Affirmative Action and Economic Mobility in California*

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Abstract

Proposition 209 has prohibited race-based affirmative action at California public colleges and universities since 1998. Fifteen years later, the median wages of black and Hispanic Californians in their early 30s – the first impacted cohorts – were substantially lower than those of comparable groups. To assess the labor market consequences of Proposition 209, I construct a novel database linking 1994-2001 undergraduate University of California (UC) freshman applications with national degree attainment and California earnings records. This study presents three findings, each identified using difference-in-difference designs. First, I show that ending AA caused declines in age 24-37 median earnings (∼5 percent) and likelihood of earnings over $100,000 (∼1.5 percent each year) among each of UC's 10,000 annual underrepresented minority (URM) freshman applicants, mediated in part by declines in undergraduate and graduate degree attainment. Among all early-30s Californians, Proposition 209 decreased the number of URM workers earning over $100,000 by between 3 and 6.5 percent. Second, I link the UC application with statewide high school records and College Board SAT data to show that Proposition 209 discouraged UC application among a sizable group of high-testing URM high school graduates, likely explaining further labor market deterioration among URM youths. Finally, I link the application database with student transcripts, finding that Proposition 209 did not deliver a silver lining in terms of URM students' improved performance or persistence in core STEM courses, within or across impacted universities. These findings suggest that prohibitions on university affirmative action policies modestly exacerbate American socioeconomic inequities.

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1 Introduction

Stagnant wages and declining labor market participation contributed to a 9 percent decline in young Americans' real median wages between 2007 and 2015.[1] Panel (a) of Figure 1 shows that age 30-34 black and Hispanic California-natives faced a wage decline of more than twice that magnitude, far larger that similarly-aged black and Hispanic non-Californians, similarly-aged white and Asian Californians, or Californians of other age groups. The relative wage gap faced by early-career black and Hispanic Californians appears largely between 2010 and 2014, the years in which those cohorts would have faced declining university access after high school graduation as a result of California's Proposition 209, which prohibited universities from implementing race-based affirmative action (AA) admissions policies. Panel (b) shows that the proportion of high-earning youths exhibits an even starker gap, with a persistent decline in the fraction of young Black and Hispanic Californians earning at least $100,000 by as much as 40 percent.[2] This study analyzes how California's university AA ban shaped the state's distribution of wages over the subsequent 20 years.

While several recent studies have highlighted the importance of university access and selection in generating economic mobility (Chetty et al., 2017; Rothstein, 2019), and a long literature has identified the personal return to selective university enrollment (e.g. Hoekstra (2009); Zimmerman (2014); Bleemer (2018a)), analyses of the long-run ramifications of university policies that increase enrollment among low socioeconomic-status applicants have been frustrated by data limitations.[3] As a result, studies of university AA policies have almost exclusively focused on short-run outcomes like enrollment, major choice, and degree attainment, using cross-state variation or highly-censored student-level data.[4]

This study exploits a novel highly-detailed database of 1994-2001 University of California applicants – linked to national educational data and state UI employment data – in combination with archival admission records to analyze the impact of Proposition 209 on underrepresented minority (URM) youths' short- and long-run educational and labor market outcomes. My primary research design estimates difference-in-difference models comparing URM to non-URM applicants before and after the university ceased implementing AA, conditional on detailed academic preparedness characterics observed in the application data. Linking the application database to state K-12 educational records, I find evidence that a non-negligible number of qualified URM high school graduates selected out of the UC applicant pool after Proposition 209; this

[1] In this study, 'real wages' refers to CPI-deflated 2018 dollars, in which all dollar statistics are denominated.

[2] Statistics from author's analysis of the American Community Survey (Ruggles et al., 2018).

[3] Chetty et al. (2017) argues that need-affirmative university admissions policies could reduce the gap between low- and high-income students' likelihood of achieving high earnings by 34 percent. Rothstein (2019) argues that 1/9 of cross-commuting-zone income transmission is attributable to human capital acquisition, most of which "seems to reflect access to higher education", and 1/3 of variation reflects "earnings differences not mediated by [aggregate] human capital", which include differences in university selectivity and field of study. Other recent papers on the return to university selectivity include Cohodes and Goodman (2014) and Goodman, Hurwitz, and Smith (2017).

[4] Several studies have analyzed the state-level impact of policies prohibiting public universities from implementing race-based AA policies (Backes, 2012; Hinrichs, 2012, 2014; Blume and Long, 2014), but cross-state mobility and limited individual-level records have challenged estimation of how students fared after the policy change. Many studies have analyzed censored University of California student records around the time of Proposition 209 (Sander and Taylor, 2012; Antonovics and Sander, 2013; Antonovics and Backes, 2013, 2014; Arcidiacono et al., 2014; Arcidiacono, Aucejo, and Hotz, 2016), but the absence of key preparedness measures (SAT scores, high school GPA) and outcomes (out-of-system enrollment and degree attainment, postgraduate earnings) yields concerns of sample selection bias and challenges estimation of long-run outcomes. One exception is Bertrand, Hanna, and Mullainathan (2010), which presents evidence of wage returns to a caste-based AA program in India. For reviews of the past literature, see Arcidiacono, Lovenheim, and Zhu (2015); Arcidiacono and Lovenheim (2016).

would likely have magnified the policy's labor market costs, while also necessitating robustness checks of the selection-on-observables assumptions of the main analysis. Finally, I link the observed application records to detailed university transcript data (including quarterly course enrollment and grades) for five UC campuses, directly examining whether ending AA provided the silver lining of improving URM students' performance and persistence in natural or computer science courses.

I find that AA provided massive admissions advantages to nearly all URM UC applicants, exceeded 80 percentage points at many campuses for many applicants (a conclusion supported by archived admissions documents). AA more than doubled URM enrollment at UC's most-selective Berkeley and UCLA campuses. Ending AA caused a cascade of freshman URM applicants to enroll at less-selective universities, itself causing (1) declines in Bachelor's and graduate degree attainment and (2) lower log earnings and likelihood of high earnings over the following two decades. URM UC applicants became 1.4-3.1 p.p. less likely to earn at least $100,000 per year in their early 30s, alone explaining as much as 5 p.p. of the gap in California-resident URM high earners presented in Panel (c) of Figure 1. It also led to a 10-15 percent decline in the number of URM applicants applying to any UC campus, most of whom would have been admitted to at least one campus, which likely led to further unobserved labor market effects. STEM major choice provided no silver lining: I find that ending AA *decreased* URM enrollees' STEM persistence at Berkeley, and find no evidence of any systematic changes, let alone improvement, in URM students' STEM grades or persistence at more- or less-selective campuses after Proposition 209.

Section 2 provides brief background information about the University of California – which encompasses *all* public research universities in the state – and its admissions policies in the late 1990s.[5] Section 3 describes the novel database constructed for this analysis, which individually link comprehensive UC application records from UC's central administrative office to educational data from the National Student Clearinghouse, California UI employment data from the Employment Development Department, and student transcripts from the Registrar's Offices of five UC campuses.[6]

Section 4 presents the primary difference-in-difference model used in this study's analysis. Comparing 1996-1997 applicants (under AA) to 1998-1999 applicants (absent AA) by ethnicity, I find that UC's AA policy caused the average URM UC applicant to enroll at a university with a higher five-year graduation rate by about 2.0 p.p. relative to academically-comparable non-URM applicants.[7] In the reduced-form, AA is estimated to have increased UC's 10,000 annual URM applicants' likelihood of earning a college degree within six years by an average 1.4 p.p., increased their likelihood of earning a graduate degree by 1.5 p.p., and increased their likelihood of earning at least $100,000 annually between ages 30 to 37 by 1-1.5 p.p. per year.[8]

Section 5 analyzes whether qualified California high school graduates were dissuaded from UC appli-

[5]The ramifications of Proposition 209 have been frequently studied, and analysis of its educational effects using highly-censored data has provided the popular backbone supporting the popularized "Mismatch Hypothesis" (Sowell, 1972; Sander and Taylor, 2012; Arcidiacono et al., 2014). Those conclusions are inconsistent with the findings in this study.

[6]Additional data covering California public high school graduates are collected from the California Department of Education and College Board. Appendix A in Bleemer (2018a) presents detailed information about NSC coverage in the late 1990s, suggesting that most California universities were reporting enrollment and degrees throughout the sample period; details are discussed below. Estimates involving EDD earnings data are reproduced from a parallel institutional report published by the University of California (Bleemer, 2019c). The Registrar's Office's data includes complete student transcripts (including course enrollment and grades) for 1995-2000 enrollees at UC's Berkeley, Davis, Santa Barbara, Santa Cruz, and Riverside campuses.

[7]Covariates include SAT I and II scores, high school courses and grades, gender, and high school fixed effects.

[8]This college degree attainment result contrasts sharply with Arcidiacono et al. (2014). See Appendix A.

cation following Proposition 209. Difference-in-difference analysis of the proportion of students from each high school who applied to UC by ethnicity and academic preparedness (grades and test scores) shows that UC received about 400 fewer black applicants and 1400 fewer Hispanic applicants after AA ended, about 70% of whom would likely have been admitted to some campus).[9] Application declines were proportionally larger at UC's most-selective Berkeley and UCLA campuses, even among applicants likely to be admitted to those schools. Labor market outcomes are unobserved for non-applicants, but likely exacerbated the observed effects among applicants. While these small changes in the applicant pool could generate sample selection bias in the baseline results, I find that conditional on high school and grades, the presented estimates are highly insensitive to detailed socioeconomic and academic covariates, suggesting the absence of remaining bias.[10]

Section 6 turns to STEM major choice, using a difference-in-difference model to examine course performance in core introductory science courses at the five UC campuses where I observe student transcripts. Contrary to the expectations of prior literature (Griffith, 2010; Sander and Taylor, 2012; Arcidiacono, Aucejo, and Hotz, 2016), I find that the cascade of less academically-prepared students to lower-selectivity universities did not improve their performance or persistence in these introductory courses.[11] In combination with difference-in-difference estimates on STEM major choice, these estimates suggest that STEM major selection failed to blunt the economic costs faced by applicants no longer targeted by AA.

While Proposition 209 required public universities to end their AA policies in 1998, I show that some campuses began phasing out AA in 1996, the year of Prop. 209's passage. As a result, difference-in-difference estimation around 1998 is likely to underestimate the full magnitude of UC's AA program, which may have been already phasing out. As a result, I also present estimates using 1994-1995 as an alternative baseline, which generally yields larger net effects of ending AA.[12]

This study provides the first evidence that state affirmative action prohibitions have first-order implications for economic mobility, causing a substantially-widened gap in median wages – and especially the proportion of youths earning high wages – by ethnicity. It presents both aggregate- and micro-level evidence that AA provides large educational benefits to otherwise-disadvantaged university applicants, with massive admissions preferences yielding more-selective enrollment, higher Bachelor's and graduate degree attainment, and stronger long-run labor market performance, particularly at the high end. One appeal of AA policies is their absence of implementation costs, though they crowds out non-URM applicants with substantially higher average family incomes.[13]

This study also presents new evidence on the return to university selectivity in the context of affirmative action. The highly-detailed novel admissions data used to construct a selection-on-observables difference-in-difference model provides more reliable estimates of the short-run enrollment, major choice, and graduation

[9]These results contrast sharply with Card and Krueger (2005). See Appendix B.

[10]I follow Card, Fenizia, and Silver (2018) and conduct a Monte Carlo exercise randomly selecting sets of detailed covariates (including parental income, parental occupation, parental education, and other measures of academic preparation) for model inclusion. I find that specifications including a baseline high school GPA covariate are relatively and symmetrically insensitive to alternative specifications, which suggests that unobserved heterogeneity is unlikely to be a substantial concern (Altonji, Elder, and Taber, 2005).

[11]Hill (2017) shows that URM STEM degree completion decreases at public universities in states that prohibit race-based AA.

[12]Proposition 209 also impacted the non-URM comparison group (who replaced no-longer-admitted URM applicants), and the newly-admitted non-URM applicants likely benefited from their more-selective enrollment; assuming similar treatment effect magnitudes, and given that about 20% of UC students at the time were URM, this suggests the possibility that the estimated baseline results could also be over-estimated by as much as 15-20 percent.

[13]The fraction of first-year UC students with bottom-quartile family incomes persistently fell by more than 10 percent in 1998.

effects of AA on impacted applicants than most previous studies, and provides the first quasi-experimental estimates of AA's impact on graduate school completion and post-graduate earnings. The findings strongly suggest persistent negative ramifications of UC's URM applicants attending less-selective universities, similar to the findings of other studies estimating the effect of enrolling at less-selective institutions along other margins (Zimmerman, 2014; Dale and Krueger, 2014; Hastings, Nielsen, and Zimmerman, 2018; Bleemer, 2018a) but contrasting with some model predictions (Arcidiacono, 2005).

Finally, this study's detailed examination of students' STEM course performance under AA also contributes to a literature interested in the production and socioeconomic composition of STEM university graduates (Ehrenberg, 2010). Several recent studies have investigated the consequences of various university policies for students' STEM major choice, but this is the first known study to estimate how students' performance and persistence in specific STEM courses changes under different policy regimes (in particular, in the presence and absence of AA).[14] Despite documenting large STEM performance and persistence gaps by ethnicity at a selective university implementing AA – almost wholly explained by URM students' lower measured academic preparedness – I find that ending AA does *not* shrink these STEM gaps, nor does the end of AA increase URM students' performance or persistence in STEM courses at the less-selective universities at which they subsequently enroll.[15]

2 Background

The University of California (UC) comprises all of the state's public research universities, and was tasked by the 1960 Master Plan for Higher Education to educate students from the top 12.5 percent of California public high school graduates. As a result, the system's California-resident undergraduate enrollment has grown proportional to the state, with 137,000 enrolled in 1999. UC had eight undergraduate campuses in the study period – Berkeley, Davis, Los Angeles (UCLA), Riverside, San Diego, Santa Cruz, Santa Barbara, and Irvine, in order of their founding – and a ninth graduate-only campus in San Francisco.[16] The University of California campuses range in selectivity from the highly-selective Berkeley and UCLA campuses (which in 1997 admitted about 35 percent of applicants with an average SAT score 1.5 sd above mean) to the less-selective Santa Cruz and Riverside campuses (85 percent and 0.5 sd above mean). Ranking campuses by their admissions rates in the period, in the analysis below, I refer to Berkeley, UCLA, and San Diego campuses as 'more selective', the Davis, Santa Barbara, and Irvine campuses as 'selective', and the Santa Cruz and Riverside campuses as 'less selective'.

California also had a 22-campus system of local teaching-oriented universities – the California State University (CSU) system, which today enrolls 420,000 undergraduates – and a broad system of 114 community colleges which enroll more than 2 million students annually.

Race-based affirmative action (AA) was practiced in University of California admissions since at least

[14] See Sjoquist and Winters (2015); Denning and Turley (2017); Castleman, Long, and Mabel (2018).

[15] This is contrary to the anticipation of several previous studies (Griffith, 2010; Arcidiacono, Aucejo, and Spenner, 2012; Arcidiacono, Aucejo, and Hotz, 2016; Estevan, Gall, and Morin, 2019). URM students' performance in STEM courses at UC Berkeley (relative to similarly-prepared non-URM students) was higher before Proposition 209 ended its AA program, which could reflect over-performance by low-measured-preparedness URM students (Vars and Bowen, 1998; Niu and Tienda, 2010), peer effects from the larger number of URM students (Sacerdote, 2011), or other factors.

[16] The system's tenth campus, UC Merced, was founded in 2005.

1978, when UC Berkeley's course catalog advertised "Affirmative Action Counseling" that "helped [URM] students realize their potential and achieve academic success at Berkeley".[17] UC's affirmative action policies allowed campuses to provide admissions advantages to students deviating from their standard admissions policy, in which at least half of students were admitted almost-solely on the basis of applicants' "Academic Index" (AIS), a straightforward linear combination of high school GPA and SAT scores.[18] Figure 2 shows the relative likelihood of admission of URM students – including black, Chicano, Latino, and Native American students – by AIS compared to non-URM students, in two-year increments from 1994 to 2000, restricting the sample to applicants in the 'normal' pool.[19] At the most-selective Berkeley campus, for example, 1994-1995 URM applicants with AIS from about 5200 to 5700 were 20-30 percentage points more likely than non-URM applicants to be admitted, but those with AIS from about 6000 to 7200 were *80 percent* more likely to be admitted. The admissions advantage declines to zero above $AIS = 7400$ because Berkeley admitted all applicants, URM or non-URM, with those scores. Seven of the eight UC campuses provided similar admissions advantages to URM applicants in the mid-1990s; UC Riverside admitted all eligible applicants, and thus could not implement AA for these applicants.

Increasing controversy around AA came to a head in mid-1990s, when it was prohibited first by the UC Regents in July 1995 and then by a voter referendum to the same effect in November 1996; for a detailed history, see Douglass (2018). While SP-1, the original Regents policy, was rescinded in 2001, Proposition 209 has prohibited UC and other public institutions in California from "discriminat[ing] against, or grant[ing] preferential treatment to, any individual or group on the basis of race, sex, color, ethnicity, or national origin" since the Fall 1998 admission cohort.[20] Figure 2 shows that most campuses continued providing large admissions advantages to many URM applicants in 1996-1997 (though UCLA, Irvine, and Santa Cruz curtail their programs), and by 1998 admissions advantages had shrunk considerably as campuses' AA programs ended.

Starting in 1998, UC implemented a number of costly school-specific outreach programs to increase enrollment from majority-URM high schools and communities, but those programs wound down after 2001 with little evidence of success in even increasing URM application rates (Atkinson and Pelfrey, 2004; UCOP, 2003). Instead, UC's primary policy response to the end of affirmative action was its 2001 Eligibility in the Local Context program (Bleemer, 2018a), for which reason I do not extend this study's analysis beyond that year.

3 Data

This study relies on four primary data sources. The first, collected contemporaneously for administrative use by the UC Office of the President, covers all California-resident freshman applicants to any of the nine undergraduate University of California campuses since 1994. These data are the raw version of a highly-censored publicly-available UC admissions data that have been used in a host of previous studies (Antonovics

[17] Available at http://digitalassets.lib.berkeley.edu/generalcatalog/text/1978_1979_intro.pdf

[18] In particular, $AIS = min(HSGPA, 4) * 1,000 + SATI + SATIIs$, with three SAT II's, with the resulting index having the highest possible value of 8,000.

[19] This excludes applicants without the minimum high school credentials qualifying them for UC enrollment and applicants who applied to specially-restricted programs like Berkeley's College of Engineering.

[20] Proposition 209 simultaneously prohibited AA at the California State Universities, though their lesser selectivity entailed smaller-magnitude AA policies.

and Sander, 2013; Antonovics and Backes, 2013, 2014; Arcidiacono et al., 2014; Arcidiacono, Aucejo, and Hotz, 2016), which, e.g., only include high school GPA quartiles, SAT septiles, and start years in three-year bands, with no gender, high school, or post-graduate information.[21] Each raw record contains the applicant's high school attended (linked to the school's location and public/private status by ATP code), gender, ethnicity, parental education, parental occupations, and intended major.[22] For those applying to enter UC as freshmen, SAT/ACT standardized test scores and grade point average measures are available, as are SAT II scores, the number of honors courses taken in 12th grade, and family income.[23] Indicators show to which UC campuses each applicant applied, to which they were admitted, and (conditional on enrollment) at which they enrolled.

The second dataset, from the National Student Clearinghouse's StudentTracker database, contains enrollment and graduation information across nearly all US two- and four-year colleges and universities for all students in the UC application dataset. In particular, it contains semesterly enrollment records (including institution name and location) and graduation records (including institution name and location, degrees and majors earned, and year of graduation) for all postsecondary degree-granting institutions that accept federal Title IV funding (a near-universal set) and had commenced reporting to NSC in the given year. Students are defined as studying STEM if their stated major is included on a US federal list of 278 "fields involving research, innovation, or development of new technologies using engineering, mathematics, computer science, or natural sciences (including physical, biological, and agricultural sciences)" (US Department of Homeland Security, 2016).[24] Records are linked to the UC applications by first and last name, middle initial, and birth date (with flexibility for common nicknames and typos).

The primary concern with using NSC records from the 1990s is the possibility of incomplete records, especially at the smaller private universities that absorbed some URM UC students following the end of affirmative action. Appendix A in (Bleemer, 2018a) presents the years in which each postsecondary institution in California began reporting enrollment and graduation to the NSC.[25] Most public universities were reporting semesterly enrollment by 1996, but many community colleges did not report enrollment until around 1999-2001, and some private universities were not reporting until the late 2000s. As a result, 1990s applicants whose enrollment is not observed in the NSC are likely to have been enrolled at community colleges. Nearly

[21]The censored records do include a continuous 'academic index', a linear combination of high school GPA and SAT score.

[22]High school characteristics data from the California Department of Education. Parental education is observed as an index of maximum parental education for up to two parents, from 1 (no high school) to 7 (graduate degree). Parental occupations are observed as one of 17 occupation codes each for two parents (or 289 total codes), including codes like 'Clerical', 'Laborer', 'Professional', or codes like 'Homemaker', 'Retired', 'Other', or 'Deceased'.

