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University Differences in the Graduation of Minorities in STEM Fields: Evidence from California

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Abstract
The low number of college graduates with science degrees - particularly among under-represented minorities - is of growing concern. We examine differences across universities in graduating students in different fields. Using student-level data on the University of California system during a period in which racial preferences were in place, we show significant sorting into majors based on academic preparation, with science majors at each campus having on average stronger credentials than their non-science counterparts. Students with relatively weaker academic preparation are significantly more likely to leave the sciences and take longer to graduate at each campus. We show the vast majority of minority students would be more likely to graduate with a science degree and graduate in less time had they attended a lower ranked university. Similar results do not apply for non-minority students.

Keywords: STEM majors, minorities, college graduation

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1 Introduction

Increasing the number of Science, Technology, Engineering, and Math (STEM) majors is seen as one of the key components to keeping the U.S. competitive in a global economy (Carnevale, Smith, and Melton 2011).[1] In a 2012 report, the President's Council of Advisors on Science and Technology suggested that the number of STEM majors needed to increase by 34% over current rates to meet the demand for STEM professionals. The lack of STEM majors occurs despite STEM majors earning substantially more than other college degrees with the exception of perhaps business (Arcidiacono 2004, Kinsler and Pavan 2012, Melguizo and Wolniak 2012) and that the STEM premium has increased over time (Gemici and Wiswall 2011).[2]

Of particular concern is the lack of representation of minority students (Council of Graduate Schools 2007). Seymour and Hewitt (2000) point out that the National Science Foundation alone has spent more than $1.5 billion to increase participation of minorities in the sciences, and two programs at the National Institute of Health have invested $675 million in the same endeavor. At college entry, black and Hispanic students exhibit preferences for STEM fields that are similar to white preferences, yet their probabilities of persisting in these fields are much lower (Anderson and Kim 2006). The data for the University of California system between 1995 and 1997 used in this study show similar patterns. Namely, the percentage of college enrollees expressing an interest in science majors is 35% for both minorities and whites.[3] Yet, 19% of white enrollees complete a degree in the sciences with the corresponding number for minorities at less than 11%. In a similar vein, among those who complete a degree in five years, 31% of whites and 17% of minorities graduate with a STEM major.

While different programs have been implemented with the aim to reduce the current racial disparities in shares of the U.S. workforce with STEM degrees, little is known about the role that colleges play in "producing" STEM degrees, especially for underrepresented minority groups.

[1] The importance of STEM majors has recently been highlighted in a Florida proposal to freeze tuition for majors that are in high demand (Alvarez 2012) as a way of facilitating recovery from the recession. At the same time, some schools charge high tuition for more lucrative majors, citing fairness issues and differences in educational costs of different majors (Stange 2012).

[2] Data on subjective expectations from a variety of schools indicates students are aware of the general differences in earnings across fields. See Arcidiacono, Kang, and Hotz (2012), Stinebrickner and Stinebrickner (2011), Wiswall and Zafar (2012), and Zafar (forthcoming).

[3] Asian students have a higher initial interest in the sciences at 51%.

An important exception is the study by Griffith (2010), who finds that characteristics of colleges play a key role in the decision of students to remain in a STEM major and obtain a degree in any of these fields. For example, she finds that students at selective colleges with large research expenditures relative to total educational expenditures have lower persistence rates of students in the sciences, especially minority students. In this regard, understanding campus disparities in terms of the benefits and costs of producing STEM majors among minorities (and non-minorities) may have important implications for the way agencies, such as the National Science Foundation (NSF) and National Institutes of Health (NIH), allocate resources across colleges in the U.S. to increase the representation of minorities in such majors. Moreover, studying these differences by types of colleges (e.g., more selective vs. less selective) among minorities can be relevant to assess whether programs, such as affirmative action, improve minority representation among STEM degree holders or hinder it by encouraging minority students to attend colleges where success in STEM fields is unlikely.

