The Effects of Proposition 209 on College Enrollment and Graduation Rates in California*

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Abstract

Proposition 209 banned the use of racial preferences in admissions at public colleges in California. Although enrollments for minorities fell post-Prop 209, two-thirds of the drop came from the CSU system which consists primarily of non-selective institutions. More notably, we find that minority graduation rates increased after Prop 209 was implemented, a finding consistent with the argument that affirmative action bans result in better matching of students to colleges. To address the robustness of the positive effects on graduation and the role of matching, we analyze unique data for all applicants and enrollees within the University of California (UC) system before and after Prop 209. The positive Prop 209 effects on minority graduation rates persist, even after controlling for observed and unobserved qualifications of UC enrollees. We present evidence that certain institutions are better at graduating more-prepared students while other institutions are better at graduating less-prepared students and that these matching effects are particularly important for the bottom tail of the qualification distribution. In terms of graduation rates, we find that Prop 209 led to a more efficient sorting of minority students.

Keywords: Affirmative Action, College Enrollment, College Graduation.

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1 Introduction

In 1996, the voters of California approved Proposition 209 – Prop 209 hereafter – which stipulates that: "The state shall not discriminate against, or grant preferential treatment to, any individual or group on the basis of race, sex, color, ethnicity, or national origin in the operation of public employment, public education, or public contracting." The Proposition took effect in 1998. It set off a debate about the consequences of its ban on the use of affirmative action in the admissions at California's public colleges and universities[1] and its impact on the educational opportunities and attainment for minorities that has continued across the U.S. as other states contemplated similar bans or had them imposed by courts.[2]

Proponents of affirmative action in college admissions claim that bans like Prop 209 reduce minority enrollments at public colleges, especially ones with selective admissions, and thereby help to preserve existing racial and ethnic disparities in employment and earnings in later life.[3] In contrast, opponents of affirmative action argued that such bans reduce the problem of "minority mismatch." According to the mismatch hypothesis,[4] affirmative action in admissions leads to underrepresented minorities being admitted to colleges with entering credentials that are lower than their non-minority counterparts, with this disparity typically more pronounced at more-selective ones. As a result, minority students are likely to achieve lower grades and are less likely to graduate than their non-minority counterparts, which would be remedied if affirmative action was banned.[5]

In this paper we examine the effects that Prop 209 had on college enrollments and graduation rates in California. As noted above, much of the debate about the effects of affirmative action bans centers on their impacts on the college attendance of underrepresented minorities, whether they graduate and how long it takes them if they do.[6] Furthermore, as documented in Turner (2004), Bound and Turner (2007, 2011), and Bound, Lovenheim and Turner (2010a), while the number of students attending college has increased over the past three decades in the U.S., college graduation rates (i.e., the fraction of college enrollees that graduate) and college attainment rates (i.e., the fraction of the population with a college degree) have hardly changed since 1970 and the time it takes college students to complete a baccalaureate (BA) degree has increased (Bound, Lovenheim and Turner, 2010b). The disparities between the trends in college attendance and completion or time-to-completion of college degrees is all the more stark given that the earnings premium for a college degree relative to a high school degree nearly doubled over this same period (Goldin and Katz, 2008).

We follow recent studies of the effects of affirmative action bans (Hinrichs, 2010, 2011, and Backes, 2011) and examine how the one under Prop 209 affected enrollments and graduation rates at baccalaureate granting colleges. In particular, we focus much of our analyses on what

[1] Hereafter, we refer to both colleges and universities as "colleges."

[2] Affirmative action bans affecting public university admissions also were passed in Washington, Georgia, Nebraska, Michigan and Arizona, were court-ordered in Texas and were instituted by executive order in Florida.

[3] See Kellough (2006) for a concise introduction to various arguments for and against affirmative action.

[4] See Arcidiacono et al. (2011) for characterization of this hypothesis.

[5] See the debate over mismatch effects in law schools in Sander (2004), Ayres and Brooks (2005), Ho (2005), Chambers et. al. (2005), Barnes (2007) and Rothstein and Yoon (2008).

[6] Research also has examined the effects of affirmative action (or banning it) on aspects of the college application process (Card and Krueger, 2005; Long 2004) and Antonovics and Backes (2011). Also see Arcidiacono (2005) for evidence for the effects of affirmative action on labor market earnings after college.

happened to enrollments and graduation rates for the campuses/schools within the University of California (UC) and California State University (CSU) systems, as the admissions procedures of both systems were subject to Prop 209's ban. We distinguish the effects that occurred at selective public colleges from those with less-selective admissions policies, since previous research has found that the effects of such bans have been concentrated among selective colleges (Hinrichs 2010, 2011). Finally, we also examine what, if any, indirect effects the implementation of Prop 209 had on California's private universities. While private universities in the state were not subject to this ban, they may have been affected to the extent that they "compete" with California's public universities for students.[7]

To examine the effects of Prop 209 we use two different sources of data. As in several recent studies (Hinrichs 2010, 2011, and Backes 2011), we begin our analysis with college-level data from the Integrated Postsecondary Education Data System (IPEDS) to examine the patterns of the enrollments and graduation rates – both on-time and within 6 years – of students at all California public and private colleges both before and after this ban took effect. These data provide us with a comprehensive picture of what happened at different types of colleges, i.e., public vs. private and more- vs. less-selective. Exploiting the longitudinal nature of these data, we formulate model-based estimates of the effects of Prop 209 on enrollment and graduation that control for institution by race/ethnic group fixed effects to better isolate the causal effects of this ban. But, as we discuss below, the IPEDS data have some important limitations for our analysis. Chief among them is that they contain no information on student preparation for college (high school grade point averages (GPA) and SAT or ACT test scores) or family background (parental income) of enrolled or graduating students. As a result, it is difficult to sort out the impact of affirmative action bans on enrollment and graduation outcomes at different types of schools from differences and changes in the composition of students attending particular colleges. The difficulty in accounting for the latter differences has plagued many of the recent evaluations of affirmative action bans.[8]

To help sort out these two forces, we make use of a second, and unique, source of student-level data for the universe of individuals that applied to one or more of the UC campuses in the years before and after Prop 209. These data, obtained from the University of California Office of the President (UCOP).[9] These data contain measures of high school GPAs and SAT scores and of parental income and education, which allow us to both control for these factors in evaluating the effects of Prop 209 but also assess how they influence minority (and non-minority) graduation probabilities at the various UC campuses. The UCOP data provide information not only on which UC campus a student enrolled and gradyated, if they did, but also on the other UC campuses to which they applied and the ones to which they were admitted. We use the information on the UC campuses to which students were admitted, and the quality of those UC campuses, to implement a modified version of the Dale and Krueger (2002) to control for student qualifications beyond those measured by high school GPA and test scores.

Using the IPEDS data, we find that after the implementation of Prop 209 *college enrollment rates* of African Americans and Hispanics in California's 4-year public colleges *fell*, both relative

[7] Backes (2011) also examines the effects of bans on the college enrollments and completion rates of minorities.

[8] As Hinrichs (2011) notes in his study of the effects of such bans on college graduation rates using IPEDS data, "I do find that graduation rates for underrepresented minorities at selective universities rise, although I acknowledge that this may be due to the changing composition of students who enroll at such universities." (p. 5).

[9] These data were obtained by Professor Richard Sander of UCLA under a Freedom of Information Act request.

to pre-Prop 209 rates and relative to the corresponding rate of whites and Asian Americans. These findings are consistent with previous research on the effects of bans on minority enrollment (Tienda et al. 2003; Long, 2007; Hinrichs, 2010; Backes, 2011). However, two-thirds of the decline in minority public college enrollment occurred in the CSU system, which primarily consists of non-selective institutions. This result is particularly surprising given that less-selective UC schools – which are still more selective than CSU schools – saw *increases* in minority enrollment. Given that admissions in the CSU should have been relatively unaffected by Prop 209, we would have expected *increases* in minority enrollment in the CSU system as a result of minority students now being rejected from more-selective UC schools. We present evidence that a different policy change, unique to the CSU system and implemented around the same time as Prop 209, appears to have been responsible for the observed declines in minority enrollments within this system.

In contrast to the results on enrollment, minority *college graduation rates*, both on-time and within 6 years of enrollment, *improved* for California's public 4-year colleges with the implementation of Prop 209 and improved relative to the corresponding rates of whites or Asian Americans. And we find that on-time *college* (degree) *attainment rates* either remained constant or increased slightly after passage of Prop 209. Moreover, the improvements in minority graduation rates tend to be larger at either the less-selective UC campuses (for African Americans) or the CSU system (Hispanics). Again, these patterns show up in our unadjusted tabulations and our model-based estimates using IPEDS data.

Our finding that minority college graduation rates improved after the implementation of Prop 209 is consistent with what one would predict would happen after such a ban if minority mismatch occurred under affirmative action admissions policies. But, it also is consistent with Prop 209 disproportionately reducing the number of less-academically prepared minorities attending all public colleges, including less-selective ones, and minority graduation rates increasing solely due to the change in pool of minority college enrollees.

Using the UCOP student-level data, we still find that underrepresented minorities are more likely to graduate from a UC campus post-Prop 209, even after one controls for direct and indirect measures of pre-college preparation and family background. The improvements over pre-Prop 209 graduation rates range from 3% to 7% depending on the controls used. Moreover, the increase in graduation rates for minorities are substantially larger than the corresponding estimates for other racial/ethnic groups.

What might account for these improvements in graduation rates in the UC system after the implementation of Prop 209? Are they the result of better matching of students to campuses based on the former's academic preparation? We investigate how campuses differ in the academic preparation of their students and their graduation rates. Unsurprisingly, we find that more-selective UC campuses, such as UC Berkeley and UCLA, enroll better prepared minority and non-minority students and have higher graduation rates than less-selective campuses, such as UC Santa Cruz and UC Riverside. This is true both before and after the implementation of Prop 209. Both the graduation rates and academic preparation of minority students improved at each campus after Prop 209 went into effect. However, these improvements in graduation rates were not uniform across campuses and were not that highly correlated with school selectivity. For example, UC Santa Barbara had the biggest improvement in graduation rates for minority (*and* non-minority) students after Prop 209 was implemented, even though it ranked in the bottom third of UC campuses in the 1997 *U.S. News & World Report* university rankings. These

patterns suggest that campuses differ in their capacities to train and graduate students with differing academic preparations and that better matching of students to campuses on academic preparation after Prop 209 may have contributed to the improvements in graduation rates.

To better isolate the potential importance of student-campus matching, we estimate a model of the graduation rates of UC enrollees that allows campuses to differ in their likelihood of graduating students with differing academic preparation. We find substantial heterogeneity across campuses in their graduation "productivities," especially across students with differing academic preparations. While some UC campuses (UC Santa Barbara) appear to have had an absolute advantage in producing high graduation rates across the academic preparation of minority students, other campuses are particularly well-suited for graduating more-prepared students (UCLA and UC San Diego) and other campuses are particularly well-suited for graduating less-prepared students (UC Riverside and UC Santa Cruz). The match between the school and the university is particularly important for students who are less prepared, as those who are more prepared are likely to graduate regardless of the school they attend. Finally, we find that part of the reason graduation rates for minorities improved after Prop 209 was because of more efficient matching, with the largest improvements occurring among less-prepared students.

The remainder of the paper is organized as follows. In Section 2, we summarize enrollment and graduation trends at California's colleges for minority and non-minority students using IPEDS data. Section 3 presents forecasts of the effects of Prop 209 from estimates of a model of college enrollment and graduation decisions that we estimate with the college-level IPEDS data. As noted above, we find somewhat anomalous evidence that minority enrollment rates declined with the CSU system, even though they went up at less-selective UC campuses. We examine an alternative explanation for these findings in Section 3.2. In Section 4 we take a closer look at the effects of Prop 209 with new and rich individual-level data for the UC system. We describe these data in Section 4.1 and present estimates of the net effect of Prop 209 on the graduation rates of minorities and non-minorities UC enrollees in Section 4.2. Finally, in Sections 4.3 and 4.4 we present our findings concerning across-campuses differences in the production of minority graduation rates and their implications for the role that better student-campus matching can and did play in improving these rates.

2 Enrollment and Graduation at California's Colleges Before and After Prop 209

We begin by examining what happened to enrollments and graduations at California's universities and colleges before and after the enactment of Prop 209. We use data from the Integrated Postsecondary Education Data System (IPEDS). IPEDS includes information on all post secondary institutions that participate in Title IV federal student financial aid programs, such as Pell Grants or Stafford Loans.[10] We focus on enrollments and graduation of students seeking a bachelor's degrees at 4-year institutions.

Over the period we consider (1996 - 2001), there were 83 4-year colleges/universities in

[10]Institutions that do not participate in these programs can still submit their information to IPEDS on a voluntary basis.

