Arcidiacono, Peter; Aucejo, Esteban; Coate, Patrick; Hotz, V. Joseph

Working Paper

Affirmative action and university fit: Evidence from proposition 209

IZA Discussion Papers, No. 7000

Provided in Cooperation with:
IZA – Institute of Labor Economics

Suggested Citation: Arcidiacono, Peter; Aucejo, Esteban; Coate, Patrick; Hotz, V. Joseph (2012) : Affirmative action and university fit: Evidence from proposition 209, IZA Discussion Papers, No. 7000, Institute for the Study of Labor (IZA), Bonn

This Version is available at:
https://hdl.handle.net/10419/67195

DISCUSSION PAPER SERIES

IZA DP No. 7000

Affirmative Action and University Fit: Evidence from Proposition 209

Peter Arcidiacono
Esteban Aucejo
Patrick Coate
V. Joseph Hotz

November 2012

Forschungsinstitut
zur Zukunft der Arbeit
Institute for the Study
of Labor

Affirmative Action and University Fit: Evidence from Proposition 209

Peter Arcidiacono
Duke University and NBER

Esteban Aucejo
London School of Economics

Patrick Coate
Duke University

V. Joseph Hotz
Duke University, NBER and IZA

Discussion Paper No. 7000
November 2012

IZA

P.O. Box 7240
53072 Bonn
Germany

Phone: +49-228-3894-0
Fax: +49-228-3894-180
E-mail: iza@iza.org

IZA Discussion Paper No. 7000
November 2012

ABSTRACT

Affirmative Action and University Fit: Evidence from Proposition 209*

Proposition 209 banned using racial preferences in admissions at California's public colleges. We analyze unique data for all applicants and enrollees within the University of California (UC) system before and after Prop 209. After Prop 209, graduation rates of minorities increased by 4.4%. We characterize conditions required for better matching of students to campuses to account for this increase. We find that Prop 209 did improve matching and this improvement was important for the graduation gains experienced by less-prepared students. At the same time, better matching only explains about 20% of the overall graduation rate increase. Changes after Prop 209 in the selectivity of enrolled students explains 34-50% of the increase. Finally, it appears UC campuses responded to Prop 209 by doing more to help retain and graduate its students, which explains between 30-46% of the post-Prop 209 improvement in the graduation rate of minorities.

JEL Classification: I23, J15

Keywords: affirmative action, college enrollment, college graduation, mismatch

Corresponding author:

V. Joseph Hotz
Department of Economics
Box 90097
Duke University
Durham, NC 27708-0097
USA
E-mail: hotz@econ.duke.edu

* The individual-level data on applicants to University of California campuses used in this paper was provided by the University of California Office of the President (UCOP) in response to a data request submitted by Professors Richard Sander (UCLA) and V. Joseph Hotz, while Hotz was a member of the UCLA faculty. We thank Samuel Agronow, Deputy Director of Institutional Research, UCOP, for his assistance in fulfilling this request and to Jane Yakowitz for her assistance in overseeing this process. Peter Arcidiacono and Esteban Aucejo acknowledge financial support from Project SEAPHE. We thank Kate Antonovics, Chun-Hui Miao, Kaivan Munshi, Justine Hastings, Peter Kuhn, Jesse Rothstein, David Card, Enrico Moretti, David Lam and seminar participants at Brown, IZA and UC Berkeley for their comments on earlier drafts of this paper.

1 Introduction

The U.S. Supreme Court is set to yet again rule on the constitutionality of race-based preferences (affirmative action) in university admissions.[1] One of the arguments opponents of affirmative action have advanced is that affirmative action actually hurts the individuals it is supposed to help – the *mismatch hypothesis*. According to the mismatch hypothesis, affirmative action in admissions leads to underrepresented minorities being admitted to colleges with entering credentials that are significantly lower than their non-minority counterparts resulting in the minority students not being competitive.[2]

In this paper we examine the mismatch hypothesis in the context of college graduation rates. 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 examine differences in graduation rates and the academic preparation of minority and non-minority students attending the various UC campuses between the years 1995-2000, using a unique source of student-level data that covers the universe of students who applied to one or more of the UC campuses. We obtained these data from the University of California Office of the President, the administrative offices of the entire UC system and refer to them as the "UCOP" data. The UCOP data cover a period where race-based preferences were banned in California. 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

[1] The Supreme Court heard oral arguments in the case of Fisher v. University of Texas on October 10, 2012 and is expected to rule on the case in 2013.

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

operation of public employment, public education, or public contracting." The Proposition took effect in 1998.

Using these student-level data, we find evidence that the graduation rates of minorities increased after Prop 209 was implemented. Indeed, the data reveal that under-represented minorities were 4.4 percentage points more likely to graduate in the period after Prop 209 that the period before. We also find that the distribution of minorities entering the UC system shifted from its more selective campuses (e.g., UC Berkeley and UCLA) towards its less selective ones. Moreover, while there was an overall improvement in the academic preparation of minorities enrolling at UC campuses after Prop 209 went into effect, the greatest improvements occurred at the less-selective campuses. Taken together, this evidence may be consistent with the mismatch hypothesis noted above.

As we argue below, the scope for the mismatch of students to campuses with affirmative action and its alleviation with bans on its use hinges on whether some campuses, presumably less-selective ones, are better-suited to produce positive outcomes, e.g., graduation rates, for less-prepared students while other universities, typically more-selective ones, are better-suited for more-prepared students. In contrast, if more-selective universities were able to produce better outcomes, such as graduation rates, for students of all levels of preparation than less-selective ones, then there is no scope for student-university mismatch. Bans on affirmative action would not be expected to improve the graduation rates of minority students, especially those with weaker backgrounds. We formalize these arguments below, characterizing and estimating graduation production functions for each of the UC campuses and examining whether and how they differ across campuses.

The student-level UCOP data we examine also reveal that after Prop 209 there was a decline in the number of under-represented minorities enrolled at one of the UC campus. And, if the minority students who did not attend a UC campus after Prop 209 were the least prepared, then graduation rates would have likely risen, regardless of the campus they would have attended. That is, Prop 209 may have induced a significant *selection effect* on minority enrollments within the UC system that would provide an alternative explanation to mismatch for why minority graduation rates improved.

To separate the mismatch from the enrollment selection explanations post-Prop 209 minority

graduation rate increases, we exploit the richness of the UCOP data on cohorts of students that entered the UC system before and after Prop 209. 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 and 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 (as well as whether they graduated from that campus), 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 method used in Dale and Krueger (2002) to control for student qualifications beyond those measured by high school GPA and test scores.

We decompose the post-Prop 209 change in minority graduation rates into three components: better matching, better students, and a third, residual, category of post-Prop 209 change in graduation rates not accounted for by the matching or selection. We refer to the latter (residual) component as the *university response* to the Prop 209 affirmative action ban.

We find that better matching can explain only 20% of the improvement in minority graduation rates within the UC system. However, this small overall effect, masks two notable phenomena with respect to the potential role of matching. First, we find that matching is much more important in accounting for the graduation gains of students in the bottom of the academic preparedness distribution; moreover, it would have been even larger had minorities been allocated to universities in the same way whites were allocated conditional on academic preparation. Second, as we discuss in the Conclusion, Arcidiacono, Aucejo and Hotz (2012) find that improved matching played a much more prominent role in improved graduation rates of minorities who initially enrolled at UC campuses in STEM (Science, Technology and Engineering) majors, especially in the higher rates that minorities who started in STEM majors actually graduated with a STEM degree.