In this paper, we make use of a rich database that contains information on applicants, enrollees and graduates of baccalaureate programs at the various campuses within the University of California (UC) system. These data include measures of students' academic preparation, intended major, and, conditional on graduating, their final major. The data reveal substantial sorting across majors between freshmen and senior year. Those with SAT scores that are high relative to the campus average are more likely to persist in a science major and graduate with a science degree.[4] This is especially true for minority students. For example, at UC Berkeley minorities who persisted in the sciences had SAT scores over 100 points higher than those who switched to a major outside of the sciences. For non-minority students the gap was only 30 points. These differences also are reflected in the likelihood of graduating. At UC Berkeley, minority students who began in the sciences had less than a 31% probability graduating with a science degree within five years, with the corresponding four-year graduation rate of 11%.

The differences across campuses in the rates of persistence in STEM majors and graduation

[4]Arcidiacono, Aucejo, and Spenner (2012) find that science, engineering, and economics classes give lower grades and require more study time than courses in the humanities and social sciences at the university they study. Further, those who switch majors were more likely to report it was due to academic issues if the initial major was in the sciences, engineering, or economics. Differences in grading standards may be part of the reason Sjoquist and Winters (2013) find negative effects of state merit-aid programs on STEM graduation as these programs often have GPA requirements.

rates reflect, in part, differences across campuses in the academic preparation of their students. But, they may also reflect campus differences in how academic preparation, especially in STEM majors, translates into graduation. As we discuss below – and document in our empirical analysis – while the more selective UC campuses (e.g., UC Berkeley and UCLA) have greater success in graduating better prepared students in STEM fields, they are not as successful as less-selective campuses (e.g., UC Riverside) in graduating less-prepared students in such majors.

We use data on minority and non-minority students[5] who enrolled at one of the UC campuses between 1995 through 1997 to estimate a model of students' decision to graduate from college with a particular major. We account for the initial selection into colleges via a Dale and Krueger (2002) approach, taking advantage of the rich data on where students submitted applications and where they were accepted. In addition, we allow campuses to differ in the attractiveness of particular majors. We do so by allowing the returns to academic preparation to be specific to the school and major combination. These returns are the combination of the reward in the labor market net of the difficulty of the course work. Schools and majors that reward academic preparation more than others will have relatively high persistence rates for those with high levels of academic preparation but relatively low persistence rates for those with lower levels of academic preparation.[6]

Estimates of the choice model reveal that the match between the student and the university is an important component for persistence in STEM majors. Students with relatively low levels of academic preparation will find majoring in a STEM field relatively less attractive at the most selective schools.[7] Our estimates suggest that the vast majority of minority students who begin in the sciences at UC Berkeley would be more likely to graduate with a science degree had they enrolled in a less-selective campus, such as UC Santa Cruz or UC Riverside.[8] The potential

[5]Throughout this paper, minority students consist of African Americans, Hispanics, and Native Americans, i.e., "under-represented minority groups" and non-minority students consist of whites and Asian Americans.

[6]Clearly those with higher levels of academic preparation will be more likely to persist at all schools. However, the school which makes it most likely that a particular student will graduate in a particular major may depend on the academic preparation of the student.

[7]Smyth and McArdle (2004) and Luppino and Sander (2012) also illustrate the importance of relative preparation in the choice of college major, finding that those who are significantly under-prepared are less likely to persist in the sciences. What distinguishes our work is the importance of the matching of student preparation with campus selectivity: students with strong (weak) academic characteristics are more likely to graduate in the sciences at the more (less) selective campuses.

[8]This finding is related to those in Arcidiacono (2005), who examines how the returns to college quality in

gains in minority graduation rates in the sciences from reallocating minority students are quite large. For example, minorities from UC Berkeley that are in the bottom quartile of the SAT score distribution would be twice as likely to graduate in the sciences at UC Santa Cruz or UC Riverside as they are observed to do so at UC Berkeley.[9] In contrast, non-minority students that were enrolled at UC Berkeley would have had lower rates of persistence in the sciences if they had attended the two lowest-ranked UC campuses (UC Santa Cruz and UC Riverside). That is, for the purposes of science graduation rates, non-minority students are well-matched.