Table 1: Characteristics of California's 4-Year Universities and Colleges, 1996-2001

	Number	Share of Calif. 4-yr College	Share of 1996 Enrollments	Share of Graduates in $\leq$ 6 yrs
4-yr Colleges/Universities	83			
U. of Calif. (UC) campuses	8	9.6%	33.9%	43.8%
Calif. State Univ. (CSU) campuses	22	26.5%	39.8%	27.7%
Private Universities	49	59.0%	24.2%	27.7%
For-Profit Universities	4	4.8%	2.1%	0.8%
Public Univ. in Top 50 *U.S. News* Ranking†	6	7.2%	29.1%	38.5%
Private Univ. in Top 50 *U.S. News* Ranking†	6	7.2%	8.0%	11.0%

Data Source: IPEDS. Share of graduates refers to the 1996 entering cohort.
† Number of colleges/universities that were in the 1997 *U.S. News & World Report* Top 50 "National Universities" or Top 50 "Liberal Arts Colleges." See *U.S. News & World Report*, Sept 16, 1996, 121(11): 110, 116.

California [Table 1].[11] Eight of these institutions were campuses in the University of California (UC) system, 22 were in the California State University (CSU) system, 49 were private, not-for-profit schools and there were 4 for-profit universities with campuses in California during this period. While private schools outnumber public schools, their share of enrollments was much smaller, as shown in column 3 of Table 1. The CSU system had the largest share of enrollments, but their graduation rates were lower, with the UC system having the largest share of graduates from the 1996 entering cohort.

We report enrollments by entry "cohorts"[12] of students that enrolled as freshman in the fall of the years 1996 through 2001. The IPEDS data also contains the number of graduates for each of these enrollment cohorts. The cohorts that entered in the years 1996 and 1997 are the "Pre-Prop 209" cohorts, while those that entered from 1998 through 2001 are the "Post-Prop 209" ones. With respect to graduation, the IPEDS collects data on the number of people in a given enrollment cohort that graduate in 4 years or less, which characterize "on-time" graduation, and in 6 years or less, which is a fairly good measure of the number of an enrollment cohort that will ever graduate from the institution.

2.1 College Enrollments

The top panel of Table 2 records the average number of freshmen that enrolled in California's 4-year colleges prior to Prop 209 years, 1996 and 1997, and for the post-Prop 209 years, 1998-2001, by race and ethnicity. The number of college enrollees grew for all race/ethnic groups except for African Americans. However, some of this enrollment growth was the result of growth in California's college age population. In the second panel of Table 2, we tabulate the average number of high school seniors who graduated from California's public high schools in the spring of each year, for the Pre- and Post-Prop 209 years. The sizes of the cohorts of California's

[11] In fact, there were more institutions in California during this period, but some of them were not included in the sample due to missing values. Most of these institutions are private for-profit ones and represent a quite small proportion of the total sample.

[12] Enrollment numbers correspond to the Bachelor adjusted cohort of IPEDS database, i.e., revised cohort minus exclusions, where exclusions denote students who died, or became permanently disabled, or left the school to serve the armed forces, among others.

public high school graduates grew for each racial and ethnic group over this period, with the Hispanic graduation cohorts growing by an average of 5.7% per year over this period and with the size of high school graduating classes growing an average of 4.1% per year for all race/ethnic groups. While the total number of California's public high school graduates recorded in Table 2 underestimates the number of students who were "at risk" of entering one of California's colleges as a freshman,[13] we use them to form college freshman college enrollment rates,[14] in order to account for differential population growth. Such enrollment rates are presented in Table 3 for the various race/ethnic groups and for various classifications of California's 4-year colleges.

While there is a slight increase in the overall enrollment rate at California's 4-year colleges after Prop 209 is implemented [columns 1 and 2, Table 3], enrollment rates fell for African Americans, Hispanics and Asian Americans. The declines in college enrollment rates for African Americans and Hispanics at California's colleges are driven by the declines that occur at California's *public* 4-year colleges. The latter colleges were subject to the provisions of Prop 209. The average annual enrollment rates for African Americans declined by 15% (or by 0.024) post-Prop 209 and by 10.3% (or by 0.013) for Hispanics. These declines in enrollment rates occurred both within the UC system and the campuses of the CSU system. The magnitude of the declines in enrollment rates for both minorities were larger for the CSU system, given that the CSU system accounted for more than 71% of the freshman enrollments of African Americans at 4-year colleges and 68% for Hispanics prior to the implementation of Prop 209. But, the declines were proportionately larger at UC campuses, with rates for African Americans declining by 21.3% and by 12.7% for Hispanics.

The final two columns of Table 3 show the pre-Prop 209 college enrollment rates and their change after Prop 209 is implemented at California's 49 *private* colleges. None of these colleges were subject to the affirmative action bans under the Proposition. In contrast to what we found for California's public colleges, the freshmen enrollments rates at private 4-year colleges actually increased slightly for African Americans and declined very slightly among Hispanics. At the same time, the enrollment rates for both of these groups at private colleges in California are quite low before and after Prop 209, i.e., the numbers of minorities attending private 4-year colleges in California were small.

An important feature of the IPEDS data that complicates drawing conclusions about enrollment (or graduation) trends for minority (or non-minority) groups is the precipitous rise, starting in 1998, in the number of entering students at California's universities that did not designate a race or ethnic group, i.e., students "declined to state" their race or ethnicity and it was recorded as "Unknown." The average number of college freshmen enrolled in college with Unknown race/ethnicity goes from 4,835 a year before Prop 209 to 7,851 after Prop 209 is implemented [Top panel, Table 2], a 62% increase. While not shown in Table 2, 80% of this increase is due to the rise in the incidence of Unknowns among enrollees at California's 4-year public colleges. Between 1997 and 1998, the first year after the implementation of Prop 209, Unknowns enrolling at 4-year public colleges goes from 4,252 to 6,805, a 60% increase. Moreover,

[13]The more complete pool of students at risk to enroll as freshmen at one of California's public (or private) colleges would include three other groups of students: (a) those who graduated from a private high school in California; (b) those who graduated from out-of-state high schools in the U.S.; and (c) those who graduated from foreign high schools or their equivalents.

[14]More formally, college enrollment rates are defined to be $\frac{Enroll_{jt}}{HSGrad_{jt}}$, where $Enroll_{jt}$ is the number of college freshman of race/ethnic group j entering one of California's public universities in year t, and $HSGrad_{jt}$ the number of graduates from California's public high schools in the spring of year t for race/ethnicity group j.

Table 2: Enrollments in California's Public High School Graduates and 4-Year College Enrollments in California, by Race and Ethnicity, Pre- and Post-Prop 209

Period	African American	Hispanic	Asian American	Whites	Unknown	Total
Total Number of Public High School Graduates:						
Pre-Prop 209	20,089	80,317	29,730	122,894		264,071
Post-Prop 209	22,060	96,903	35,0564	134,860		302,027
Average Annual Freshman Enrollments:						
Pre-Prop 209	4,218	12,575	17,353	30,204	4,835	71,690
Post-Prop 209	4,152	13,859	20,280	34,744	7,851	83,313

Data Sources: IPEDS and California Department of Education, DataQuest website at www.cde.ca.gov.

All entries are annual averages. The averages for "Pre-Prop 209" are for 1996-1997 and for "Post-Prop 209" are for 1998-2001.

the post-Prop 209 average number of Unknowns among public college enrollees in any given year is sizeable. It is two times the number of African American college enrollees and 60% of the number of Hispanic enrollees. In short, how one treats these Unknowns can materially affect one's conclusions about how college enrollments of minorities was affected by Prop 209.

Most previous studies of the effects of affirmation action or Prop 209 on college enrollments do not mention, let alone account for, the precipitous rise in the number of students who declined to report their race/ethnicity after the implementation of this ban on affirmative action in admissions to California's public universities. An important exception is the study by Card and Krueger (2005) noted in the Introduction. Card and Krueger examine changes in whether minorities sent their SAT test scores to the highly selective campuses of the UC system after the implementation of Prop 209.[15] Card and Krueger note a similar rise in the fraction of SAT test takers in California that declined to state their race or ethnicity. But they find a corresponding decline in white non-Hispanic test takers and conclude that "most non-identified test takers are white" (p. 425). Consistent with Card and Krueger (2005), several news accounts of the minorities admission rates at UC campuses immediately after the implementation of Prop 209 cited claims that students who declined to report their race/ethnicity after Prop 209 were disproportionately non-Hispanic whites and Asian Americans.[16]

2.2 College Graduation

We next examine how college graduation rates changed with the implementation of Prop 209. In Table 4, we display on-time (4-year) and 6-year graduation rates before and after Prop

[15] They also analyze test sending by minorities to selective public universities in Texas.

[16] A 1998 story in the *Los Angeles Times* stated that "UC San Diego determined that most of those 'decline-to-state' applicants were white or Asian American-accounting for declines in the admissions figures for those two groups." ("Fewer Blacks/Latinos Admitted to 3 UC Schools," *Los Angeles Times*, March 17, 1998.) And reporter Carl Irving cited a survey by the director of student research at UC Berkeley that two-thirds of the freshman that enrolled at UC Berkeley in 1997 who declined to state their race or ethnicity, "were white and the rest were Asian Americans." (Carl Irving, "There's No Valid Surrogate for Race: Diligent efforts to mitigate ban on 'affirmative action' admissions fail at UC." *National Cross Talk*, Spring 1998, 6(2).)

Table 3: Ratio of Entering Freshman Enrollments to Public High School Graduates in California, by Types of College, Pre- Prop 209 and Change Post Prop 209

	All 4-Yr Colleges		Public 4-Yr Colleges		UC System		CSU System		Private 4-Yr Colleges	
Race/Ethnic Group	Pre-Prop 209	Change	Pre-Prop 209	Change	Pre-Prop 209	Change	Pre-Prop 209	Change	Pre-Prop 209	Change
African American	0.210	-0.022	0.159	-0.024	0.046	-0.010	0.113	-0.014	0.051	0.002
Hispanic	0.157	-0.014	0.124	-0.013	0.040	-0.005	0.085	-0.008	0.032	-0.001
Asian American	0.584	-0.006	0.484	-0.001	0.292	-0.003	0.192	0.001	0.100	-0.004
Whites	0.246	0.012	0.159	0.008	0.078	-0.002	0.082	0.010	0.086	0.004
All Groups	0.271	0.004	0.199	0.003	0.092	0.000	0.107	0.003	0.072	0.001

Data Source: IPEDS.

The "Pre Prop 209" columns are averages for the years 1996-1997 and the "Change" columns are the difference between the average for the Post Prop 209 years (1998-2001) and the Pre Prop 209 Column.

209,[17] and, in Table 5, college (degree) attainment rates.[18] The layout of these tables parallel that in Table 2.

While minority freshman college enrollment rates at California's public colleges declined for both African Americans and Hispanics after Prop 209, minority enrollees at public colleges were *more likely to graduate* after it was implemented ["Public 4-Year Colleges," Table 4]. The on-time graduation rates of African Americans went up by 0.025 for a 23.1% increase after Prop 209 and by 0.034 in the 6-year graduation rate for a 9.3% increase. Hispanic on-time graduation rates at public colleges increased 0.033 for a 23.8% improvement and increased 0.030 for a 6.4% improvement in 6-year graduation rates. Moreover, the graduation rates of minority enrollees improved in both the UC and CSU systems, with the size of improvements in graduation rates greater for UC campuses but with larger relative improvements at CSU campuses. Finally, minority graduation rates improved, post-Prop 209, in California's private colleges, even though the latter group was not subject to this law. Below, we provide some limited evidence that these improvements in minority graduation rates at private colleges may have been the result of a change (improvement) in the academic preparedness of minority students entering these schools after Prop 209 went into effect.

As shown in Table 4, the graduation rates of students enrolled at a public college that declined to state their race or ethnicity with the passage of Prop 209 also increased after Prop 209 went into effect, by 0.056 for on-time graduation (a 24% improvement) and by 0.045 in 6-year graduation rates (a 8.0% improvement). The magnitude of these improvements with Prop 209 for the Unknowns are comparable in size to those for minorities and substantially larger than those for Asian Americans or whites. At the same time, the post-Prop 209 college graduation rates for the Unknowns are closer to those for non-minorities than minorities. This latter pattern is consistent with news accounts and the contention by Card and Krueger (2005) that the post-Prop 209 rise in the college enrollees that were recorded as Unknowns were not minorities.

We also find improvements in rates of college degree attainment with Prop 209 for minorities at California's public colleges [Table 5]. The number of on-time graduations from a public college relative to the number of public high school graduates improved for both African Americans and Hispanics with the implementation of Prop 209. Again, we find improvement in on-time college attainment rates at California's private colleges post Prop 209. Finally, with respect to minority high school students who ever graduate from a California 4-year college, i.e., graduate in 6 years or less, after the implementation of Prop 209 [Table 5], the shares at public colleges go down. But, while the share of minorities ever attaining a BA degree from a UC campus declines, the share improves slightly at CSU campuses.

The improvements in minority (and non-minority) graduation from college, post-Prop 209, are consistent with the implementation of Prop 209 resulting in greater sorting of students to colleges based on the former's academic preparedness that resulted in higher graduation rates, especially on-time graduation, even if college attainment rates declined among minorities. But, drawing conclusions about what role such matching played in the improvement of minority

[17] More formally, the X-year college graduation rate is equal to $\frac{GradX_{jt}}{Enroll_{jt}}$, where $GradX_{jt}$ is the number of college freshman of race/ethnic group j in entry cohort t that graduated from one of California's colleges in X years or less, where X is either 4 or 6 years.