[23]Estimates involving reported family income data for applicants are reproduced from parallel institutional reports published by the University of California (Bleemer, 2019c). Family income is not reported by applicants who do not apply for federal, state, or institutional financial aid, most of whom likely have high family incomes. For students who submit ACT scores, the UC system uses a standard cross-walk to transform the score into the same scale as the SAT, which I follow in my analysis. Throughout the study period, UC applicants were required to submit an SAT (Math and Verbal) score, an SAT II writing score, an SAT II mathematics score, and at least one additional SAT II score (which could be taken in a variety of academic subjects). For the SAT II mathematics requirement, students could submit scores from one of two exams, called Math 1 and Math 2, with the latter testing higher-order mathematical ability.

[24]Particularly for major choice in the late 1990s, the frequent absence of CIP codes in the NSC required hand-coding of each observed major in the NSC dataset (omitting majors ever earned by fewer than 20 UC applicants). A complete crosswalk is available from the author.

[25]NSC reports that about 4 percent of records are censored due to student- or institution-requested blocks for privacy concerns (National Student Clearinghouse Research Center, 2017), and that the only public university in California with censorship greater than 10 percent is UC Berkeley. Enrollment coverage has been greater than 90 percent in California since at least 2003, though coverage has not been explicitly examined in previous years (Dynarski, Hemelt, and Hyman, 2015).

all institutions have been reporting degree attainments since the mid-1990s. Appendix **??** also compares student-level degree attainment and STEM major selection observations for each UC campus for the 1995-2012 incoming classes. Degree attainment was highly censored at UC Santa Cruz until the 2000 class, but censorship rates have been low across the other campuses since 1997, with the highest rates at Riverside (5-11 percent) and UCLA (4-9 percent).[26]

Third, I observe quarterly 1999-2018 earnings from the California Employment Development Department, which maintains records for unemployment insurance administration.[27] The earnings data were linked by reported social security numbers from UC applications, and are unavailable for workers outside California and federal government employees.[28] Annual wages are measured as the sum of quarterly wages in that year. About 65 percent of applicants in the sample have positive covered earnings in each of 10-15 years after high school graduation.

The fourth dataset includes comprehensive student transcript records – including the course enrollments and grades – for five UC campuses: Berkeley, Davis, Santa Barbara, Santa Cruz, and Riverside. These records were obtained directly from each campus's Registrar's Office as part of the UC ClioMetric History Project (Bleemer, 2018b); the other three UC campuses are omitted only because their data remain unavailable. I assign GPA numbers to each course based on attained letter grades and define an indicator for whether the course was taken without earning a letter grade, generally indicating poor expected performance (and resulting in a grade of Pass, No Pass, Withdraw, or Incomplete).

Additional educational administrative data come from several sources. I measure several university characteristics using Integrated Postsecondary Education Data System data, including universities' 2006 admissions rate, 2000 sticker price of tuition, and the 2008 estimated net cost of attendance for students by family income bracket (where those years represent the earliest available IPEDS data). Data from the California Department of Education include the number of graduates from every public California high school by year, gender, and ethnicity. Finally, I pull statewide California SAT-taker data from the College Board, linked by name and birth date to the UC applicant pool, in order to compare the application likelihood estimates below with those from Card and Krueger (2005) in Appendix B.

3.1 Descriptive Statistics

Table 1 provides descriptive statistics of UC's non-URM application, admission, and enrollment outcomes in the 1990s, focusing on the restricted sample of California-resident freshman applicants (and defining URM to include black, Hispanic, Chicana/o, and Native American applicants). Statistics are presented for three periods of cohorts (enumerated by the year in which they would enroll as freshmen): 1994-1995, who applied prior to the passage of SP-1 and Proposition 209; 1996-1997, who applied after the policies ending AA were approved but before they were binding; and 1998-1999, following the implementation ending UC's affirmative

[26] As discussed below, the six-year graduation rate estimates discussed below are somewhat sensitive to augmenting NSC graduation records with UC's Santa Cruz graduation records, though there is little reason to be concerned about the graduate degree outcome estimation.

[27] All earnings results are replicated from institutional research conducted at the UC Office of the President (see Bleemer (2019c)).

[28] Social security numbers on UC applications are not verified unless the student enrolls at a UC campus. Among enrollees, the verified social security number differs from that reported on their application in fewer than 0.25% of cases. In order to preserve comparability across applicants, I strictly link applicants by their reported SSN from their application.

action admissions policy. The average number of non-URM annual applications received by UC increased by more than 25 percent in this period, with increases of more than one-third at the more-selective Berkeley and UCLA campuses. As a result, admissions rates were consistently falling throughout this period at all but the less-selective Riverside campus; Berkeley and UCLA admitted about 40 percent of 1994-1995 non-URM applicants but only about 32 percent of 1998-1999 applicants. Increasing yield rates – the percent of admitted students who enrolled – across most campuses stemmed the decline in the proportion of applicants who enrolled at each campus; for example, while admissions likelihood at UC San Diego dropped by 15 percentage points in the period, the percent of applicants who enrolled dropped only 3 percentage points.

Meanwhile, the average SAT scores and high school GPAs of applicants to most campuses were steadily rising, as were the average scores and grades of students admitted to each campus. At UCLA, for example, average SAT scores of applicants rose 17 points while the average score of admits rose by 27 points. Taken together, the increasing application and yield rates, lower admissions rate, and stronger academic preparedness of both the applicant and admitted pool present the image of a university system steadily increasing in selectivity and competitiveness throughout the 1990s. These baseline trends in non-URM application and admission characteristics are the key justification for the difference-in-difference research design implemented below (comparing outcomes for URM and non-URM applicants), since the UC campuses' baseline characteristics were changing in important ways throughout the period that could otherwise bias estimates of the effect of ending UC's affirmative action policy.

About 80 percent of UC applicants were non-URM in 1997, and because of UC's changing affirmative action policies in the period, their application and admission behavior diverges from that of their non-URM peers. URM applicants also grew in the period, but at a far slower rate than that of non-URM applications, with essentially no growth between 1994 and 1997. The average SAT score and high school GPA of URM applicants rose swiftly through the period, suggesting that less-competitive URM applicants were choosing against UC application with greater likelihood than comparable non-URM applicants, though both measures remained substantially below non-URM averages.

More striking than the changes in applicant characteristics are campuses' changes in URM admissions rates. Most campuses reflect patterns like UC Berkeley's: a small decline in admissions likelihood between 1994 and 1997 (similar to the decline among non-URM applicants), and then a large decline over the two subsequent years (by almost 25 p.p. in Berkeley's case, leading to a 9 p.p. decline in applicants' likelihood of enrollment). These campuses also experienced large increases in the measured academic preparedness of their admitted URM applicants starting in 1998; URM admitted students to Davis after 1998 had higher SAT scores than previous-year URM admits by 19 points, compared to a one-point decline among non-URM students.

However, despite URM applicants' disproportionately-rising measures of academic preparation, three campuses – UCLA, Irvine, and Riverside – manifest disproportionate admissions declines between 1994-1995 and 1996-1997, suggesting that they may have begun phasing out their AA policies prior to the 1998 mandated deadline. While URM applicants to UCLA and Irvine also face large declines in admissions likelihood in 1998, these patterns suggest that the research design discussed below may underestimate the full effect of ending universities' affirmative action programs, since the "pre-treatment" 1996-1997 years may reflect an incomplete imeplementation of AA at some UC campuses. I further discuss the consequences of this underestimation in the Robustness section below.

Finally, the enrollment pattern across UC campuses shows that while enrollment rates fell precipitously in 1998 at UC's more-selective campuses, the decline is far smaller at the middle- and less-selective campuses, with an increase at the Riverside campus (though the increase is smaller than that among non-URM applicants). This reflects a cascade effect documented in prior research: URM applicants no longer admitted to more-selective UC campuses chose to enroll at less-selective campuses instead, partly replacing the less-competitive URM applicants no longer admitted to those campuses. I document this cascade effect in more detail in the difference-in-difference analysis below.

4 Baseline Educational and Labor Market Outcomes

4.1 Application, Admissions, and Enrollment

Proposition 209 ended the practice of race-based affirmative action (AA) at all postsecondary public institutions in California starting with the 1998 cohort (that is, students who applied to enroll in Fall 1998). In order to estimate the impact of the end of affirmative action on URM enrollment, I estimate a simple difference-in-difference model of application outcomes on applicants' URM status, using detailed academic preparation covariates in a selection-on-observables framework. First, I estimate campus-specific models of application, admission, and enrollment to estimate how affirmative action practically influenced URM applicants' behavior and immediate outcomes:

$$Y_{iyc} = \alpha_{h_i} + \beta_{1c} NoAA_y + \beta_{2c} URM_i + \beta_{3c} NoAA_y * URM_i + \gamma_c X_{iy} + \epsilon_{iyc} \quad (1)$$

where Y_{iyc} indicates whether individual i applied to UC campus c in year y, was admitted to that campus, or ultimately enrolled at that campus. The sample is restricted to 1996-1999, two years before and after the 1998 end of AA; no UC campus implemented any other known large-scale change in their admissions processes in this period. Models estimating application decisions are estimated by OLS over the full population of UC freshman California-resident applicants, while the admission models are restricted to each campus's applicants; enrollment models are estimated with restrictions to either applicants and admits to the campus.[29] Each campus and outcome is estimated independently. The coefficients of interest are β_2, the degree to which URM students were more likely to have Y_{iyc} under the AA regime, and β_3, the change in that likelihood after AA ended (indicated by $NoAA_y$).

The key difference between this model and similar estimates elsewhere in the literature (Card and Krueger, 2005; Chang and Rose, 2010; Antonovics and Backes, 2014) is the inclusion of high school fixed effects α_{h_i}, which absorb considerable spurious cross-school application variation, in combination with a detailed set of individual-level covariates X_{iy}.[30] These controls can be generally summarized as students' observed academic preparation, conditioning the resulting estimates despite possible changes in the academic preparedness of UC applicants throughout the period. Standard errors are robust.

URM UC applicants became much less likely to be admitted to every UC campus (compared to similarly-

[29] All OLS estimation in this study is conducted using the *felm* function in the *lfe* R package, version 2.8-2.

[30] X_{iy} includes SAT score, high school GPA, SAT II Writing score, SAT II Math score, an indicator for submitting a score from the more-difficult SAT II Math 2 exam, and gender. I test models' sensitivity to these covariates' inclusion below.

prepared non-URM applicants), especially at UC's more-selective campuses, and their application and enrollment behavior followed suit. Table 2 shows estimates of β_2 and β_3 for each model, along with each model's R^2 value. In the AA era, URM applicants to UC were 8-12 percentage points more likely to apply to the Berkeley and UCLA campuses and 3-11 percentage points less likely to apply to all remaining campuses than non-URM applicants, but this trend partially reversed when AA ended; while URM applicants remained more likely to apply to the most-selective campuses, the differential gaps shrunk by as much as half. This was likely in response to sharp changes to URM admissions at UC's flagship campuses: while URM applicants were 29.0 and 39.5 percentage points more likely than comparable non-URM applicants to be admitted to UCLA and UC Berkeley, these advantages fell to 10.9 and 13.0 p.p. after AA's end.[31] URM applicants faced similar-magnitude declines in their likelihood of admission to the San Diego and Davis campuses; indeed, all campuses had URM admissions advantages that substantially narrowed after 1998. Among all applicants to any UC campus, URM applicants' admissions advantage over non-URM applicants (to be admitted to at least one campus) fell from 8.08 to 1.26 p.p. Applicants' observed academic preparation and URM status explain 30-55 percent of variation in admission.

The third panel of Table 2 shows that URM applicants were also far more likely to enroll at UC's flagship campuses under AA than academically-comparable non-URM applicants, reflecting their increased likelihood of admission. When AA ended, URM applicants went from being more likely to enroll at any UC campus than a comparable non-URM applicant (by 3.5 p.p.) to less likely by 2.1 p.p., with the decline driven by the most-selective campuses. Interestingly, however, while URM applicants to all campuses became less likely to earn admission relative to similar non-URM applicants, they became more likely to enroll at some campuses (Santa Cruz, Santa Barbara, and Irvine). This is likely the result of a trickle-down effect, with URM applicants who would previously have attended the flagship campuses now more likely to attend other campuses as a result of the flagships' rejection.

The bottom panel of Table 2 shows that admitted URM applicants under AA were less likely to enroll at every UC campus than similar non-URM peers, but that this trend weakened when AA ended.[32] Interestingly, the last column shows that URM applicants who were admitted to some UC campus became *less* likely to enroll at UC, a case of Simpson's Paradox in part reflecting declines in the number of UC campuses to which URM applicants were admitted.

In order to better understand the timing of Proposition 209's impact on URM applicants, I re-estimate models following Equation 1 but replacing $NoAA_y$ with annual indicators (omitting 1997). I then estimate the model over the 1994-2001 period, with estimates for admissions and enrollment plotted in Figure 3. Panel A show that URM students' likelihood of admission had already fallen between 1994-1995, prior to SP-1 and Proposition 209, and their 1998 implementation date: URM applicants to UCLA and Riverside experienced admission declines of greater than 10 p.p., while Berkeley and Santa Cruz decreased URM admissions likelihood by 5-10 p.p. However, with the exception of the low-selectivity Santa Cruz and Riverside campuses, the 1998 impact on URM admissions dwarfed previous changes; the average declines for URM students ranged

[31] Note that these models do not control for economic hardship or other potential applicant disadvantages, some of which are likely correlated with URM status. Since hardship was partially considered in the admission of some students at each campus at the time, it is unsurprising that these models still find admissions advantages for URM applicants despite the end of explicit selection on URM status.

[32] Antonovics and Sander (2013) argue that this "warming effect" resulted from an increase in the signaling value of attending UC for URM applicants.

from 3 to 30 percentage points, and were highly persistence between 1998 and 2001. A similar pre-1998 pattern holds for unconditional UC enrollment among URM applicants: while there are URM enrollment declines at UCLA and Riverside in 1996, the declines are larger and persistent in 1998 at the more-selective campuses of 1-5 p.p. URM applicants' likelihood of enrollment is unchanged at the middle-selectivity campuses – as they absorb students from the more-selective campuses while rejecting others and sending them to the less-selective campuses – and those less-selective campuses experienced net gains in URM likelihood of enrollment in 1998, in part because they appear to have largely phased out their AA programs in 1996. In sum, these annual estimates suggest that AA began phasing out at UC prior to 1998, though the large 1998 enrollment declines at more-selective UC campuses suggest that difference-in-difference estimation around that year will nevertheless recover (attenuated) estimates of AA's impact on URM students.

Given that enrollment at the more-selective UC campuses declined, where did URM students enroll instead? In order to examine the ramifications of AA's end in the larger postsecondary market, I estimate Equation 1 replacing Y_{iyc} with indicators for enrolling at the institution observed in the National Student Clearinghouse, partitioning the institutions into seven types. Table 3 shows that compared to similarly academically-prepared non-URM applicants, URM applicants were 11.8 p.p. more likely to enroll at the more-selective Berkeley, UCLA, and San Diego campuses under AA, but became 9.0 p.p. less likely to enroll at those schools after AA's end. On average, those students flowed to most of the other parts of the higher education market: the selective (2.5 p.p.) and less-selective (2.4 p.p.) UC campuses, the CSU schools (1.6 p.p.), private California universities (0.9 p.p.), and universities outside the state (1.2 p.p.).[33] The 1.2 p.p. increase in community college enrollment and 0.9 p.p. decrease in non-NSC-observation likely reflect sorting within community colleges, with little net enrollment change.

However, AA's impacts were strikingly different for URM students with different measured levels of preparedness. Panel B of Table 3 re-estimates the model by Academic Index quartile.[34] Relative to comparable non-URM applicants, bottom-quartile students became less likely to enroll at more- or middle-selective UC campuses, instead enrolling at the CSU universities and California privates. Second-quartile students were massively impacted at the more-selective campuses, becoming 17 p.p. less likely to enroll, but 12 p.p. enrolled at middle-selective UC campuses instead, with the rest absorbed by less-selective UCs and private and out-of-state universities. The third quartile's 7.5 p.p. decline was also largely absorbed by the middle-selective UCs, while the top quartile was only slightly less likely to enroll at either the more- or middle-selective universities, enrolling at out-of-state schools instead. Comparing these enrollment changes to the degree attainment deterioration presented below gives a sense of which university switches are most impactful with regard to the measured outcomes.

A final summary of the change in enrollment outcomes for URM students following Proposition 209 is presented in Table 4, which summarizes changes in the characteristics of their enrollment institutions. The table makes clear that URM UC applicants continued to enroll at more-selective institutions than academically-comparable non-URM peers after Proposition 209, though the gap substantially declined. Only considering students who enrolled at four-year universities, URM applicants enrolled at universities with 5.8 percentage point lower admissions rates under AA, though the end of AA closed that gap by 3.4 percentage points. Using

[33] See Geiser and Caspary (2005).

[34] Academic Index is defined above as a linear combination of SAT score and HS GPA, giving each equal weight.

the selectivity and quality measures defined by Bleemer (2018a), which define institutions' characteristics by the characteristics of 2001-2011 UC applicants who enrolled at those institutions, under AA URM students enrolled at institutions with 50 points higher average SAT scores and 3.6 p.p. higher five-year graduation rates, with those gaps closing by 50-60 percent after Proposition 209. In general, these institutional differences changed to similar degrees across the bottom three terciles of applicants by Academic Index, though the characteristics of top-tercile URM applicants' institutions were largely unchanged; indeed, they enrolled at institutions with somewhat higher median parental incomes after AA ended (the result of tending to enroll at private out-of-state universities).

The last column of Table 4 shows that Proposition 209 appears to have led URM applicants – especially from the bottom Academic Index quartile – to enroll at institutions with lower expected net costs of attendance (for middle-income students), though the small magnitude of the difference (about $50 per year) makes this difference negligible in comparison with the educational and labor market impacts described below.

4.2 Educational Outcomes

I estimate medium- and long-run educational and labor market outcomes using the same model as in Equation 1 for alternative definitions of Y_{iy}, estimated across the population of 1996-1999 California-resident freshman UC applicants. Table 5 shows estimates of β_2 and β_3 for a series of educational outcomes estimated from matches in the National Student Clearinghouse.

The first two columns show that URM applicants were already less likely to earn university degrees than non-URM applicants under affirmative action, but became even less likely to earn university degrees within five or six years after affirmative action was eliminated.[35] These represent relatively large declines in degree attainment relative to the 9 p.p. decline in more-selective UC enrollment that was the first-order effect of ending AA; to a first-order approximation (ignoring the cascading selectivity declines at California's public institutions), this suggests that about one in nine of those URM applicants would have earned a college degree if not for AA's end. The first and third quartiles of URM applicants by Academic Index – those who enrolled at largely enrolled at less-selective California public institutions as a result of Proposition 209 – faced the largest declines in graduation likelihood.[36]

The third and fourth column of Table 5 show measurable small but directionally-inconclusive effects on students' likelihood of earning degrees in STEM fields.[37] Estimates are shown for the full sample as well as for the conditional sample that earned degrees as reported by NSC (within six years); the point estimates suggest

[35]These results stand in sharp contrast with estimates from Arcidiacono et al. (2014), who present results suggesting that the elimination of affirmative action in California would *increase* URM graduation rates as a result of improved "match quality" between student preparedness and university selectivity. Appendix A shows that Arcidiacono et al. (2014)'s findings are driven by selection on unobservables: while their data include only a linear combination of SAT score and high school GPA, replacing the combination with the independently-measured metrics near-completely attenuates the observed effect. See Appendix A for details.

[36]The estimated ratio of change in own likelihood of graduation within five years to change in institutional five-year graduation rate is 1/2 in this context, lower than that estimated by Bleemer (2018a) among the high-GPA low-SAT students impacted by UC's 2001-2011 Eligibility in the Local Context program, suggesting that the students targeted by AA are less sensitive to the institutional changes caused by AA than were marginally-eligible ELC students to that policy. Moreover, there is evidence of differential responsiveness among the various Academic Index quartiles; the bottom and top quartiles had estimated ratios close to 1, while the third quartile had a ratio above 1 and the second quartile a ratio below 0.

[37]As discussed above in more detail, students are defined as studying STEM if their stated major is included on a US federal list of 278 "fields involving research, innovation, or development of new technologies using engineering, mathematics, computer science, or natural sciences (including physical, biological, and agricultural sciences)" (US Department of Homeland Security, 2016).

a small 0.55 (s.e. 0.66) p.p. increased likelihood of STEM degree attainment among URM college graduates after Proposition 209, but the decreased likelihood of all degree attainment yields a negative unconditional decline in STEM degree attainment by 0.42 (0.45) percentage points. There is no measurable heterogeneity in these effects across the four academic index quartiles.

Likely as a result of data limitations, previous research on the impact of Proposition 209 on student educational outcomes has largely focused on the impacts of UC enrollees rather than the broader pool of UC applicants. Restricting to enrollees limits the change in university selectivity experienced by impacted URM students; for example, while Table 4 shows that URM applicants faced a relative 26 (s.e. 1.6) point decline in their institution's average SAT score and a 2.07 (0.21) p.p. decline in its graduation rate, URM UC enrollees only faced declines of 13.4 (3.1) points and 0.7 (0.42) p.p., respectively, largely because the sample excludes students who alternatively enrolled at California's lower-selectivity public institutions. Panel D of Appendix Table A-4 shows that there was no measurable relative change in URM UC enrollees' likelihood of college graduation after Proposition 209 – that decline appears to wholly reflect decreased degree attainment among URM applicants who left the UC system – but persistent negative (though statistically insignificant) 0.6 p.p. point estimates on STEM degree attainment.[38] These estimates starkly contrast with the structural-model predictions presented in Arcidiacono, Aucejo, and Hotz (2016), and will be investigated in greater detail in the next section.