The rest of the paper is organized as follows. In Section 2 we describe the data we use on students who entered a UC campus in the falls of 1995, 1996 or 1997 and provide summary statistics. We also document the across-campus differences in the rates at which minority students persisted in and graduated with STEM and non-STEM majors. In Section 3 we develop an econometric model of the decision of students to graduate in alternative majors or not graduate when colleges differ in the net returns to students' academic preparation. Section 4 shows model estimation results and presents counterfactual simulations. Section 5 concludes.

2 The Data and Descriptive Findings by Race across UC Campuses

2.1 Majors and Graduation Rates

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. The data are organized by years in which these students would enter as freshmen. Due to confidentiality concerns, some individual-level information was suppressed. In particular, the UCOP data have the following limitations:[10]

terms of subsequent earnings vary by a student's choice of major. His estimates suggest that, while the returns to college quality are slightly higher in the social sciences/humanities (but not education) than in the natural sciences, the differences in the return to college quality are small relative to the differences in earnings across majors.

[9]The fraction of minority students at Berkeley in the bottom quartile of the applicant distribution was 34% for the years 1995-1997, the period of our study.

[10]See Antonovics and Sander (2012) for a more detailed discussion of this data set.

1. The data does not provide the exact year in which a student entered as a freshman, but rather a three year interval.
2. The data provide no information on gender, and race is aggregated into four categories: white, Asian, under-represented minority, and other.[11]
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.
4. Detailed information on students' initial and graduating majors was not provided. Rather, we were only provided information on three categories of majors: STEM or *Science*, Humanities and Social Science.[12] In the following analyses, we aggregated the Humanities and Social Science categories into one, the *Non-Science* category.

Weighed against these limitations is having access to the universe of students who applied to at least one campus in the UC system and also whether they were accepted or rejected at every UC campus where they submitted an application.

Our analysis focuses on the choices and outcomes of minority and non-minority students who enrolled at a UC campus during the interval 1995-1997. During this period, race-conscious admissions were legal at all of California's public universities. Starting with the entering class of 1998, the UC campuses were subject to a ban on the use affirmative action in admissions enacted under Proposition 209.[13] While available, we do not use data on the cohorts of students for this later period (i.e. 1998-2005) as there is evidence that the campuses changed their admissions selection criteria in order to conform with Prop 209.[14]

We begin by examining the differences across campuses in enrollments, graduation rates and SAT scores by UC campus for both non-minority and minority students. Tabulations are presented in Table 1, with the UC campuses listed according to the *U.S. News & World Report* rankings as of the fall of 1997.[15] Minorities made up 18.5% of the entering classes at UC campuses during this period. The three campuses with the highest highest minority shares are

[11]The other category includes those who did not report their race.
[12]A list of what majors were included in each of these categories is found in Table 12 in the Appendix.
[13]See Arcidiacono, Aucejo, Coate and Hotz (2012) for analyses of the effects of this affirmative action ban on graduation rates in the UC system.
[14]See Arcidiacono, Aucejo, Coate and Hotz (2012).
[15]The 1997 *U.S. News & World Report* rankings of National Universities included 6 of the 8 UC campuses in their Top 50: UC Berkeley (27); UCLA (31); UC San Diego (34); UC Irvine (37); UC Davis (40); and UC Santa Barbara (47). Neither UC Santa Cruz or UC Riverside ranked in the Top 50 National Universities.

at the two most-selective universities (UCLA and UC Berkeley) and the least-selective university (UC Riverside). A similar U-shaped pattern was found in national data in Arcidiacono, Khan, and Vigdor (2011), suggesting diversity at the top campuses comes at the expense of diversity of middle tier institutions.

We next examine the distribution of SAT scores across the campuses for minorities and non-minorities.[16] For both non-minority and minority students, the average test scores generally follow the rankings of the UC campuses. However, SAT scores for minority students are substantially lower than their white counterparts at each campus, with the largest racial gaps occurring at UC Berkeley (193) and UCLA (161). Moreover, the spread of scores across campuses is greater for non-minorities (235 points) than it is for minority students (177 points).