[18] The college (degree) attainment rates in Table 5 are defined as $\frac{GradX_{jt}}{HSGrad_{jt}}$, where $GradX_{jt}$ is defined in footnote 17 and $HSGrad_{jt}$ is defined in footnote 14.

graduation rates is premature for a number of reasons. First, we need to take into account time trends in enrollments and graduation rates and how these trends vary across races. Second, the claims about improvements in student-college matching resulting from acts like Prop 209 presume that colleges differ in their level of difficulty, or quality, and that supply of higher quality institutions is limited. Third, assessing whether Prop 209 might have improved the sorting of potential students on their academic preparation requires that we have an independent measure of this preparation. In the next section, we attempt to address the first two of these concerns, deferring our discussion of the third concern until Section 4.2.

3 Estimating Prop 209 Effects with IPEDS Data

Below, we present forecasts from a student-level choice model to better isolate the role that Prop 209 had on the enrollment and graduation trends presented in the previous section. The model is estimated with the college-level IPEDS data. Using these more aggregated data, rather than student-level data, to estimate these effects has pluses and minuses. As we will see in Section 4.2, using individual-level data on students who apply to one or more of the UC campuses allows us the ability to control for direct and indirect measures of academic preparation of students that are not feasible with the IPEDS data. But, using the IPEDS data allows us to see how the effects of Prop 209 differed across public and private colleges as well as more- versus less-selective ones. The before-versus-after trends discussed in the previous section clearly suggest that Prop 209 may have had very different effects across these different types of colleges and the IPEDS data allow us a unique data source to evaluate such differences.

In the Appendix we layout an empirical model of the college enrollment decisions that high school graduates face that is estimable with college-level, aggregated data sources like IPEDS. With respect to college enrollment decisions, there are a series of choices that underly enrollment rates. High school graduates decide whether or not to apply to one or more college out a feasible set of colleges or to not go to college at all. Colleges decide which applicants to accept. And, finally, accepted students decide in which college they will enroll. Given the nature of our data, we cannot model each of these stages.[19] Rather, we set out a simple model in which students are assumed to choose whether to enroll at a particular college or not go to any college and characterize the assumptions required to map the parameters of this model to the aggregated data available on enrollments from the IPEDS. The model effectively reduces to a multinomial logit model of a student's choice of a college from the set of available colleges, public and private, in California and a logit model of students' choice of whether to graduate from the college they choose to attend. The parameter estimates for these models are displayed in the Appendix.

3.1 Forecasts of the Prop 209 Effects at California's Colleges

We use the parameter estimates and model in the Appendix to forecast the effect of Prop 209 on enrollment and graduation rates relative to the corresponding pre-Prop 209 rates for these outcomes. Column (1) of Table 6 displays the average annual enrollment shares of 1997 African American and Hispanic high school graduates – the last pre-Prop 209 cohort of high

[19] See Arcidiacono (2005) for an estimable structural model that characterizes each of these decisions using student-level data.

Table 4: Share of College Enrollees that Graduate, Pre-Prop 209 and Change Post-Prop 209, by Types of College

	All 4-Yr Colleges		Public 4-Yr Colleges		UC System		CSU System		Private 4-Yr Colleges	
Race/Ethnic Group	Pre-Prop 209	Change	Pre-Prop 209	Change	Pre-Prop 209	Change	Pre-Prop 209	Change	Pre-Prop 209	Change
Graduated in 4 Years or Less:										
African American	0.169	0.048	0.109	0.025	0.282	0.067	0.038	0.017	0.357	0.069
Hispanic	0.206	0.034	0.138	0.033	0.321	0.043	0.053	0.032	0.466	0.018
Asian American	0.345	0.035	0.296	0.044	0.441	0.062	0.077	0.021	0.578	0.002
Whites	0.399	0.021	0.307	0.026	0.486	0.049	0.137	0.031	0.559	0.021
Unknown	0.258	0.048	0.231	0.056	0.466	0.034	0.117	0.025	0.401	0.003
All Groups	0.326	0.032	0.253	0.038	0.438	0.054	0.094	0.030	0.527	0.017
Graduated in 6 Years or Less:										
African American	0.398	0.050	0.367	0.034	0.664	0.031	0.245	0.047	0.495	0.073
Hispanic	0.503	0.027	0.474	0.030	0.710	0.021	0.363	0.039	0.614	0.005
Asian American	0.669	0.022	0.659	0.026	0.804	0.022	0.438	0.036	0.717	-0.001
Whites	0.660	0.009	0.642	0.011	0.790	0.017	0.502	0.026	0.680	0.018
Unknown	0.560	0.034	0.567	0.045	0.802	-0.009	0.452	0.035	0.519	-0.013
All Groups	0.607	0.023	0.589	0.027	0.779	0.019	0.427	0.039	0.656	0.012

Data Source: IPEDS.

The "Pre Prop 209" columns are averages for the years 1996-1997 and the "Change" columns are the difference between the average for the Post Prop 209 years (1998-2001) and the Pre Prop 209 Column.

Table 5: Ratio of No. of Freshman that Graduate from College to No. of High School Graduates, by Types of College, Pre-Prop 209 and Change Post-Prop 209

	All 4-Yr Colleges		Public 4-Yr Colleges		UC System		CSU System		Private 4-Yr Colleges	
Race/Ethnic Group	Pre-Prop 209	Change	Pre-Prop 209	Change	Pre-Prop 209	Change	Pre-Prop 209	Change	Pre-Prop 209	Change
Graduated in 4 Years or Less:										
African American	0.035	0.005	0.017	0.001	0.013	0.000	0.004	0.001	0.018	0.005
Hispanic	0.032	0.002	0.017	0.002	0.013	0.000	0.005	0.002	0.015	0.000
Asian American	0.201	0.019	0.144	0.021	0.129	0.017	0.015	0.004	0.058	-0.002
Whites	0.098	0.010	0.049	0.007	0.038	0.003	0.011	0.004	0.049	0.003
All Groups	0.088	0.010	0.050	0.009	0.040	0.005	0.010	0.004	0.038	0.002
Graduated in 6 Years or Less:										
African American	0.083	0.001	0.058	-0.004	0.031	-0.005	0.028	0.001	0.025	0.005
Hispanic	0.079	-0.003	0.059	-0.003	0.028	-0.003	0.031	0.000	0.020	0.000
Asian American	0.390	0.009	0.319	0.012	0.235	0.004	0.084	0.007	0.072	-0.003
Whites	0.162	0.010	0.102	0.007	0.061	-0.001	0.041	0.007	0.060	0.003
All Groups	0.165	0.009	0.117	0.008	0.072	0.002	0.046	0.006	0.047	0.001

Data Source: IPEDS.

The "Pre Prop 209" columns are averages for the years 1996-1997 and the "Change" columns are the difference between the average for the Post Prop 209 years (1998-2001) and the Pre Prop 209 Column.

school graduates – for different types of colleges and column (2) displays the change in these shares due to Prop 209 that is predicted by our model. For this cohort, the share of African Americans enrolled in public schools would have been predicted to fall by 3.33% if Prop 209 had been implemented a year earlier. Private schools would have increased their enrollment share by 0.21%, which is statistically insignificant from zero. The latter increase would have only partially offset the enrollment declines in public universities, implying that Prop 209 would have lead to a decline of 3.12% in enrollments in 4-year colleagues in California for this cohort of African American high school graduates. This is a sizeable decline, especially considering that only 21.2% of African Americans in this pre-Prop 209 cohort actually enrolled in a 4-year college. Our model predicts that the share of Hispanic high school graduates in this cohort that would have enrolled in a 4-year colleges would have declined by 1.56% if Prop 209 had been implemented a year early or about half the size of the African American effect. (This decline is statistically significant.) However, we note that the actual share of Hispanics in this cohort that enrolled in a 4-year college was slightly lower (15.6%) than that of African Americans.

While the enrollment rates of African American and Hispanics declined at the Top 50 (ranked) UC campuses, they actually increased at non-Top 50 UC campuses (UC Riverside and UC Santa Cruz). But, our estimates imply that Prop 209 led to statistically significant *declines* in the enrollments of both African Americans and Hispanics in the CSU system, even though almost all of the CSU campuses are less selective in their admissions than any of the UC campuses, including UC Riverside and UC Santa Cruz. Moreover, these declines at CSU campuses are sizeable and account for 65% of the overall enrollment drop for both minority groups. In Section 3.2, we explore the possibility that a different policy change, that only affected the CSU system, may account for the latter declines in minority enrollments.

Columns (3) and (4) and columns (5) and (6) in Table 6 display estimates of the marginal effects of Prop 209 on college graduation rates for African Americans and Hispanics. These estimated effects are obtained by calculating the graduation probabilities at each school for African Americans and Hispanics in the same 1997 high school graduation cohort and then weighting these probabilities by the predicted enrollments for these two groups at each school. We find that college graduation rates for African Americans and Hispanics – both 4-and 6-year – would have been significantly *higher* if Prop 209 had been implemented a year earlier. This is true for almost all types of colleges, including those in the CSU system which had substantially lower pre-Prop 209 (conditional) graduation rates. The estimated Prop 209 effects on 4-year graduation rates are particularly strong for African Americans. Our model predicted that college enrollees for this minority group would have experienced a 4.7 percentage point increase in graduation rates, where the pre-Prop 209 4-year graduation rate for African Americans in the 1997 cohort is less than 8%. As we found for enrollments, the predicted Prop 209 effects on conditional graduation rates for Hispanics are muted relative to African Americans. Graduation rates conditional on enrollment increase by 1.8 and 2.2 percentage points for 4-year and 6-year graduation rates respectively, with base rates absent Prop 209 of 21% and 51%.

Finally, we present estimates of the marginal effects of Prop 209 on the college degree attainment rates for African American and Hispanics in columns (8) and (10) of Table 6. These estimates are obtained by multiplying the predicted probabilities of enrolling by the predicted probabilities of graduating at each institution and then summing up these probabilities over colleges for each college type. Our model predicts that Prop 209 increased the on-time college attainment rates of African Americans, with the positive effects on conditional graduation rates

outweighing the negative effects on enrollments. However, we find that 6-year college attainment rates for African Americans decline by 0.62%, relative to the pre-Prop 209 rate of 8.6%. Furthermore, for Hispanics, we estimate that Prop 209 had no effect on 4-year graduation rates, but a negative effect of 0.5% for 6-year graduation rates.

3.2 Did another policy contribute to the CSU enrollment drop?

Based on the evidence presented in the previous section, it appears that Prop 209 reduced minority enrollments at campuses within the CSU system. As already noted, we would have expected minority enrollments in the CSU system to respond in a similar way to those at less-selective UC schools, with minorities turned away from top schools after Prop 209 expected to increase the pool of minorities available for enrollment at less-selective schools. Indeed, the admission rate for African Americans to the CSU system fell by only 0.4% but the enrollment rate conditional on being admitted fell by 6%.[20] As we discuss below, a policy implemented in the CSU system at the same time that Prop 209 may account for drops in minority enrollments at CSU campuses that our model attributed to Prop 209.

In the fall of 1998 – the same year that Prop 209 took effect – CSU campuses were required to comply with an executive order issued by the CSU Board of Trustees and the CSU Chancellor's Office. This order, Executive Order 665 (EO 665), established that all incoming freshmen in the CSU system must take the English Placement Test (EPT) and the Entry Level Mathematics (ELM) test, unless they were exempted by having sufficiently high SAT, ACT or AP scores. In addition, students who did not pass the EPT and/or ELM also were required to enroll in the appropriate preparatory courses in their first semester of enrollment. All preparatory courses had to be completed within the student's first 12 or 15 months after initially enrolling on campus; otherwise, the student was not allowed to continue at the university, resulting in administrative disqualification. It is this latter restriction that made EO 665 binding as many students already were taking remedial classes.

The implementation of EO 665 may have deterred enrollments in the CSU system, especially among minorities. According to the Legislative Analyst's Office of California (LAO) more than two thirds of admitted freshmen failed at least one of the entry exams and one third failed both tests. Furthermore, compared to non-minorities, minorities were much more likely to have taken one or more of the remedial courses. Table 7 shows the percentages of students enrolled in CSU Freshman remediation courses by race and ethnicity; 80% and 47% of the African American and white freshmen, respectively, were enrolled in math remediation courses in 1997. In addition, 64% of African Americans had to enroll in English remediation courses compared to only 28% of whites. Furthermore, according to the LAO, 20% of freshmen students at CSU could not complete remediation courses on time, with one third of them leaving the CSU system voluntarily, another third being dis-enrolled and the final third given an extension into their second year of college to complete their remedial course work. We do not have data on the distribution of these reductions in enrollment by race and ethnicity but, if they were proportional to the distribution of those who had to take these courses, the imposition of EO 665 may have reduced the enrollments of minorities at CSU campuses at just the same time that Prop 209 went into effect.

[20] See Statistical Abstracts for the California State University system at http://www.calstate.edu/AS/abstract.shtml. Similar patterns are observed for Hispanics.

Table 6: Marginal Effects of Prop 209 on Minority Enrollment and Graduation Probabilities for 1997 Entering Freshman Cohort.