We find that the largest share of the increase in minority graduation rates, 35-50%, is due to the changes in student characteristics with Prop 209. But the changes in the characteristics of minority enrollees post-209 are not all in the same direction. While some measures of preparation were higher in the post Prop 209 period (high school grades and SAT scores) other measures

actually fell (parental income and parental education). Hence, the pool of minority enrollees actually became more diverse from a socioeconomic perspective.[3]

Finally, we attribute the remaining 30-45% of the minority graduation gains to the residual category of university response. Below, we present some anecdotal evidence that suggest that universities did indeed respond to Prop 209 by focusing more resources on the retention of their enrolled students, increasing their graduation rates. That such a large share of the gains in graduation result from responses to UC campuses suggests that potential negative effects on minorities from the removal of affirmative action may be over-stated in one important respect: universities may respond to decreased diversity by investing more in the minorities and other students from disadvantaged backgrounds who do enroll.

The remainder of the paper is organized as follows. In Section 2 we describe the UCOP data and present the unadjusted levels and post-Prop 209 changes in minority and white student enrollments, measures of their academic preparation and their graduation rates. In Section 3 we characterize the mismatch hypothesis for the assignment of minority students to colleges of differeing quality and establish the conditions it requires in terms of the differences across colleges in their capacity to produce graduation for students of disparate academic preparation. In Section 4 we develop and estimate a model of college graduation that embed campus-specific graduation production functions that depend on student preparation and allow for a post-Prop 209 effect. In Section 5 we present the results. Given the estimates of the model, Section 6 examines the extent to which Prop 209 increased graduation rates through better matching of students to schools. Section 7 decomposes the increased graduation rates following Prop 209, focusing in particular on the roles of better matching, university responses to Proposition 209, and changes in the selection of students who enrolled in the UC system. Section 8 concludes.

2 Graduation Patterns in the UC System Before and After Prop 209

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

[3]This may be a result of the UC system placing more weight on characteristics correlated with race after Prop 209 since they could not explicitly take race into account. See Antonovics, Backes, and Ramey (2012) for a discussion.

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:[4]

1. The data are aggregated into three year intervals from 1992-2006.
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 1, 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.[5] The first panel gives the descriptive statistics for under-represented minorities (URMs). As a fraction of the number of minority graduates from California's public high schools,[6] enrollment rates fell from 4.6% to 3.6%. Conditional on enrolling, minority graduation rates increased by 4.4% off a base rate of 62.4% post-Prop

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

[5]The corresponding data for Asian American and Other Races (including un-reported) are given in Table 9 in the appendix.

[6]The number of California public high school graduates by race and year is given at http://www.cpec.ca.gov/StudentData/StudentSnapshot.ASP?DataReport=KGrads. The number of California applicants by race and year can be found at http://statfinder.ucop.edu. While not all of the minorities applying to, enrolling at or graduating from UC campuses are from California's public high schools, a large fraction are and we use this benchmark to account for the trends in the numbers of minorities at risk to go to college.

209.[7] While the share of white high school graduates who applied, attended, and graduated in the UC system all did not significantly change post-Prop 209 (second panel), graduation rates conditional on enrolling also showed a significant increase at 2.5%.

With respect to applications at UC campuses before and after Prop 209, while applications by URMs increased, as a share of California public high school graduates, they declined 1.1%. The latter decline suggests the possibility of a chilling effect of Prop 209, where minorities are less likely to apply under the new admissions rules. However, other evidence suggests otherwise. For example, using the same UCOP data as used in this paper, Antonovics and Sander (2012) argue that affirmative resulted in a warming, rather than a chilling, effect, in that minorities, as a group, were more likely to enroll in the UC school conditional on being admitted and Antonovics and Backes (2012) show that the sending of SAT scores by minority applicants to UC campuses did not change post-Prop 209.

With respect to academic preparation as measured by the student's 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 (Table 1). This difference in academic preparation accounts, in part, for the lower proportion of minority high school students being admitted to a UC campus ("Share of Calif. 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. This improvement in academic preparation of the minority students that enrolled at a UC campus after Prop 209 suggests that changes in minority student *selectivity* with respect to academic preparation noted in the Introduction may have accounted for some, if not all, of the improved graduation rates of minorities after the implementation of Prop 209.

But, the change in the selectivity of enrolled minority students with Prop 209 may not have improved uniformly. As shown in Table 1, there was a significant and sizable decline in the proportion of minority enrollees and graduates from more "advantaged" family backgrounds after Prop 209 went into effect. 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

[7] Graduation rates are measured as graduating in 5 years or less. There are a small number of individuals that are listed as graduating but do not have a graduation time. In the period we analyze, these individuals are almost exclusively listed as having a major classified as 'Other'. We drop these individuals from our sample though are qualitative are unaffected by the treatment of these individuals.

Table 1: Characteristics of UC Applicants, Admits, and Enrollees Pre-Prop 209 and Post-Prop 209 Change, Under-represented Minorities and Whites†

	Applied		Admitted		Enrolled		Graduated	
	Pre-Prop 209	Change	Pre-Prop 209	Change	Pre-Prop 209	Change	Pre-Prop 209	Change
Under-represented Minorities:								
No. of Minorities	30,911	2,511	24,332	-470	13,278	-707	8,198	92
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***
Share of Calif. Public HS Grads	0.107	-0.011***	0.084	-0.016***	0.046	-0.010***	0.028	-0.005*
Whites:								
No. of Whites	67,781	8,202	54,480	4,385	27,617	1,945	20,770	2,211
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***
Share of Calif. Public HS Grads	0.187	0.003	0.150	-0.003	0.076	-0.002	0.057	0.000

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

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 and Others (including Unknowns) are omitted from table, but are available in the appendix.

a BA degree and a corresponding 0.046 reduction (an 11% decline) among those minorities that graduated from a UC campus after Prop 209 was implemented. Similarly, post-Prop 209 a greater share of applicants and 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.[8] This decline in minority students from more advantaged backgrounds that enrolled at UC campuses after Prop 209 would seem to work against improved graduation rates, given previous findings that students from wealthier and better educated parents do better in college.[9]

We next consider how graduation rates and academic preparation varied across UC campuses before and after Prop 209. Table 2 gives the distribution of both for minorities and whites, respectively. The campuses are listed in order of their *U.S. News & World Report* ranking as of the fall of 1997.[10] We use this ranking throughout our study as our measure of the selectivity and/or quality of the UC campuses. 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 1, whites have higher academic indices and graduation rates than do minorities, a pattern that holds campus-by-campus.

The *changes* in student preparedness and graduation rates post-Prop 209 are not ordered according to the selectivity of the various campuses (Table 2). 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

[8] 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.

[9] For example, Turner (2005) finds that students of mothers with a college degree have a 14 percentage point higher probability of attaining a BA degree than do students whose mothers do not.

[10] The 1997 *U.S. News & World Report* rankings of National Universities are based on 1996-97 data, the academic year before Prop 209 went into effect. The rankings of the various campuses were: 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).

Table 2: High School Academic Index and College Graduation Rates by UC campus for Minorities & Whites, Pre Post Prop 209 & Change Post Prop 209

	Under-represented 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.

ranked UC campuses, were both in the bottom third of post-Prop 209 gains in minority academic preparedness and graduation rates.

Taken together, the across-campus changes that occur in minority graduation rates and the academic preparation of those minorities that do enroll is potentially consistent with the view that the Prop 209 ban of affirmative action resulted in minority students being *better matched* to campuses based on their academic preparation. But as noted earlier, this improvement also may be consistent with greater selectivity in UC minority enrollments post-Prop 209. In order to sort of these factors, we provide, in the next section, a more precise characterization of the conditions required for better matching when affirmative action in the admission process is banned and, in the following section, a strategy for isolating these matching and post-Prop 209 effects from selectivity in enrollments.