The last three columns of Table 5 show the relative impact of Proposition 209 on URM students' likelihood of earning a graduate degree at any American institution within 18 years of high school graduation, as reflected in the NSC. Graduate degrees tend to offer large labor market returns (Altonji, Arcidiacono, and Maurel, 2016) and represent an important benefit to more-selective university enrollment. Indeed, URM students become 1.4 (s.e. 0.57) p.p. less likely to earn graduate degrees after Proposition 209 relative to academically-comparable non-URM applicants, with particularly-large declines among applicants from the bottom two Academic Index quartile (who faced the largest decline in the graduation rate of their enrollment institution). More than one-third of this decline came from a decreased relative likelihood to earn law degrees, which URM students became 0.51 (0.26) p.p. less likely to obtain; this might be an important contributor to the earnings declines discussed in the following subsection. There is no observed change in URM applicants' likelihood of earning medical degrees.

4.3 Labor Market Outcomes

Next, I turn to URM applicants' medium- and long-run labor market outcomes associated with the end of AA, focusing on covered California earnings. I estimate Equation 1 separately for each annual earnings outcome, measured in years from high school graduation; the observed data cover 19 years after graduation, when most applicants were 37 years old. Earnings are CPI-inflated to 2018.

The end of UC's affirmative action program likely had a mixed effect on the extensive margin of URM applicants' covered California employment: more-selective university enrollment likely increases applicants' likelihood of seeking employment outside the state (since the credential is less geographically-specific), but

[38] As discussed in the Data section above, NSC graduates' majors' STEM status is determined by hand in the NSC data where CIP codes are unavailable. However, CIP codes are available for all UC graduates (though each graduate is only assigned a single code, omitting second majors). As a result, STEM degree attainment is defined in the UC records as having an assigned CIP major code included on the list provided in US Department of Homeland Security (2016).

AA encourages staying in the state for the undergraduate degree, whereas out-of-state enrollment might have led to out-of-state employment. The first Panel of Figure 4 suggests that the former effect is the larger of the two; after Proposition 209, URM California employment is noisy but likely somewhat higher among URM applicants throughout their early career (though the annual estimates are statistically-insignificant). Estimates of the effect on unconditional log California earnings are similarly noisy, though it appears that URM students have similar covered California earnings to comparable non-URM peers after Proposition 209.

As a result, the effect of Proposition 209 on *conditional* California log earnings – omitting applicants without covered earnings – show a persistent earnings decline among URM applicants of about 3 percentage points. Panel B of Figure 4 shows further evidence of poorer labor market outcomes for URM applicants following Proposition 209, with substantial declines in URM applicants' likelihood of having high California earnings relative to the earnings of academically-comparable non-URM applicants – with thresholds at $75,000 (roughly California's 2018 median household income), $100,000, and $150,000 – over the two decades following high school graduation. On average, mid-career URM UC applicants became about 2 p.p. less likely to earn at least $75,000, and 1 p.p. less likely to earn $100,000, in California in each year when compared to academically-comparable non-URM applicants.

One reason for these earning declines could be that the end of California's AA policy led positively-selected applicants to exit the state – in some cases to attend universities in other states – which would increase their likelihood of potentially-high but unobserved earnings in the available EDD data. Indeed, Table 3 shows that URM applicants from the second, third, and fourth quartiles by Academic Index became relatively more likely to enroll at out-of-state universities after Proposition 209. If this were the key driver of the observed earnings results, one would expect that bottom-quartile applicants fared better with regard to California earnings outcomes than applicants from the other quartiles.

Panel C of Figure 4 shows that this is not the case: URM applicants' decreased likelihood of earning $75,000 is similar in magnitude across the four Academic Index quartiles, with substantial declines among first-quartile students despite no relative change in their likelihood of enrolling at out-of-state universities. Appendix Figure A-2 shows the same trend for earning at least $100,000, despite the large increase in California employment among bottom-quartile applicants (who appear to have been less likely to seek out-of-state employment after earning degrees from less-selective institutions). These findings suggest that the end of UC's affirmative action program had substantial

4.4 Robustness

I consider three potential concerns with the difference-in-difference estimates presented above. First, I examine the timing of the change in URM applicants' educational and labor market deterioration by estimating annual difference-in-difference effects relative to the 1997 baseline. Figure 5 presents model estimates for four outcomes: six-year degree attainment, graduate degree attainment, average annual log earnings (conditional on covered CA employment) 6-19 years after graduating high school, and the number of those years in which the applicant had earnings above $75,000. It shows some evidence of noise in the data: URM degree attainment returns to baseline for one year in 2000, the third year following Proposition 209, while the two earnings outcomes sharply decline between 1995 and 1996, when some campuses began phasing out their AA programs but two years before the AA program's official end. However, all four outcomes exhibit sta-

bility between 1997 and 1998 before sharply declining between 1998 and 1999, and the decline in persistent in direction, magnitude, and statistical significance in 2001, four years later. These patterns provide additional evidence that Proposition 209 and the end of AA were responsible for these large observed declines in URM UC applicants educational and labor market outcomes relative to academically-comparable non-URM applicants.

Second, I test the estimates' sensitivity to alternative covariate specifications. I re-estimate Equation 1 specifying X_{iy} in the following ways: null (no covariates); including only high school GPA; and then including high school GPA and between 1 and 8 additional sets of covariates (including all available academic and socioeconomic covariates in the data), selecting the covariates that lead to the largest and smallest estimates of β_3 for the same four outcomes described above.[39] The resulting estimates are shown in Figure 6. While high school GPA is an important covariate for several outcome measures, likely absorbing important changes in the composition of UC applicants around 1998, there is no further combination of these detailed covariates that substantially changes any of the estimates' sign, magnitude, or statistical significance. Moreover, the general symmetry of the span of possible coefficients under different covariate specifications around the median estimate (across specifications) suggests that unobserved applicant heterogeneity is unlikely to be a central contributor to the presented estimates (Altonji, Elder, and Taber, 2005). These results show that the estimates presented above are highly insensitive to alternative model specifications, despite the highly-detailed covariates observed in this study.

Third, Appendix A in Bleemer (2018a) shows that while many California colleges were not reporting enrollment statistics to NSC by the mid-1990s, only a small number of extant universities may not have been reporting graduation statistics by 1999 (the earliest year that 1996 applicants could plausibly earn a four-year degree), the largest of which was 2,100-student Brandman University, which primarily functions as an adult education institution. The same trend likely holds for other states. A comparison between UC and NSC graduation records suggests that only UC Santa Cruz failed to report a substantial number of earned degrees among the late 1990s graduation cohorts, while a comparison between NSC and UC major reporting (measured by which students earned STEM degrees) shows that NSC routinely captures more than 90 percent of STEM degree attainment at all campuses throughout the period. The six-year graduation and STEM major choice estimates presented in Panel A of Table 5 are robust to augmenting NSC graduation records with graduation records from UCSC or the full UC system, though the estimated six-year graduation coefficient attenuates.[40] As a result, differential NSC non-reporting by non-UC-enrolled URM applicants is unlikely to explain the observed degree attainment patterns. Moreover, this concern does not extend to the graduate degree estimates; most such degrees are not earned at the same institutions at which applicants earned their undegraduate degrees, and by the time applicants in the sample were earning graduate degrees, NSC coverage was very wide.

Finally, it is important to note that the second difference in the difference-in-difference models discussed above compare URM students to non-URM students, and the latter would have also been impacted by the

[39]The sets of covariates are: (1) SAT Math and Verbal scores, (2) SAT II Writing, (3) SAT II Mathematics and an indicator for whether the applicant submitted a Math 2 score (as opposed to Math 1), (4) log family income and an indicator for missing family income, (5) the number of honors courses taken in high school's senior year, (6) female indicator, (7) 7 indicators for highest parental education, and (8) 289 indicators for paired parental occupation codes.

[40]See A-4.

end of AA, crowding-in the former URM enrollment. About 19 percent of 1996-1999 UC applicants were URM, implying that the likelihood of a non-URM applicant's UC enrollment would increase by less than 1/4 of the decline in each URM applicants' UC enrollment as a result of crowd-in. An alternative specification could omit this second difference altogether, but this would wrongly attribute important non-ethnicity-related changes in UC admissions to AA. In particular, the proportion of Californian 18-year-olds who applied to the University of California increased by 14 percent between 1995 and 2000 (Douglass and Bleemer, 2018), contributing to 11-14 percentage point declines in Berkeley and UCLA's admission rate over those years. As admission to UC's more-selective campuses became more restrictive, their student bodies became more academically prepared independently of consideration of race; average non-URM SAT scores increased by more than 0.1 s.d. despite their increased likelihood of admission from crowd-in. As a result, differencing estimates by non-URM outcomes is imperative in order to avoid confounding AA with other UC admissions trends, though AA's impact on non-URM students could upwardly-bias estimates by up to 20% (assuming similar treatment effects for the two groups).

5 Application Likelihood After Proposition 209

The previous section focused on the educational and labor market outcomes UC applicants who enrolled at less-selective universities after the end of affirmative action at California's public universities. However, an additional group of high school graduates may have faced similar (or even larger) costs if the absence of AA caused them to not apply to any University of California campus in the first place, for which reason they would have remained outside of the previous section's estimation sample. This section focuses on quantifying the number and academic preparedness of those discouraged applicants.

Figure 7 presents trends in the average fraction of students from public California high schools who applied to any University of California campus.[41] The sample of high school students and UC applicants is restricted to students who satisfactorily completed a college-preparatory high school curriculum (termed 'UC-eligible'). Panel (a) shows that white, black, and Hispanic UC-eligible students all had similar likelihoods of applying to at least one UC campus in 1995 (Asian students were twice as likely), but by 1998 white students were about 5 p.p. more likely to apply than either black or Hispanic. Panel (b) shows a similar trend in applications to UC's most-selective Berkeley and UCLA campuses. Panels (c) through (e) present these trends by free and reduced price lunch percentage quintile, a typical measure of school affluence. The panels show steady growth in white students' application rates in the late 1990s, but substantial declines in 1996-1998 black application rates across all schools and Hispanic rates at higher-affluence schools. While application rates partially recover in the early 2000s, especially at less-affluent schools, they largely remain below their pre-209 levels.

Card and Krueger (2005) use SAT 'sends' (measured in College Board data) as a proxy for university applications and present evidence that the decline in UC applications after 1998 was wholly driven by low-testing students unlikely to earn admission whether or not they applied. Appendix B replicates their finding in similar College Board data (available only for *public* high schools in California), but shows that replacing

[41] High school data from the California Department of Education are linked to applicants' high schools by ATP code, successfully matching the large majority of public schools.

SAT 'sends' with actual applications (observed by linking College Board and UC applicant records) reverses their result; in fact, a substantial number of high-testing URM high school graduates go so far as to send SAT scores to a UC campus, but many nevertheless choose against actually applying after AA's end.

I implement an alternative estimation strategy to identify the number of 'missing' URM applications – and the number who would have been admitted to a UC campus – after 1998. I construct a database at the high-school-year-ethnicity level covering most California public schools from 1994 to 2001 and estimate regressions of the following form:

$$\frac{A_{syea}}{UC_{sye}} = \sum_{e' \in \{W,B,H\}} \sum_{y' \in \{96,98,00\}} \beta e' y' \mathbb{1}_{e=e', y \in \{y', y'+1\}} + \zeta_{se} + \zeta_{sy} + \epsilon_{syet} \quad (2)$$

where A_{syea} is the number of UC-eligible UC applicants from school s in year y of ethnicity e with an AIS in range a, and UC_{sye} is the number of UC-eligible high school graduates that year. Because Academic Indices are only observed for UC applicants, the implicit assumption in estimating this regression equation is that the true distribution of AIS across school-year-ethnicity cohorts remains unchanged over time; the only reason that the fraction of applicants from that group changes is as a result of changes in students' application behavior. Equation 2 is estimated separately for each a, which are defined as 200-point bins from 4000 to 8000

Appendix Table A-5 presents estimated coefficients for a specification of Equation 2 where a includes the full spectrum of AIS, 4000 to 8000. It shows substantial evidence of overall declines in URM application rates following Proposition 209 of between 4 and 6 percent of all UC-eligible URM California high school graduates.

Figure 8 presents scaled estimates of the 1998-99 β coefficients from Equation 2, with the coefficients scaled by the average number of URM UC applicants in that AIS bin in 1998-99. The figure also shows the proportion of those applicants who would likely have been admitted to some UC campus had they applied, where admission is predicted solely on the basis of their AIS. The figure shows that while there were large application declines among black and Hispanic high school graduates unlikely to be admitted to any UC campus, there were also a large number of applicants certain to be admitted to some campus – indeed, very likely to be admitted to UC's most-selective campuses – who chose against application after AA ended. The sum across the scaled statistics suggests that the number of black UC applicants declined by about 400 students in 1998 while the number of Hispanic applicants declined by more than 1,300, each representing 12-13 percent declines. Of those applicants, the large majority – 10-11 p.p. – would have likely been admitted to some UC campus. The bottom panel serves as a sort of placebo test, showing minimal changes in Asian high school graduates behavior (relative to white graduates) following Proposition 209.

Of course, many of the non-applicants would still not have enrolled at UC campuses had they send in applications and been admitted. Moreover, these non-applicants' labor market outcomes are unobserved, challenging quantification of their non-application's impact on URM Californians' downstream labor market outcomes. However, these students' exit from the UC system was likely just as detrimental as the selectivity declines faced by the remaining applicants – and perhaps even more so, since these applicants may have faced larger declines in university enrollment selectivity (given their lack of access to any public university in California). These evidence suggest that the baseline estimates presented above serve as underestimates

of the full impact of ending UC's affirmative action admissions policy on URM Californians' labor market prospects.

6 STEM Major Selection

Much of the academic literature on affirmative action has been focused on evaluations of the Mismatch Hypothesis – a broad set of claims that generally hold that affirmative action is harmful to targeted URM applicants – and disproportionate interest has focused on URM students' performance in challenging courses, particularly in the sciences. For example, Loury and Garman (1993) argue that "with higher required levels of performance and smaller offsetting increases in actual performance, blacks at more selective schools will have poorer grades, be less likely to graduate, and choose less lucrative majors than if they had attended less selective institutions." Recent scholarship has frequently proxied "lucrative majors" with the STEM major designation; Arcidiacono, Aucejo, and Hotz (2016), for example, notes that "STEM majors [earn] substantially more than other college degrees with the exception of perhaps business ... and the STEM premium has increased over time". Those authors go on to argue that students who attend more-selective universities as a result of affirmative action become less likely to earn STEM degrees, implying that this may be the result of poor grades that they receive in STEM courses when competing with the more-prepared peers at those universities.[42]

In the previous section, I discuss the finding (shown in Table 5) that the end of affirmative action does not appear to increase URM applicants' likelihood of earning STEM degrees (despite their less-selective university attendance); indeed, the point estimate suggests an unconditional decline in URM applicants' STEM degree attainment following Proposition 209. In this section, I narrow my focus to the hypothesis that URM applicants who enroll at more-selective University of California campuses as a result of affirmative action earn lower grades and are less likely to persist in popular STEM fields of study. I focus on specific grades in particular core STEM courses to avoid the calculating cross-course GPA measures: grades tend to be deflated in more-technical departments and inflated in more-advanced courses and at more-selective universities, challenging their interpretation.[43]

In order to provide a careful test of the 'Science Mismatch Hypothesis', it is first necessary to identify a specific comparison group. In fact, previous research has tested three versions of this hypothesis against three different comparison groups, all of which are testable in the current setting; I provide each with a name and will test each of them in turn. First, the "Weak Science Mismatch Hypothesis" (WMH) states that URM students at AA-implementing universities receive lower grades and be less likely to persist in STEM than non-URM students at the same university. I term this hypothesis "weak" because it appears *prima facie* true, given the lower measured academic preparation of URM students at AA-implementing universities. Second, the "Strong Science Mismatch Hypothesis" (SMT) claims that AA-targeted URM students earn lower grades and are less likely to persist in STEM than non-URM students with observable-comparable academic preparation

[42] "Science, engineering, and economics classes give lower grades and require more study time than courses in the humanities ... [a study shows that] those who switch majors were more likely to report that it was due to academic issues if the initial major was in the sciences, engineering, or economics" (Arcidiacono, Aucejo, and Hotz, 2016).

[43] In particular, estimates of declines in GPA may be the result of students' poorer student performance, but may also result from an increased likelihood of taking more-technical courses (despite stronger performance) or taking more introductory courses across many departments (rather than swiftly moving to higher-grade upper-division courses).

at the same university. This claim might be expected to hold given that the URM students were less likely to have been admitted if not for AA, implying that they have fewer of the other possibly performance-enhancing characteristics by which the non-URM students were admitted. Finally, the "Cross-Campus Science Mismatch Hypothesis" (CCMH) claims that AA-targeted URM students are less likely to persist in STEM than they would have been at less-selective universities. This claim is similar in structure to the estimates presented in the previous section. Using a mixed bag of settings and research designs, previous studies have provided evidence favoring each of these hypotheses: WMH (Loury and Garman, 1993; Holzer and Neumark, 2000; Fischer and Massey, 2007), SMH (Rose, 2005), and CCMH (Griffith, 2010; Arcidiacono, Aucejo, and Hotz, 2016).

In order to test these hypotheses in the context of Proposition 209, I restrict the applicant sample to enrollees at the five UC campuses for which I observe detailed course enrollment records – Berkeley, Davis, Santa Barbara, Santa Cruz, and Riverside – and estimate a series of difference-in-difference models. Outcomes are defined for each of the courses in universities' core science curricula: four courses in Chemistry (two introductory, two organic), two in Biology, two in Physics (one mechanics, one electromagnetism), two in Mathematics (the first two courses in calculus, prior to multivariate), and three in Computer Science. Some schools have multiple versions of a given introductory course, all of which are included in the analysis.[44] In nearly-all cases, each of these courses has the previous course as a prerequisite.[45]

I define two outcomes of interest for each course: persistence and grade. Persistence in a given course is defined as having completed the subsequent course in the field's sequence (conditional on having completed the given course), and thus is not defined for the final course in each sequence. The course's grade is defined as the numerical value (0 to 4) associated with the letter grade earned in the course, and thus is not defined for students who Pass or otherwise withdraw from the course.[46] Grades are unobserved at UC Santa Cruz, which provided narrative evaluations instead of grades for much of this period.

I test the WMH and SMH hypotheses by estimating difference-in-difference models for 1995-2000 Berkeley students, the most-selective UC campus and the campus where Proposition 209 most impacted URM students' likelihood of admission (a 26 p.p. decline relative to academically-comparable no-URM applicants). Because of the smaller samples resulting from focusing on students at a single campus, I include three years

[44] Where schools on quarter systems required three courses instead of two, I use the first and third courses. Here is the full list:

- Introductory Chemistry: UCB CHEM 1A/B, UCD CHEM 2A/C, UCR CHEM 1A/B, UCSC CHEM 1B/C, UCSB CHEM 1A/B
- Organic Chemistry: UCB CHEM 3A/B or 12A/B, UCD CHEM 8A/B or 118A/B, UCR CHEM 112A/B, UCSC CHEM 108A/B or 112A/B, UCSB CHEM 6A/B or 107A/B
- Biology: UCB BIO 1B/A, UCD BIO 1A/C, UCR BIO 5A/C, UCSC BIOL 20A/C, UCSB MCDB 1A/B or 4A/B
- Physics: UCB PHYSICS 8A/B, UCD PHYSICS 7A/C, UCR PHYSICS 2A/B, UCSC PHYS 5A/B or 6A/B or 7A/B, UCSB PHYS 6A/B
- Mathematics: UCB MATH 1A/B or 1AM/BM or 16A/B, UCD 16A/B or 21A/B, UCR MATH 9A/B, UCSC 11A/B or 19A/B, UCSB 3A/B or 34A/B
- Computer Science: UCB COMPSCI 61A/B/C, UCD ECOMPSCI 20-or-30/40/50, UCR EEC 10/12/14, UCSC CMPS 12A/B/C-or-101, UCSB CMPSC 10/20/30

[45] Berkeley allows students to take BIO 1A before BIO 1B, but only 25% of students do so. Berkeley also allows many students to skip CHEM 1B; persistence to CHEM 1B includes students who take CHEM 3A or 12A.

[46] I do not show estimates for a third potential outcome, an indicator for whether the student takes the given course but fails to earn a letter grade (suggesting that they dropped out, likely as a result of course difficulty); however, estimates for such outcomes are closely inversely related to those of GPA.

of student data on either side of the 1998 end of AA.[47] In particular, I estimate:

$$Y_{iysm} = \alpha_1 sh_i + \alpha_2 sy + \beta_{s2} URM_i + \beta_{s3} NoAA_y * URM_i + \gamma_s X_{iy} + \epsilon_{iysm} \quad (3)$$

for Berkeley student i from high school h_i in cohort y who takes course s in term m, where URM_i indicates URM status and $NoAA_y$ indicates post-1998. The model is estimated separately for each science course: Chemistry classes 1 through 4, Biology 1-2, Physics 1-2, Math 1-2, and Computer Science 1-3 (13 models in all, omitting the last course in each group when estimating persistence models). Covariates X_{iy} are either null (which also excludes $\alpha_1 sh_i$, high school fixed effects) or include the full set of academic preparation measures used in the previous section. When the outcome is defined as grade, I also include course-term fixed effects ζ_{sm} to control for grade inflation and other grading differences across courses, allowing the resulting estimates to be interpreted as differences from the course mean grade. Standard errors are robust, and the coefficients of interest are β_{s2} – how URM students compared to non-URM students under affirmative action – and β_{s3}, how that changed after affirmative action ended.