	Enrollment		Grad≤ 4|Enroll		Grad≤ 6|Enroll		Grad≤ 4		Grad≤ 6	
	Pre-Prop 209	Change	Pre-Prop 209	Change	Pre-Prop 209	Change	Pre-Prop 209	Change	Pre-Prop 209	Change
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
African Americans:										
Top 50 UC	0.0395	-0.0132***	0.2840	0.0223	0.6888	-0.0039	0.0112	-0.0032***	0.0272	-0.0092***
Non-Top 50 UC	0.0071	0.0018***	0.2711	0.0852**	0.5656	0.0315	0.0019	0.0012***	0.0040	0.0013***
CSU	0.1142	-0.0218***	0.0377	0.0065	0.2542	0.0162	0.0043	0.0043	0.0290	-0.0041***
Top 50 Private	0.0167	0.0047***	0.5631	0.0750**	0.7910	0.0319	0.0094	0.0042***	0.0132	0.0044***
Non-Top 50 Private	0.0344	-0.0026	0.2808	0.0580***	0.3786	0.0746***	0.0097	0.0011	0.0130	0.0014
Public	0.1608	-0.0333***	0.1084	0.0113	0.3747	0.0037	0.0174	-0.0022	0.0603	-0.0120***
Private	0.0512	0.0021	0.3731	0.0859***	0.5135	0.0883***	0.0191	0.0054***	0.0263	0.0058***
All 4-Yr Colleges	0.2120	-0.0312***	0.1723	0.0474***	0.4082	0.0360***	0.0365	0.0032	0.0865	-0.0062**
Hispanics:										
Top 50 UC	0.0319	-0.0059***	0.3175	0.0169	0.7262	0.0244***	0.0101	-0.0014***	0.0231	-0.0036***
Non-Top 50 UC	0.0079	0.0009***	0.3438	0.0022	0.6430	-0.0066	0.0027	0.0033**	0.0051	0.0006**
CSU	0.0845	-0.0104***	0.0547	0.0191***	0.3704	0.0265***	0.0046	0.0008***	0.0313	-0.0019**
Top 50 Private	0.0086	-0.0001	0.6201	0.0267	0.8194	0.0077	0.0053	0.0002	0.0070	0.0000
Non-Top 50 Private	0.0237	-0.0002	0.4300	0.0048	0.5646	0.0102	0.0102	0.0000	0.0134	0.0000
Public	0.1243	-0.0153***	0.1405	0.0177***	0.4790	0.0218***	0.0175	-0.0002	0.0595	-0.0050***
Private	0.0322	-0.0003	0.4805	0.0105	0.6322	0.0047	0.0155	0.0002	0.0204	0.0000
All 4-Yr Colleges	0.1565	-0.0156***	0.2105	0.0231***	0.5105	0.0211***	0.0329	0.0000	0.0799	-0.0050***

Data Source: IPEDS.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Standard errors were bootstrapped.

Table 7: Freshmen Remediation Rates in CSU System by Subject, Fall 1997†

	Math	English
African American	80%	64%
Asian American	43%	66%
Hispanic	70%	59%
White	47%	28%
All groups	54%	47%

† Source: CSU Database: http://www.asd.calstate.edu/remediation/97/index.shtml

We cannot definitively separate the effects of EO 665 versus Prop 209 on CSU enrollments. As a result, we cannot determine whether the latter enrollments would have increased – as the non-Top 50 UC campuses did – if Prop 209 had been the only policy change. However, we can try to isolate the net effect of Prop 209 on minority enrollments for that part of California's public (4-year) college that was not directly affected by E0 665, namely the UC system. As shown in Table 6, Prop 209 had different effects on the enrollment of the Top 50 ranked UC campuses versus those outside of the Top 50. To estimate these effects, we constrain the coefficients on the CSU post-Prop 209 interaction in (16) to be zero, using the estimates from the enrollment model in Section 3, and then re-calculate the changes in enrollment attributable to Prop 209. Note that this is likely to be an upper bound on the negative enrollment effects of Prop 209, given the positive and significant coefficient on post times UC schools not in the top-50 in the estimates of the enrollment process [Table 6].

Results for the net effects of Prop 209 on enrollments in the UC sytem are given in Table 8. The total effect on African American enrollments at public universities falls to 1.09%, compared to the 3.3% decline we estimated when we included the effect on the CSU system in the overall public college estimate [Table 6]. Similarly, we estimate that Prop 209 effect on UC enrollments of Hispanics is -0.48%, which also is about one-half of the enrollment effect recorded in Table 6. Thus, while the net effect of Prop 209 was to reduce minority enrollments in the UC system, it appears that these effects were relatively modest. At the same time, the results in Table 6 make clear that Prop 209 did affect the distribution of minorities enrolling in the various campuses. In the next section we focus more closely on these distributional impacts of Prop 209 on the UC system.

4 A Closer Look at the Effects of Prop 209 within the UC System

In the remainder of the paper we focus on the impact that Prop 209 had on the graduation rates of minority students within the UC system. We use a unique source of data that follows individuals who applied to one or more UC campuses through to graduation. As described in the next section, these data allow us to control for the academic preparation of students that attended, and possibly graduated, from a UC campus before and after Prop 209. We use these data to isolate the effect of Prop 209 on graduation rates, *net* of the selectivity of the admission processes at the various UC campuses, both before and after Prop 209 was implemented. Below,

Table 8: Marginal Net Effects of Prop 209 on Minority Enrollments in UC System, for 1997 Entering Freshman Cohort

	Pre-Prop 209	Change
African Americans:		
Public	0.1608	-0.0109***
Private	0.0512	0.0008
All 4-Yr Colleges	0.2120	-0.0102***
Hispanics:		
Public	0.1243	-0.0048***
Private	0.0322	-0.0007
All 4-Yr Colleges	0.1565	-0.0055***

Data Source: IPEDS.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Standard errors were bootstrapped.

we present evidence that Prop 209 did have a net positive effect on the graduation rates of minorities within the UC system.

Isolating the net effect of Prop 209 is important for addressing the extent to which reducing the mismatch of students to colleges based on the former's academic preparation played a key role in the graduation rates of minorities after Prop 209 was implemented. Recall from the Introduction that reducing this type of mismatch has been a key argument by proponents for banning affirmation action in the admissions processes of public universities in California and other states. To examine whether the Prop 209 ban reduced such mismatch, we use these individual-level data to determine how the various UC campuses "converted" the academic preparedness of minority (and non-minority) students into graduations. Interestingly, we find substantial differences across campuses in their "production" of graduation rates for students from different parts of the distribution of academic preparation. Such differences imply potential gains from better matching of students to colleges on academic preparation. We examine the potential sizes of these gains and the extent to which they can account for the observed improvements in minority graduation rates under different assumptions about the consequences Prop 209 had for the admission processes within the UC system.

4.1 Student-level Data for the UC System

The data we use were obtained from the University of California Office of the President (UCOP) under a California Public Records Act request. These data contain information on applicants, enrollees and graduates of the UC system. Due to confidentiality concerns, some individual-level information was suppressed. In particular, the UCOP data we were provided have the following limitations:[21]

1. The data are aggregated into three year intervals from 1992-2006.

[21] See Antonovics and Sander (2011) for a more detailed discussion of this data set.

2. The data provide no information on gender, and race is aggregated into four categories: white, Asian, minority, and other

3. Academic data, such as SAT scores and high school grade point average (GPA), were only provided as categorical variables, rather than the actual scores and GPAs.

Weighed against these limitations is having access to two important pieces of information about the individuals who applied to and possibly enrolled at a UC campus. First, we have information on every individual who applied to any of the schools in the UC system over the period, including to which campuses they applied and were admitted. As described below, we use the latter information to adapt a strategy used in Dale and Krueger (2002) in order to account for unmeasured student qualifications. Second, we were provided with access to an index of each student's preparation for college, given by the sum of a student's SAT I score, rescaled to be between 0 to 600, and his or her high school GPA, rescaled to be between 0 to 400. Below, we refer to this as a student's high school *Academic Index*. We have data for the entering cohorts in the three years prior to the implementation of Prop 209 (1995, 1996 1997), and for three years after its passage (1998, 1999, 2000).

In Table 9, we present summary statistics for the individual-level UCOP data and its measures of student qualifications by race and for applicants, admits, enrollees and graduates for campuses in the UC system, pre- and post-Prop 209. As already seen with the college-level IPEDS data, minority enrollments at UC campuses declined ["Enrolled" column, Table 9], minority graduation rates improved ["Graduated" column, Table 9] and the proportion of high school graduates that attained a BA degree declined after Prop 209 went into effect. We find the same trends with the UCOP data as with IPEDS data for the enrollment, graduation and college degree attainment rates of Whites [Table 9], Others, including the Unknowns [Table 9], and Asian Americans (not shown).

Relative to the number of public high school graduates, minority applications and admissions to one or more UC campuses also decline after Prop 209 went into effect,[22] while there are small and statistically insignificant changes in these rates for whites. With respect to academic preparation (high school Academic Index), minorities had much lower scores at each stage of the college process than whites both prior to and after Prop 209 was implemented. This difference in preparation accounts, in part, for the lower proportion of minority high school students being admitted to a UC campus ("No. of Obs./No. of HS Grads") compared to whites. However, after Prop 209 is implemented, the academic preparation of minority applicants, admits, enrollees, and graduates *improved*, both absolutely and relative to whites. Presumably, this improvement in academic preparation contributed to the higher graduation rates of minorities within the UC system after the implementation of Prop 209.

But, there was a notable change in the socioeconomic backgrounds of the minorities that enrolled at and graduated from a UC campus after Prop 209 went into effect. In particular, there was significant and sizeable decline in the proportion of minority enrollees and graduates from more "advantaged" family backgrounds. For example, among admitted minorities who actually enrolled at a UC campus, there was an 0.039 reduction (a 10% decline) in the proportion with parents who had a BA degree and a corresponding 0.046 reduction (a 11% decline) among those

[22] Antonovics and Sander (2011) and Antonovics and Backes (2011) use these data to examine the effects of Prop 209 on minority applications to and admissions at UC campuses, respectively.

minorities that graduated from a UC campus after Prop 209 was implemented. Similarly, Post 209 a greater share of applicants an admits had parents with incomes above $80,000. Yet, the share of enrollees whose parental income was greater that $80,000 *fell*. That is, while minorities from more advantaged family backgrounds continued to apply and be admitted to UC campuses after Prop 209 (though the set of UC campuses where they were admitted may have changed), they were less likely to enroll at one of the campuses and less likely to graduate from one of them. We are unable to determine whether, after Prop 209, these more advantaged minorities who applied and were accepted to a UC campus went to colleges not subject to Prop 209, i.e., private colleges in California or public or private colleges outside of the state. But we doubt that they disproportionately ended up at less-selective public colleges in the state, i.e., at CSU campuses or one of California's community colleges, or not attending college.

4.2 Net Effect of Prop 209 on UC Graduation Rates

Using the UCOP data, we adapt the (college) graduation decision-rules developed in Section 3 to estimate the net impacts of Prop 209 for the UC system. Using the notation of the model in the Appendix, V_{ijtr} denotes the utility that individual i, from college entry cohort t and of racial/ethnic group r, receives from graduating from UC campus j and is given by the following function:

$$V_{ijtr} = \phi'_{0j} + \phi'_{1r} + POST_{itr}\phi'_{2r} + A_{itr}\phi'_3 + X_{itr}\phi'_4 + \zeta'_{itr} \tag{1}$$

where A_{itr} is student i's high school academic index, X_{itr} is the vector of their observed family background characteristics, such as parental education, family income, etc., $POST_{itr}$ is the post-Prop 209 indicator variable, and ϕ'_{0j} is a fixed effect for UC campus j. For now, our primary interest is in estimating ϕ'_{2r}, the effect of Prop 209 on the propensity of race/ethnic group r to graduate from a UC campus *net* of differences in the academic preparation (A_{itr}) and family background (X_{itr}). To proceed, let Q_{ijrt} denote a 0/1 indicator of whether student i graduates from college and assume that the probability of graduating is given by a linear probability model, i.e.,

$$\begin{aligned} Pr(Q_{ijtr} = 1|A_{itr}, POST_{itr}, X_{itr}, r, \phi') &\equiv P^{g\prime}(A_{itr}, POST_{itr}, X_{itr}, r, \phi') \\ &= \phi'_{0j} + \phi'_{1r} + POST_{itr}\phi'_{2r} + A_{itr}\phi'_3 + X_{itr}\phi'_4, \end{aligned} \tag{2}$$

where $\phi' \equiv (\{\phi'_{0k}\}_{k=1}^{J}, \{\phi'_{1l}, \phi'_{2l}\}_{l=m,w,o}, \phi'_2, \phi'_3, \phi'_4)$ and we used ordinary least squares to estimate ϕ'. Estimates for this specification are presented below.