3 The Mismatch Hypothesis and University Graduation Production Functions

In this section, we characterize the mismatch hypothesis as it applies to minority graduation rates. To fix ideas, consider the following characterization of the *graduation production function* for one of the UC campuses. Let $P_j^g(AI)$ denote the graduation rate that campus j can produce for a minority student with an academic preparation index of AI. For simplicity, assume that this production function is linear and increasing in AI, i.e.,

$$P_j^g(AI) = \phi_{0j} + \phi_{1j} AI \tag{1}$$

for UC campus $j, j = 1, ..., J$, where $\phi_{1j} > 0$.

One could proceed by specifying the admission criteria of campuses in the presence and absence of affirmative action, characterizing the criteria students have for the campuses to which they apply and to which they enroll if admitted and that campuses use in its admission decisions and, thus, the matching of students to colleges (or alternative activities).[11] For the purposes of assessing the mismatch hypothesis, it is sufficient to assume that relative to an affirmative

[11] See Epple, Romano and Sieg (2008) for such an equilibrium model of college admissions under affirmative action and when it is banned.

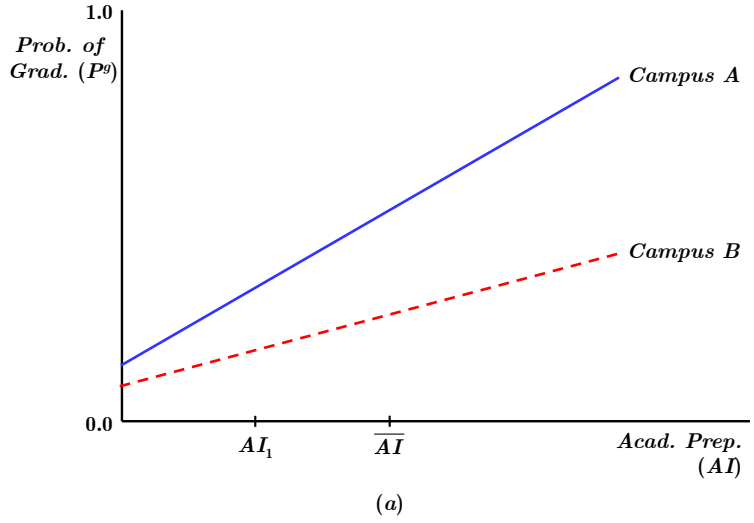
action regime, a college under an affirmative action ban will place less (or no) weight on the diversity of an incoming student body and more weight on selecting students based on their academic preparation or AI. The mismatch hypothesis asserts that, under affirmative action, minority students are more likely to be matched to higher quality colleges for which they are less well-prepared than their non-minority counterparts. By banning affirmative action, this form of mismatch of minority students will be reduced, i.e., minority students will be "better matched" to colleges on the basis of their academic preparation (AI), and the outcomes of minorities, such as their graduation rates, will improve.[12]

The validity of this mismatch explanation hinges on whether colleges differ in their graduation production functions and how they differ between high-quality (more selective) and lower quality (less selective) colleges. To see this, consider Figure 1, which illustrates two possibilities for the relationship between the production functions of a more-selective college, *Campus A*, and a less-selective one, *Campus B*. Panel (a) illustrates the case where Campus A has an *absolute advantage* over Campus B in producing higher graduation rates for students of *all* levels of academic preparation (AI). At the same time, the way Panel (a) is drawn, the higher quality campus, A, has a comparative advantage at producing higher graduation rates among better prepared students than Campus B. This latter assumption provides a motivation for why better prepared students tend to attend higher quality colleges.

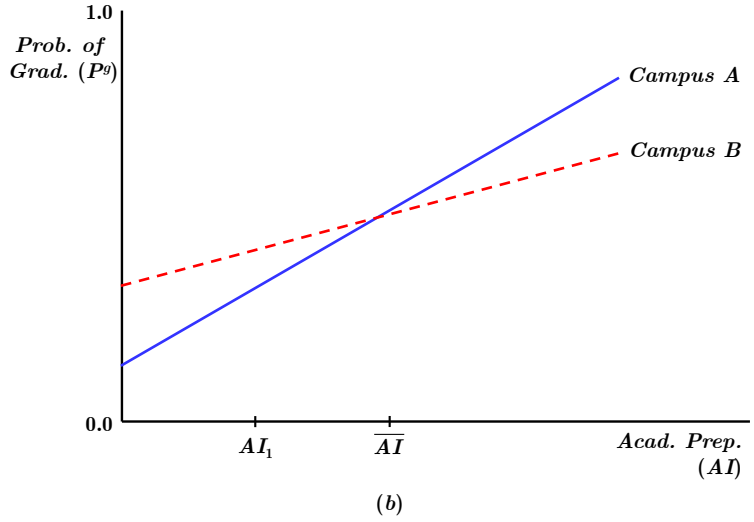
For the predictions of the mismatch hypothesis to hold, one requires a stronger set of differences between the production functions of higher- and lower-quality campuses. To see this, consider Panel (b) of Figure 1. As before, Campus A has a comparative advantage in graduating better prepared students. Now, however, Campus A only has an absolute advantage in the production of graduations for better prepared students, i.e., only for $AI > \overline{AI}$. And, Campus B now has an absolute advantage in the production of graduations for less-prepared students ($AI < \overline{AI}$). Now consider what happens to a minority student with academic preparation AI_1 who was admitted and attended Campus A under affirmative action but is no longer able to get into Campus A once affirmative action is banned.[13] Because it has an absolute advantage in graduating less prepared students, this student's likelihood of graduating from college increases

[12] See Dillon and Smith (2009) for reasons why students end up over-matched or under-matched.

[13] If students know their academic preparation then they would presumably internalize the fact that their graduation rates are lower at the more selective campus. However, as discussed in Arcidiacono, Aucejo, Fang, and Spenner (2011), when schools have private information on the probability of success, it is possible for minority students to be made worse off under affirmative action.



(a) Campus A has ***absolute advantage*** in graduations over Campus B for ***all*** levels of AI



(b) Campus A ***better*** than Campus B at graduating ***better prepared*** students ($AI > \overline{AI}$) but B ***better*** than A for ***less prepared*** ones ($AI < \overline{AI}$)

Figure 1: Alternative Relationships between Graduation Production Functions of Higher Quality and Lower Quality Campuses

by enrolling in Campus B, as the mismatch hypothesis predicted.[14]

[14]Campus B having a comparative, but not absolute, advantage over A with respect to graduations among less prepared students, as in Panel (a) of Figure 1, is not enough to generate the implications of the mismatch hypothesis. To see this, note that if higher quality colleges have an absolute advantage in graduating all students as in Panel (a), then a less prepared minority student with AI_1 ($AI_1 < \overline{AI}$) that was admitted to Campus A under affirmative action will experience a *lower*, rather than *higher*, graduation rate after affirmative action is banned and she can no longer attend Campus A.

As the above discussion makes clear, the mismatch hypothesis requires lower-quality (less selective) universities to have an absolute advantage, and not just a comparative advantage, in graduating less academically prepared minority students. Below, we estimate campus-specific graduation production functions for each of the UC campuses and assess whether this condition holds across the UC system's higher and lower ranked campuses.