Panel A of Table 6 tests the WMH by estimating STEM performance and persistence outcomes for URM students relative to non-URM students at Berkeley, without conditioning on academic preparation. Restricting attention to URM students under Berkeley's AA regime, there appears to be evidence of disparate outcomes: URM students earn far lower grades in every measured STEM course, with gaps ranging from 0.48 to 1.08 grade points (s.e. around 0.07) and lower persistence by more than 11 p.p. in every STEM track. Moreover, when affirmative action ends, URM students' grades slightly improve in many courses. However, the grade improvements are small relative to the massive gaps under AA (fewer than half of the gaps close by more than one-third) and there is no evidence that URM students' persistence in science courses improves after the end of AA. In fact, despite known improvements in URM students' academic preparation, they appear to become (if anything) *less* likely to persist in chemistry courses, which are required for nearly all science majors at Berkeley, with non-neglible negative point estimates in introductory Biology and Physics courses as well.

This evidence suggests that the WMH misdiagnoses the reason for poor URM performance and persistence under the AA regime; if the cause were admissions mismatch, then the elimination of AA would have substantially shrunk the URM-to-non-URM gaps in these measures. As a result, this evidence strongly weighs against the Weak Science Mismatch Hypothesis.

Given the lacking evidence for WMH and the fact that URM academic preparation declined after Proposition 209, the SMH appears highly unlikely to hold in this context. Panel B of Table 6 shows that the end of affirmative action led to substantial and statistically-significant *declines* in URM students' persistence in Organic Chemistry, Biology, and Physics, along with declines in Chemistry and Physics grades, when URM students were compared to non-URM students with similar observable academic preparation. Moreover, observed academic preparation wholly explains URM students' low persistence and performance under AA; compared to similarly-prepared non-URM students, URM students earn similar grades and are actually *more* likely to persist in many science fields. These results reject the Strong Science Mismatch Hypothesis in favor of an opposing claim: that the students who enrolled at Berkeley under AA actually had higher levels of science persistence (and similar academic performance) in science fields relative to similarly-prepared non-URM

[47] Results are generally similar when only including only 1996-1999, and are available from the author.

students.

Even if AA-enrolled URM students have better performance and are more likely persist in STEM fields than similarly-prepared non-URM students at Berkeley, it may still be the case that they're performance and persistence would have been higher still if they had enrolled at a less-selective university. In order to test the CCMH, I expand Equation 3 to allow for differences by campus, resulting in a triple-difference design:

$$Y_{iysmc} = \alpha_1 sh_i + \alpha_2 sy + \beta_{sc2} URM_i + \beta_{sc3} NoAA_y * URM_i + \gamma_s X_{iy} + \epsilon_{iysm} \tag{4}$$

where I continue to estimate separately by course s.[48] I parameterize the model to estimate main effects β_{s2} and β_{s3} and then estimate interactions with four of the campuses, omitting Riverside (the least-selective campus). X_{iy} includes the same academic preparation measures, and I again add course-term fixed effects ζ_{sm} when grades are the outcome. The resulting coefficients can be interpreted as URM students' differential science performance or persistence relative to outcomes in parallel courses by academically-similar students at UC Riverside. The estimates are further differenced from the outcomes of comparable non-URM students to absorb spurious cross-campus differences in admissions, course difficulty, and student services.

Under CCMH, one would expect that URM students would have higher performance and persistence in science courses at less-selective universities than at more-selective universities under AA (relative to their academically-comparable non-URM peers), but URM performance would improve across all campuses after affirmative action ends. Given the present empirical framework, then, the following claims follow from CCMH:

- Claim 1: Under affirmative action, relative URM science persistence and grades should be lower at more-selective campuses.
- Claim 2: After the end of affirmative action, relative persistence and performance will rise (in comparison with Riverside) at more-selective campuses.

Table 7 presents estimates of the coefficients from Equation 4. There is some evidence favoring Claim 1: under AA, science grades for academically-comparable URM students were generally lower at Berkeley and Santa Barbara than Riverside, and persistence was generally lower at Berkeley as well (in Chemistry, Biology, Physics, and Mathematics). Persistence was also lower in Biology and Mathematics at the Santa Barbara and Santa Cruz campuses. However, the relatively-selective Davis campus had consistently-higher URM persistence levels compared to Riverside, implying that selectivity is far from the only relevant determinant of science persistence across the UC campuses.

The remaining estimates in Table 7 reject any large effect in line with Claim 2, though in most cases I cannot reject small increases in performance and persistence among URM students at the more-selective UC campuses following Proposition 209. Despite relatively-small standard errors – on the order of 5% changes in persistence or or 0.15 GPA points, though errors are larger in Computer Science (which enrolled very few URM students) – I find little evidence of changes in URM science course performance at more-selective UC campuses after the end of AA (relative to URM performance at Riverside, and differenced from changes in

[48] The third difference, by non-URM outcomes, captures within-campus cross-year variation in science performance and persistence opportunity.

non-URM course performance); the majority of UC Berkeley's science-grade point estimates are negative, the opposite of Claim 2's expectation, and are generally quite small. URM students' grades relatively improved in the medium-selectivity Davis and Santa Barbara first quarter of Physics by 0.2 to 0.4 grade points, but I observe no evidence of any other changes in course grades.

The persistence estimates provide even more trouble for Claim 2: after Proposition 209, URM persistence in each Organic Chemistry course *declined* at Berkeley by 8 to 10 p.p., and persistence in the first semester of Biology declined by 11 percentage points (all relative to UC Riverside). Persistence increased in Mathematics, but these declines strongly suggest that ending AA did not increase the science persistence of URM students now attending less-selective universities; in fact, it appears those students would have been more likely to persist in science at UC's most-selective campus. While there is some evidence of relative increased science persistence at Santa Cruz, lowest-selectivity campus other than Riverside, this hardly bolsters Claim 2; instead, it provides increased evidence that relative to academically-comparable URM students at UC's less-selective campuses, those at the more-selective campuses had been more likely to persist in science fields under the AA regime. In general, while there is insufficient evidence to reject CCMH outright, there is suggestive evidence that CCMH does not match the observed patterns in the data following the end of AA at the University of California.

The performance and persistence patterns in science courses presented in Tables 6 and 7 do not appear to accord to any of the three potential statements of the Mismatch Hypothesis defined above.[49] They do provide evidence suggesting a mechanism explaining the noisily-estimated negative effect of ending UC's AA policy on URM applicants' likelihood of earning STEM degrees: Berkeley's URM students appear to have performed and persisted in science fields (compared to non-URM students) with greater likelihood when that school was implementing its AA policy, and ending AA decreased URM students' science persistence at Berkeley (if anything) relative to academically-comparable students at less-selective campuses. One possible explanation would be that observed academic preparation could a downward-biased estimate of URM students' ability to perform in university courses as a result of disparate educational opportunity available to those students (Vars and Bowen, 1998; Niu and Tienda, 2010), but that those observably-less-prepared URM students benefited (in terms of science performance and persistence) attending a more-selective university. Another possible explanation is that URM students' diminished enrollment at Berkeley after Proposition 209 could have led to a decline in the remaining URM students' performance and persistence in science courses (Sacerdote, 2011). I leave further discussion of potential mechanisms explaining these patterns to future research.

7 Conclusion

The total enrollment of black and Hispanic students at the University of California declined by about 700 students per year after 1998, when the university's nine campuses all ceased implementing their race-based affirmative action admissions policies as a result of Proposition 209 Bleemer (2019b). Conditional on observable academic preparedness, URM UC applicants' university enrollment sharply shifted away from UC's more-selective Berkeley, UCLA, and San Diego campuses, with students enrolling instead at less-selective

[49] They do draw a sharp contrast with the estimates presented by Arcidiacono, Aucejo, and Hotz (2016), who argue that URM UC students' likelihood of STEM major selection increased after Proposition 209, relative to those same students under AA. That study differs in many ways from the current analysis – estimates

public institutions and a wide variety of private universities; on average, they enrolled at universities with substantially lower SAT scores and graduation rates. As a result of this change in university enrollment, impacted URM applicants became less likely to earn a Bachelor's or graduate degree and became 1-2 percentage points less likely to have California earnings above the state's median household income – despite not being less likely to have California employment – in each year of their 20s and 30s. While estimates of the end of affirmative action on URM students' major choice are noisier, it appears that URM students had stronger performance and persistence in lucrative STEM coursework at more-selective universities under the affirmative regime, with Proposition 209 likely causing a decline in URM students' STEM major attainment.

These results strikingly differ from existing estimates of the impact of affirmative action, even among analyses of Proposition 209's effect at the University of California, and highlight the importance of detailed administrative data to account for sample selection bias results from changes in UC's applicants and enrollees in the 1990s. However, while the directions of the presented results appear robust to alternative specifications, they are almost certainly underestimates of the full impact of ending a large-scale affirmative action program, since some UC campuses had begun phasing out their AA policies even before the 1998 deadline. Future analysis will combine UC's detailed available admissions records with machine-learning predictive tools to fit the admissions rules used by each UC campus prior to 1996, which will enable specific identification of which post-1998 URM (and non-URM) applicants would have been admitted (or not) under the AA regime. That analysis will facilitate more careful estimation of the magnitude and heterogeneity of Proposition 209's effect on impacted applicants.

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A Appendix A: Selection on Unobservables in Arcidiacono et al. (2014):

The estimated presented in this study suggest that Proposition 209, which ended the University of California's race-based affirmative action admissions program, led to a decline in the likelihood of all URM UC applicants' likelihood of earning any university degree within six years relative to similarly-academically-prepared non-URM applicants (see Table 5 and Figure 6). Arcidiacono et al. (2014) (hereafter AACH) present a near-opposite finding, arguing that Proposition 209 increased the likelihood with which URM UC enrollees earned university degrees within five years. This appendix discusses the important estimation differences between the two studies, and presents augmented estimates of the models used by AACH that suggest that their results are driven by selection on student characteristics that are unobserved in their data.

There are a number of differences in the research design used in these two studies. The most consequential is a difference in the available data. AACH employ a highly-censored database provided under a California Public Records Act request. The relevant differences between their data and those used in the study above are:

1. AACH observe three-year time intervals instead of application year, including the 1995-1997 interval and the 1998-2000 interval.

2. AACH observe binned high school GPA (4 bins), SAT math score (7 bins), and SAT verbal score (7 bins), and do not observe either the continuous values or students' SAT II scores. They do observe students' "Academic Index", defined as a weighted average between applicants' unweighted high school GPA and SAT math + verbal score.

3. AACH do not observe gender, high school (or even an anonymized high school indicator), or any linked records from any external database (like National Student Clearinghouse). They do observe the students' ethnicity (four bins), parents' highest attained educational level (7 bins), binned parental income (12 bins), and binned intended major (STEM or non-STEM, as defined by UC).

4. Both studies observe which UC campuses each applicant applied to, was admitted to, and enrolled at.

AACH present a summary table they argue provides direct evidence that the end of affirmative action increases URM graduation rates. They employ a single-difference design similar to the diff-in-diff shown in Equation 1, estimated separately for URM and White applicants:

$$GRAD_{iy} = \alpha + \beta_{q_i} POST_y + \gamma X_i + \epsilon iy \tag{5}$$

where $GRAD_{iy}$ indicates five-year graduation and $POST_y$ indicates 1998 or later entry to university (after the end of affirmative action). AACH present estimates in their Table 3 for various specifications of X_i, from null up to their "Full AACH Controls" (referred to in AACH as "Extended Controls 2") in which X_i contains binned intended major indicators, binned parental income indicators, and the parental education index all interacted with the continuous Academic Index measure. They also present estimates for a constant q_i or for q_i indicating Academic Index quartiles, with the first through third quartiles estimated relative to the fourth (top). The sample includes all freshman California-resident UC enrollees between 1995 and 2000.

I replicate AACH's Table 3 in Table AA-1. Unfortunately, I do not observe the specific weighted high school GPA used to produce AACH's Academic Index, and instead construct a highly-similar index (with the same weights between HS GPA and SAT score) using my observed weighted GPA. The resulting estimates are highly similar but non-identical to those presented in AACH. AACH show that when X_i is null, URM students are estimated to graduate with 4.4% greater likelihood after 1998, while White students are estimated to graduate with 2.5% greater likelihood (with my estimates matching both). These estimates fall once the full set of controls have been added, to 3.0% (I estimate 3.1%) for URM and 1.4% (1.5%) for White, suggesting

that URM students' likelihood of graduation increased more than that of White students after the end of affirmative action. Finally, when split by Academic Index quartile, they show that these graduation gains are enjoyed by only the bottom three quartiles of URM students, but by all four quartiles of White students, which AACH suggest reflects "students in the lower quartiles are attending campuses that better match their levels of preparation" after 1998.

Table AA-1 adds a new specification to those discussed in AACH: I replace the Academic Index in X_i with the the underlying measures of student academic preparedness: weighted high school GPA, SAT Math and Verbal scores, and SAT II Writing score (I do not adjust the interacted effects). This change substantially attenuates the estimates, especially for URM students, to 0.9% for URM and 0.6% for White. Interestingly, the coefficients on X_i show that by far the most important covariate is high school GPA, of which the Academic Index is essentially a noisy proxy. In any case, the graduation gap between URM and White students all but disappears. I also re-estimate the model with Academic Index quartiles, showing that the top and bottom quartiles of URM students face no change in graduation rate, though evidence of increases for the third quartile (and perhaps the second quartile) of URM students remains.

I also estimate the same model for all non-URM students, including Asian students as well as White students in the comparison group. I estimate β to be 1.0% for non-URM students; it appears that in the years after the end of affirmative action, non-URM students actually became slightly *more* likely to graduate than URM students (though the estimates are statistically-identical). Estimates with Academic Index quartiles show a similar pattern to those of URM students, with an increase in graduation likelihood in the second quartile (and the next-most-positive increase in the third quartile).

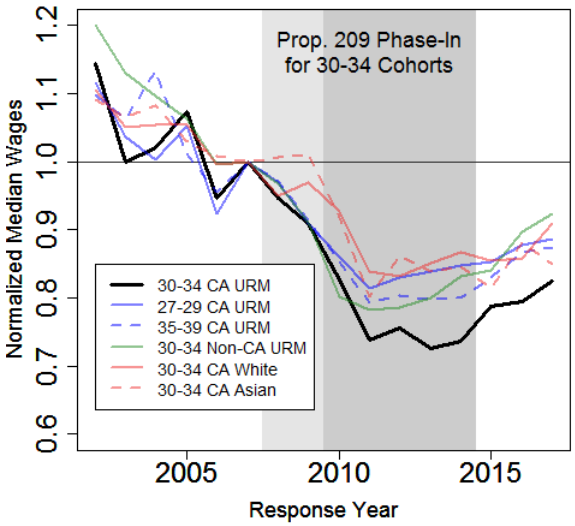
While these estimates remain importantly different from my preferred specification shown in Equation 1 – which includes a different more-detailed set of covariates, restricts the analyzed years to 1996-1999, and expands the sample to all UC applicants (and the outcome to degree attainment at *any* university reporting degrees to NSC) – the comparison between the resulting URM versus non-URM estimates here appears highly similar to the first estimate in Panel C of Table 5, with a tightly-estimated 0 effect on graduation among UC enrollees. As I discuss in the main text, the change in UC applicants' likelihood of degree attainment appears to be driven by changes among applicants who exited UC enrollment following the end of Proposition 209. In any case, it appears that AACH's estimated decline in likelihood of graduation after 1998 was the product of selection on unobservable characteristics in highly-censored data.

B Appendix B: Selection into Application, and Reanalyzing Card and Krueger (2005):

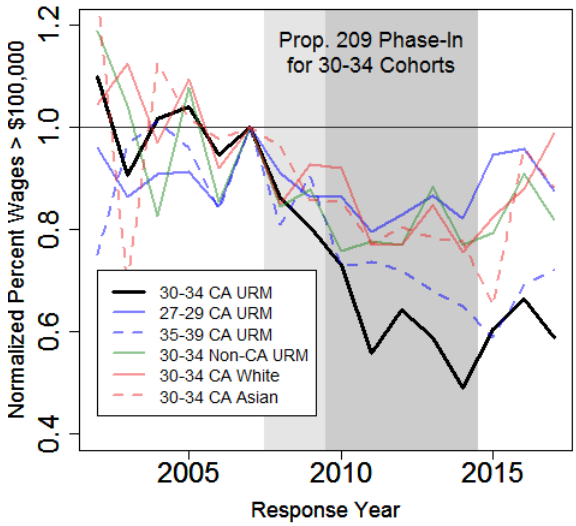
In progress.

Figure 1: Early-Career Labor Market Characteristics of the First "Prop. 209" Cohort

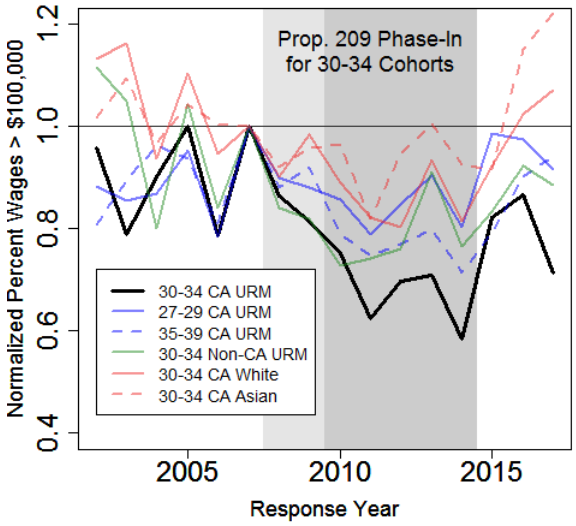
(a) CA-Born Median Wages



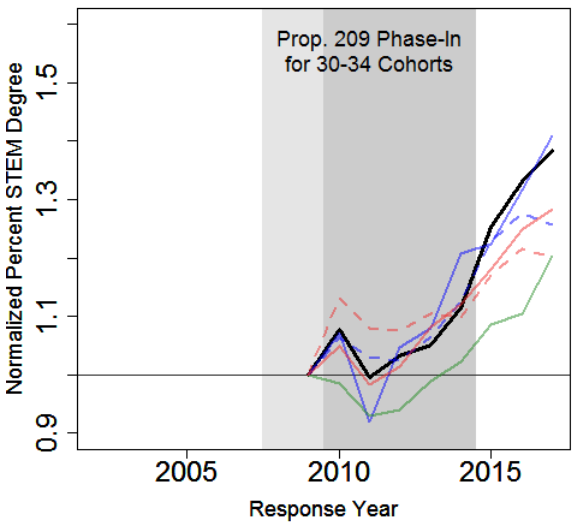
(b) CA-Born Fraction Earning $\geq$ \$100,000