While a student's academic index characterizes two important factors (high school GPA and the SAT scores) that go into a student's admission decisions at those UC campuses to which she applied, there are other factors that go into these decisions, including letters of recommendation, personal essays, quality of one's high school and its curriculum, that are not included in the UCOP data. But, as has been noted in the literature on the effects of graduating from a selective university (Black, Daniel, and Smith, 2001; Dale and Krueger, 2002; Black and Smith, 2004; Hoxby, 2009) failure to control for the full set of criteria used in admissions decisions are likely to result in biased estimates of the effects of attending more-selective colleges – or, in our case, of Prop 209 – on the likelihood of graduating and other subsequent outcomes (e.g., earnings). To help mitigate this source of selection bias, we implement a modified version of the selection correction method of Dale and Krueger (2002), using information in the UCOP

Table 9: Characteristics of UC Applicants, Admits, and Enrollees by Race, Pre-Prop 209 and Change Post Prop 209†

	Applied		Admitted		Enrolled		Graduated	
	Pre-Prop 209	Change	Pre-Prop 209	Change	Pre-Prop 209	Change	Pre-Prop 209	Change
Under-represented Minorities:								
High School Acad. Index	619.7	14.7***	645.7	17.2***	641.5	15.6***	653.7	12.4***
Parents have BA	0.369	0.004	0.381	-0.014***	0.385	-0.039***	0.417	-0.046***
Parents' Income $\leq$ \$30K	0.379	-0.019***	0.364	-0.008*	0.364	0.008	0.334	0.012
Parents' Income $\geq$ \$80K	0.195	0.015***	0.203	0.009**	0.211	-0.010*	0.238	-0.018***
Graduation Rate							0.624	0.044***
No. of Observations	30,911	2,511	24,332	-470	13,278	-707	8,198	92
No. of Obs./No. of HS Grads	0.107	-0.011***	0.084	-0.016***	0.046	-0.010***	0.028	-0.005*
Whites:								
High School Acad. Index	710.4	11.1***	729.8	8.8***	722.6	13.3***	730.7	12.4***
Parents have BA	0.801	-0.002	0.813	-0.010***	0.805	-0.008**	0.822	-0.008**
Parents' Income $\leq$ \$30K	0.103	-0.008***	0.101	-0.006***	0.109	-0.006***	0.100	-0.006*
Parents' Income $\geq$ \$80K	0.528	0.019***	0.533	0.013***	0.525	0.015***	0.540	0.016***
Graduation Rate							0.769	0.025***
No. of Observations	67,781	8,202	54,480	4,385	27,617	1,945	20,770	2,211
No. of Obs./No. of HS Grads	0.187	0.003	0.150	-0.003	0.076	-0.002	0.057	0.000
Others, including Unknowns:								
High School Acad. Index	719.3	-2.6**	741.3	-2.8**	731.2	2.0	741.6	1.1
Parents have BA	0.745	0.018***	0.765	0.010	0.751	0.010	0.769	0.009
Parents' Income $\leq$ \$30K	0.195	-0.013**	0.186	-0.008	0.203	-0.010	0.184	-0.004
Parents' Income $\geq$ \$80K	0.402	0.044***	0.413	0.034***	0.384	0.047***	0.409	0.040***
Graduation Rate							0.741	0.015*
No. of Observations	10,143	12,161	8,231	8,810	4,129	4,693	3,081	3,622

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Data Source: UCOP individual data, Pre-Prop 209 (1995-97); Post-Prop 209 (1998-2000).

Variables: *No. of Observations* is the total number of students who engaged in activity indicated in column heading; *No. of Obs./No. of HS Grads* is ratio of a column's No. of Observations to the number of public high school graduates per year in California; *Graduation Rate* is share of enrolled students that graduated in 5 years or less; *High School Acad. Index* is sum of re-scaled student's SAT I score (0 to 600 scale) plus re-scaled student's UC-adjusted high school GPA (0 to 400 scale); *Parents have BA* is indicator variable of whether student has at least one parent with Bachelor Degree or more; *Parents' Income $\leq$ \$30K* is indicator variable for whether parents' annual income is $\leq$ \$30,000, where Pre-Prop 209 income are inflation-adjusted to Post-Prop 209 levels; *Parents' Income $\geq$ \$80K* is corresponding variable whether parents' annual income is $\geq$ \$80,000; and where *Graduated* denotes those who graduated in 5 years or less.

† Descriptive statistics for Asian Americans are omitted from table, but are available from the authors upon request.

data on the selectivity of the UC campuses to which students were admitted as a proxy for their unmeasured qualifications for college.

Following Dale and Krueger (2002), we construct the following set of dummy variables that measure the selectivity of the UC campuses to which a given student was admitted. The UC campuses were ranked from most selective to least selective based on the *U.S. News & World Report* Top 50 University rankings for 1997. Recall that this ranking of the 8 UC campuses (with a campus's rank in parentheses) was: UC Berkeley (27); UCLA (31); UC San Diego (34); UC Irvine (37); UC Davis (40); UC Santa Barbara (47); UC Santa Cruz (NR); and UC Riverside (NR). The first dummy variable was set equal to 1 for all the students that were admitted at UC Berkeley (the most selective) and 0 otherwise. The second dummy was set equal to 1 for all students admitted at UC Berkeley and/or UCLA and 0 otherwise. We continue creating dummy variablies in this way, with the final one set equal to 1 for students that were admitted to one or more campus that was at least as selective as UC Santa Cruz, the second-least selective school in our data. More formally, denote $a_{ijrt} = 1$ if individual i of group r at time t was admitted to a school at least as good as j, with $a_{ijtr} = 0$ otherwise. Denote the resulting vector as $a_{itr} \equiv (a_{i1rt}, a_{i2rt}, ..., a_{i7rt})$.

To implement the selection-correction method exactly as Dale and Krueger did in their study, one would estimate the following specification of the (linear) probability model of graduating from a UC campus that includes a_{itr}:

$$P^{g*}(A_{itr}, X_{itr}, a_{itr}, POST_{itr}, r, \phi^*) = \phi^*_{0j} + \phi^*_{1r} + POST_{itr}\phi^*_{2r} + A_{itr}\phi^*_3 + X_{itr}\phi^*_4 + \sum_{j=1}^{7} a_{ijtr}\phi^*_{5j} \quad (3)$$

However, resulting estimates of the parameters in (3), especially ϕ^*_{2r}, still are likely to be biased because, unlike the case considered in Dale and Krueger (2002), the admissions processes of campuses were required to change under Prop 209. In particular, Prop 209 required that a person's race or ethnicity could no longer be used as a criteria for admission at any UC campus. As a result, the probability that a minority applicant, with a given set of non-race/ethnicity qualifications, was admitted to a UC campus, especially highly selective ones, was likely to have changed with the implementation of Prop 209. Based on the selectivity of the UC campuses to which a minority was admitted measured by a_{itr}, it will appear as though minorities pre-Prop 209 were stronger than those post-Prop 209 because more minorities were admitted to the more-selective UC campuses based on their race/ethnicity prior to Prop 209 than after it was implemented.

To account for this problem, we adjust the Dale and Krueger (2002) method in the following way. First, we run the regression in (3) and retrieve the Dale and Krueger "index" of college preparedness, $\sum_{j=1}^{7} a_{ijtr}\hat{\phi}_{5j}$, for each student that enrolled at a UC campus. We then regress these indices on a student's family background characteristics, X_{itr}, and the dummy indicator of whether the student was a post-Prop 209 enrollee, allowing the effect of the latter variable to differ by race/ethnicity. That is:

$$\sum_{j=1}^{7} a_{ijtr}\hat{\phi}_{5j} = POST_{itr}\theta_{1r} + X_{itr}\theta_2 + \eta_{itr} \quad (4)$$

We then attempt to purge any post-Prop 209 differences in the Dale and Krueger index by

forming the adjusted residuals from the regression in (4), i.e.,

$$\hat{\Gamma}_{itr} = \sum_{j=1}^{7} a_{ijtr}\hat{\phi}_{5j} - POST_{itr}\hat{\theta}_{1r}, \tag{5}$$

and then estimate the following adaption of the specification in (2):

$$P^g(A_{itr}, X_{itr}, \hat{\Gamma}_{itr}, POST_{itr}, r, \phi) = \phi_{0j} + \phi_{1r} + POST_{itr}\phi_{2r} + A_{itr}\phi_3 + X_{itr}\phi_4 + \hat{\Gamma}_{itr} \tag{6}$$

where $\phi \equiv (\{\phi_{0k}\}_{k=1}^{J}, \{\phi_{1l}, \phi_{2l}\}_{l=m,w,o}, \phi_2, \phi_3, \phi_4)$. Estimates for this adaptation of Dale and Krueger also are presented below.

Results for all specifications are given in Table 10. Column (1) presents estimates of the changes in graduation rates, post-Prop 209, for the various race/ethnic groups with no adjustments for students' academic qualifications or background. Column (2) presents estimates that control for observable measures of preparation and background as in (1), while column (3) displays estimates that also controls for the "corrected" version of the Dale and Krueger index of unobserved academic qualifications. Without any adjustments [column (1)], graduation rates for minorities in the UC system increased by 4.4% (= 0.025 + 0.019) for a 7.1% improvement over this group's pre-Prop 209 graduation rates. Controlling for observed measures of preparedness and family background [Column (2)] result in only a small decline in the post-Prop 209 improvement in minority graduation rates to 4.3% (= 0.017 + 0.026). Once we control for the corrected Dale and Krueger index [column (3)], the estimated net effect of Prop 209 falls to 3.1% (= 0.013 + 0.018), for 5% improvement over pre-Prop 209 graduation rates. The size of this net effect of Prop 209 is equivalent to a 0.5 standard deviation increase in the student's academic index.[23] Furthermore, the positive effects are significantly stronger for minorities, suggesting the possibility of improved school matches for this group. In the next section, we more closely examine whether matching was the mechanism for the improvements in minority graduation rates.

4.3 Differences across UC Campuses in "Production" of Graduation Rates

In order to assess the role that changes in student-campus matching on student preparation may have had in the net improvement in minority graduation rates that accompanied Prop 209, we begin by examining, in Table 10, the distribution of academic preparation and graduation rates across the UC campuses for minorities and whites, respectively. The campuses are listed in order of their *U.S. News & World Report* ranking. Focusing initially on the pre-Prop 209 tabulations, one sees that the academic index and graduation rates are systematically related to the rankings of UC campuses, with more-selective campuses having students that are better prepared and more likely to graduate. This is true for minorities and for whites. And, consistent with the tabulations in Table 9, whites have higher academic indices and graduation rates than do minorities, a pattern that holds campus-by-campus.

Somewhat more surprising are the across-campus patterns in the post-Prop 209 changes in student preparedness and graduation rates found in Table 10. In particular, the post-Prop 209 changes in preparedness and graduations are not systematically related to the selectivity of the

[23] Such an increase in a student's academic index could be achieved, for example, by a 50 point increase in the student's verbal or math section of the SAT.

Table 10: The Effect of Prop 209 on graduation rates at UC campuses, by Race/Ethnicity[†]

	(1)	(2)	(3)
Minority	-0.145***	-0.069***	-0.078***
Asian American	-0.020***	0.003	0.002
Other	-0.008	-0.006	-0.006
POST	0.025***	0.017***	0.013***
POST × Minority	0.019***	0.026***	0.018**
POST × Asian American	0.012**	0.013**	0.013**
POST × Other	-0.010	-0.006	-0.006
High School Academic Index[‡]		68.918***	61.258***
Family Background	No	Yes	Yes
Initial Major	No	Yes	Yes
Student's UC Campus dummies	No	Yes	Yes
Dummy Unobservables	No	No	Yes
Dummy Unobservables Correction	No	No	Yes
Adj. R^2	0.014	0.060	0.061
Observations	150,156	150,047	150,047

Data Source: UCOP.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

[†] Missing values on family background characteristics (i.e. income and parents education) were filled with a dummy for missing data. Standard errors in these specifications were obtained by bootstrapping.

[‡] In these regressions, we used a rescaled version of the Academic Index (A_{itr}), namely $\tilde{A}_{itm} = \frac{(A_{itm} - \mu_m)}{\sigma_m} \cdot \frac{1}{1000}$, where $\mu_m = 713.8255$ and $\sigma_m = 92.79792$.

various campuses. For example, UC Santa Barbara had the largest post-Prop 209 improvements in student academic preparedness and graduation rates, even though it ranked sixth out of the eight UC campuses in the *U.S. News & World Report* rankings. Furthermore, UC Berkeley and UC Riverside, which were the top and bottom ranked UC campuses, were both in the bottom third of post-Prop 209 gains in minority academic preparedness and graduation rates. Finally, while the magnitudes of the post-Prop 209 gains in academic preparation and graduation rates of whites displayed in Table 10 differ from those for minorities, the pattern of their distributions across the UC campuses is remarkably similar.