Differences in the academic preparation of students across campuses appear to track differences in graduation rates, regardless of whether one looks at on-time graduation (in 4 years) or 5 year graduation rates. Non-minority students at UC Berkeley have 5-year graduation rates that are almost 18 percentage points higher than minority students at UC Berkeley, while the gap at UC Riverside is less than 3 percentage points. Differences in four-year graduation rates are even starker, with 56.1% of non-minority students at UC Berkeley graduating in four years compared to only 32.5% for minorities. Not withstanding the racial differences, the tabulations in Table 1 indicate that, within each racial group, the top-ranked UC campuses tend to attract students with better academic preparation and achieve higher graduation rates.

Table 1 also indicates that a substantial fraction of students intended to major in the sciences when they entered college – 42.7% for non-minorities and 35.4% for minorities.[17] However, sizeable fractions of initial STEM majors end up switching to a different majors; 42.9% and 57.3% of non-minority and minority students who initially declared a STEM major ended up in

[16]As noted above, the UCOP data does not include the exact scores students received on the verbal and math sections of the SAT test. Rather, it provides only whether a student's score on each section fell into one of the following one of the following seven ranges: 200-449; 450-499; 500-549; 550-599; 600-649; 650-699; 700 or above. We assigned students the midpoint of the range their score was in for the verbal and math tests, respectively, and summed these values to get a student's SAT score.

[17]The initial major is taken from the application of the school they attended. The difference in initial interests between minority and non-minority students is driven by Asians. White students have the same initial interest in the sciences as minority students. Of those who applied to two or more UC schools, less than 19% listed a science major on one application and a non-science major on another application, with the fraction similar across races. We explore gaming of the initial major in the next section.

Table 1: Average SAT Scores and Graduation Rates by UC Campus & Minority Status, 1995-97

	Berkeley	UCLA	San Diego	Davis	Irvine	Santa Barbara	Santa Cruz	Riverside	All Campuses
No. of Freshmen Enrollees:									
Non-Minority	8,073	8,256	7,525	8,638	7,445	8,277	4,511	3,415	56,140
Minority	2,287	2,803	1,081	1,497	1,129	1,845	970	1,156	12,768
% of Enrollment Minority	22.1%	25.4%	12.6%	14.8%	13.2%	18.2%	17.7%	25.3%	18.5%
Ave. SAT Scores:									
Non-Minority	1,335	1,279	1,245	1,182	1,136	1,156	1,164	1,100	1,211
Minority	1,142	1,119	1,121	1,071	1,025	1,023	1,019	965	1,074
Difference	193	161	124	111	111	133	145	135	136
5-Year Graduation Rates:									
Non-Minority	85.9%	83.3%	80.4%	76.1%	68.3%	72.5%	67.7%	63.0%	76.1%
Minority	68.4%	66.0%	66.4%	54.8%	63.2%	60.0%	60.9%	59.2%	63.0%
Difference	17.6%	17.2%	14.0%	21.3%	5.1%	12.5%	6.7%	3.8%	13.1%
4-Year Graduation Rates:									
Non-Minority	56.1%	48.2%	49.5%	37.2%	32.7%	44.5%	45.9%	38.9%	44.5%
Minority	32.5%	26.1%	32.2%	20.1%	24.9%	27.8%	38.4%	29.3%	28.4%
Difference	23.5%	22.1%	17.3%	17.1%	7.9%	16.8%	7.5%	9.5%	16.0%
% of Race/Ethnic Group Enrollees whose Initial Major = Science:									
Non-Minority	48.9%	43.9%	52.2%	45.4%	48.0%	29.0%	26.0%	40.1%	42.7%
Minority	29.9%	34.7%	50.1%	44.4%	46.9%	28.2%	26.9%	30.5%	35.4%
Difference	19.0%	9.2%	2.1%	1.0%	1.2%	0.8%	-0.9%	9.6%	7.2%
% of Initial Science Majors that Switch Out of Science:									
Non-Minority	38.5%	41.2%	36.4%	41.5%	46.4%	48.2%	65.4%	44.7%	42.9%
Minority	65.1%	58.1%	52.9%	50.0%	55.2%	52.9%	70.9%	60.1%	57.3%
Difference	-26.6%	-16.9&	-16.5%	-8.5%	-8.8%	-4.7%	-5.5%	-15.4%	-14.4%
% of Graduates whose Major = Science:									
Non-Minorities	38.4%	31.7%	41.3%	34.3%	29.2%	16.9%	17.6%	31.7%	31.2%
Minorities	14.1%	16.9%	27.2%	24.0%	19.8%	12.8%	12.9%	14.8%	17.2%
Difference	24.3%	14.8%	14.1%	10.3%	9.4%	4.1%	4.8%	17.0%	13.9%