Before discussing our estimation strategy, several caveats and comments are in order. First, our claims about what is required about the graduation production functions of more and less selective campuses/colleges for the mismatch hypothesis to hold does not characterize how the admission and enrollment processes of students will change after affirmative action bans like Prop 209. As noted in Section 2, the number and composition of minority student enrolled at UC campuses changed with Prop 209. Presumably, a complete model of admission and enrollment *selection processes* would be required to characterize these outcomes. In what follows, we do not specify or estimate an explicit model, but we do develop strategies to correct for selection effects associated with the Prop 209 ban.

Second, it is possible that affirmative action bans also may affect what colleges do with respect to the graduation rates of minority and non-minority students. For example, colleges subject to affirmative action bans may try to improve their tutoring and counseling programs especially at freshman in order to help them get through their first year of collegiate studies in order to reduce the rates of drop-out and improve graduation rates.

There is anecdotal evidence that UC campuses did take actions after Prop 209 to improve student retention rates. For example, UCLA changed the way its introductory courses for first year students were organized in the wake of Prop 209 in an attempt to improve the retention of "disadvantaged students."[15] While some of these efforts were direct responses to the passage of Prop 209, others appear to have been in response to the rising (and continuing) attention to retaining college enrollees, especially those from disadvantaged groups.[16] We note that the efforts by UC campuses to improve outreach and retention of minority students after Prop 209 could not directly target racial and ethnic groups, which was deemed a violation of ban on the use of race and ethnicity "in the operation of ... public education" (Text of Proposition 209).[17]

[15]See "Intercollegiate Forums at UCLA discuss Retention of Minorities," *Daily Bruin*, March 2, 1998.

[16]See "Scholars urge Early Help for Minorities," *UCLA Today*, March 16, 1998.

[17]See "Prop. 209 Mandates Changes on Campus," *UCLA Today*, October 10, 1997. As noted in Horn and Flores (2003), some of the post-Prop 209 efforts to improve the retention of minority enrollees at UC Berkeley

This led to a restructuring of official campus programs to target disadvantaged, rather than only minority, students based on "academic profiles, personal backgrounds and social and environmental barriers that may affect [a student's] university experience, retention and graduation."[18] As a result, some of these retention efforts in response to, or coincident with, Prop 209 may affect the graduation rates of minority and non-minority students.

In the empirical analyses presented below we allow for post-Prop 209 changes in graduation rates at UC campuses, net of changes in selectivity in student enrollments and campus-specific graduation production functions. We examine the extent to which such changes occurred not just among minorities but also among non-minorities. The latter effects might be expected to the extent that efforts to improve retention and graduation rates were not (or could not be) targeted exclusively to minorities. We refer to these effects as the "university response," although it is really a residual effect since we are not able to directly quantify or characterize the programs that were put in place to improve retentions after the passage of the ban.

4 Estimating Graduation Production Functions and the Post-Prop 209 Effect on Graduations

In order to assess the role of mismatch, selection and any post-Prop 209 response by UC campuses to improve graduation rates, we specify and estimate models of college graduation. In the discussion below, we focus on minority students, although we later present estimates for corresponding models estimated for whites and Asian Americans.

Our interest focuses on estimating the parameters of the campus-specific production functions in (1) and any post-Prop 209 additional change in minority graduation rates among enrollees, net of the post-Prop 209 changes in the admissions and enrollment processes that were manifested in the changing characteristics of minority students seen in Table 1. As before, the probability i in cohort t graduates from institution j is specified as depending on the student's academic preparation. We now extend the model from the previous section to also allow the probability of graduating to depend on her family background characteristics, X_{it}, to capture, for example, financial constraints and preferences, and whether the individual was a part of the post-Prop 209 cohort, $POST_{it}$, to capture factors such as the response by universities to Prop-209. Let

were handled by student-run organizations who were not directly subject this provision of Prop 209.

[18] "Prop. 209 Mandates Changes on Campus," *UCLA Today*, October 10, 1997.

G_{ijt} denote the 0/1 indicator of whether minority student i who enrolled at UC campus j in cohort t graduated. We then specify G_{ijt} as:

$$\begin{aligned} G_{ijt} &= P_j^g(AI_{it}, POST_{it}, X_{it}) + \zeta_{it} \\ &= \phi_{0j} + \phi_{1j} AI_{it} + \phi_2 POST_{it} + \phi_3 X_{it} + \zeta_{it} \end{aligned} \tag{2}$$

where ζ_{it} is an error term that captures unobserved (to the econometrician) student preferences and characteristics and where ϕ_{0j} and ϕ_{1j} are the parameters of the campus-specific production function in (1).[19]

Ideally, a student's unobserved preferences and characteristics captured by ζ_{it} would be independent from which campus they attended, whether they were enrolled in a pre- or post-Prop 209 entry cohort, their AI and their family background, X. If so, the parameters in linear probability model in (2) would be consistently estimated using standard regression methods. But some of a student's unobserved characteristics are likely to correlated with the quality/selectivity of the campus they attend. As has been noted in the literature,[20] failure to control for the full set of factors will likely to result in biased estimates of the effects of attending more-selective colleges on the outcomes of interest. 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 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 indicator variables that measure the selectivity of the UC campuses to which a given student was admitted. Using the *U.S. News & World Report* Top 50 University rankings for 1997, we array the UC campuses from highest ranked to lowest ranked.[21] The first indicator, a_{i1t} is set equal to 1 for all students that were admitted at UC Berkeley (the top ranked campus) and 0 otherwise. The second indicator, a_{i2t} is set equal to 1 for all students that were admitted to UC Berkeley and/or UCLA (the second ranked school), and we proceed in this way until we define the final indicator, $a_{i,J-1,t}$, which is set equal to 1 if a student was admitted to at least one of the UC campuses ranked

[19] We maintain the linear probability model specification in (2) to model graduation rates throughout.

[20] See, for example, Black, Daniel, and Smith (2001), Dale and Krueger (2002), Black and Smith (2004), and Hoxby (2009).

[21] Recall that these rankings were (with a campus's rank in parentheses): 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).

higher than or equal to UC Santa Cruz, the second-lowest ranked campus in the UC system at the time in 1997. We add these these controls variables to the specification in (2) to obtain:

$$G_{ijt} = \phi^*_{0j} + \phi^*_{1j} AI_{it} + \phi^*_2 POST_{it} + \phi^*_3 X_{it} + \sum_{k=1}^{J-1} \phi^*_{4k} a_{ikt} + \zeta^*_{it} \quad (3)$$

We refer to (3) as our *Baseline Specification*.

While accounting for selection on unobservables based on the application of Dale-Krueger in (3) may produce unbiased estimates of the campus-specific production function parameters, $(\phi^*_{0j}, \phi^*_{1j})$, the resulting estimate of the direct effect of Prop 209 on graduation rates, ϕ^*_2, is likely to be biased for the following reason. 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 credentials 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_{it}, 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 the change in UC admission criteria with Prop 209, 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, $\sum_{k=1}^{J-1} \hat{\phi}^*_{4k} a_{ikt}$, for each student that was accepted at a UC campus. We then regress these indices on student's academic index, AI_{it}, family background characteristics, X_{it}, and the dummy indicator of whether the student applied in the post-Prop 209 period:

$$\sum_{k=1}^{J-1} \hat{\phi}^*_{4k} a_{ikt} = \theta_0 + \theta_1 POST_{it} + \theta_2 AI_{it} + \theta_3 X_{it} + \eta_{it} \quad (4)$$

It follows that our estimate of the response by universities to Prop 209 is given by:

$$\ddot{\phi}^*_2 = \hat{\phi}^*_2 + \hat{\theta}_1 POST_{it}. \quad (5)$$

We expect $\hat{\theta}_1$ to be negative, as we anticipate that failure to make this adjustment for post-Prop 209 differences in selection procedures, we would tend to overestimate the response by universities to Prop 209. We refer to the above adjustment of the Baseline Specification as selection adjustment *Method 1*.