What accounts for the unequal distribution of post-Prop 209 changes in academic preparedness and gains in graduation rates across the UC campuses? Consistent with the matching story cited earlier, campuses may differ in their institutional ability to graduate students of differing preparedness and that the implementation of Prop 209 led to a sorting of students across campuses based on these differences. But, there are other possible explanations. For example, the distribution of students may have changed across the campuses due to temporal changes in the popularity of particular majors, e.g., pre-med or engineering. Or, the number and backgrounds of students that enrolled at various campuses after Prop 209 was implemented may have been affected by other institutional changes, including differential growth across campuses, over this period that had nothing to do with Prop 209.[24]

To better isolate the potential importance of student-campus matching we estimated a variant of the graduation choice model in (6) that allows campuses to differ in their conversion of different degrees of academic preparation to the probability of graduating. In particular, the probability of graduation from campus j is:

$$P_j^g(A_{itr}, X_{itr}, \hat{\Gamma}_{itr}, POST_{itr}, \phi_r) = \phi_{0jr} + \phi_{1r} + POST_{itr}\phi_{2r} + A_{itr}\phi_{3jr} + X_{itr}\phi_{4r} + \hat{\Gamma}_{itr} \quad (7)$$

where $\phi_r \equiv (\{\phi_{0kr}\}_{k=1}^J, \phi_{1r}, \phi_{2r}, \{\phi_{3kr}\}_{k=1}^J, \phi_{4r})$. This specification allows variation across campuses in the graduation rates of students with different academic preparations.[25] For example, those campuses with a comparative advantage at preparing less academically prepared minority (or non-minority) students for graduation would have high values of ϕ_{0jr} and low values of ϕ_{3jr}. Since we are primarily interested in the matching of underrepresented minority students, in this section we only report results for this group of UC enrollees.

Estimates of the UC campus-specific intercepts and coefficients on the academic index variable are given in Table 12.[26] Based on these estimates, we can decisively reject that all of the

[24]For example, UC Riverside's undergraduate program grew by over 56% from 1995 to 2001, while enrollments at UC Berkeley, UCLA and UC Santa Barbara hardly changed at all over the same period. All of these changes were part of the University of California's master enrollment plan that had been in place well in advance of Prop 209.

[25]The specification in (7) assumes that Prop 209 has no differential effect on graduation probabilities across UC campuses except through the assignment rules. To test this, we estimated the following version of (7)

$$P_j^{g*}(A_{itr}, X_{itr}, \hat{\Gamma}_{itr}, POST_{itr}, r, \phi^*) = \phi_{0jr}^* + \phi_{1r} + POST_{itr}\phi_{2jr}^* A_{itr}\phi_{3jr}^* + A_{itr}POST\alpha_{jr}^* + X_{itr}\phi_{4r}^* + \hat{\Gamma}_{itr}$$

that allowed for post-Prop 209 differences in baseline graduation rates by race/ethnicity *and* and in each campus's conversion of student preparation (A_{itr}) to graduation rates. We could not reject the hypothesis, $\phi_{2jr}^* = \phi_{2r}, \forall j$, and $\alpha_{jr}^* = 0, \forall j, r$, i.e., we found no evidence that campuses changed their treatment of students after Prop 209 went into effect that affected their chances of graduating.

[26]We also estimated (7) with data for the other demographic groups. While the campus-specific intercepts and coefficients differed across groups, the relative rankings of the coefficients by campus were similar across all race/ethnic groups.

Table 11: High School Academic Index and College Graduation Rates by UC campus for Minorities & Whites, Pre Post Prop 209 & Change Post Prop 209

	Minorities				Whites			
	Acad. Index		Grad. Rate		Acad. Index		Grad. Rate	
Campus‡	Pre Prop 209	Change	Pre Prop 209	Change	Pre Prop 209	Change	Pre Prop 209	Change
UC Berkeley	679	15	0.675	0.030	794	5	0.847	0.026
UC UCLA	674	29	0.656	0.057	766	19	0.839	0.036
UC San Diego	681	41	0.661	0.061	760	13	0.826	-0.005
UC Irvine	621	33	0.626	0.039	693	8	0.685	0.047
UC Davis	637	12	0.540	0.091	721	2	0.776	0.009
UC Santa Barbara	605	44	0.599	0.104	682	35	0.743	0.054
UC Santa Cruz	590	29	0.598	0.044	683	4	0.688	0.033
UC Riverside	582	14	0.583	0.005	669	-1	0.636	-0.014

Data Source: UCOP.

‡ Campuses are listed in order of their ranking in the 1997 *U.S. News & World Report* Top 50 National Universities.

Table 12: Graduation Estimates of UC Campus-Specific Intercepts and Academic Index Slopes†

Campus	Intercept	Academic Index§
UC Berkeley	-0.387***	0.513***
UCLA	-0.504***	0.723***
UC San Diego	-0.265**	0.388**
UC Irvine	-0.187*	0.272*
UC Davis	-0.523***	0.692***
UC Santa Barbara	-0.122	0.223
UC Santa Cruz	-0.002	-0.016

Data Source: UCOP.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
† Estimated on UCOP data for pre- and post-Prop 209 minority UC enrollees. (N = 23,177). The estimated coefficient on the Academic Index variable (see below) was 32.703^{***} and estimated overall intercept was 0.681^{***}.
§ In this regression, we used a rescaled version of the Academic Index (A_{itr}), namely $\tilde{A}_{itm} = \frac{(A_{itm}-\mu_m)}{\sigma_m} \cdot \frac{1}{1000}$, where $\mu_m = 713.8255$ and $\sigma_m = 92.79792$.

UC campuses have the same baseline graduation rates (i.e., that $\phi_{0jr} = 0\ \forall j$) or the same rates of converting student academic preparation into graduations (i.e., that $\phi_{3jr} = 0\ \forall j$). The relative magnitudes of ϕ_{0jr}s and ϕ_{3jr}s across the UC campuses are correlated with their degree of selectivity. Namely, the correlation coefficient for the institution-specific intercepts and the average minority academic index for the institution is -0.79 with the correlation coefficient for the slope and minority academic index being 0.80. Hence, more (less) selective schools have a comparative advantage in graduating better (worse) prepared students.

To better illustrate the student-campus sorting implied by the estimates in Table 12, we used the parameter estimates in Table 12 to predict campus-specific graduation probabilities for minority students from different parts of the academic index distribution. More formally, we calculated the following predicted graduation probabilities for hypothetical student h with academic preparation A_s:

$$P_k^g(A_s, X_h, \hat{\Gamma}_h, POST_h, \hat{\phi}_m) = \hat{\phi}_{0km} + \hat{\phi}_{1m} + POST_h\hat{\phi}_{2m} + A_s\hat{\phi}_{3km} + X_h\hat{\phi}_{4m} + \hat{\Gamma}_h \qquad (8)$$

where A_s is the cutoff value for sth percentile of the minority distribution of A, and where these probabilities were evaluated for each UC campus $k = 1, ..., J$, for various values of A_s, at the values of $(X, \hat{\Gamma}, POST)$ for the members of the minority ($r = m$) sample of UC enrollees. The rankings of the UC campuses for each percentile are based on the means of the appropriate predicted graduation.

The rankings of UC campuses by their predicted minority graduation rates are displayed in Table 13. Several patterns emerge from this Table. First, the rankings of campuses in terms of their graduation rate productivity differ across the academic index distribution. (This is consistent with the across-campus differences in the estimates of ϕ_{0jr}s and ϕ_{3jr}s in Table 12.) Second, some of the UC campuses appear to have *absolute advantage* (or *disadvantage*) in producing high

graduation rates across the distribution of student preparedness, while others have a *comparative advantage* (or *disadvantage*) in producing graduations with students of differing academic preparations. For example, UC Santa Barbara is predicted to produce among the highest, if not the highest, minority graduation rates at each part of the academic index distribution, whereas, somewhat surprisingly, UC Berkeley would produce among the lowest. Alternatively, UCLA, the second-most selective UC campus, is predicted to produce relatively low graduation rates for less-prepared students but is one of the best campuses at producing high graduation rates among the best-prepared minorities. In contrast, UC Santa Cruz and UC Riverside, the two least-selective UC campuses, appear to have comparative advantages in graduating less-prepared minorities but not better-prepared ones.

4.4 Can (and Did) Re-Allocating Students across Campuses Improve Minority Graduation Rates?

As documented in the preceding section, UC campuses differed in their "productivity" of graduating students from differing academic backgrounds. Moreover, it appears that less-selective campuses had either absolute productivity advantages in producing higher graduation rates among all students or had comparative ones with less prepared students. We also have documented [Table 6] that minority enrollments increased at the less-selective UC campuses after Prop 209, while more-selective ones lost minority enrollments. Finally, we found that Prop 209 did result in higher minority graduation rates [Table 10], even after we netted out the effects of changes in the academic and parental backgrounds of minorities that accompanied Prop 209. So, to what extent were these Prop 209 gains in minority graduation rates the result of better student-campus matching based on academic preparation that many proponents of banning the use of affirmative action in college admissions claim will result from such bans? And, more generally, to what extent can re-allocating students across campuses improve minority graduation rates?

In this section we attempt to provide partial answers to these questions. We do so by examining the consequences for minority graduation rates from using several "rules" for allocating, or assigning, students across the UC campuses. The assignment rules we consider either capture how minorities (and non-minorities) were allocated across the UC campuses under Prop 209 or provide a quantitative benchmark for how much student-campus matching on academic preparation could have changed minority graduation rates. To avoid confounding the effect of re-allocating students across campuses with those from changes in the composition of minority enrollees that occurred with Prop 209, we use the same "population" of minority students, namely those who enrolled at a UC campus prior to Prop 209, calculating the campus assignments and implied graduation rates under each rule.

We consider the following three rules for assigning minority students across the UC campuses:

AR1: Assign students to the campus that maximizes their probability of graduating

AR2: Assign students to campuses following (implicit) rule used to assign minorities post-Prop 209

AR3: Assign students to campuses following (implicit) rule used to assign whites post-Prop 209

Table 13: Rankings of UC Schools by Predicted Graduation Rates at Various Percentiles of the High School Academic Index Percentiles based on Minority Coefficients Estimates[†]

Percentile of the Minority Academic Index				
10th	25th	50th	75th	90th
UC Riverside (0.603)	UC Santa Barbara (0.628)	UC Santa Barbara (0.671)	UC Santa Barbara (0.715)	UCLA (0.756)
UC Santa Cruz (0.594)	UC Riverside (0.627)	UC Riverside (0.653)	UC San Diego (0.689)	UC Santa Barbara (0.753)
UC Santa Barbara (0.590)	UC Santa Cruz (0.616)	UC Santa Cruz (0.642)	UC Irvine (0.685)	UC San Diego (0.738)
UC Irvine (0.549)	UC Irvine (0.590)	UC Irvine (0.637)	UCLA (0.685)	UC Irvine (0.726)
UC San Diego (0.527)	UC San Diego (0.577)	UC San Diego (0.632)	UC Riverside (0.680)	UC Davis (0.713)
UC Berkeley (0.466)	UC Berkeley (0.523)	UCLA (0.603)	UC Santa Cruz (0.667)	UC Berkeley (0.711)
UCLA (0.450)	UCLA (0.522)	UC Berkeley (0.589)	UC Berkeley (0.654)	UC Riverside (0.703)
UC Davis (0.416)	UC Davis (0.486)	UC Davis (0.564)	UC Davis (0.644)	UC Santa Cruz (0.690)

Data Source: UCOP.

[†] Average predicted graduation probabilities in parentheses. The predicted probabilities were formed using the estimated coefficients for specification (7) for minorities and were predicted using the characteristics of minority students that enrolled at one of the UC campuses in the years 1995-2001.

The first assignment rule (AR1) focuses exclusively on achieving high graduation rates, providing the benchmark for the potential impact of student-campus matching on academic preparation. To operationalize AR1, we use the predicted graduation probabilities for minority student h given in (8) to assign her to that UC campus that yields the highest probability that she will graduate. Let that school be denoted by j^{max}, and the graduation probability associated with it is $P^g_{j^{max}}(A_h, X_h, \hat{\Gamma}_h, POST_h, \hat{\phi}_m)$. As noted above, we evaluate these graduation probabilities for the sample of pre-Prop 209 ($POST = 1$) minority ($r = m$) UC enrollees.

The second assignment rule, AR2, characterizes how minorities were allocated across the UC campuses after Prop 209 went into effect. We also investigate a third assignment rule (AR3) that characterizes what would have happened to minority graduation rates if minority students had been allocated across the UC campuses as whites were after Prop 209. While Prop 209 stipulated that California's public universities could not use race or ethnicity as a criteria for admission, this does not imply that the post-Prop 209 across-campus assignment rules for the *enrollment* of minorities and whites will necessarily be the same. Minorities and whites may have differed in their preferences for attending a particular campus and/or differed in their in-state private and out-of-state college alternatives. Furthermore, in contrast to AR1, neither AR2 or AR3 is insured, by design, to improve the graduation rates of enrolled students. Comparing the results for AR2 and AR3 helps one assess the importance these other factors might play in minority graduation rates.