(c) CA-**Resident** Fraction Earning $\geq$ \$100,000

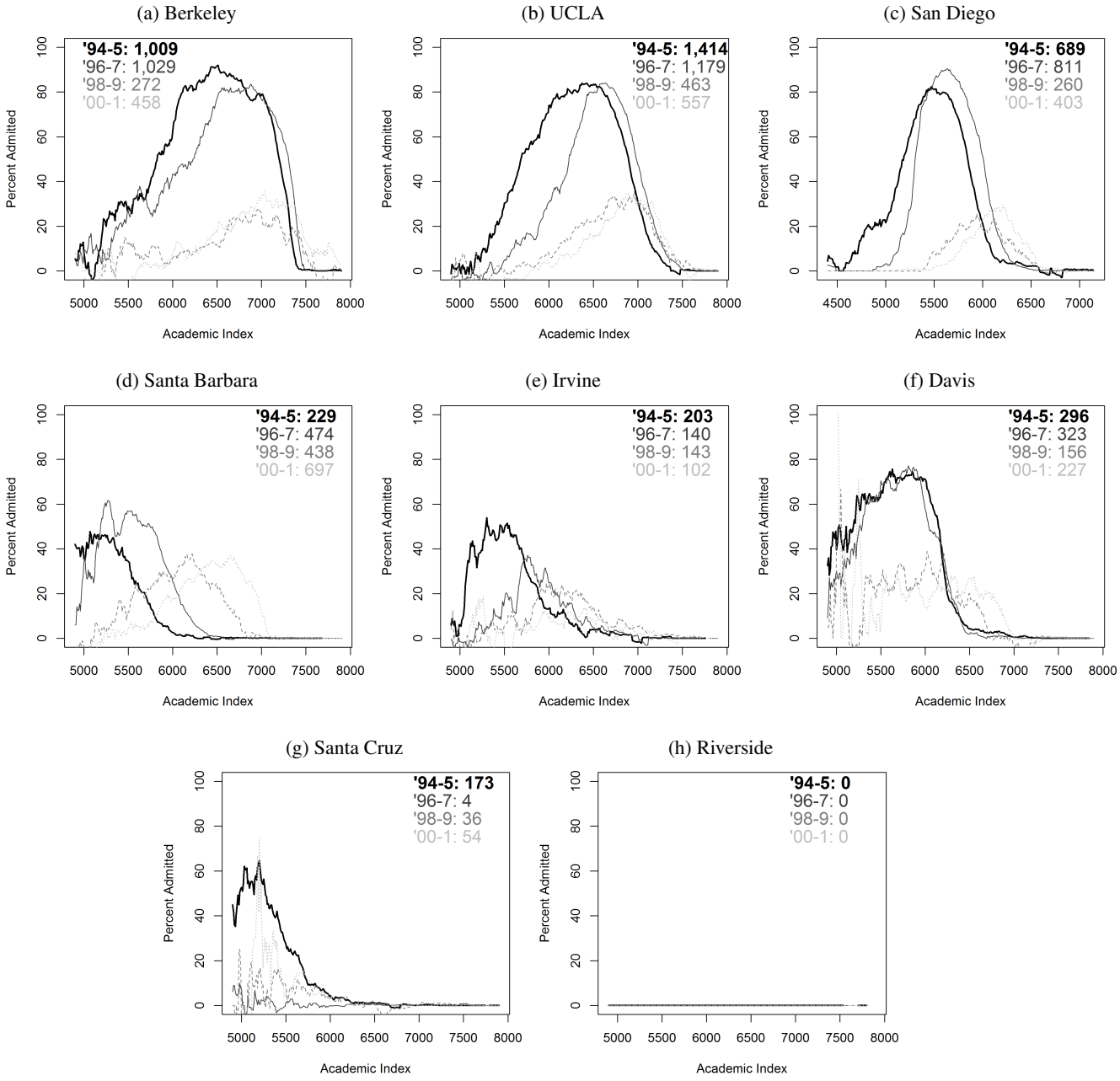


(d) CA-Born Fraction Earned STEM Degree



Note: Median wages, fraction earning at least \$100,000 per year in wages, and fraction earned a STEM college degree by ethnicity, contemporaneous age range, and either California birth or contemporaneous California residency status, normalized to 1 in 2007 for each group. Grey lines denote the years (2010-2014) in which the age 30-34 URM cohort would have largely switched from people who graduated high school prior to the 1998 implementation of Proposition 209 to those who graduated after implementation, assuming graduation at age 18. Some public universities began phasing out affirmative action two years earlier (in 1996), justifying the 2007 baseline. Samples are not conditional on labor market participation. Wages are in 2018 CPI-adjusted dollars. All statistics are two-year moving averages. Source: 2001-2017 American Community Survey (Ruggles et al., 2018)

Figure 2: Impact of AA on 'Normal' URM Applicants' Likelihood of Admission, by Campus and AIS



Note: The difference between the percent of URM applicants and the percent of non-URM applicants admitted to each campus by academic index (AIS), in each of four two-year periods (1994-2001), with darker lines corresponding to earlier periods. The two later periods are after the implementation of Proposition 209 ended UC's affirmative action policies. The displayed statistics show the total number of additional URM students admitted to the campus in each period on the basis of their higher likelihood of admission, calculated as the rounded sum of the products between the increased admissions likelihood and the number of URM applicants in that period with that academix index. The sample is restricted to freshman fall California-resident applicants who (a) were UC-eligible, which means that they satisfactorily completing the required high school coursework, and (b) who selected intended majors that did not have special admissions restrictions (e.g. engineering at some campuses). UC Riverside admitted all such applicants. URM applicants include Black, Chicano, Latino, and Native American applicants; non-URM applicants include all Asian and White applicants. Source: UC Corporate Student System

Table 1: Descriptive Statistics of 1990s UC Admissions for **Non-URM** Applicants

	Application			Admission			Enrollment		
	'94-5	'96-7	'98-9	'94-5	'96-7	'98-9	'94-5	'96-7	'98-9
Panel A: Non-URM Applicants									
Average Number or % of Applications									
Berkeley	14,384	17,398	19,722	37.4	32.3	30.9	15.1	14.0	13.9
UCLA	16,648	20,178	23,859	44.4	37.4	33.9	15.3	13.3	13.5
San Diego	15,710	18,992	22,905	63.1	60.1	48.3	15.3	12.9	12.2
Santa Barbara	12,888	14,760	18,672	84.5	74.9	57.7	18.5	18.4	14.7
Irvine	11,663	13,136	16,060	76.2	71.3	64.2	19.8	19.4	17.5
Davis	13,363	15,063	17,094	71.1	72.0	67.7	18.8	19.7	17.8
Santa Cruz	7,466	8,142	9,936	85.3	85.4	81.1	16.7	18.8	17.6
Riverside	6,954	7,433	10,166	82.0	85.7	88.0	14.7	17.9	17.4
All UCs	33,415	37,792	42,066	84.9	83.6	83.9	49.7	49.4	49.6
Average SAT Score									
Berkeley	1250	1256	1263	1371	1375	1368	1345	1349	1339
UCLA	1209	1215	1228	1316	1333	1343	1262	1283	1299
San Diego	1212	1213	1223	1274	1298	1307	1224	1250	1260
Santa Barbara	1141	1144	1166	1162	1183	1224	1122	1156	1190
Irvine	1146	1151	1161	1186	1194	1213	1127	1137	1159
Davis	1181	1184	1187	1232	1231	1230	1171	1176	1169
Santa Cruz	1156	1154	1157	1177	1173	1180	1153	1151	1155
Riverside	1115	1115	1119	1137	1134	1136	1095	1091	1092
All UCs	1183	1188	1194	1207	1212	1216	1196	1208	1217
Panel B: URM Applicants									
Average Number or % of Applications									
Berkeley	3,638	3,972	4,036	54.1	48.1	23.8	19.6	19.0	10.4
UCLA	4,962	5,245	5,501	55.4	42.5	24.8	21.4	16.7	11.3
San Diego	3,166	3,376	4,080	59.4	57.5	32.6	12.2	11.8	8.4
Santa Barbara	3,256	3,602	4,086	77.1	77.0	54.4	16.4	18.0	15.4
Irvine	2,956	2,814	3,311	73.5	62.6	54.8	15.8	13.0	14.2
Davis	2,656	2,684	2,918	83.2	83.2	62.7	21.8	18.6	17.9
Santa Cruz	2,276	2,128	2,338	83.6	81.2	72.9	16.0	14.5	15.5
Riverside	2,264	2,351	3,266	79.6	77.1	79.6	19.7	18.3	20.2
All UCs	9,665	9,678	10,124	81.1	79.2	73.4	47.0	44.2	39.8
Average SAT Score									
Berkeley	1073	1089	1104	1153	1169	1202	1132	1139	1146
UCLA	1032	1049	1068	1121	1156	1188	1091	1119	1142
San Diego	1062	1070	1084	1127	1152	1198	1092	1120	1165
Santa Barbara	1010	1022	1044	1046	1059	1105	1002	1024	1076
Irvine	999	1014	1027	1045	1072	1100	1006	1028	1064
Davis	1050	1057	1069	1084	1092	1111	1052	1073	1076
Santa Cruz	1012	1018	1032	1035	1043	1061	992	1014	1039
Riverside	960	969	984	986	997	1011	965	961	969
All UCs	1027	1040	1050	1056	1072	1083	1054	1073	1079

Note: Count and mean average descriptive statistics of 1994-1999 California-resident freshman UC applicants who are or are not underrepresented minorities (URM). URM includes African-American, Hispanic, Chicano/a, and Native American applicants. SAT score includes the Math and Verbal components and was on the 1600 scale. Percent admitted and percent enrolled are conditional on applying to that campus.

Source: UC Corporate Student System

Table 2: Difference-in-Difference Estimates of Post-1998 URM Admissions by UC Campus

Campus:	UCLA	UCB	UCSD	UCSB	UCI	UCD	UCSC	UCR	Total
Application conditional on UC application (%)									
URM	11.7	8.4	-4.3	-5.3	-10.1	-4.7	-3.2	-7.1	
	(0.4)	(0.4)	(0.5)	(0.4)	(0.4)	(0.4)	(0.4)	(0.4)	
URM ×	-2.6	-4.2	0.7	-0.7	0.1	0.6	0.5	4.1	
Prop. 209	(0.5)	(0.6)	(0.6)	(0.6)	(0.5)	(0.5)	(0.5)	(0.5)	
R^2	0.24	0.18	0.12	0.16	0.23	0.23	0.14	0.22	
Obs.	182,525	182,525	182,525	182,525	182,525	182,525	182,525	182,525	
Admission conditional on application (%)									
URM	39.4	29.1	28.0	17.1	10.9	26.8	6.1	3.1	8.3
	(0.6)	(0.5)	(0.5)	(0.6)	(0.6)	(0.6)	(0.6)	(0.6)	(0.3)
URM ×	-26.7	-18.3	-22.2	-6.4	-4.1	-17.7	-4.9	-2.2	-7.1
Prop. 209	(0.7)	(0.6)	(0.7)	(0.7)	(0.8)	(0.8)	(0.8)	(0.7)	(0.4)
R^2	0.33	0.44	0.54	0.45	0.46	0.40	0.34	0.34	0.25
Obs.	86,489	103,944	94,059	76,591	66,103	71,027	41,453	41,328	182,525
Enrollment conditional on **application** (%)									
URM	14.4	9.1	2.5	0.3	-5.9	-0.7	-5.9	-5.7	3.4
	(0.5)	(0.4)	(0.5)	(0.6)	(0.7)	(0.7)	(0.8)	(0.8)	(0.5)
URM ×	-10.0	-6.7	-3.6	1.9	2.9	1.0	3.4	3.5	-5.9
Prop. 209	(0.7)	(0.6)	(0.6)	(0.7)	(0.8)	(0.9)	(1.0)	(0.9)	(0.6)
R^2	0.09	0.09	0.07	0.05	0.07	0.07	0.07	0.11	0.09
Obs.	86,489	103,944	94,059	76,591	66,103	71,027	41,453	41,328	182,525
Enrollment conditional on **admission** (%)									
URM	-17.3	-17.3	-16.6	-8.7	-16.1	-15.1	-9.0	-8.1	-1.7
	(1.1)	(0.9)	(0.8)	(0.7)	(0.9)	(0.8)	(0.9)	(0.9)	(0.5)
URM ×	7.5	6.8	9.3	6.1	6.6	9.5	5.6	5.5	-2.1
Prop. 209	(1.5)	(1.3)	(1.2)	(1.0)	(1.1)	(1.1)	(1.1)	(1.0)	(0.6)
R^2	0.16	0.18	0.14	0.12	0.19	0.15	0.12	0.16	0.06
Obs.	28,437	37,716	47,718	51,906	45,346	50,316	34,968	35,752	156,338

Note: OLS coefficient estimates of β_2 and β_3 from Equation 1, a difference-in-difference model of 1996-1999 URM UC freshman California-resident applicants' UC applications, admissions, and enrollment compared to non-URM applicants after the 1998 end of UC's affirmative action program. Covariates include high school fixed effects and a series of academic preparation controls: a female indicator, SAT I verbal and math scores, high school GPA, three SAT II scores (writing, mathematics, and a third of the student's choice), indicators for SAT II exam choices, and the number of honors courses enrolled in senior year of high school. Models are estimated independently by campus or "Total", including all applicants to any UC campus. Robust standard errors in parentheses.

Source: UC Corporate Student System

Table 3: Difference-in-Difference Estimates of URM UC Applicants' Post-1998 Postsecondary Enrollment

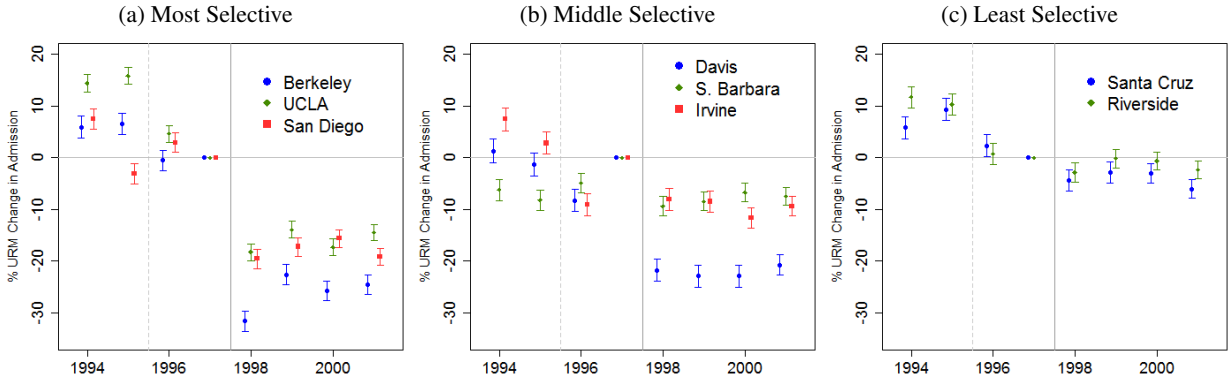
	UC Campuses by Selectivity							
	Most	Middle	Least	CSU	Comm. Coll.	CA Priv.	Non-CA	Not in NSC
Panel A: Diff-in-Diff Coefficients Overall								
URM	11.80	-5.76	-2.94	-3.76	-3.39	2.67	0.30	0.80
	(0.36)	(0.37)	(0.22)	(0.29)	(0.28)	(0.28)	(0.29)	(0.22)
URM ×	-8.98	2.48	2.39	1.64	1.23	0.88	1.16	-0.89
Prop. 209	(0.47)	(0.48)	(0.29)	(0.38)	(0.36)	(0.37)	(0.37)	(0.28)
R^2	0.182	0.041	0.058	0.108	0.072	0.035	0.084	0.018
Obs.	184,182	184,182	184,182	184,182	184,182	184,182	184,182	184,182
Panel B: Estimates of URM × Prop. 209 by AIS Quartile								
Bottom	-5.32	-1.58	1.27	3.92	0.60	1.64	0.10	-1.10
Quartile	(0.45)	(0.75)	(0.61)	(0.91)	(0.82)	(0.57)	(0.54)	(0.55)
Second	-17.29	12.09	1.93	-0.14	0.54	1.76	1.45	-0.60
Quartile	(0.70)	(1.06)	(0.67)	(0.80)	(0.77)	(0.71)	(0.66)	(0.53)
Third	-7.51	4.59	1.07	-0.35	0.75	-0.36	1.50	0.27
Quartile	(1.15)	(1.18)	(0.59)	(0.73)	(0.72)	(0.84)	(0.83)	(0.61)
Top	-1.32	-1.94	-0.25	0.14	-0.00	-0.37	3.22	0.12
Quartile	(1.71)	(1.03)	(0.52)	(0.61)	(0.64)	(1.11)	(1.30)	(0.82)

Note: Estimates of β_2 and β_3 from Equation 1, an OLS difference-in-difference model of 1996-1999 URM UC freshman California-resident applicants' enrollment outcomes compared to non-URM outcomes after the 1998 end of UC's affirmative action program. Outcomes defined as enrollment by college or university type in the fall after graduating high school, as measured in the NSC. Covariates include high school fixed effects and a series of academic preparation controls: a female indicator, SAT I verbal and math scores, high school GPA, three SAT II scores (writing, mathematics, and a third of the student's choice), indicators for SAT II exam choices, and the number of honors courses enrolled in senior year of high school. Academic Index (AIS) is the sum of SAT I scores, SAT II scores, and weighted high school GPA (censored at 4) multiplied by 1,000; estimates by quartile are estimated independently. Robust standard errors in parentheses.

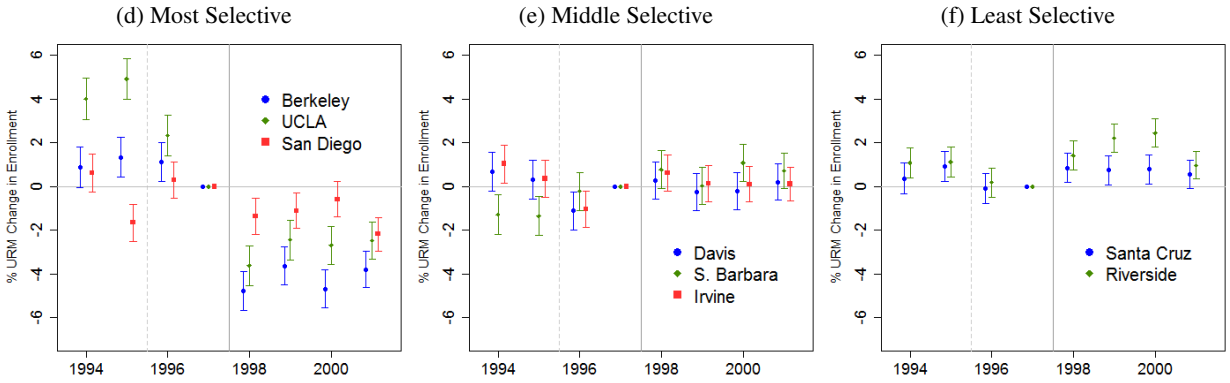
Source: UC Corporate Student System and National Student Clearinghouse

Figure 3: Annual Difference-in-Difference Estimates of Post-1998 URM Admissions by UC Campus

Panel A: UC Admissions



Panel B: UC Enrollment



Note: OLS difference-in-difference coefficient estimates of the change in URM applicants' likelihood of admission or enrollment at each UC campus relative to non-URM applicants' respective likelihood, compared to the 1997 baseline. Campuses are ordered by their mid-1990s admissions rate. Covariates include high school fixed effects and a series of academic preparation controls: a female indicator, SAT I verbal and math scores, high school GPA, three SAT II scores (writing, mathematics, and a third of the student's choice), indicators for SAT II exam choices, and the number of honors courses enrolled in senior year of high school. Bars show 95-percent confidence intervals from robust standard errors. Admission is conditional on applying to that campus; enrollment is conditional on applying to any UC campus. Source: UC Corporate Student System

Table 4: Difference-in-Difference Estimates of URM UC Applicants' Post-1998 University Characteristics

	First Four-Year Institution (IPEDS)					Institutional VA	
	Admission Rate	Average SAT Score	Six Year Grad. Rate	Sticker Price	Own Net Price	Five Year BA Attain.	Ten Year Earnings
Panel A: Diff-in-Diff Coefficients Overall							
URM	-6.1	48.0	3.3	1,585	-59.6	3.1	3,429
	(0.2)	(1.5)	(0.1)	(80.8)	(23.6)	(0.1)	(84.1)
URM × Prop. 209	3.3	-24.0	-2.0	16.9	-54.6	-1.3	-1,237
	(0.2)	(1.9)	(0.2)	(101)	(29.5)	(0.2)	(106)
R^2	0.20	0.39	0.33	0.17	0.13	0.19	0.30
Obs.	140,413	138,290	140,590	134,961	109,333	167,575	165,674
Panel B: Estimates of URM × Prop. 209 by AIS Quartile							
Bottom Quartile	2.8	-33.2	-3.1	-53.5	-259	-2.0	-1,280
	(0.4)	(3.2)	(0.3)	(138)	(57.0)	(0.3)	(138)
Second Quartile	4.8	-24.7	-1.5	135	224	-0.2	-1,766
	(0.4)	(3.4)	(0.3)	(181)	(51.5)	(0.4)	(177)
Third Quartile	2.5	-13.7	-0.7	-264	22.4	-0.6	-1,098
	(0.5)	(3.9)	(0.3)	(229)	(53.0)	(0.4)	(220)
Top Quartile	-0.8	13.7	0.4	660	-61.3	0.1	365
	(0.8)	(6.5)	(0.4)	(422)	(86.6)	(0.4)	(455)

Note: Estimates of β_2 and β_3 from Equation 1, a difference-in-difference model of 1996-1999 URM UC freshman California-resident applicants' outcomes compared to non-URM outcomes after the 1998 end of UC's affirmative action program. Outcomes defined as characteristics of the first four-year university (IPEDS statistics) or the first two- or four-year institution (value-added measures) at which the applicant enrolled (as measured in the NSC) within six years of high school graduation. Covariates include high school fixed effects and a series of academic preparation controls: a female indicator, SAT I verbal and math scores, high school GPA, three SAT II scores (writing, mathematics, and a third of the student's choice), indicators for SAT II exam choices, and the number of honors courses enrolled in senior year of high school. Value-added measures are estimated using the 2001-2011 UC applicant pool, linked to first institution by NSC, using parental income and SAT score to absorb selection bias (following Chetty et al. (2017)); see Bleemer (2018a) for details. Academic Index (AIS) is the sum of SAT I scores, SAT II scores, and weighted high school GPA (censored at 4) multiplied by 1,000; estimates by quartile are estimated independently. IPEDS data linked by OPE ID and year to NSC enrollment. Each outcome is fixed by institution in the first year in which it is available: admissions rate (2006), sticker price (2000), and net price (2008). Sticker price is defined using on-campus residency unless unavailable, in which case it is defined using off-campus non-family residency. Robust standard errors in parentheses.