The adjustment in (5) may still be biased upward because less minorities were admitted to *any* UC campus after Prop 209, implying the set of admits in the post-period would be on average stronger (beyond observables) than those in the pre-period. To adjust for this, we throw out pre-period individuals in the bottom 7% of the $\sum_{k=1}^{J-1} \hat{\phi}^*_{4k} a_{ikt}$ distribution, which roughly corresponds to the drop in minorities admitted to any campus in the post period. We then re-estimate (4) and calculate again the adjustment given in (5). We refer to this second adjustment of the Baseline Specification as selection adjustment *Method 2*. Note that neither of these adjustments of the coefficient on $POST$ affects the estimates of the other coefficients.

5 Results

Parameter estimates for the Baseline Specification in (3) for under-represented minorities (URM), whites and Asian Americans are presented in Table 10 in the Appendix. To focus attention on the heterogeneity across schools, we re-display the UC campus-specific graduation production function parameters estimates for minorities in Table 3. All coefficients are expressed relative to those for UC Riverside. Based on these estimates, we can decisively reject that all of the UC campuses have the same intercept for minorities (i.e., that $\phi^*_{0j} = 0 \; \forall j$) or the same rates of converting the academic preparation into graduation (i.e., that $\phi^*_{1j} = 0 \; \forall j$). The relative magnitudes of ϕ^*_{0j}s and ϕ^*_{1j}s across the UC campuses also are correlated with their degree of selectivity. The correlation coefficient for the institution-specific slopes with the average minority academic index in the pre-period is 0.72, suggesting that more (less) selective schools have a *comparative* advantage in graduating better (worse) prepared students. In contrast, the correlation coefficient for the institution-specific intercepts and the average minority academic index is -0.72.

To illustrate the student-campus sorting implied by the estimates in Table 3, we use the parameter estimates in Table 3 to predict campus-specific graduation probabilities for minority students from different parts of the academic index distribution. More formally, we use the

Table 3: Parameters Estimates for UC Campus-Specific Graduation Production Functions for Minorities[†]

Campus	Intercept	Academic Index[§]
UC Berkeley	-0.405***	0.538***
	(0.086)	(0.129)
UCLA	-0.547***	0.766***
	(0.089)	(0.133)
UC San Diego	-0.291**	0.413**
	(0.123)	(0.178)
UC Davis	-0.553***	0.722***
	(0.093)	(0.144)
UC Irvine	-0.198*	0.282*
	(0.104)	(0.162)
UC Santa Barbara	-0.136	0.236*
	(0.090)	(0.142)
UC Santa Cruz	0.010	-0.024
	(0.093)	(0.149)

Data Source: UCOP. N = 23,177.

[†] See equation (1) for specification of graduation production function. The intercepts and slope coefficients are measured relative to those for the UC Riverside, the lowest ranked UC campus.

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

parameter estimates for the baseline estimating equation in (3) to predict graduation probabilities for hypothetical student h with academic preparation AI_s in the pre-Prop 209 period:

$$P_j^{g*}(AI_s, X_h, POST_h, \hat{\phi}^*) = \hat{\phi}_{0j}^* + \hat{\phi}_{1j}^* AI_s + \hat{\phi}_2^* POST_h + \hat{\phi}_3^* X_h + \sum_{k=1}^{J-1} \hat{\phi}_{4k}^* a_{hk} \tag{6}$$

where AI_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 AI_s. Here, we set the values of X_h to the averages for minority enrollees in pre-Prop 209 period.[22] The rankings of the UC campuses for each percentile are based on the means of the predicted graduation rates based on (6) evaluated at corresponding values of AI_s.

The rankings of UC campuses by their predicted minority graduation rates are displayed in Table 4. 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_{1j}s and ϕ_{3j}s in Table 3.) Second, some of the UC campuses appear to have an *absolute advantage* (or disadvantage) in producing high graduation rates across the whole distribution of student preparedness. 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, UC Davis is predicted to the lowest, or near the lowest, graduation rates at each level of academic preparation. At the same time, most of the rest of the campuses exhibit an absolute advantage in minority graduations for some parts of the preparation distribution but not others. (Recall that absolute differences among campuses in the production of graduations for students at different parts of the preparation distribution is a necessary condition for the mismatch hypothesis.) For example, 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, perform well in graduating less-prepared minorities but not better-prepared ones.

Table 4 also makes clear that heterogeneity in graduation rates across universities is particularly large for those at the bottom of the distribution. The gap between the highest and lowest

[22]Note that since our estimating equation is linear, the relative rankings of the campuses will not change if we instead considered the post-Prop 209 period or varied the values of the family background characteristics.

graduation rates across schools for students at the 10th percentile of the academic index was over 16 percentage points. For students at the 75th percentile of the academic index, the gap between the highest and lowest graduation rates across schools was less than half that at 7.1 percentage points.

With the estimates of (3) and making the corresponding adjustments given by Method 1 and Method 2, we can calculate the effect of Proposition 209 beyond that due to selection and changes in the matching of students to schools. Table 5 gives the estimates of the coefficient on *POST*, both under the Baseline Specification and with the corrections outlined in Methods 1 and 2, respectively. Without adjustments, we see that while these net effects are statistically significant for minorities and whites, their values – 4.0% for URMs and 2.3% for whites – are not much different from the unadjusted estimates in Table 1. However, when we further adjust for the consequences that Prop 209 had on UC admissions criteria, these estimates fall. Under Method 1 we assume that the pre-Prop 209 admits had the same distribution of unobservables as the post-Prop 209 admits. We find that the direct effect of enrolling in the post-Prop 209 period on graduation rates was 2 percentage points for minorities and 1.5 percentage points for whites. Since the evidence in Table 1 clearly indicates that some minorities would not be admitted to any campus post Proposition 209, Method 2 further drops the bottom 7% of minority admits in the pre-Prop 209 period when calculating the adjustment to the *POST* coefficient. Under Method 2, the effect falls to 1.3 percentage points for minorities, which is still substantial. Complementing the anecdotal evidence given in Section 3, these results are consistent with campuses within the UC system responding to Prop 209 by providing more resources to help retain and facilitate higher graduation rates of those students who did enroll after the ban went into effect. As we noted in Section 3, the campuses did undertake such efforts and our findings are suggestive that they had a positive effect on minority, and non-minority, graduation rates.

6 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-

Table 4: 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	95th
UC Riverside (0.613)	UC Santa Barbara (0.631)	UC Santa Barbara (0.666)	UC Santa Barbara (0.702)	UCLA (0.763)
UC Santa Cruz (0.610)	UC Riverside (0.631)	UC Riverside (0.651)	UC Irvine (0.673)	UC Santa Barbara (0.753)
UC Santa Barbara (0.601)	UC Santa Cruz (0.627)	UC Santa Cruz (0.645)	UC San Diego (0.672)	UC San Diego (0.739)
UC Irvine (0.563)	UC Irvine (0.596)	UC Irvine (0.633)	UC Riverside (0.672)	UC Irvine (0.727)
UC San Diego (0.539)	UC San Diego (0.579)	UC San Diego (0.625)	UCLA (0.665)	UC Berkeley (0.723)
UC Berkeley (0.490)	UC Berkeley (0.536)	UCLA (0.595)	UC Santa Cruz (0.665)	UC Davis (0.722)
UCLA (0.468)	UCLA (0.527)	UC Berkeley (0.590)	UC Berkeley (0.646)	UC Riverside (0.701)
UC Davis (0.439)	UC Davis (0.495)	UC Davis (0.560)	UC Davis (0.628)	UC Santa Cruz (0.692)

Data Source: UCOP.