To operationalize AR2 and AR3, we estimated a multinomial logit model of the UC campus that students actually attended for each of two samples: post-Prop 209 minority UC enrollees for AR2 and post-Prop 209 white UC enrollees for AR3. The probability of choosing a given campus is a function of the same measures of student academic preparedness, A, and family background, X, used in the estimation of the campus-specific graduation model presented above. Let $\hat{\pi}^{ARn}$, $n = 2, 3$, denote the estimated parameter vectors for the UC campus enrollment models for the samples corresponding to assignment rules AR2 and AR3, respectively. The predicted probability of being assigned to UC campus j under assignment rule ARn is given by:

$$P^a_j(A_h, X_h, \hat{\pi}_{ARn}) = \frac{\exp(A_h\hat{\pi}^{ARn}_{1j} + X_h\hat{\pi}^{ARn}_{2j})}{\sum_{k=1}^{J}\exp(A_h\hat{\pi}^{ARn}_{1k} + X_h\hat{\pi}^{ARn}_{2k})} \tag{9}$$

for $n = 2, 3$. As with the graduation probabilities evaluated under AR1, we evaluate these assignment probabilities at the characteristics of the pre-Prop 209 UC minority enrollees. Finally, the graduation probabilities associated with these two assignment rules are weighted averages of the predicted graduation probabilities for the UC campuses, using the rule-specific assignment probabilities in (9) as weights, i.e.:

$$P^g_{ARn}(A_h, X_h, \hat{\Gamma}_h, POST_h, \hat{\phi}_m, \hat{\pi}^{ARn}) \equiv \sum_{k=1}^{J} P^g_k(A_h, X_h, \hat{\Gamma}_h, POST_h, \hat{\phi}_m)P^a_k(A_h, X_h, \hat{\pi}^{ARn}) \tag{10}$$

for $n = 2, 3$.

The estimated minority graduation rates for the three assignment rules are recorded at the top of Table 14, along with the actual graduation rates for the pre-Prop 209 minority UC enrollees. As noted above, we used the characteristics of the latter group of minorities to generate the predictions associated with each of the assignment rules to facilitate comparisons.[27] For both

[27]While not presented, we also evaluated AR1, along with AR2 and AR3, on the post-Prop 209 minority UC enrollees and the pre- and post-Prop 209 white UC enrollees.

the observed rates and those predicted under each of the three assignment rules, we display the (overall) mean graduation rate and those for the deciles of the minority academic index distribution. The mean graduation rate observed for the pre-Prop 209 minority enrollees is 0.624 and ranges from just below 50% for minorities in the bottom decile of the Academic Index distribution to over 78% for the top decile. The graduation rates predicted for assignment rule AR1 are higher than the actual rates at each decile of the academic preparedness distribution. The same is true for those in the bottom half of this distribution under AR2 and AR3.

To better gauge the predicted changes in graduation rates relative to the pre-Prop 209 ones, we present, in rows (A), (B) and (C) of Table 14, the differences between the predicted graduation rates and the pre-Prop 209 observed rates. Below the labeled rows in this table, we express these differences as a percentage of the observed minority graduation rates and, where appropriate, as a percent of the difference between the predicted rates for AR1 and the actual ones.

The average maximum possible improvement in minority graduation rates through matching under AR1 is 0.046, which is a 7.3% improvement over pre-Prop 209 minority graduation rates. This average masks more sizeable predicted gains across the distribution of minority academic preparedness. In particular, minorities in the bottom half of the academic index distribution would experience an improvement in graduation rates of almost 11% if students were re-allocated according to AR1. At the same time, the sizes of these gains suggest there are limits to what can be achieved via better matching, an issue to which we return below.

What would the re-allocation of minority students across the UC campuses under AR1 look like and how big a change would it be to the pre-Prop 209 distribution? We present, in Table 15, tabulations of the shares of minorities that would be assigned to each of the eight UC campuses under the three assignment rules, as well as the actual shares of minorities that enrolled at these campuses prior to Prop 209. Prior to Prop 209 minorities were disproportionately enrolled at the more-selective UC campuses. Almost one-half of them were at the three most selective campuses, UC Berkeley, UCLA and UC San Diego, with UC Berkeley and UCLA having the two largest shares. At the same time, UC Santa Barbara had a sizeable share (14.3%) of the minorities enrolled in the UC system prior to Prop 209. Under AR1, the allocation of minorities would change dramatically [columns under (A)]. In particular, almost 75% of them would be enrolled at UC Santa Barbara, with the remaining 15.8% and 9.4%, enrolling at UC Riverside and UCLA, respectively. *No* minorities would enroll at any of the other campuses. Recall that UC Santa Barbara appeared to have an absolute advantage in converting minority enrollments into graduations. This advantage is exploited under AR1 and is manifest in the improved graduation rates, especially for academically less-prepared minorities, displayed in Table 14.

In row (B) of Table 14 we display the changes in minority graduation rates that would have occurred if the pre-Prop 209 cohorts of UC enrollees would have sorted themselves across the UC campuses in the manner that minorities did after Prop 209 (AR2). Note that this is a counterfactual evaluation, since we know that the characteristics of the minorities that enrolled within the UC system after Prop 209 did change [Table 9]. We find an average improvement of 0.009 in minority graduation rates, a 1.4% improvement over pre-Prop 209 rates. The magnitudes of the gains in minority graduation rates from the re-allocation under AR2 are modest, but higher for the bottom half of the academic preparedness distribution where minority graduation rates would improve by 3.7%. The AR2 allocation achieves 19.1% of the maximum attainable gains associated with AR1 [row (A)]. (It would achieve more of the maximum possible gains for the bottom part of the preparedness distribution, accounting for 35% of this possible gain for those

in the bottom half of the distribution.)

We next examine how much of the 0.031 net effect of Prop 209 on minority graduation rates presented above [Table 10] can be accounted for by the post-Prop 209 re-allocation of minority students. In the third row under row (A), we see that this re-allocation would account for 28% of the overall estimated net gain from Prop 209, while the share is almost 67% of this average net gain among those in the lower half of the academic preparedness distribution. Thus, while other factors were at play, the net impact of Prop 209 on minority graduation rates, the re-allocation of students across campuses was a contributor, especially for those with less preparation.

A look at the two columns under (B) of Table 15 shows how AR2 re-allocated students across the UC campuses. While obviously less dramatic than the re-allocation associated with AR1, we predict that the pre-Prop 209 UC enrollees would have been reallocated from the three most-selective UC campuses (UC Berkeley, UCLA and UC San Diego) to the less-selective ones (UC Riverside and UC Santa Cruz). In contrast to the re-allocation under AR1, only a modest share of the minorities would be re-allocated to UC Santa Barbara under AR2, the UC campus that we found had an absolute advantage at graduating its minority students.

Finally, we examine what would have happened to minority graduation rates after Prop 209 was implemented if minorities had been assigned to UC campuses in the same way that whites were. In row (C) of Table 14 we present the graduation rates associated with this counterfactual change in assignment rules (AR3). On average, minorities would have done better under AR3 than under AR2, although the difference in the average graduation rates is only 0.003 [= 0.0012 - 0.0009]. Under the white post-Prop 209 rule, minorities would have attained over 25% of the maximum possible gain from re-allocation of students across campuses. Moveover, under the white assignment rule, the gains in graduation rates would have been even greater than the minority assignment rule generated for those in the bottom half of the academic preparedness distribution.

What about the re-allocation of students under AR3 would have produced these graduation gains for minorities? Comparing the AR3 re-allocation in the columns under (C) of Table 15 with those for AR2 in the columns under (B), we see that the post-Prop 209 assignment rule for whites even more dramatically moved students out of the most-selective campuses than did AR2 and, importantly, re-allocated many more of them to UC Santa Barbara, the most productive campus for producing graduation rates for students of all levels of academic preparation. As we noted above, Prop 209 does not require that minority and non-minorities have the same *enrollment* rules. Furthermore, our analysis does not imply that any of the UC campuses, especially the more-selective ones, circumvented Prop 209 in their admissions procedures. While beyond the scope of this paper, it is entirely possible, and likely, that there are racial and ethnic differences in geographical preferences for the college one attends or in the sets and types of colleges, in-state or out-of-state, to which they are admitted. Finally, minorities may have less information about their likelihood of graduating from a more-selective college than whites.[28] Any or all of these factors may account for why minorities and whites ended up attending different campuses within the UC system.

At the beginning of this section, we posed two questions. With regard to the first one – did

[28]See Arcidiacono, Aucejo, Fang, and Spenner (2011) for conditions under which minorities may be worse of under affirmative action. The argument hinges on schools having private information about the student's probability of success.

better student-campus matching on academic preparation account for the net effect Prop 209 had on minority graduation rates – the answer is: "yes somewhat." We found that the assignment rule that mimiced what minorities did after Prop 209 was implemented (AR2) accounted for 28% of our estimated net effect of Prop 209 on minority graduation rates and almost 67% for the bottom part of the preparedness distribution. As noted above, there are a range of other factors that also may have played a role. With regard to the second question – what was the scope for better matching to improve minority graduation rates – our findings indicate limits to how much this mechanism can improve minority graduation rates, regardless of whether it comes about via an affirmative action ban or by some other means. The only exception we would make to this conclusion is for less-prepared minority students, who we estimate would realize much larger improvements in graduation rates via better matching. This finding is of great policy relevance, since less-prepared minorities disproportionately lost enrollments after Prop 209 was implemented.

More generally, finding ways – even limited ones – to improve the graduation rates of minorities is of growing importance, given the increasing penalties to not having a college degree. These penalties apply not only to those who do not attend college but also to those who do but do not graduate. Consider, for example, the disparity in labor market earnings between those who attend but do not graduate from college and those that do. Based on data from the 2008-2010 waves of the American Community Survey (ACS), we estimate that the annual earnings of African American men who completed their BA degree is 47.1% higher than for those who attended but did not graduate from college. The corresponding differentials are even larger for African American women (51.1%) and sizeable for both Hispanic men (36.1%) and women (41.1%).[29]

[29]By way of comparison, the corresponding differentials are 46.5% for white men and 43.0% for white women.

Table 14: Minority Graduation Rates within UC System by Academic Preparation, Pre-Prop 209 & under Alternative Post-Prop 209 Campus Assignment Rules†

		Overall	Deciles of Minority Academic Index Distribution									
	Assignment Rule	Mean	1	2	3	4	5	6	7	8	9	10
	Pre-Prop 209 Minority (Actual)	0.624	0.497	0.539	0.576	0.580	0.609	0.644	0.666	0.688	0.726	0.785
	AR1: Maximize Grad. Rates Rule	0.670	0.558	0.599	0.625	0.648	0.668	0.683	0.702	0.720	0.746	0.807
	AR2: Post-Prop 209 Minority Rule	0.633	0.525	0.563	0.585	0.605	0.625	0.641	0.663	0.685	0.720	0.778
	AR3: Post-Prop 209 White Rule	0.636	0.520	0.566	0.590	0.612	0.632	0.648	0.668	0.689	0.721	0.775
(A)	Maximum − Pre Minority (Actual)	0.046	0.061	0.060	0.049	0.068	0.059	0.039	0.036	0.032	0.020	0.022
	% of Pre Minority (Actual)	7.3%	12.2%	11.1%	8.5%	11.6%	9.8%	6.0%	5.3%	4.6%	2.8%	2.8%
(B)	Post (Minority) − Pre Minority (Actual)	0.009	0.028	0.024	0.009	0.025	0.016	-0.003	-0.003	-0.003	-0.006	-0.007
	% of Pre Minority (Actual)	1.4%	5.5%	4.4%	1.6%	4.2%	2.7%	-0.5%	-0.5%	-0.4%	-0.8%	-0.9%
	% of [Max − Pre Minority (Act.)]	19.1%	45.5%	39.8%	18.4%	36.4%	27.6%	-8.9%	-9.6%	-9.4%	-27.7%	-30.3%
	% of Ave. Net Eff. of Prop 209‡	28.1%	88.9%	76.9%	29.2%	79.3%	52.9%	-11.1%	-11.0%	-9.7%	-18.2%	-21.8%
(C)	Post (White) − Pre Minority (Actual)	0.012	0.023	0.027	0.014	0.032	0.023	0.004	0.002	0.001	-0.005	-0.010
	% of Pre Minority (Actual)	1.9%	4.5%	5.0%	2.4%	5.4%	3.8%	0.6%	0.2%	0.1%	-0.6%	-1.2%
	% of [Max − Pre Minority (Act.)]	25.6%	37.2%	44.9%	28.6%	46.7%	39.4%	9.3%	4.5%	3.1%	-22.8%	-43.8%

Data Source: UCOP.

† See text for description of how the predicted graduation rates were formed for each of the three assignment rules, AR1, AR2, AR3. Equations used to estimate this.

‡ Estimate of average net effect of Prop 209 is 0.031, which is the sum of the coefficients on $POST$ and $POST \times Minority$ in Col. 3, Table 10.

Table 15: Distribution of Minority Enrollees across UC Campuses, Pre-Prop 209 & Predicted under Alternative Post-Prop 209 Assignment Rules†

Campus	Pre Prop 209 Minority (Actual)	AR1: Max Grad Rate	AR2: Post Prop 209 (Min)	AR3: Post Prop 209 (White)	(A) AR1 − Pre Min (Actual) *Estimate*	(A) AR1 − Pre Min (Actual) % *of Actual*	(B) AR2 − Pre Min (Actual) *Estimate*	(B) AR2 − Pre Min (Actual) % *of Actual*	(C) AR3 − Pre Min (Actual) *Estimate*	(C) AR3 − Pre Min (Actual) % *of Actual*
UC Berkeley	0.180	0.000	0.100	0.041	-0.180	-100%	-0.079	-44%	-0.139	-77%
UCLA	0.218	0.094	0.140	0.083	-0.124	-57%	-0.078	-36%	-0.135	-62%
UC San Diego	0.084	0.000	0.072	0.069	-0.084	-100%	-0.012	-14%	-0.015	-18%
UC Irvine	0.087	0.000	0.113	0.118	-0.087	-100%	0.026	30%	0.031	36%
UC Davis	0.118	0.000	0.127	0.164	-0.118	-100%	0.009	8%	0.046	39%
UC Santa Barbara	0.143	0.747	0.152	0.194	0.604	421%	0.009	6%	0.050	35%
UC Santa Cruz	0.077	0.000	0.107	0.189	-0.077	-100%	0.030	39%	0.112	147%
UC Riverside	0.094	0.158	0.190	0.143	0.064	68%	0.096	102%	0.048	51%

Data Source: UCOP.