Source: UC Corporate Student System, National Student Clearinghouse, and the Integrated Postsecondary Education Data System (IPEDS)

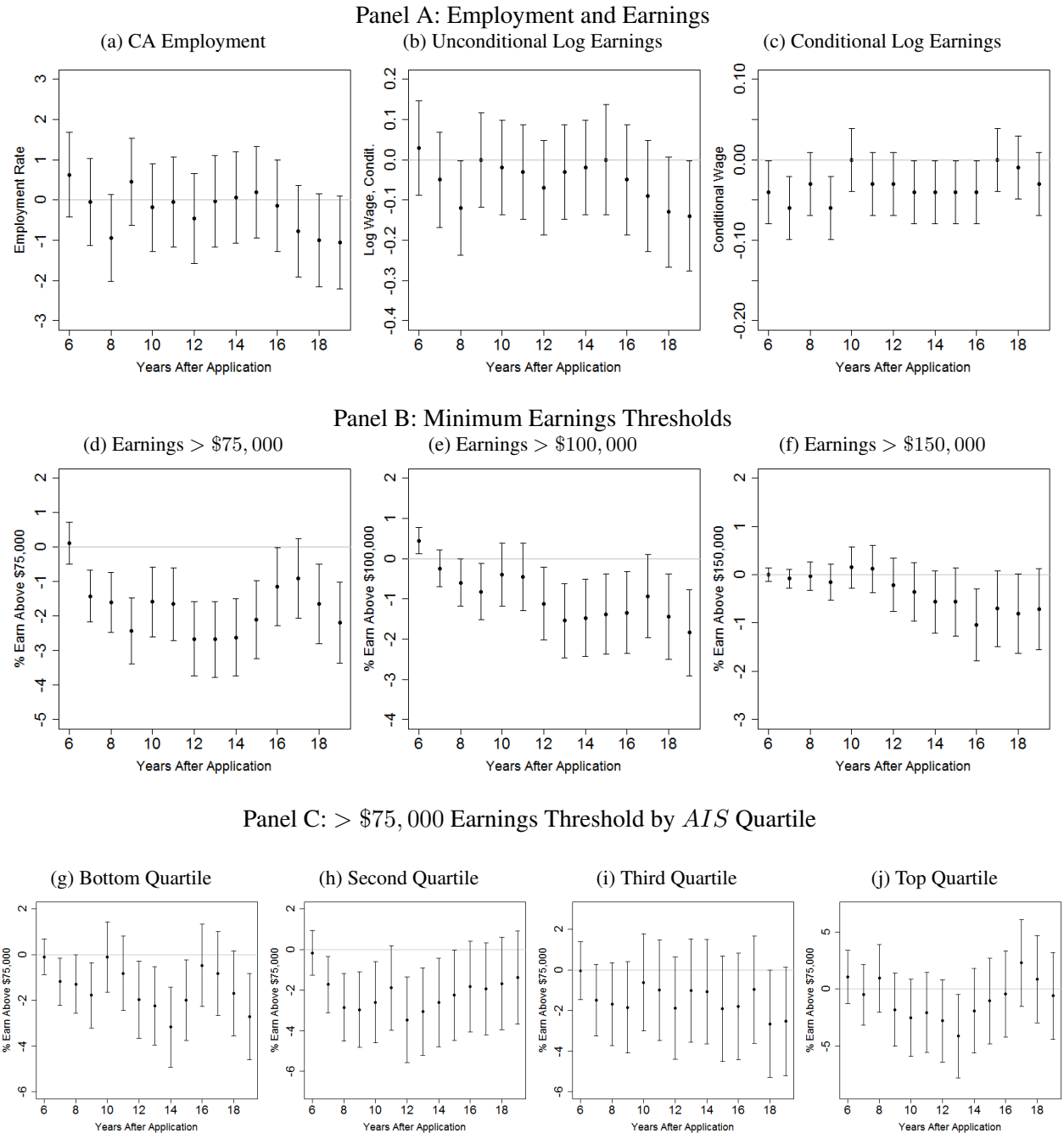
Table 5: Difference-in-Difference Estimates of URM UC Applicants' Post-1998 Educational Outcomes

	Earn Bach. Degree		Earn STEM Degree		Earn Grad. Degree		
	5-Year	6-Year	Uncondit.	Condit.	All	JD	MD
Panel A: Diff-in-Diff Coefficients Overall							
URM	-0.61	-0.90	-0.20	-0.70	5.17	1.10	1.06
	(0.43)	(0.41)	(0.36)	(0.52)	(0.46)	(0.21)	(0.14)
URM ×	-1.42	-1.40	-0.49	0.46	-1.47	-0.39	-0.03
Prop. 209	(0.54)	(0.51)	(0.45)	(0.66)	(0.58)	(0.27)	(0.18)
R^2	0.13	0.10	0.18	0.23	0.08	0.04	0.04
Obs.	182,525	182,525	182,525	120,637	182,525	182,525	182,525
Panel B: Estimates of URM × Prop. 209 by AIS Quartile							
Bottom	-2.01	-2.55	0.21	1.44	-2.21	-0.34	-0.08
Quartile	(0.96)	(0.95)	(0.49)	(0.98)	(0.85)	(0.27)	(0.09)
Second	0.47	0.31	-0.81	-1.19	-1.30	-0.74	0.06
Quartile	(1.11)	(1.05)	(0.83)	(1.21)	(1.12)	(0.45)	(0.21)
Third	-1.44	-0.78	-0.11	0.93	1.16	0.18	-0.11
Quartile	(1.15)	(1.07)	(1.13)	(1.41)	(1.36)	(0.65)	(0.37)
Top	-1.32	-0.13	1.43	2.15	-0.26	-0.60	0.11
Quartile	(1.47)	(1.37)	(1.77)	(2.06)	(1.97)	(1.19)	(0.96)

Note: Estimates of β_2 and β_3 from Equation 1, an OLS difference-in-difference model of 1996-1999 URM UC freshman California-resident applicants' educational outcomes compared to non-URM outcomes after the 1998 end of UC's affirmative action program. Outcomes defined as having earned a Bachelor's degree in five or six years, having earned a Bachelor's degree in a STEM field (unconditional or conditional on six-year degree attainment), or having ever earned a graduate degree (any, JD, or MD), all as measured in the NSC. Covariates include high school fixed effects and a series of academic preparation controls: a female indicator, SAT I verbal and math scores, high school GPA, three SAT II scores (writing, mathematics, and a third of the student's choice), indicators for SAT II exam choices, and the number of honors courses enrolled in senior year of high school. Academic Index (AIS) is the sum of SAT I scores, SAT II scores, and weighted high school GPA (censored at 4) multiplied by 1,000; estimates by quartile are estimated independently. Robust standard errors in parentheses.

Source: UC Corporate Student System and National Student Clearinghouse

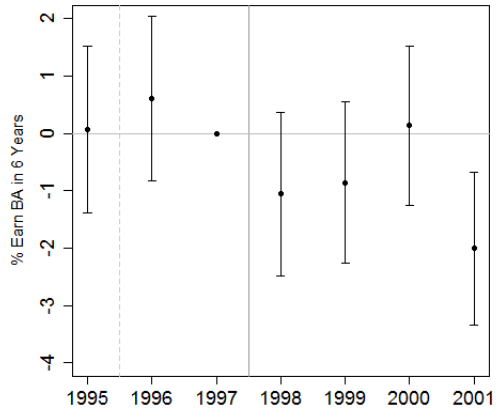
Figure 4: Difference-in-Difference Estimates of URM UC Applicants' Post-1998 Labor Market Outcomes



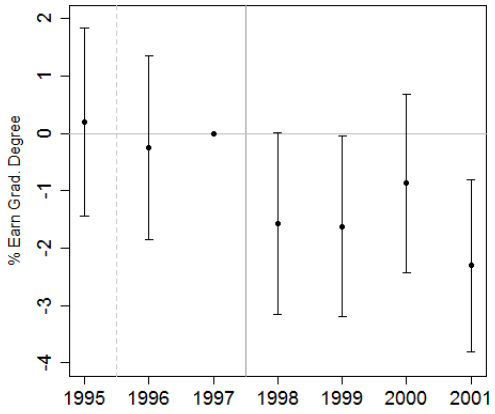
Note: Estimates of β_2 and β_3 from Equation 1, an OLS difference-in-difference model of 1996-1999 URM UC freshman California-resident applicants' educational outcomes compared to non-URM outcomes after the 1998 end of UC's affirmative action program. Outcomes defined as non-zero California earnings ("CA Employment"), unconditional log California earnings, log California earnings (omitting 0's), and unconditional indicators for having earnings above specified earnings thresholds ($75,00, $100,000, and $150,000) as measured in the California Employment Development Department database, which excludes out-of-state, self-employment, and federal government earnings. Coefficients in each year after high school graduation are estimated independently. Covariates include high school fixed effects and a series of academic preparation controls: a female indicator, SAT I verbal and math scores, high school GPA, three SAT II scores (writing, mathematics, and a third of the student's choice), indicators for SAT II exam choices, and the number of honors courses enrolled in senior year of high school. Academic Index (AIS) is the sum of SAT I scores, SAT II scores, and weighted high school GPA (censored at 4) multiplied by 1,000; estimates by quartile are estimated independently. Robust 95-percent confidence intervals shown. Source: UC Corporate Student System and the California Employment Development Department

Figure 5: Annual Difference-in-Difference Estimates of URM UC Applicants' Post-1998 Outcomes

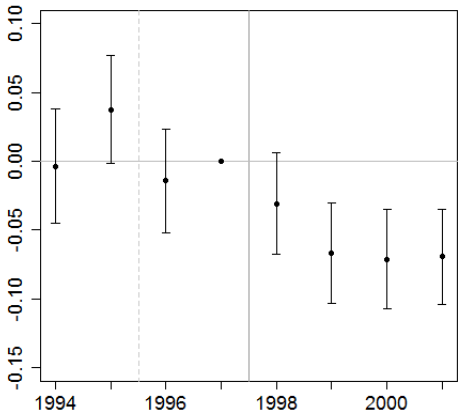
(a) Six-Year Degree Attainment



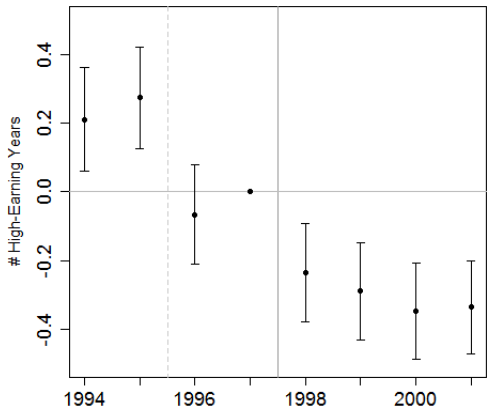
(b) Grad. Degree Attainment



(c) Avg. Annual Conditional Log Earnings



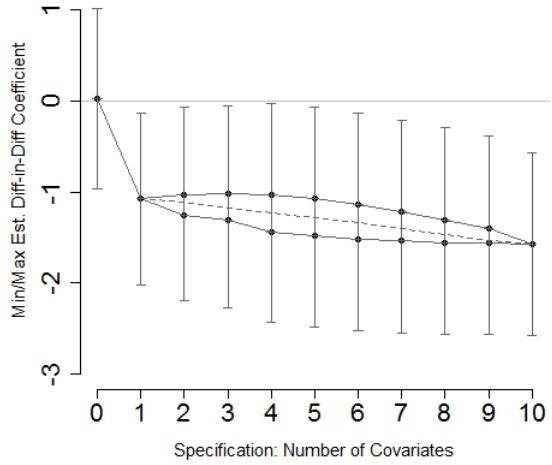
(d) Number of Above-$75,000 Years



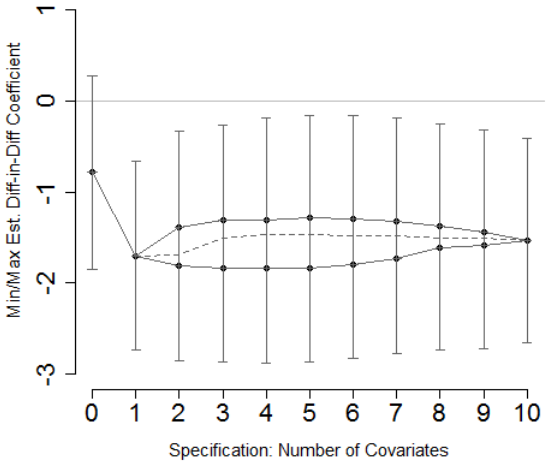
Note: OLS difference-in-difference coefficient estimates of the change in four URM applicant outcomes relative to non-URM applicants, compared to the 1997 baseline. Outcomes include six-year Bachelor's degree attainment in the NSC, graduate degree attainment in the NSC, average annual conditional (omitting 0's) log California covered earnings 6-19 years after high school graduation, and the number years (6-19 years after high school graduation) in which California covered earnings exceed $75,000. Bars show 95-percent confidence intervals from robust standard errors. Covariates include high school fixed effects and a series of academic preparation controls: a female indicator, SAT I verbal and math scores, high school GPA, three SAT II scores (writing, mathematics, and a third of the student's choice), indicators for SAT II exam choices, and the number of honors courses enrolled in senior year of high school. Source: UC Corporate Student System, National Student Clearinghouse, and California Employment Development Department

Figure 6: Difference-in-Difference Estimates of URM UC Applicants' Post-1998 Outcomes with Alternative Covariate Specifications

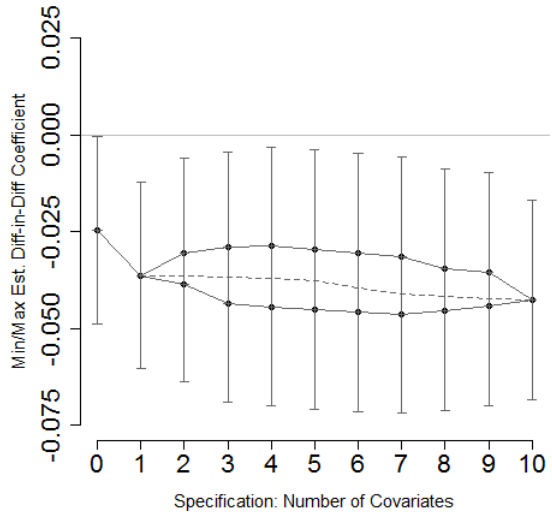
(a) Six-Year Degree Attainment



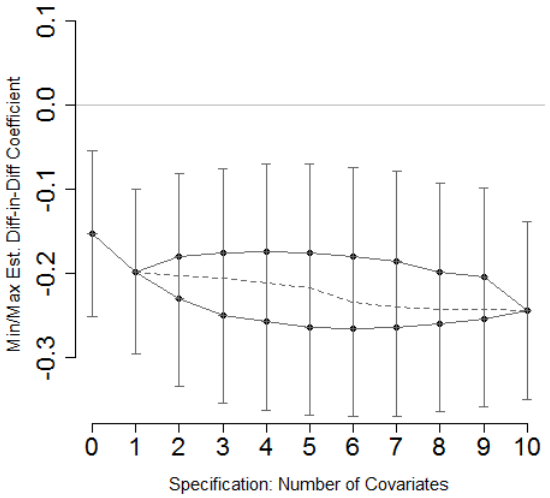
(b) Grad. Degree Attainment



(c) Avg. Annual Conditional Log Earnings



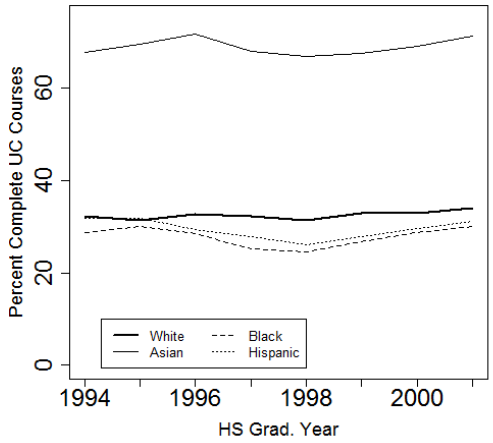
(d) Number of Above-$75,000 Years



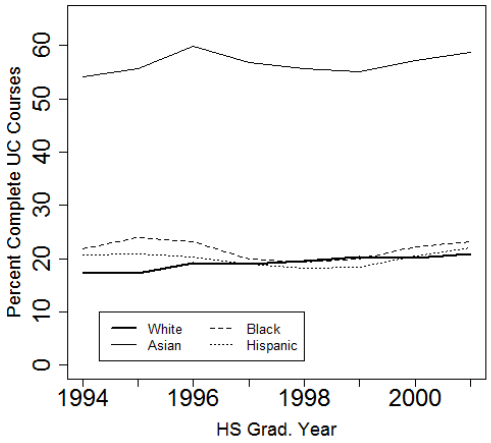
Note: Estimates of β_3 from Equation 1, an OLS difference-in-difference model of the change in four URM UC applicant outcomes after the end of UC's affirmative action policy relative to non-URM applicants, with different specifications of the covariate matrix X_{it}. Specification 0 includes only high school fixed effects (null X_{it}), while Specification 1 includes applicants' high school GPA. Specifications 2-9 add additional sets of covariates progressively, presenting the highest and lowest β_3 estimates from models including 2-9 sets of covariates (always including high school GPA), respectively. For example, the points in Specification 3 show the highest and lowest possible β_3 estimates when X_{iy} is high school GPA and any two other sets of covariates, with the following possibilities: SAT score (Math and Verbal), SAT II writing score, SAT II mathematics score (and indicator for SAT II Math 2), number of senior-year honors courses, gender indicator, log income (and indicator for unreported income), (seven) indicators for highest parental education, and (289) indicators for parents' occupation codes. Outcomes include six-year Bachelor's degree attainment in the NSC, graduate degree attainment in the NSC, average annual conditional (omitting 0's) log California covered earnings 6-19 years after high school graduation, and the number years (6-19 years after high school graduation) in which California covered earnings exceed $75,000. Bars show the union of the 95 percent confidence intervals of the two presented estimates, using estimated robust standard errors. Source: UC Corporate Student System, National Student Clearinghouse, and California Employment Development Department

Figure 7: UC Application Trends Among Californian High School Graduates by Ethnicity

(a) Apply to UC

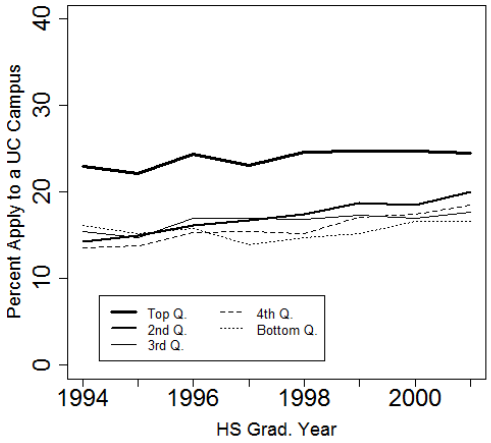


(b) Apply to Sel. UC

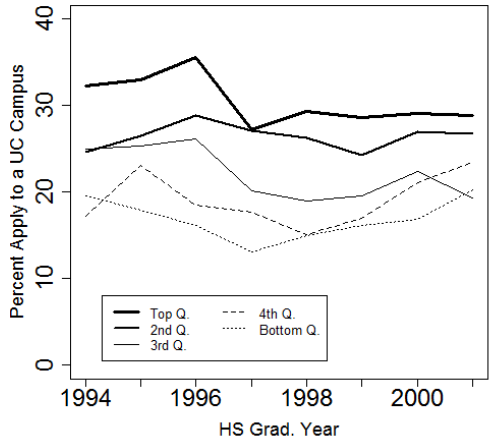


Apply to Selective UC Campus, by School FRPL Quintile

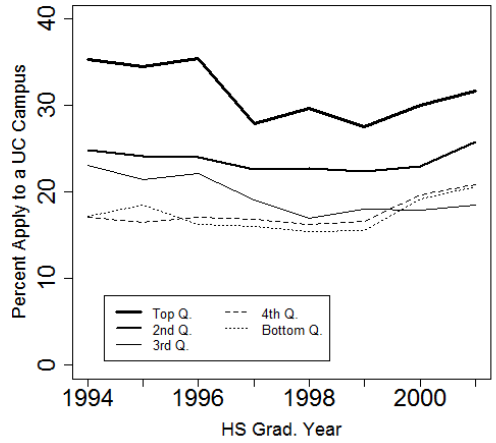
(c) White



(d) Black



(e) Hispanic

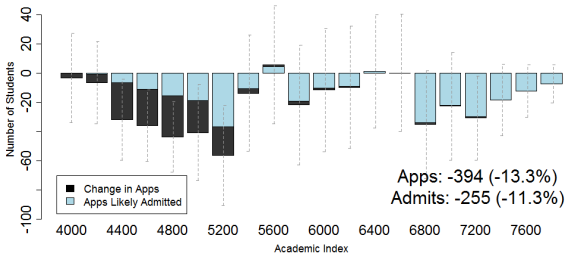


Note: In Progress

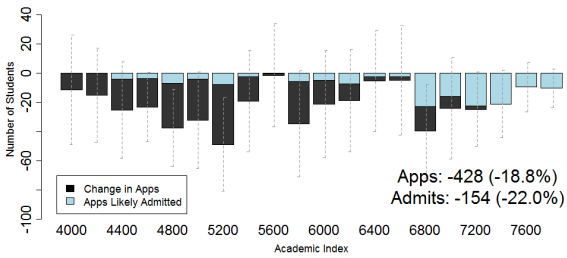
Figure 8: Estimated Declines in 1998-99 Application and Admission by Ethnicity

Panel A: Black

(a) Any UC Campus

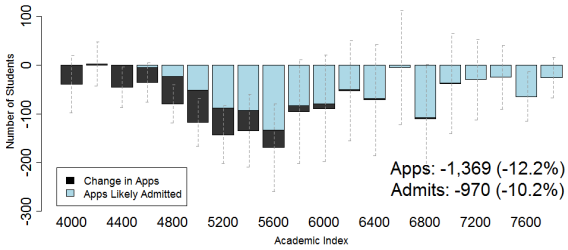


(b) Most-Selective Campuses

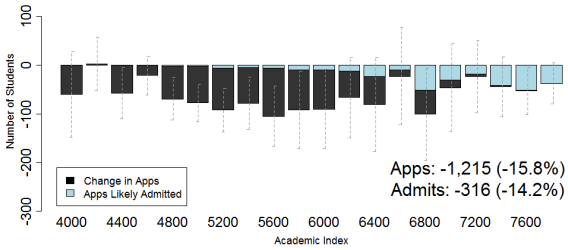


Panel B: Hispanic

(c) Any UC Campus

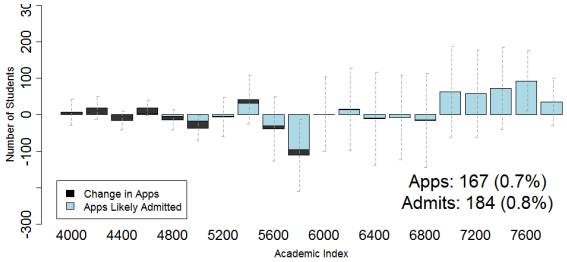


(d) Most-Selective Campuses

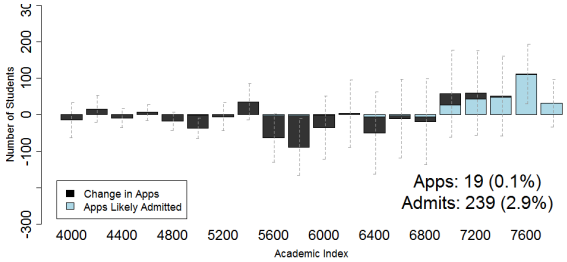


Panel C: Asian

(e) Any UC Campus



(f) Most-Selective Campuses



Note: In Progress.