[†] Average predicted graduation probabilities in parentheses. The predicted probabilities were formed using the estimated coefficients for specification (6) for minorities and were predicted using the characteristics of minority students that enrolled at one of the UC campuses in the years 1995-1998.

Table 5: Adjusted Post-Proposition 209 Effects

	Coeff	Standard Error
Unadjusted		
Minority	0.040***	(0.006)
White	0.023***	(0.004)
Asian	0.032***	(0.004)
Adjusted		
Minority (Method 1)	0.020***	(0.006)
Minority (Method 2)	0.013*	(0.007)
White	0.015***	(0.004)
Asian	0.024***	(0.004)

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

selective campuses had either an absolute advantage in producing higher graduation rates for all students or for less prepared students, with the latter being a necessary condition for mismatch. 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?

6.1 Alternative Assignment Rules

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

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 (6) 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 $P^{g*}_{j^{max}}(AI_s, X_h, POST_h, \hat{\phi}^*)$. As noted above, we evaluate these graduation probabilities for the sample of pre-Prop 209 ($POST = 0$) minority 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, AI, 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:

$$P_j^a(AI_h, X_h, \hat{\pi}^{ARn}) = \frac{\exp(AI_h\hat{\pi}_{1j}^{ARn} + X_h\hat{\pi}_{2j}^{ARn})}{\sum_{k=1}^{J}\exp(AI_h\hat{\pi}_{1k}^{ARn} + X_h\hat{\pi}_{2k}^{ARn})} \tag{7}$$

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 (7) as weights, i.e.:

$$P_{ARn}^{g*}(AI_h, X_h, POST_h, \hat{\phi}, \hat{\pi}^{ARn}) \equiv \sum_{k=1}^{J} P_k^g(AI_h, X_h, \hat{\Gamma}_h, POST_h, \hat{\phi})P_k^a(AI_h, X_h, \hat{\pi}^{ARn}) \tag{8}$$

for $n = 2, 3$.

6.2 Graduation predictions from alternative assignment rules

The estimated minority graduation rates for the three assignment rules are recorded at the top of Table 6, 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. For both 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. 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 6, 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 4.7 percentage points, which is a 7.5% 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 10% 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.

In row (B) of Table 6 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 1]. We find an average improvement of 0.9 percentage point increase 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 preparation distribution, where minority graduation rates would improve by 2.8% (a 1.5 percentage point increase) for those in the second decile. The AR2 allocation achieves 19.3% of the maximum attainable gains associated with AR1 [row (A)]. It achieves more of the maximum possible gains for the bottom part of the preparedness distribution, accounting for up to 27.4% of the possible gains.

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 6 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 0.3 percentage points. Under the white post-Prop 209 assignment rules, minorities would have attained over 26% of the maximum possible gain from re-allocation of students across campuses. Moreover, under the white assignment rules, the gains in graduation rates would have been especially large for those at the bottom of the distribution, achieving up to 39.3% of the maximum possible gains.

6.3 Alternative assignment rules and school-specific minority representation

We now turn to how these alternative assignment rules would affect the distribution of minority students across universities. First, we consider what the re-allocation of minority

Table 6: 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 (Predicted)	0.625	0.510	0.548	0.572	0.594	0.617	0.635	0.659	0.683	0.718	0.771
	AR1: Maximize Grad. Rates Rule	0.671	0.562	0.603	0.626	0.649	0.669	0.685	0.704	0.721	0.747	0.802
	AR2: Post-Prop 209 Minority Rule	0.634	0.523	0.563	0.586	0.607	0.626	0.642	0.664	0.686	0.719	0.776
	AR3: Post-Prop 209 White Rule	0.637	0.527	0.570	0.592	0.613	0.631	0.646	0.667	0.687	0.719	0.774
(A)	Maximum − Pre Minority (Predicted)	0.047	0.051	0.055	0.054	0.055	0.052	0.049	0.045	0.039	0.029	0.031
	% of Pre Minority (Predicted)	7.5%	10.0%	10.0%	9.5%	9.3%	8.4%	7.7%	6.9%	5.7%	4.1%	4.1%
(B)	Post (Minority) − Pre Minority (Predicted)	0.009	0.013	0.015	0.014	0.013	0.009	0.007	0.006	0.003	0.002	0.005
	% of Pre Minority (Predicted)	1.4%	2.5%	2.8%	2.5%	2.2%	1.4%	1.1%	0.8%	0.5%	0.2%	0.7%
	% of [Max − Pre Minority]	19.3%	24.5%	27.4%	26.1%	23.3%	17.0%	14.5%	12.4%	9.0%	6.1%	17.2%
(C)	Post (White) − Pre Minority (Predicted)	0.012	0.016	0.022	0.021	0.019	0.014	0.011	0.008	0.004	0.001	0.003
	% of Pre Minority (Predicted)	2.0%	3.2%	3.9%	3.6%	3.2%	2.2%	1.7%	1.2%	0.6%	0.2%	0.4%
	% of [Max − Pre Minority]	26.5%	31.9%	39.3%	37.9%	34.2%	26.7%	22.6%	17.9%	11.3%	3.8%	10.1%

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.

students across the UC campuses under AR1 would look like and how big a change it would be relative to the pre-Prop 209 distribution. In Table 7 we present 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 minorities 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 sizable 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 70% of them would be enrolled at UC Santa Barbara, with the remaining 23.8%, 7.8%, and 0.6% enrolling at UC Riverside, UCLA, and UC Santa Cruz 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 for most students.

A look at the two columns under (B) of Table 7 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 for graduating most minority students.

Comparing the AR3 re-allocation in the columns under (C) of Table 7 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

Table 7: Distribution of Minority Enrollees across UC Campuses, Pre-Prop 209 & Predicted under Alternative Post-Prop 209 Assignment Rules†

Campus	Pre Min. (Pred.)	AR1: Max Grad Rate	AR2: Post Min.	AR3: Post White	(A) AR1 − Pre Min (Pred.) *Est.*	(A) AR1 − Pre Min (Pred.) *% of Pred.*	(B) AR2 − Pre Min (Pred.) *Est.*	(B) AR2 − Pre Min (Pred.) *% of Pred.*	(C) AR3 − Pre Min (Pred.) *Est.*	(C) AR3 − Pre Min (Pred.) *% of Pred.*
UC Berkeley	0.178	0.000	0.100	0.041	-0.178	-100%	-0.078	-44%	-0.137	-77%
UCLA	0.217	0.078	0.140	0.083	-0.139	-64%	-0.077	-36%	-0.134	-62%
UC San Diego	0.084	0.000	0.072	0.069	-0.084	-100%	-0.012	-15%	-0.016	-19%
UC Irvine	0.087	0.000	0.113	0.118	-0.087	-100%	0.026	30%	0.031	35%
UC Davis	0.118	0.000	0.127	0.164	-0.118	-100%	0.009	8%	0.046	39%
UC Santa Barbara	0.144	0.679	0.152	0.194	0.535	372%	0.008	6%	0.050	35%
UC Santa Cruz	0.077	0.006	0.107	0.189	-0.072	-93%	0.029	38%	0.112	144%
UC Riverside	0.095	0.238	0.190	0.143	0.143	151%	0.096	101%	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.

graduation rates for students of most levels of academic preparation.[23]

7 Decomposing the Effects of Proposition 209 on Minority Graduation Rates

Having examined the role matching played in the higher graduation rates post-Prop 209, we summarize our findings by decomposing the effects Prop 209 had on graduation into three parts. First, as discussed in the previous section, is the effects on matching. Second, is the effect that we term "university response," the estimated effect of enrolling in the post-Prop 209 period beyond the due to matching and selection. Finally, is the part due to Prop 209 resulting in a better set of minority student attending college.