Data Source: UCOP.
All figures are on an annual basis.

a non-science major by the time they graduated or dropped out of school. The racial difference in switching is greatest at UC Berkeley and UCLA, the two most-selective campuses. For example, almost two-thirds (65.1%) of minorities at UC Berkeley who initially declared themselves to be science majors had switched out of science by the time they graduated or dropped out. As a result of this lack of persistence in the sciences, only 17.2% of minorities that graduate from a UC campus do so in the sciences, which is around 14 percentage points lower than the corresponding share of non-minorities (31.2%).

2.2 Persistence in the Sciences

Given these sizeable rates of switching out of science majors and the low graduation rates in the sciences shown in Table 1, especially for minorities, we take a closer look at the across-campus and across-race differences in persisting and graduating with STEM majors. Table 2 displays both average SAT scores (top row) and the share of students (second row) for the three completion categories (graduate in the sciences, graduate but not in the sciences, do not graduate) by initial major and race for each campus, using completion status 5 years after enrollment.

Table 2 shows significant sorting on academic preparation at UC campuses, with students that graduate in the sciences having higher average SAT scores than those who do not, regardless of initial major. SAT scores for non-minority students who persist in the sciences – i.e., start in and graduate with a science major – are between 8 to 43 points higher than those who switch to a non-science major. The differences are much larger for minority students. At each campus, minority students who persist and graduate in the sciences have SAT scores that are between 27 and 115 points higher than those students who switch out of the sciences and graduate with a non-science major. Moreover, as reflected in the rates of switching from the sciences in Table 1, non-minorities are much more likely to persist in and graduate with a degree in the sciences than are minorities. For example, while 55% non-minorities who start in start in the sciences at UC Berkeley graduate in that major, only 24.9% of minorities who start in the sciences do so. This racial gap in persistence rates in the sciences, i.e., the share of students who remain in a science major and graduate, shrinks with the selectivity of the UC campus. We also note that switching into the sciences and graduating with a science degree is low for both racial groups but is much lower for minority students, with gaps again largest at the top campuses. While 9.2% of non-minority students in the non-sciences switch into the sciences, only 3.5% of minority students do so.

It is also the case that students who start in science majors are less likely graduate from their initial UC campus compared to those who start out in majors outside of the sciences. With the exception of UC Berkeley, non-minority students whose initial major is in the sciences are less likely to graduate than those whose majors are not in the sciences, despite those who start out in the sciences having higher SAT scores. This shows the importance of the initial major, both in its effect on the student's final major and on whether the student graduates at all. Differences in graduation rates between initial science and non-science majors are much starker for minorities. Among non-minorities who start out in the sciences, 25.2% do not graduate; in contrast, 40.7% of minorities who start out in the sciences do not graduate. For minorities, those who begin in a non-science major are between 2.7 (for UC San Diego) and 10.5 (for UC Santa Cruz) percentage points more likely to graduate in 5 years than those who start in a non-science major, again despite the fact that those with initial science majors had higher SAT scores.

Table 2 showed that persistence rates in the sciences were higher at the top campuses but that these campuses also had higher average SAT scores. Similarly, persistence rates were higher for non-minority students than minority ones, but this, too, may be the result of differences in average SAT scores by race. We now take a first step towards separating out whether higher persistence rates at top campuses are due to better students or due to something top campuses are doing differently than the the less-selective campuses by breaking out persistence rates by quartiles of the SAT score distribution.