Table 6: Difference-in-Difference Estimates of URM Berkeley Students' Post-1998 Science Performance and Persistence

	Chemistry				Biology		Physics		Mathematics		Comp. Science		
	1	2	3	4	1	2	1	2	1	2	1	2	3
Panel A: Unconditional (Weak STEM Mismatch Hypothesis)													
Grade in Course (if earned grade)													
URM	-0.80	-1.01	-1.03	-0.64	-0.83	-0.74	-0.87	-0.65	-0.91	-0.78	-0.93	-0.90	-0.48
	(0.04)	(0.07)	(0.07)	(0.08)	(0.06)	(0.08)	(0.06)	(0.09)	(0.05)	(0.07)	(0.15)	(0.20)	(0.22)
URM × Prop. 209	0.19	0.32	0.34	0.25	0.15	0.14	0.16	-0.00	0.28	0.33	0.20	0.57	-0.95
	(0.06)	(0.11)	(0.12)	(0.14)	(0.10)	(0.15)	(0.11)	(0.16)	(0.08)	(0.12)	(0.26)	(0.35)	(0.39)
# of Obs.	5,533	4,177	3,810	2,882	3,314	3,153	3,704	2,386	4,105	2,590	1,388	820	789
Mean of Y	2.81	2.60	2.56	2.65	2.71	2.61	2.71	2.78	2.66	2.67	2.65	2.83	2.93
Indicator for Persistence to Next Course (%)													
URM (β_2)	-12.1	1.5	-15.5		-13.0		-13.8		-13.0		-11.3	-16.0	
	(2.2)	(1.8)	(2.7)		(2.9)		(3.2)		(2.2)		(6.8)	(8.0)	
URM × Prop. 209 (β_3)	-1.4	-6.6	0.4		-8.2		-5.5		2.1		9.4	11.8	
	(3.6)	(3.0)	(4.7)		(5.0)		(5.4)		(3.5)		(11.6)	(13.8)	
# of Obs.	5,699	4,249	3,879		3,345		3,769		4,212		1,414	841	
Mean of Y	68.5	89.8	71.8		73.2		55.8		42.0		51.2	72.8	
Panel B: Conditional on Academic Preparation (Strong STEM Mismatch Hypothesis)													
Grade in Course (if earned grade)													
URM	0.06	-0.13	-0.11	-0.01	-0.04	0.12	0.03	0.20	-0.02	0.10	-0.25	-0.15	0.11
	(0.04)	(0.08)	(0.08)	(0.10)	(0.06)	(0.09)	(0.07)	(0.11)	(0.06)	(0.09)	(0.21)	(0.35)	(0.35)
URM × Prop. 209	-0.13	-0.14	-0.16	-0.11	-0.18	-0.26	-0.25	-0.38	-0.02	-0.12	0.38	0.03	0.07
	(0.06)	(0.12)	(0.13)	(0.16)	(0.10)	(0.16)	(0.11)	(0.19)	(0.08)	(0.13)	(0.33)	(0.51)	(0.61)
Acad. Prep.	X	X	X	X	X	X	X	X	X	X	X	X	X
# of Obs.	5,506	4,164	3,800	2,878	3,302	3,146	3,694	2,383	4,055	2,565	1,381	815	784
Mean of Y	2.81	2.60	2.56	2.65	2.71	2.61	2.71	2.78	2.66	2.67	2.65	2.83	2.93
Indicator for Persistence to Next Course (%)													
URM	4.9	0.3	2.8		6.1		9.5		-2.8		-3.7	18.1	
	(2.7)	(2.2)	(3.4)		(3.7)		(3.9)		(2.9)		(10.5)	(13.9)	
URM × Prop. 209	-4.3	-4.6	-13.0		-17.6		-13.3		-2.4		16.1	-21.1	
	(4.0)	(3.4)	(5.3)		(5.9)		(6.3)		(4.1)		(16.4)	(20.4)	
Acad. Prep.	X	X	X		X		X		X		X	X	
# of Obs.	5,669	4,236	3,869		3,333		3,758		4,159		1,406	836	
Mean of Y	68.5	89.8	71.8		73.2		55.8		42.0		51.2	72.8	

Note: Difference-in-difference OLS regression coefficient estimates across 1995-2000 UC Berkeley enrollees (excluding out-of-state students, transfer students, and engineering students), differencing across URM status and post-1998 (after the end of UC's affirmative action policy) using Equation 3. Outcomes include indicator variables for having completed the following course in a sequence of courses by academic field (conditional on having completed the present course in the sequence) or the grade points received in the course (conditional on the student's having earned grade points). Academic preparation covariates in Panel B include: a female indicator, SAT score, high school GPA, SAT writing score, SAT math score, an indicator for submitting an SAT Math 1 score instead of SAT Math 2, and the number of honors courses enrolled in senior year of high school. Standard errors (in parentheses) are robust. The specific courses comprising each course series at Berkeley can be seen in Footnote 44.

Source: UC Corporate Student System and UC-CHP Database (Bleemer, 2018b)

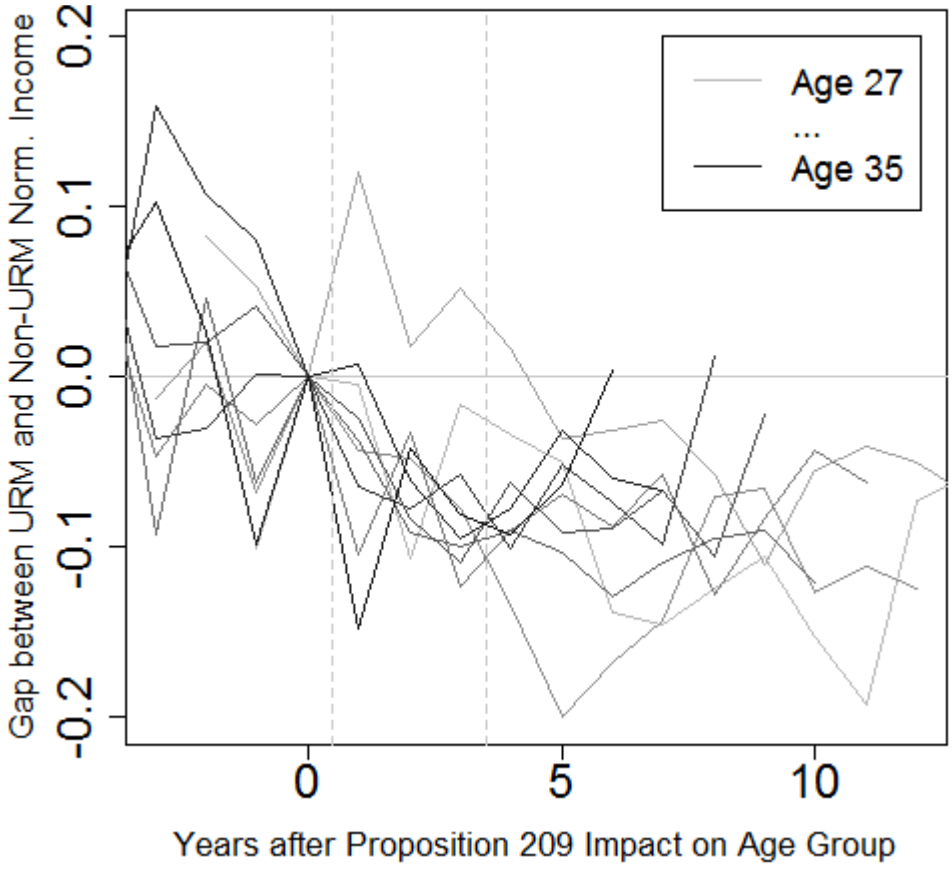
Table 7: Triple-Difference Estimates of URM UC Students' Post-1998 Science Performance and Persistence by Campus

	Chemistry				Biology		Physics		Mathematics		Comp. Science		
	1	2	3	4	1	2	1	2	1	2	1	2	3
Grade in Course (if earned grade)													
URM	0.08†	0.11†	0.17†	0.15	0.09	0.08	0.16*	0.19*	-0.00	-0.03	0.16	0.68*	0.14
×Berkeley	-0.07	-0.43**	-0.50**	-0.30*	-0.13	-0.21†	-0.41**	-0.24*	-0.17*	-0.07	-0.26	-0.58	-0.14
×Davis	0.13*	0.02	-0.11	-0.26*	-0.02	-0.09	-0.04	-0.08	0.11	0.15†	-0.05	-0.56	-0.09
×Santa Barbara	0.07	0.01	-0.22†	-0.17	-0.13	-0.07	-0.25**	-0.30**	-0.05	0.01	-0.19	-0.99*	-0.16
URM × Prop. 209	-0.06	-0.10	-0.15	-0.09	-0.09	0.07	-0.27**	-0.04	0.02	0.12	-0.13	-0.47	0.30
×Berkeley	-0.01	0.13	0.17	-0.00	-0.04	-0.18	0.17	-0.25	0.01	-0.14	0.04	0.61	-1.08
×Davis	-0.06	0.04	0.18	0.22	0.01	-0.16	0.21†	-0.02	-0.02	-0.18†	0.08	0.56	0.07
×Santa Barbara	-0.06	-0.01	0.26	0.03	0.16	-0.04	0.41**	0.11	0.06	-0.09	0.01	0.27	-0.70
Acad. Prep.	X	X	X	X	X	X	X	X	X	X	X	X	X
# Obs.	26,976	17,947	14,046	11,720	16,403	11,103	13,378	9,503	30,786	26,431	5,841	3,210	2,580
Mean of Y	2.51	2.53	2.54	2.58	2.47	2.58	2.72	2.78	2.50	2.53	2.46	2.54	2.80
Indicator for Persistence to Next Course (%)													
URM	2.1	-1.9	-2.3		7.4*		2.6		-1.9		-1.5	-3.0†	
×Berkeley	-6.8†	9.4*	-3.3		-10.2**		-13.6**		-33.7**		-2.8	-0.1	
×Davis	-1.1	8.9*	16.0**		8.1*		-1.3		18.6**		-0.6	0.7	
×Santa Barbara	3.5	3.3	0.9		-23.4**		2.1		-9.8**		-0.4	1.7	
×Santa Cruz	-7.3	-1.9	4.3		-17.6**		7.6†		-17.1**		2.1	4.5†	
URM × Prop. 209	0.5	-1.1	-0.3		-5.4		0.6		0.8		-2.6	0.1	
×Berkeley	-3.9	-8.7†	-9.8*		-11.1*		-5.3		13.4**		-1.2	-3.2	
×Davis	3.2	4.0	0.2		-0.2		-2.8		2.1		-2.1	-3.0	
×Santa Barbara	6.7	5.7	8.0†		15.9**		2.8		2.9		-0.6	-3.2	
×Santa Cruz	5.2	8.5	-5.0		15.1*		2.6		19.7**		8.6*	0.8	
Acad. Prep.	X	X	X		X		X		X		X	X	
# Obs.	28,910	19,388	15,094		17,213		15,066		33,312		7,035	3,922	
Mean of Y	62.3	69.0	78.4		60.1		62.6		68.6		46.3	64.4	

Note: Triple-difference OLS regression coefficient estimates across 1995-2000 UC enrollees from five UC campuses (excluding non-residents, transfer students, and engineering students), differencing across URM status and post-1998 (after the end of UC's affirmative action policy) using Equation 4. The omitted campus is UC Riverside, the least-selective campus. Outcomes include indicator variables for having completed the following course in a sequence of courses by academic field (conditional on having completed the present course in the sequence) or the grade points received in the course (conditional on the student's having earned grade points). Grades are not observed for the Santa Cruz campus, which provided narrative evaluations in place of grades for most of the sample period. Academic preparation covariates include: a female indicator, SAT score, high school GPA, SAT writing score, SAT math score, an indicator for submitting an SAT Math 1 score instead of SAT Math 2, and the number of honors courses enrolled in senior year of high school. Standard errors (not reported) are robust. The specific courses comprising each course series can be seen in Footnote 44. Statistical significance from 0 denoted † 10 percent, * 5 percent, ** 1 percent.

Source: UC Corporate Student System and UC-CHP Database (Bleemer, 2018b)

Figure A-1: Normalized URM Median Wage Gap by Age Group, Relative to pre-Prop. 209 Cohorts



Note: The difference between the (separately) normalized median wages of URM and non-URM California-born respondents in the years before and after baseline year 0, the year in which respondents in that age group would have been 18 in 1995. The dotted grey lines denote the years (1996-1998) in which Proposition 209 phased out AA for members of that age group (when they had graduated high school, assuming age-18 graduation). Samples are not conditional on labor market participation. Wages are in 2018 CPI-adjusted dollars. All statistics are two-year moving averages. Source: 2001-2017 American Community Survey (Ruggles et al., 2018)

Table A-1: Difference-in-Difference Estimates of Post-1998 URM Admissions by UC Campus, Compared to '94-5 Baseline

Campus:	UCLA	UCB	UCSD	UCSB	UCI	UCD	UCSC	UCR	Total
Application conditional on UC application (%)									
URM	12.3	9.5	-3.1	-9.4	-9.6	-5.8	-3.4	-9.3	
	(0.5)	(0.5)	(0.5)	(0.5)	(0.4)	(0.4)	(0.4)	(0.4)	
URM ×	-3.3	-5.4	-0.2	4.0	-0.5	2.3	1.2	6.7	
Prop. 209	(0.6)	(0.6)	(0.6)	(0.6)	(0.5)	(0.5)	(0.5)	(0.5)	
R^2	0.23	0.18	0.12	0.15	0.22	0.23	0.13	0.22	
Obs.	170,083	170,083	170,083	170,083	170,083	170,083	170,083	170,083	
Admission conditional on application (%)									
URM	46.8	41.7	23.5	10.5	19.3	30.4	11.8	13.8	11.1
	(0.6)	(0.5)	(0.6)	(0.6)	(0.6)	(0.7)	(0.6)	(0.7)	(0.3)
URM ×	-33.0	-30.9	-20.0	-1.2	-13.0	-21.6	-11.4	-13.9	-10.4
Prop. 209	(0.8)	(0.6)	(0.7)	(0.7)	(0.8)	(0.8)	(0.8)	(0.8)	(0.4)
R^2	0.37	0.46	0.53	0.44	0.44	0.39	0.33	0.32	0.24
Obs.	78,556	94,783	85,774	71,025	62,329	66,191	39,587	39,776	170,083
Enrollment conditional on **application** (%)									
URM	15.7	15.1	-0.2	-1.9	-2.5	2.6	-2.3	0.5	8.0
	(0.6)	(0.5)	(0.6)	(0.6)	(0.7)	(0.7)	(0.8)	(0.8)	(0.5)
URM ×	-11.5	-12.8	-1.9	3.2	-1.0	-2.8	0.0	-3.2	-11.6
Prop. 209	(0.7)	(0.6)	(0.7)	(0.8)	(0.9)	(0.9)	(1.0)	(1.0)	(0.6)
R^2	0.09	0.09	0.06	0.05	0.07	0.07	0.08	0.12	0.08
Obs.	78,556	94,783	85,774	71,025	62,329	66,191	39,587	39,776	170,083
Enrollment conditional on **admission** (%)									
URM	-21.4	-18.4	-16.4	-8.4	-14.8	-12.6	-6.7	-4.4	1.3
	(1.1)	(0.9)	(0.9)	(0.8)	(0.9)	(0.8)	(0.9)	(0.9)	(0.5)
URM ×	11.3	9.5	9.7	5.5	5.4	6.8	3.9	1.4	-6.1
Prop. 209	(1.6)	(1.2)	(1.2)	(1.0)	(1.1)	(1.1)	(1.1)	(1.1)	(0.7)
R^2	0.15	0.18	0.13	0.13	0.18	0.16	0.12	0.16	0.06
Obs.	27,682	37,998	47,064	50,178	44,267	46,880	33,558	34,248	147,833

Note: OLS coefficient estimates of β_2 and β_3 from Equation 1, a difference-in-difference model of 1994-1995 and 1998-1999 URM UC freshman California-resident applicants' UC applications, admissions, and enrollment compared to non-URM applicants after the 1998 end of UC's affirmative action program. The years 1996-1997 are omitted because some universities preemptively curtailed their AA programs in those years. Covariates include high school fixed effects and a series of academic preparation controls: a female indicator, SAT I verbal and math scores, high school GPA, three SAT II scores (writing, mathematics, and a third of the student's choice), indicators for SAT II exam choices, and the number of honors courses enrolled in senior year of high school. Models are estimated independently by campus or "Total", including all applicants to any UC campus. Robust standard errors in parentheses.

Source: UC Corporate Student System

Table A-2: Difference-in-Difference Estimates of URM UC Applicants' Post-1998 Postsecondary Enrollment

	UC Campuses by Selectivity							
	Most	Middle	Least	CSU	Comm. Coll.	CA Priv.	Non-CA	Not in NSC
Panel C: Diff-in-Diff Coefficients Overall (versus 1995)								
URM	12.20	-6.02	-2.34	-4.76	-2.85	2.49	0.40	0.56
	(0.54)	(0.55)	(0.33)	(0.43)	(0.40)	(0.41)	(0.43)	(0.33)
URM ×	-9.72	2.48	1.63	2.96	0.73	1.30	1.70	-0.96
Prop. 209	(0.61)	(0.62)	(0.38)	(0.49)	(0.45)	(0.46)	(0.48)	(0.38)
R^2	0.18	0.05	0.07	0.11	0.08	0.04	0.09	0.03
Obs.	134,101	134,101	134,101	134,101	134,101	134,101	134,101	134,101

Note: This table extends Table 3 in the text; see the note to that table. Estimates of β_2 and β_3 from Equation 1, an OLS difference-in-difference model of 1994-1995 and 1998-1999 URM UC freshman California-resident applicants' enrollment outcomes compared to non-URM outcomes after the 1998 end of UC's affirmative action program. The years 1996-1997 are omitted because some universities preemptively curtailed their AA programs in those years.

Source: UC Corporate Student System and National Student Clearinghouse

Table A-3: Difference-in-Difference Estimates of URM UC Applicants' Post-1998 University Characteristics

	First Four-Year Institution (IPEDS)					Institutional VA	
	Admission Rate	Average SAT Score	Six Year Grad. Rate	Sticker Price	Own Net Price	Five Year BA Attain.	Ten Year Earnings
Panel C: Diff-in-Diff Coefficients Overall (versus 1995)							
URM	-6.1	53.3	3.9	1,479.9	-35.5	2.8	3,420.1
	(0.3)	(2.2)	(0.2)	(116.2)	(33.4)	(0.2)	(121.4)
URM ×	3.5	-31.5	-2.7	99.8	-104.8	-1.2	-1,320.0
Prop. 209	(0.3)	(2.4)	(0.2)	(129.9)	(37.4)	(0.2)	(135.9)
R^2	0.21	0.39	0.33	0.18	0.13	0.19	0.30
Obs.	102,794	101,236	102,927	98,907	80,440	122,459	121,078

Note: This table extends Table 4 in the text; see the note to that table. Estimates of β_2 and β_3 from Equation 1, a difference-in-difference model of 1995 and 1998-1999 URM UC freshman California-resident applicants' outcomes compared to non-URM outcomes after the 1998 end of UC's affirmative action program. The years 1996-1997 are omitted because some universities pre-emptively curtailed their AA programs in those years.