Table 8 breaks out the various mechanisms behind the increased graduation rates post-Prop 209. Recall from Table 1 that the overall graduation rate increased by 4.4 percentage points for minority enrollees. Of this increase, 20.5% can be explained by better matching of students to the UC campuses based on the students' preparation and campus graduation production functions. Recall that the university response is measured by $\ddot{\phi}_2^*$, the coefficient on $POST$ in equation (5). We estimated this effect under two scenarios (Methods 1 and 2) that are likely to bound the true effect. The first, Method 1, assumes that the distribution of unobservables for enrollees in the same in the pre- and post-Prop 209 periods, while the second, Method 2, removed pre-Prop 209 minority enrollees with the lowest levels of academic preparation to be more comparable with the better prepared post-Prop 209 minority enrollees. Our estimates imply that this university response accounts for between 29.5% and 45.5% of the graduation rate increase, depending on the Method used. It follows that the remainder of the increase in graduation rates is due to changes the selectivity in the academic preparation and backgrounds of minorities that enrolled after Prop 209. We find that this change in selectivity accounts for between 34% and 50% of the

Table 8: Decomposing the Effect of Proposition 209 on Graduation†

	Method 1		Method 2	
	Level	Share of Total	Level	Share of Total
Total increase = 4.4%				
(a) Improved Matching	0.9%	20.5%	0.9%	20.5%
(b) University Response	2.0%	45.5%	1.3%	29.5%
(c) Selection	1.5%	34.0%	2.2%	50.0%

† Selection effect calculated as *Total Increase* − (a) − (b).

graduation rate increase.

8 Conclusion

In this paper we have examined how the match between the student and the school affects college graduation rates. We have found evidence that less-selective UC schools tend to be better at graduating less-prepared students, with more selective schools better at graduating more-prepared students. These results are relevant to the debate over the merits of affirmative action in university admissions to the extent that affirmative action leads to inefficient sorting.

Using data before and after an affirmative action ban, we found evidence that Prop 209 did lead to a more efficient sorting of minority students within the UC system. However, the effects were relatively small and we can say little about what happened to those that did not attend a UC school as a result of Prop 209.[24] Given large differences in academic preparation due to differences in the family backgrounds of students and the quality of the primary and secondary schools they attended, there is little scope for dramatic shifts in graduation outcomes by re-sorting of students across campuses.[25] That being said, our results indicate that better matching of students to campuses based on academic preparation does produce the largest graduation rate gains for those students in the bottom part of the distribution of academic preparation. Further, while matching effects are small when comparing five-year graduation rates, a companion paper (Arcidiacono, Aucejo, and Hotz, 2012) shows that mismatch effects are much larger when looking

[23] As we noted earlier, Prop 209 does not require that minority and non-minorities have the same *enrollment* rules. Our analysis does not imply that any of the UC campuses circumvented Prop 209 in their admissions procedures. For example, it is possible that there are racial and ethnic differences in geographical preferences for colleges or in information about graduation probabilities.

[24] While estimates suggest selective schools see a drop in minority enrollment following affirmative action bans (Long 2004 and Hinrichs 2012), overall college enrollment rates remain relatively unaffected following a ban (Backes 2012 and Hinrichs 2012).

[25] These results are consistent with Arcidiacono and Koedel (2012) who find that most of the black/white differences in college graduation rates stem from differences in student academic preparation.

at persistence in STEM fields and in time to graduation.

Possibly our most intriguing finding is that the imposition of an affirmative action ban may have induced a response by universities in their efforts to keep students from dropping out and completing their studies. Previous studies of affirmative action have ignored the potential for such an institutional response targeted at those minorities that do enroll after a ban and our results suggest that the magnitude of the potential detrimental effects of affirmative action bans may be overstated by not taking these responses into account.

More generally, finding ways to improve the college graduation rates of minorities – regardless of the motivation – would appear to be of growing importance, given the evidence that attending but not graduating from college has sizeable consequences in one's later life. Consider, for example, the disparity in labor market earnings between those who attend but do not graduate from college and those that do graduate. 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%).[26]

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

References

[1] Antonovics, Kate and Ben Backes (2012). "Were Minority Students Discouraged From Applying to University of California Campuses After the Affirmative Action Ban?" *Education Finance and Policy*, forthcoming.

[2] Antonovics, Kate and Richard H. Sander (2012). "Affirmative Action Bans and the Chilling Effect." *American Law and Economics Review*, forthcoming.

[3] Antonovics, Kate, Backes, Ben, and Valerie Ramey (2012) "Color-Blind Affirmative Action and Student Quality", working paper.

[4] Arcidiacono, Peter, Aucejo, Esteban, Fang, Hanming and Spenner, Kenneth (2011). "Does Affirmative Action Lead to Mismatch? A New Test and Evidence" *Quantitative Economics* 2: 303-333.

[5] Arcidiacono, Peter, Aucejo, Esteban, and V. Joseph Hotz (2012) "University Production Functions and the Choice of College Major: Evidence from California," working paper.

[6] Arcidiacono, Peter and Cory Koedel (2012). "Race and College Success: Evidence from Missouri" working paper.

[7] Ayres, Ian, and Richard Brooks (2005). "Does Affirmative Action Reduce the Number of Black Lawyers?" *Stanford Law Review* 57(6): 1807-1854.

[8] Backes, Ben (2012). "Do affirmative action bans lower minority college enrollment and attainment?" *Journal of Human Resources* 47(2): 435-455.

[9] Barnes, Katherine Y. (2007). "Is Affirmative Action Responsible for the Achievement Gap Between Black and White Law Students?" *Northwestern University Law Review* 101(4): 1759-1808.

[10] Black, Dan A., Kermit Daniel and Jefrrey A. Smith (2001). "Racial Differences in the Effects of College Quality and Student Body Diversity on Wages." in *Diversity Challenged*, Harvard Educational Review.

[11] Black, Dan A. and Jeffrey A. Smith. (2004). "How robust is the evidence on the effects of college quality? Evidence from matching." *Journal of Econometrics* 121: 99-124.

[12] Bound, John and Sarah Turner (2007). "Cohort crowding: How resources affect collegiate attainment," *Journal of Public Economics* 91: 877–899.

[13] Bound, John and Sarah Turner (2011). "Dropouts and Diplomas: The Divergence in Collegiate Outcomes." in *Handbook of the Economics of Education*, Vol. 4, E. Hanushek, S. Machin and L. Woessmann (eds.) Elsevier B.V., 573-613.

[14] Bound, John, Michael Lovenheim and Sarah Turner. (2010a). "Why have College Completion Rates Declined? An Analysis of Changing Student Preparation and Collegiate Resources." *American Economic Journal: Applied Economics* 2(3): 129–157.

[15] Bound, John, Michael Lovenheim and Sarah Turner. (2010b). "Increasing Time to Baccalaureate Degree in the United States." NBER Working Paper 15892.