† See text for description of how the assignment probabilities for each of the three assignment rules, AR1, AR2, AR3, were determined.

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A Appendix

In this appendix we present the model and parameter estimates that underlie Table 6. Let U_{ijtr} denote the utility that high school graduate i in college entry cohort t who is a member of racial/ethnic group r would get from enrolling in college j is given by

$$U_{ijtr} = U_{jtr} + \epsilon_{ijtr} \tag{11}$$

where U_{jtr} is the student's systematic utility that varies by college and race and ϵ_{ijtr} is the unobserved and idiosyncratic component of utility that is assumed to be independent of U_{jtr} and distributed i.i.d. Type I extreme value. Also let U_{i0tr} denote the utility of not enrolling in any of the J colleges, which we normalize to zero.

To formulate an estimable version of (11), we need to invoke some additional assumptions. First, we assume that each student's choice set includes the complete set of California colleges and, going further, that all students are accepted to each of these colleges. Clearly, some students do not apply to particular colleges and students who apply are not always accepted. To account for these realities, we allow the net utility students derive from colleges to differ across types of schools, reflecting differences in the difficulty of a college's curriculum and/or a student's ability to complete it. Second, we allow cohorts to differ over time, such as in their college readiness, by including a race-specific linear time trend. Third, to incorporate the effects of Prop 209, we also allow the utilities of enrolling at different types of colleges to change post-Prop 209. Fourth, we express the systematic utilities of minority groups, U_{jtr}, relative to those of non-minorities in order to focus attention on the minority vs. non-minority differences in the effects of Prop 209. We allow for three racial/ethnic groups: African Americans, Hispanics and a "majority" group consisting of whites, Asian Americans, and the Unknowns.[30] Let this majority group be denoted by $r = m$ and African Americans and Hispanics be denoted by $r = b$ and $r = h$, respectively.

Incorporating these assumptions, we rewrite U_{jtr} from (11) as follows:

$$U_{jtr} = U_{jtm} + \delta_{0jr} + \delta_{1r}t + \sum_{k=1}^{K} \delta_{2kr} I(C_j = k) POST_t \tag{12}$$

for $r = b, h$, where U_{jtm} is the college-cohort specific utility for the majority group, $I(C_j = k)$ is an indicator function denoting whether college j is of *type* k, where types are defined below, $POST_t$ denotes an dummy variable equal to 1 if the student is in a cohort t that is Post-Prop 209 and equal to 0 otherwise, and the δ_{2kr}s are the effects of Prop 209 on enrollments at different types of colleges. Note that the second term of (12) absorbs the time-variant or pre-Prop 209 characteristics of colleges and/or race groups into a college-race specific fixed effect, δ_{0jr}. Finally, we assume that high school students make their college enrollment decisions according to:

$$j^*_{itr} = \arg\max_j U_{ijtr} \tag{13}$$

where $j \in \{0, 1, ..., J\}$ and $j = 0$ denotes the choice of not enrolling in college.

[30] Grouping the Unknowns with whites and Asian Americans is consistent with the anecdotal evidence cited in Section 2.1 and the findings of Card and Krueger (2005). To the extent that African Americans and Hispanic represent a portion of the increase in students with unknown race/ethnicity with Prop 209, we will be overestimating the negative effects of Prop 209 on these groups.

Finally, we need to invoke one additional assumption, namely that all of the students attending California's colleges graduated from a California (public) high school and that these colleges admitted no out-of-state students. This is a strong assumption but it allows us to account for the changing cohort sizes of high school students at risk of attending California's 4-year colleges discussed.[31]

Based on the above specifications and assumptions, we formulate estimators for δ_r, paying particular attention to the effects of Prop 209. It is convenient to express the systematic utilities of majority students, U_{jtm}, solely in terms of the aggregated IPEDS and high school graduation data as follows. Let the share of majority high school graduates that enrolls at college j be denoted by s_{jtm}. As seen in the previous section, we can estimate these shares from the IPEDS and high school graduation data for all cohorts t and groups r, including the majority group. It follows from the Type I Extreme Value distribution of ϵ_{ijtr} in (11) these shares have the following multinomial logit functional form:

$$s_{jtm} = \frac{\exp(U_{jtm})}{\sum_{j'=1}^{J} \exp(U_{j'tm}) + 1} \tag{14}$$

and it follows that one can "invert" the form in (14) to get:

$$U_{jtm} \quad = \quad \ln(s_{jtm}) - \ln(s_{0tm}) \tag{15}$$

so long as s_{0tm}, the share of minority students who did not enroll in a college at time t, and all of the s_{jtm}s are non-zero, a condition which holds for the majority group.

If we had a sufficient number of enrollees at each school for all race/ethnic groups, colleges and cohorts, we also could use (15) to form a modified version of the minimum-χ^2 estimator of δ by the method of Berkson[32] that allows for the college-race-cohort specific fixed effects. However, some colleges had entering cohorts with no African Americans or Hispanics (or either group). Accordingly, we estimate the utility parameters for the minority groups, δ_r, using the implied logit representation of the probability that a typical member of group r chooses to attend college j:

$$p_{jtr} = \frac{\exp(ln(s_{jtm}) - \ln(s_{0tm}) + \delta_{0jr} + \delta_{1r}t + \sum_{k=1}^{K} \delta_{2kr} I(C_j = k) POST_t)}{\sum_{j'=1}^{J} \exp(ln(s_{j'tm}) - \ln(s_{0tm}) + \delta_{0jr} + \delta_{1r}t + \sum_{k=1}^{K} \delta_{2kr} I(C_{j'} = k) POST_t)} \tag{16}$$

where $p_{jtr} \equiv s_{jtr}$, s_{jtr} is allowed to be zero and we have substituted for U_{jtm} from (15). Let N_{jtr} denote the number of individuals of race r who attended school j in cohort t, where N_{0tr} is the corresponding number that did not enroll in a 4-year college. Then the estimator for the δs in (12) are the solution to:

$$\hat{\delta} = \arg\max_{\delta} \sum_{t} \sum_{r} \left(\sum_{j=1}^{J} N_{jtr} \ln(p_{jtr}(\delta)) + N_{0tr} \ln(p_{0tr}(\delta)) \right) \tag{17}$$

To estimate the effect of Prop 209 on college graduation rates, we employ a similar choice-based model of whether and when a student enrolled in college j graduates. For students in

[31] The model can accommodate out-of-state students so long as the net effects of cross-state migration are zero, i.e., for each high school student from another state attending the jth college in California, there is a corresponding individual from California attending a college similar to j, but in a different state.

[32] See Berkson (1955) for the binary case and Theil (1969) for the multinomial extension of this method.

race/ethnic group r who were in cohort t that enrolled in college j, let the utility of graduating for minority group $r = b, h$ relative to the majority group m be given by:

$$\begin{aligned} V_{ijtr} &= V_{jtr} + \zeta_{ijtr} \\ &= V_{jtm} + \phi_{0jr} + \phi_{1r}t + \sum_{k=1}^{K} \phi_{2kr} I(C_j = k) POST_t + \zeta_{ijtr} \end{aligned} \tag{18}$$

for $r = b, h$, where ϕ_{0jr} is race/ethnic and college specific fixed effect and the parameters, ϕ_{2kr}s, characterize the relative effects of Prop 209 on college graduation rates. Let g_{jtr} denote the observed share of students in race/ethnic group r of cohort t that graduated among those in this group and cohort that enrolled in college j. These shares can be estimated from the data. We again express the systematic utility of graduating for the majority group, V_{jtm} in terms of g_{jtm} and g_{0tm} and formulate the estimator of the parameters vectors $\phi_r = (\phi_{0r}, \phi_{1r}, \phi_{21r}, ..., \phi_{2Kr})$ in terms of the following representation of the graduation probabilities:

$$q_{jtr} = \frac{\exp(\ln(g_{jtm}) - \ln(g_{0tm}) + \phi_{0jr} + \phi_{1r}t + \sum_{k=1}^{K} \phi_{2kr} I(C_j = k) POST_t)}{exp(\ln(g_{jtm}) - \ln(g_{0tm}) + \phi_{0jr} + \phi_{1r}t + \sum_{k=1}^{K} \phi_{2kr} I(C_j = k) POST_t) + 1} \tag{19}$$

where $q_{jtr} \equiv g_{jtr}$. Denote the number of college graduates of race r in cohort t at school j as G_{jtr}, then it follows that the number of students that do not to graduate is $N_{jtr} - G_{jtr}$. The parameters are then estimated using:

$$\{\hat{\phi}\} = \arg\max_{\phi} \sum_{t} \sum_{r} \sum_{j} \left(G_{jtr} \ln(q_{jtr}(\phi)) + (N_{jtr} - G_{jtr}) \ln(1 - q_{jtr}(\phi)) \right) \tag{20}$$

We estimate (20) separately for both 4 and 6 year graduations in order to determine if Prop 209 had a different effect on on-time versus ever graduation rates.

Finally, in the specifications of the college-specific utilities for enrollment and graduation decisions, we categorize California's college into one of the following five, mutually exclusive, types:

1. UC campuses that were in the 1997 *U.S. News & World Report* Top 50 National Universities;[33]
2. UC campuses that were not in the 1997 *U.S. News & World Report* Top 50 National Universities;
3. Campuses that were part of the CSU system;
4. Private (profit or non-profit) colleges/universities that were in either the 1997 *U.S. News & World Report* Top 50 National Universities or the Top 40 Liberal Arts Colleges;[34]
5. Private colleges/universities that did not make either of the *U.S. News & World Report* top rankings in 1997.

[33]Source: "Best national universities." *U.S. News & World Report*, Sept 16, 1996, 121(11): 110.
[34]Source: "Best national liberal arts colleges." *U.S. News & World Report*, Sept 16, 1996, 121(11): 116.

Note that none of the CSU campuses were ranked in the Top 50 U.S. universities or colleges in that year, whereas only UC Riverside and UC Santa Cruz were not among the ranked UC campuses.

Estimates of the post interacted with type of college for the enrollment specification (equation (17)) and graduation specification (equation (20)) for both 4 and 6 year graduates are given in Table 16. Enrollment results are reported in the first column. Both African Americans and Hispanics see significantly negative effects of Prop 209 at Top-50 UC schools with significantly positive effects at UC schools outside the Top 50. Prop 209 then shifted enrollments from the top UC schools to the UC schools that were less prestigious. This makes the enrollment results for CSU particularly surprising as the effect of Prop 209 is negative for both African Americans and Hispanics. Top-50 private schools see significant increases in enrollment for African Americans, but significant decreases for private schools outside the Top-50. No significant enrollment changes for Hispanics were seen at private schools.

Table 16 also presents estimates the effects of Prop 209 by race/ethnicity for the probability of graduating from college in 4 and 6 years, respectively. For African Americans, there are positive effects on 4 and 6 year graduation rates conditional enrollment for all types of colleges, though the results are only consistently significant at the two groups of private colleges. Positive effects are generally for Hispanics as well, with significant effects on 6 year college rates at Top-50 UC and privates schools as well as at CSU. These increased graduation rates could have occurred for at least two reasons. First, Prop 209 could lead to better minority students on average at each school, shifting the worst students at each school down a level and the worst students overall out. Second, Prop 209 may have shifted students to schools where they were a better match, raising their graduation probabilities. We explore these explanations further in Section 4.2 where we have individual-level data.

Table 16: Enrollment and Graduation Coefficients

	Enrollment		Grad$\leq$ 4|Enroll		Grad$\leq$ 6|Enroll	
	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.
African Americans:						
Top 50 UC	-0.447***	(0.042)	0.110	(0.105)	0.059	(0.090)
Non-Top 50 UC	0.183**	(0.076)	0.400**	(0.177)	0.227	(0.159)
CSU	-0.251***	(0.032)	0.167	(0.122)	0.134*	(0.071)
Top 50 Private	0.208***	(0.060)	0.329**	(0.129)	0.266*	(0.154)
Non-Top 50 Private	-0.116**	(0.052)	0.340***	(0.119)	0.367***	(0.121)
Hispanics:						
Top 50 UC	-0.222***	(0.022)	0.078	(0.052)	0.186***	(0.052)
Non-Top 50 UC	0.095**	(0.037)	0.010	(0.080)	0.059	(0.083)
CSU	-0.150***	(0.017)	0.325***	(0.057)	0.139***	(0.040)
Top 50 Private	-0.030	(0.041)	0.121	(0.087)	0.135***	(0.110)
Non-Top 50 Private	-0.027	(0.031)	0.024	(0.067)	0.022	(0.075)

Data Source: IPEDS.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.