We define the quartiles of the SAT score distribution based on all applicants to the UC system between 1995 and 1997 regardless of whether the applicant attended or even was admitted to a UC campus. Table 3 shows the share of minority and non-minority students in each quartile at each institution. At each of the campuses, minority students are disproportionately represented in the bottom quartile. Even at UC Berkeley, over 34% of minorities are in the bottom quartile

Table 2: Average SAT Scores and Shares for Major/Graduation Completion Outcomes for Freshman entering a UC Campus in 1995-1997, by Initial Major, Campus, and Minority Status†

Initial Major	Graduation Status	Berkeley	UCLA	San Diego	Davis	Irvine	Santa Barbara	Santa Cruz	Riverside	All Campuses
Non-Minority:										
Science	Grad. in Science	1,359	1,299	1,266	1,220	1,171	1,193	1,172	1,177	1,260
		55.3%	48.1%	50.1%	42.2%	34.1%	32.2%	27.8%	35.1%	43.2%
	Grad. in Non-Science	1,331	1,285	1,241	1,184	1,136	1,163	1,164	1,134	1,218
		30.7%	33.1%	27.8%	32.2%	32.1%	35.5%	36.4%	27.5%	31.6%
	Did Not Graduate	1,334	1,275	1,224	1,183	1,125	1,158	1,138	1,098	1,188
		14.0%	18.8%	22.1%	25.7%	33.9%	32.4%	35.8%	37.4%	25.2%
Non-Science	Grad. in Science	1,352	1,295	1,253	1,193	1,141	1,163	1,189	1,125	1,232
		11.6%	9.4%	14.7%	12.8%	6.8%	4.2%	6.3%	9.8%	9.2%
	Grad. in Non-Science	1,324	1,274	1,239	1,170	1,129	1,153	1,165	1,072	1,203
		74.3%	75.5%	68.4%	64.8%	63.5%	70.4%	62.5%	53.4%	67.9%
	Did Not Graduate	1,300	1,240	1,236	1,150	1,122	1,141	1,166	1,069	1,165
		14.1%	15.1%	16.9%	22.4%	29.7%	25.5%	31.1%	36.8%	22.9%
Minority:										
Science	Grad. in Science	1,266	1,179	1,177	1,175	1,109	1,089	1,064	1,062	1,161
		24.9%	25.8%	30.7%	22.3%	22.7%	23.8%	18.8%	20.1%	24.3%
	Grad. in Non-Science	1,151	1,133	1,108	1,087	1,036	1,029	1,037	991	1,087
		39.8%	35.1%	34.4%	29.4%	38.0%	33.7%	34.5%	34.6%	35.0%
	Did Not Graduate	1,155	1,108	1,095	1,077	1,038	1,022	1,012	982	1,072
		35.4%	39.1%	34.9%	48.3%	39.3%	42.5%	46.7%	45.3%	40.7%
Non-Science	Grad. in Science	1,185	1,179	1,169	1,122	1,060	1,137	1,037	989	1,125
		3.2%	3.4%	5.4%	5.9%	3.5%	1.4%	3.8%	3.7%	3.5%
	Grad. in Non-Science	1,129	1,118	1,127	1,059	998	1,025	1,024	949	1,070
		66.8%	65.4%	62.4%	51.5%	61.8%	59.6%	59.9%	57.4%	61.6%
	Did Not Graduate	1,112	1,085	1,090	1,021	998	1,001	998	945	1,037
		30.0%	31.2%	32.2%	42.6%	34.7%	39.0%	36.2%	38.9%	34.9%

† For each Initial Major & Graduation Status cluster, the top row is average SAT Score and second row is percentage of enrollees who started in a particular Initial Major.

