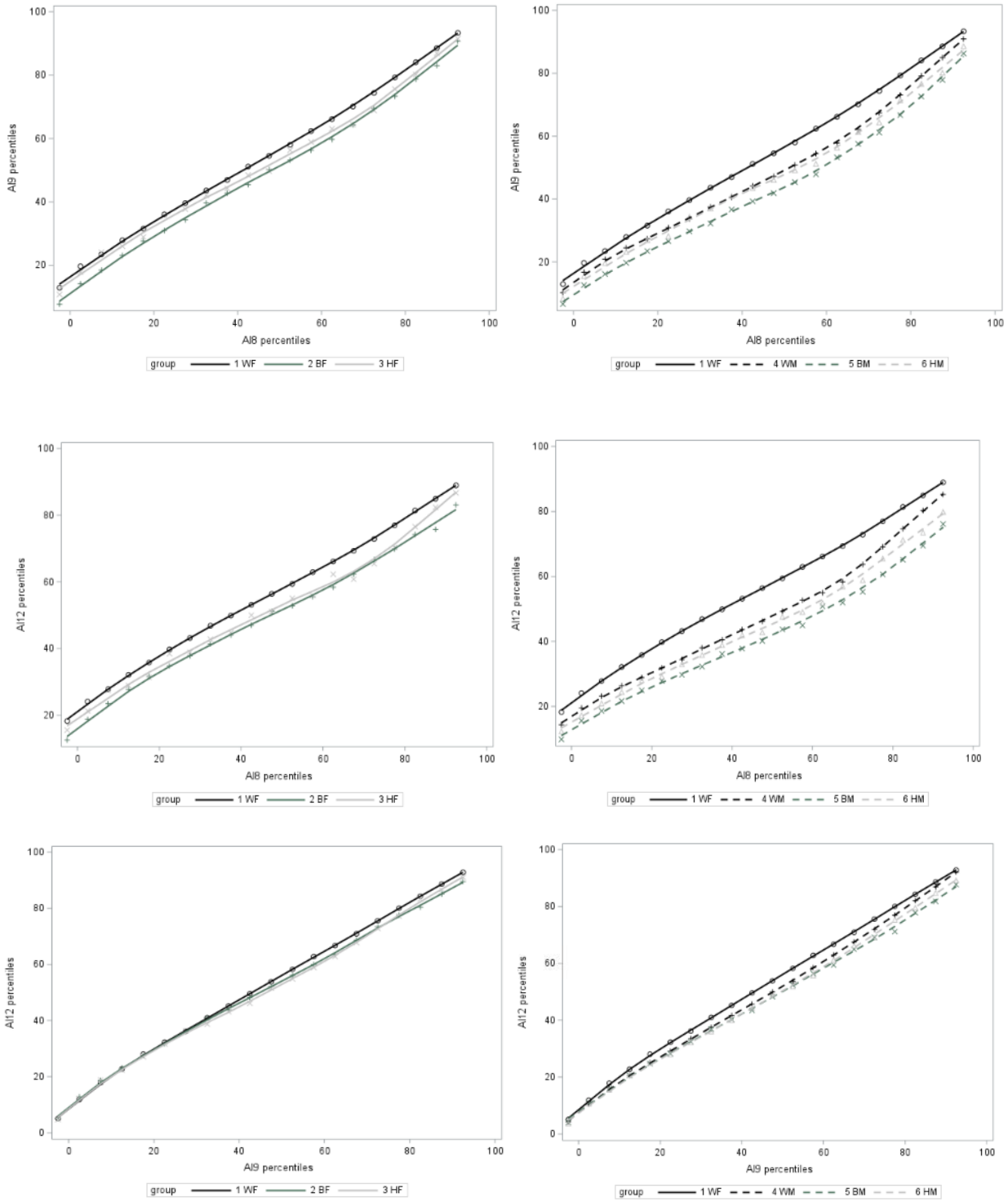
Note: WF=White Female, WM = White Male, BF = Black Female, BM = Black Male, HF = Hispanic Female, HM = Hispanic Male.
Standard errors are in parentheses.
*<.05. **<.01. ***<.001

Table 11. Conditional Race/Ethnicity-by-Gender Gaps in Bachelor's Degree Attainment by AI quintiles (AI12)

	Bachelor's Degree Attainment: College Enrollees (AI12)										
	Intercept (WF)	WM		BF		BM		HF		HM	
		FRL	FRL/FE	FRL	FRL/FE	FRL	FRL/FE	FRL	FRL/FE	FRL	FRL/FE
Q1	.011	.009	.003	-.009	-.033	-.016*	-.046**	-.031***	-.041	-.017	-.029
	(.01)	(.01)	(.022)	(.01)	(.024)	(.009)	(.023)	(.008)	(.054)	(.015)	(.049)
Q2	.028	.003	.002	.013**	-.018	.007	-.027**	.009	-.008	-.01	-.031
	(.006)	(.005)	(.009)	(.006)	(.012)	(.006)	(.012)	(.012)	(.028)	(.01)	(.024)
Q3	.119	-.01**	-.011*	.048***	.009	.034***	-.003	.023	.002	.007	-.019
	(.007)	(.004)	(.006)	(.009)	(.01)	(.008)	(.01)	(.016)	(.019)	(.014)	(.018)
Q4	.36	-.027***	-.031***	.079***	.04***	.024*	-.016	-.018	-.035**	.014	-.011
	(.011)	(.006)	(.005)	(.014)	(.009)	(.014)	(.011)	(.018)	(.016)	(.02)	(.018)
Q5	.724	-.057***	-.062***	.002	-.03***	-.088***	-.119***	-.014	-.037**	-.077***	-.093***
	(.008)	(.005)	(.004)	(.014)	(.011)	(.022)	(.017)	(.021)	(.016)	(.024)	(.019)

Note: WF=White Female, WM = White Male, BF = Black Female, BM = Black Male,
HF = Hispanic Female, HM = Hispanic Male.
Standard errors are in parentheses.
*<.05. **<.01. ***<.001

Figure 1: Comparisons of AI Percentiles at Different Grades



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