Source: UC Corporate Student System, National Student Clearinghouse, and the Integrated Postsecondary Education Data System (IPEDS)

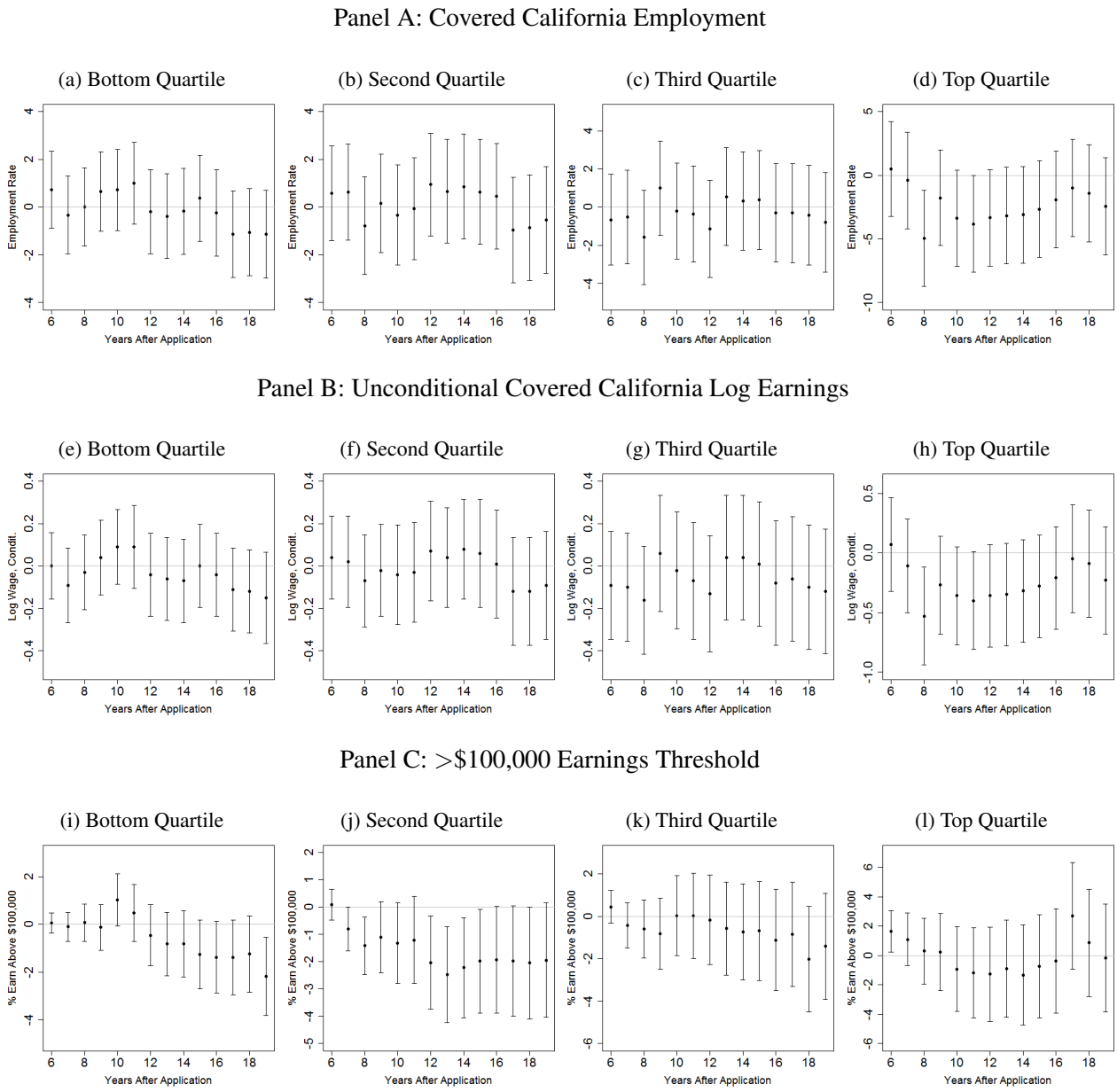
Table A-4: Difference-in-Difference Estimates of URM UC Applicants' Post-1998 Educational Outcomes

	Earn Bach. Degree		Earn STEM Degree		Earn Grad. Degree		
	5-Year	6-Year	Uncondit.	Condit.	All	JD	MD
Panel C: Diff-in-diff coefficients overall (versus 1995)							
URM	-0.71	-1.06	-0.10	-0.99	5.36	1.26	1.07
	(0.61)	(0.58)	(0.51)	(0.75)	(0.45)	(0.20)	(0.13)
URM ×	-1.29	-1.23	-0.47	0.86	-2.77	-1.06	-0.38
Prop. 209	(0.68)	(0.65)	(0.58)	(0.85)	(0.56)	(0.25)	(0.16)
R^2	0.130	0.109	0.178	0.237	0.098	0.040	0.034
Obs.	134,101	134,101	134,101	88,632	170,083	170,083	170,083
Panel D: Diff-in-diff measured with only UC administrative data							
URM	-3.06	-2.00	-0.69	-0.64			
	(0.57)	(0.53)	(0.28)	(0.33)			
URM ×	-0.04	-0.23	-0.65	-0.73			
Prop. 209	(0.73)	(0.68)	(0.36)	(0.43)			
R^2	0.11	0.09	0.04	0.04			
Obs.	92,194	92,194	92,194	74,642			
Panel E: Diff-in-diff with NSC *augmented* with UC administrative data							
URM	-2.04	-2.33	-0.33	-0.20			
	(0.42)	(0.39)	(0.36)	(0.36)			
URM ×	-0.90	-0.98	-0.61	-0.68			
Prop. 209	(0.52)	(0.49)	(0.46)	(0.45)			
R^2	0.13	0.11	0.18	0.18			
Obs.	182,525	182,525	182,525	182,525			

Note: This table extends Table 5 in the text; see the note to that table. Estimates of β_2 and β_3 from Equation 1, an OLS difference-in-difference model of 1996-1999 (or, in Panel C, 1995 and 1998-1999) URM UC freshman California-resident applicants' educational outcomes compared to non-URM outcomes after the 1998 end of UC's affirmative action program. The years 1996-1997 are omitted in Panel C because some universities preemptively curtailed their AA programs in those years. Outcomes are measured in NSC in Panel C, in UC administrative data in Panel D (excluding applicants who do not enroll at a UC campus), and in NSC augmented with UC administrative data (which are used to identify additional degrees unreported in NSC) in Panel E.

Source: UC Corporate Student System and National Student Clearinghouse

Figure A-2: Difference-in-Difference Estimates of URM Berkeley Students' Labor Market Outcomes by AIS Quartile



Note: Estimates of β_2 and β_3 from Equation 1, an OLS difference-in-difference model of 1996-1999 URM UC freshman California-resident applicants' educational outcomes compared to non-URM outcomes after the 1998 end of UC's affirmative action program. Outcomes defined as non-zero California earnings ("Covered California Employment"), unconditional log California earnings, and unconditional indicators for having earnings above a $100,000 earnings threshold as measured in the California Employment Development Department database, which excludes out-of-state, self-employment, and federal government earnings. Coefficients in each year after high school graduation are estimated independently. Covariates include high school fixed effects and a series of academic preparation controls: a female indicator, SAT I verbal and math scores, high school GPA, three SAT II scores (writing, mathematics, and a third of the student's choice), indicators for SAT II exam choices, and the number of honors courses enrolled in senior year of high school. Academic Index (AIS) is the sum of SAT I scores, SAT II scores, and weighted high school GPA (censored at 4) multiplied by 1,000; estimates by quartile are estimated independently. Robust 95-percent confidence intervals shown. Source: UC Corporate Student System and the California Employment Development Department

Table A-5: 1994-2001 Change in UC Application Rates in Public CA High Schools by Ethnicity

		All Campuses			Most-Selective Campuses		
		Unweighted	Weighted		Unweighted	Weighted	
Black	1995	0.029	0.022	0.015	0.020	0.013	0.013
		(0.028)	(0.019)	(0.017)	(0.026)	(0.018)	(0.016)
	1996	-0.017	-0.008	-0.016	-0.037	-0.011	-0.010
		(0.029)	(0.021)	(0.019)	(0.026)	(0.018)	(0.016)
	1997	-0.030	-0.033	-0.039	-0.033	-0.038	-0.042
		(0.029)	(0.020)	(0.019)	(0.026)	(0.019)	(0.017)
	1998	-0.041	-0.045	-0.048	-0.045	-0.053	-0.051
		(0.027)	(0.019)	(0.018)	(0.024)	(0.018)	(0.016)
	1999	-0.018	-0.052	-0.055	-0.048	-0.070	-0.066
		(0.029)	(0.021)	(0.019)	(0.026)	(0.019)	(0.017)
	2000	-0.024	-0.041	-0.041	-0.029	-0.054	-0.050
		(0.029)	(0.021)	(0.018)	(0.026)	(0.018)	(0.016)
	2001	-0.024	-0.046	-0.053	-0.039	-0.068	-0.066
		(0.028)	(0.022)	(0.019)	(0.025)	(0.019)	(0.016)
Hispanic	1995	0.005	-0.003	-0.010	0.001	-0.008	-0.010
		(0.018)	(0.014)	(0.012)	(0.016)	(0.012)	(0.010)
	1996	-0.033	-0.030	-0.039	-0.013	-0.013	-0.016
		(0.018)	(0.015)	(0.013)	(0.016)	(0.013)	(0.011)
	1997	-0.037	-0.049	-0.051	-0.024	-0.037	-0.041
		(0.019)	(0.015)	(0.013)	(0.017)	(0.013)	(0.011)
	1998	-0.040	-0.054	-0.053	-0.042	-0.044	-0.041
		(0.018)	(0.014)	(0.013)	(0.016)	(0.012)	(0.011)
	1999	-0.060	-0.063	-0.064	-0.060	-0.060	-0.057
		(0.018)	(0.015)	(0.013)	(0.015)	(0.012)	(0.011)
	2000	-0.042	-0.053	-0.056	-0.045	-0.048	-0.046
		(0.019)	(0.016)	(0.013)	(0.017)	(0.013)	(0.012)
	2001	-0.052	-0.052	-0.054	-0.036	-0.041	-0.042
		(0.019)	(0.016)	(0.014)	(0.017)	(0.013)	(0.012)
Asian	1995	0.021	0.003	0.007	0.020	-0.003	0.000
		(0.020)	(0.014)	(0.012)	(0.018)	(0.012)	(0.011)
	1996	-0.004	0.009	0.008	-0.003	0.013	0.012
		(0.021)	(0.014)	(0.012)	(0.018)	(0.012)	(0.011)
	1997	0.003	0.008	0.010	0.018	0.006	0.003
		(0.021)	(0.015)	(0.013)	(0.018)	(0.013)	(0.012)
	1998	0.022	0.015	0.017	0.018	-0.002	0.000
		(0.021)	(0.014)	(0.013)	(0.019)	(0.012)	(0.011)
	1999	0.024	0.004	0.002	0.015	-0.015	-0.012
		(0.022)	(0.014)	(0.012)	(0.019)	(0.013)	(0.011)
	2000	0.029	0.009	0.016	0.030	-0.006	0.002
		(0.021)	(0.015)	(0.013)	(0.020)	(0.013)	(0.012)
	2001	0.018	0.022	0.023	0.024	0.005	0.009
		(0.022)	(0.014)	(0.013)	(0.019)	(0.013)	(0.012)
HS×Eth.		X	X	X	X	X	X
HS×Year		X	X	X	X	X	X
by Eth.×Gender				X			X
R^2		0.71	0.89	0.81	0.69	0.89	0.81
N		20,777	20,777	38,442	21,333	21,333	39,319

Note: In Progress.

Table AA-1: Replication of Table 3 in Arcidiacono et al. (2014) with Additional Specifications: *Pre- to Post-Prop 209 Changes in Graduation Rates: Without & with Controls"*

	Estimates Reported in AACH (2014)				Replication			
Dep. Var:	*POST*	*POST*× *Q1(AI)*[1]	*POST*× *Q2(AI)*	*POST*× *Q3(AI)*	*POST*	*POST*× *Q1(AI)*	*POST*× *Q2(AI)*	*POST*× *Q3(AI)*
Panel A: Underrepresented Minority								
No Controls	0.044**				0.044**			
AACH Controls[2]	0.030**				0.031**			
Add GPA, SAT[3]					0.009			
AACH Controls	0.005	0.035*	0.037**	0.035**	0.005	0.032*	0.037**	0.035**
Add GPA, SAT					-0.010	0.014	0.026†	0.033**
Panel B: White								
No Controls	0.025**				0.025**			
AACH Controls	0.014**				0.015**			
Add GPA, SAT					0.006			
AACH Controls	0.011†	-0.002	0.001	0.002	0.011†	0.002	0.014†	0.001
Add GPA, SAT					0.004	-0.000	0.010	-0.004
Panel C: Non-URM								
No Controls					0.028**			
AACH Controls					0.018**			
Add GPA, SAT					0.010**			
AACH Controls					0.008†	0.008	0.018**	0.011*
Add GPA, SAT					0.002	0.005	0.017**	0.007

Note: Single-difference OLS regression coefficient estimates across all 1995-2000 University of California undergraduate enrollees (excluding transfer and out-of-state students), differencing across post-1998 (after the end of UC's affirmative action policy). The outcome is an indicator for earning a UC degree within five years of admission. Models are estimated independently by ethnicity categoty and include listed covariates. Coefficients by Academic Index quartile are estimated simultaneously relative to the top quartile. This table replicates and augments Table 3 in Arcidiacono et al. (2014). Statistical significance: † 10 percent, * 5 percent, ** 1 percent.

[1] As in Arcidiacono et al. (2014), academic index quartiles are based on pre-Prop 209 enrollees and are subgroup-specific.

[2] The same as "Extended Controls 2" in Arcidiacono et al. (2014): controls include Academic Index interacted with parental education indicators, binned parental income indicators, and indicators for intended major.

[3] The same controls as in *AACH Controls*, adding continuous high school GPA, SAT Math, SAT Verbal, and SAT II Writing scores instead of the AI main effect.

Source: UC Corporate Student System

Table BB-1: Replication of Card/Krueger (2005), All UC Campuses

	Any UC Campus						
	Send	Apply	Send	Apply	Send	Apply	Apply
1995	0.005	-0.012	0.002	-0.007	0.009	-0.002	-0.004
	(0.004)	(0.004)	(0.012)	(0.014)	(0.011)	(0.013)	(0.013)
1996	-0.002	-0.033	0.016	-0.012	0.016	-0.029	-0.032
	(0.004)	(0.004)	(0.012)	(0.014)	(0.011)	(0.013)	(0.012)
1997	-0.010	-0.040	0.011	-0.026	0.015	-0.006	-0.008
	(0.004)	(0.004)	(0.012)	(0.014)	(0.011)	(0.012)	(0.012)
1998	-0.019	-0.044	-0.010	-0.054	0.009	-0.028	-0.029
	(0.004)	(0.004)	(0.012)	(0.014)	(0.010)	(0.012)	(0.012)
1999	-0.020	-0.049	0.001	-0.027	0.015	-0.019	-0.022
	(0.004)	(0.004)	(0.012)	(0.014)	(0.010)	(0.012)	(0.012)
2000	-0.022	-0.047	0.012	-0.030	0.013	-0.038	-0.040
	(0.004)	(0.004)	(0.012)	(0.014)	(0.010)	(0.012)	(0.012)
2001	-0.028	-0.038	0.004	-0.014	0.006	-0.002	-0.006
	(0.004)	(0.004)	(0.012)	(0.014)	(0.010)	(0.012)	(0.012)
CK Controls	X	X	X	X	X	X	X
Pred. Eth.							X
Sample	Full		High SAT		High GPA		
R^2	0.20	0.31	0.12	0.18	0.09	0.17	0.17
N	891,254	891,254	208,765	208,765	179,682	179,682	179,682

Note: In Progress

Table BB-2: Replication of Card/Krueger (2005), Most-Selective UC Campuses

	Berkeley and UCLA								
	Send	Apply	Send	Apply	Send	Apply	Send	Apply	Apply
1995	0.002	-0.004	0.000	-0.013	0.011	-0.008	-0.006	-0.018	-0.019
	(0.004)	(0.003)	(0.014)	(0.014)	(0.012)	(0.013)	(0.011)	(0.012)	(0.011)
1996	-0.005	-0.026	0.024	-0.006	0.015	-0.035	0.002	-0.021	-0.022
	(0.004)	(0.003)	(0.014)	(0.014)	(0.012)	(0.013)	(0.011)	(0.011)	(0.011)
1997	-0.007	-0.030	0.012	-0.021	0.029	-0.007	-0.004	-0.035	-0.038
	(0.004)	(0.003)	(0.014)	(0.014)	(0.012)	(0.012)	(0.010)	(0.011)	(0.011)
1998	-0.016	-0.032	-0.007	-0.047	0.011	-0.032	-0.007	-0.035	-0.037
	(0.004)	(0.003)	(0.014)	(0.014)	(0.012)	(0.012)	(0.010)	(0.011)	(0.011)
1999	-0.018	-0.041	-0.005	-0.027	0.013	-0.032	-0.008	-0.075	-0.076
	(0.004)	(0.003)	(0.014)	(0.014)	(0.012)	(0.012)	(0.010)	(0.011)	(0.011)
2000	-0.020	-0.033	0.016	-0.011	0.017	-0.037	-0.006	-0.028	-0.031
	(0.004)	(0.003)	(0.014)	(0.014)	(0.012)	(0.012)	(0.010)	(0.011)	(0.011)
2001	-0.020	-0.027	0.021	-0.003	0.025	-0.001	0.014	-0.007	-0.007
	(0.004)	(0.003)	(0.014)	(0.014)	(0.012)	(0.012)	(0.010)	(0.011)	(0.011)
CK Controls	X	X	X	X	X	X	X	X	X
Pred. Eth.									X
	Full		High SAT		High GPA		AIS 5500-7000		
R^2	0.24	0.30	0.21	0.23	0.17	0.21	0.12	0.11	0.11
N	891,254	891,254	208,765	208,765	179,682	179,682	212,133	212,133	212,133

Note: In Progress

Source: In Progress

Table BB-3: Relationship between SAT Send Rates and UC Application

		Coef.	St. Err.	p			Coef.	St. Err.	p
Send		0.371	(0.003)	0.000	Send×SAT		0.189	(0.003)	0.000
URM		0.020	(0.003)	0.000	URM×SAT		0.007	(0.003)	0.018
Norm. SAT		-0.001	(0.002)	0.564	Send×URM×SAT		-0.035	(0.005)	0.000
Send×URM		0.023	(0.005)	0.000					
Indicator	1995	-0.001	(0.002)	0.701	Send×URM×	1995	-0.005	(0.007)	0.480
	1996	0.002	(0.002)	0.439		1996	-0.032	(0.007)	0.000
	1997	0.003	(0.002)	0.183		1997	-0.041	(0.007)	0.000
	1998	0.002	(0.002)	0.219		1998	-0.042	(0.007)	0.000
	1999	0.008	(0.002)	0.000		1999	-0.058	(0.007)	0.000
	2000	0.007	(0.002)	0.000		2000	-0.052	(0.007)	0.000
	2001	-0.003	(0.002)	0.161		2001	-0.045	(0.007)	0.000
Send×	1995	0.032	(0.004)	0.000	Send×SAT×	1995	0.001	(0.004)	0.875
	1996	0.042	(0.004)	0.000		1996	0.009	(0.004)	0.014
	1997	0.026	(0.004)	0.000		1997	0.016	(0.004)	0.000
	1998	0.030	(0.004)	0.000		1998	0.012	(0.004)	0.000
	1999	0.042	(0.004)	0.000		1999	-0.002	(0.003)	0.589
	2000	0.046	(0.004)	0.000		2000	-0.001	(0.003)	0.755
	2001	0.080	(0.004)	0.000		2001	0.003	(0.003)	0.453
URM×	1995	0.001	(0.005)	0.915	URM×SAT×	1995	0.001	(0.004)	0.795
	1996	-0.004	(0.005)	0.450		1996	-0.001	(0.004)	0.755
	1997	-0.001	(0.005)	0.798		1997	0.001	(0.004)	0.856
	1998	0.000	(0.005)	0.960		1998	-0.003	(0.004)	0.552
	1999	-0.007	(0.005)	0.122		1999	-0.006	(0.004)	0.157
	2000	-0.001	(0.005)	0.892		2000	-0.002	(0.004)	0.640
	2001	0.002	(0.005)	0.596		2001	-0.000	(0.004)	0.978
SAT×	1995	-0.001	(0.002)	0.541	Send×URM×SAT×	1995	0.008	(0.007)	0.258
	1996	0.002	(0.002)	0.342		1996	0.015	(0.007)	0.037
	1997	0.003	(0.002)	0.204		1997	0.004	(0.007)	0.530
	1998	0.007	(0.002)	0.001		1998	0.000	(0.007)	0.953
	1999	0.012	(0.002)	0.000		1999	0.021	(0.007)	0.002
	2000	0.009	(0.002)	0.000		2000	0.021	(0.007)	0.002
	2001	-0.000	(0.002)	0.914		2001	0.029	(0.007)	0.000
R^2					0.51				
N					841,358				

Note: In Progress

Source: In Progress