Table 3: Share of Non-Minority and Minority Students in each Quartile of the 1995-1997 Applicant SAT Score Distribution by Institution

SAT Score Quartile	Berkeley	UCLA	San Diego	Davis	Irvine	Santa Barbara	Santa Cruz	Riverside
Non-Minority:								
Q1	2.8%	5.0%	7.5%	19.1%	30.5%	24.4%	25.1%	44.1%
Q2	11.4%	20.6%	32.0%	40.2%	43.9%	45.2%	39.5%	34.1%
Q3	21.4%	35.7%	33.8%	26.4%	17.3%	20.6%	22.3%	11.9%
Q4	64.3%	38.7%	26.8%	14.2%	8.4%	9.8%	13.2%	9.9%
Minority:								
Q1	34.5%	37.1%	35.7%	51.5%	65.2%	62.4%	62.5%	77.8%
Q2	32.3%	40.4%	41.7%	31.1%	23.6%	28.2%	22.9%	18.3%
Q3	20.6%	16.3%	15.0%	10.8%	7.9%	6.6%	9.8%	2.9%
Q4	12.7%	6.2%	7.6%	6.6%	3.4%	2.8%	4.9%	1.0%

of the applicant SAT score distribution. The share of minority students in the bottom quartile at UC Berkeley is actually higher than the share of non-minority students in the bottom quartile at all institutions except for UC Riverside. In contrast, less than 3% of non-minority students at UC Berkeley were in the bottom quartile with over 64% in the top quartile. As we move down the selectivity/rankings of campuses, the share of both minority and non-minority students in the bottom quartile rises, topping out at 78% for minority students and 44% for non-minority students at UC Riverside.

Given the shares of non-minority and minority students in each SAT quartile, we now turn to persistence rates conditional on institution and SAT quartile. Table 4 gives the results for minority students. (The corresponding tabulations for non-minority students are found in Table 13 in the Appendix.) The evidence indicates that minority students with low SAT scores would be more likely to persist in the sciences if they attended a less-selective institution. For example, minority students in the bottom quartile of the SAT score distribution who attended UC Berkeley graduated in the sciences at a lower rate than similar students at UC Riverside, despite those in the bottom quartile at UC Berkeley likely being stronger in other dimensions (high school grades, parental education, etc.) than those in the bottom quartile at UC Riverside. Note that the total graduation rate for initial science majors in the bottom quartile is actually higher at UC Berkeley and UC Riverside. The primary difference is that at UC Berkeley many of the students switch to non-science majors. Indeed, initial science majors in the bottom quartile at UC Berkeley are close to five times as likely to graduate in the non-sciences than in the sciences.

The results are different for minorities in the top quartiles, with those attending UC Berkeley graduating at a higher rate in the sciences than those at UC Riverside. This is suggestive that matching may be important – at least in the sciences – with top campuses being particularly advantageous for those at the top of preparation distribution and less selective campuses being more advantageous for those further down the preparation distribution. But beyond differences across campuses, the reality is that those in the bottom quartiles of the SAT score distribution have very low persistence rates in the sciences.

Table 4 also reinforces the point that an initial major in the sciences makes graduation in any field in five years less likely, particularly for minorities in the bottom quartile of the SAT score distribution. Overall, minorities in the bottom quartile with an initial major in the sciences have graduation probabilities that are over eight percentage points lower than their non-science counterparts. The similar gap for those in the top quartile is around four percentage points.

The corresponding results for non-minority students, displayed in Table 13 in the Appendix, are very different. In particular, at all quartiles of the SAT score distribution non-minority students are, on average, more likely to graduate in the sciences at UC Berkeley than at UC Riverside, and are significantly more likely to graduate, regardless of major, at UC Berkeley than at UC Riverside. These results for non-minority and minority students suggest that mismatch of students with initial interests in STEM majors to UC campuses may be sizeable for minorities. Moreover, this mismatch may be a consequence of affirmative action policies in which race as well as academic preparation affect which campus students attend. At the same time, it would be premature to ascribe any causal explanation of these racial differences in the share of students graduating with science degrees since these tabulations do not account for selection, i.e. the fact that the students at UC Berkeley are likely to be better prepared than those at UC Riverside.