[16] Chambers, David L., Timothy T. Clydesdale, William C. Kidder, and Richard O. Lempert (2005). "The Real Impact of Eliminating Affirmative Action in American Law Schools: An Empirical Critique of Richard Sander's Study." *Stanford Law Review* 57(6): 1855-1898.

[17] Dale, Stacy Berg, and Alan B. Krueger (2002). "Estimating the Payoff to Attending a More Selective College: An Application of Selection on Observables and Unobservables." *Quarterly Journal of Economics* 117(4): 1491-1527.

[18] Dillon, Eleanor and Jeffrey Smith (2009) "The Determinants of Mismatch Between Students and Colleges." working paper.

[19] Epple, Dennis, Richard Romano, and Holger Sieg (2008). "Diversity and Affirmative Action in Higher Education." *Journal of Public Economic Theory* 10(4): 475-501.

[20] Goldin, Claudia and Lawrence Katz (2008). *The Race between Education and Technology.* Cambridge: Harvard University Press.

[21] Hinrichs, Peter (2012). "The Effects of Affirmative Action Bans on College Enrollment, Educational Attainment, and the Demographic Composition of Universities." *Review of Economics and Statistics* 94(3): 712-722.

[22] Hinrichs, Peter (2011). "Affirmative Action Bans and College Graduation Rates." Working Paper Georgetown University.

[23] Ho, Daniel E. (2005). "Why Affirmative Action Does Not Cause Black Students to Fail the Bar." *Yale Law Journal* 114(8): 1997-2004.

[24] Horn, Catherine L., and Stella M. Flores (2003). "Percent Plans in College Admissions: A Comparative Analysis of Three States' Experiences," The Civil Rights Project, Harvard University, March 2003.

[25] Hoxby, Caroline M. (2009). "The Changing Selectivity of American Colleges." *Journal of Economic Perspectives* 23(4): 95–118.

[26] Long, Mark C. (2004). "Race and College Admission: An Alternative to Affirmative Action?," *The Review of Economics and Statistics* 86(4): 1020-1033.

[27] Rothstein, Jesse, and Albert Yoon (2009). "Mismatch in Law School." Unpublished manuscript, Princeton University, May.

[28] Rothstein, Jesse and Albert Yoon (2008). "Affirmative Action in Law School Admissions: What Do Racial Preferences Do?" *University of Chicago Law Review* 75(2): 649-714.

[29] Sander, Richard H. (2004). "A Systemic Analysis of Affirmative Action in American Law Schools." *Stanford Law Review* 57(2): 367-483.

[30] Sander, Richard H. (2005a). "Mismeasuring the Mismatch: A Response to Ho." *Yale Law Journal* 114(8): 2005-2010.

[31] Sander, Richard H. (2005b). "Reply: A Reply to Critics." *Stanford Law Review* 57(6): 1963-2016.

[32] Turner, Sarah (2004). "Going to College and Finishing College: Explaining Different Educational Outcomes," in *College Choices: The Economics of Where to Go, When to Go, and How to Pay For It*, C. M. Hoxby (ed.), Chicago: University of Chicago Press.

A Appendix

Table 9: Characteristics of UC Applicants, Admits, and Enrollees Pre-Prop 209 and Post-Prop 209 Change, Asian Americans and Others†

	Applied		Admitted		Enrolled		Graduated	
	Pre-Prop 209	Change	Pre-Prop 209	Change	Pre-Prop 209	Change	Pre-Prop 209	Change
Asians:								
No. of Asians	53,739	9,629	42,556	6,412	26,130	4,316	19,337	4,265
High School Acad. Index	701.9	8.2***	723.7	5.4***	717.2	9.8***	729.6	8.3***
Parents have BA	0.652	0.004	0.659	-0.007**	0.636	-0.002	0.656	-0.008*
Parents' Income $\leq$ \$30K	0.293	-0.026***	0.301	-0.022***	0.322	-0.028***	0.301	-0.027***
Parents' Income $\geq$ \$80K	0.291	0.053***	0.288	0.046***	0.266	0.052***	0.280	0.054***
Graduation Rate							0.749	0.037***
Others, including Unknowns:								
No. of Others	10,143	12,161	8,231	8,810	4,129	4,693	3,081	3,622
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*

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

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.

Table 10: Estimates Using the Baseline Method for Under-Represented Minorities, Whites and Asian Americans

	URM	White	Asian Amer.
POST	0.040***	0.023***	0.032***
	(0.006)	(0.004)	(0.004)
UC Berkeley	-0.405***	-0.003	-0.095
	(0.086)	(0.089)	(0.073)
UCLA	-0.547***	-0.044	-0.078
	(0.089)	(0.089)	(0.077)
UC San Diego	-0.291**	0.320***	-0.061
	(0.123)	(0.100)	(0.081)
UC Davis	-0.553***	0.189**	-0.142**
	(0.093)	(0.086)	(0.069)
UC Irvine	-0.198*	0.043	-0.089
	(0.104)	(0.094)	(0.067)
UC Santa Barbara	-0.136	0.286***	-0.113
	(0.090)	(0.083)	(0.086)
UC Santa Cruz	0.010	0.479***	0.240***
	(0.093)	(0.086)	(0.093)
Acad. Index	0.327***	0.693***	0.551***
	(0.103)	(0.101)	(0.075)
UC Berkeley × Acad. Index	0.538***	0.053	0.194**
	(0.129)	(0.118)	(0.096)
UCLA × Acad. Index	0.766***	0.119	0.165
	(0.133)	(0.120)	(0.102)
UC San Diego × Acad. Index	0.413**	-0.349***	0.160
	(0.178)	(0.134)	(0.110)
UC Davis × Acad. Index	0.722***	-0.174	0.290***
	(0.144)	(0.118)	(0.098)
UC Irvine × Acad. Index	0.282*	-0.022	0.179*
	(0.162)	(0.131)	(0.095)
UC Santa Barbara × Acad. Index	0.236*	-0.289**	0.224*
	(0.142)	(0.115)	(0.126)
UC Santa Cruz × Acad. Index	-0.024	-0.628***	-0.276*
	(0.149)	(0.121)	(0.142)
Admitted to UC Berkeley	0.027**	-0.002	0.022**
	(0.013)	(0.009)	(0.009)
Admitted to UCLA or higher ranked	0.003	0.030***	0.029***
	(0.017)	(0.009)	(0.010)
Admitted to UC San Diego or higher ranked	0.005	0.039***	0.014
	(0.017)	(0.009)	(0.009)
Admitted to UC Davis or higher ranked	0.058***	0.032***	0.013
	(0.017)	(0.008)	(0.014)
Admitted to UC Irvine or higher ranked	0.004	-0.013	0.018**
	(0.016)	(0.009)	(0.009)
Admitted to UC Santa Barbara or higher ranked	-0.001	0.024**	0.044***
	(0.021)	(0.011)	(0.017)
Admitted to UC Santa Cruz or higher ranked	0.048**	0.000	-0.027*
	(0.022)	(0.019)	(0.016)
Initial Major Soc. Sci.	0.027***	0.011**	0.031***
	(0.008)	(0.005)	(0.006)
Initial Major Science	-0.083***	-0.050***	-0.047***
	(0.007)	(0.004)	(0.004)
Constant	0.443***	0.186***	0.294***
	(0.063)	(0.067)	(0.047)
Family Background Characteristics	Yes	Yes	Yes
Adjusted R^2	0.045	0.046	0.061

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.
Coefficient standard error in parentheses.
UC-Riverside is the omitted UC campus in these regressions.