The patterns of persistence in science majors and probabilities of graduating in any field are even more striking if we instead examine 4-year graduation rates. Table 5 repeats the analysis of Table 4, but this time examines 4-year graduation rates. (The corresponding results for non-

Table 4: Unadjusted Shares of Minority Students Graduating in 5 Years with Science or Non-Science Majors, by Campus, SAT Quartile, and Initial Major

Initial Major	SAT Quartile	Berkeley	UCLA	San Diego	Davis	Irvine	Santa Barbara	Santa Cruz	Riverside	All Campuses
Share Graduating with Science Major:										
Science	Q1	10.3%	15.5%	19.7%	13.1%	17.3%	18.3%	16.7%	15.6%	15.9%
	Q2	14.6%	27.4%	32.1%	21.9%	26.6%	27.4%	21.7%	28.9%	25.2%
	Q3	37.6%	34.8%	36.6%	39.8%	28.8%	41.3%	17.9%	27.8%	35.4%
	Q4	45.5%	40.0%	57.4%	42.4%	50.0%	40.0%	29.4%	50.0%	49.0%
Non-Science	Q1	2.6%	2.0%	3.0%	3.9%	3.3%	0.6%	4.0%	3.5%	2.6%
	Q2	2.3%	3.5%	6.6%	5.9%	2.4%	2.0%	1.9%	4.7%	3.4%
	Q3	3.5%	4.8%	5.0%	13.7%	8.1%	5.3%	6.0%	6.3%	5.4%
	Q4	7.6%	9.0%	11.4%	15.0%	10.0%	5.4%	6.7%	0.0%	8.7%
Share Graduating with Non-Science Major:										
Science	Q1	47.1%	35.3%	37.2%	30.8%	42.8%	35.3%	32.7%	35.7%	36.9%
	Q2	49.8%	35.4%	34.4%	32.9%	33.6%	34.1%	40.0%	32.5%	36.7%
	Q3	31.8%	34.8%	34.1%	21.6%	28.8%	21.7%	32.1%	33.3%	30.7%
	Q4	23.1%	33.3%	23.4%	20.3%	25.0%	33.3%	35.3%	25.0%	25.8%
Non-Science	Q1	65.5%	60.5%	55.1%	47.9%	62.1%	58.0%	58.2%	58.0%	58.6%
	Q2	66.3%	68.3%	65.2%	57.6%	58.5%	62.4%	63.0%	53.9%	64.2%
	Q3	70.0%	69.6%	73.8%	56.2%	67.6%	60.0%	58.2%	56.3%	67.1%
	Q4	67.5%	67.0%	60.0%	50.0%	70.0%	70.3%	73.3%	75.0%	65.9%
Share Graduating, Any Major:										
Science	Q1	57.5%	50.8%	56.9%	43.9%	60.1%	53.6%	49.4%	51.2%	52.8%
	Q2	64.4%	62.8%	66.5%	54.8%	60.1%	61.6%	61.7%	61.4%	61.9%
	Q3	69.4%	69.5%	70.7%	61.4%	57.7%	63.0%	50.0%	61.1%	66.1%
	Q4	68.7%	73.3%	80.9%	62.7%	75.0%	73.3%	64.7%	75.0%	70.8%
Non-Science	Q1	68.1%	62.5%	58.1%	51.9%	65.3%	58.6%	62.2%	61.5%	61.3%
	Q2	68.6%	71.8%	71.8%	63.4%	61.0%	64.3%	64.8%	58.6%	67.6%
	Q3	73.5%	74.4%	78.8%	69.9%	75.7%	65.3%	64.2%	62.5%	72.5%
	Q4	75.2%	76.0%	71.4%	65.0%	80.0%	75.7%	80.0%	75.0%	74.6%

minorities are recorded in Table 14 in the Appendix.) The probability that a minority in the bottom quartile of the SAT score distribution who initially was interested in a science major actually graduates in the sciences in four years at UC Berkeley is astonishingly low at 0.6% and is substantially lower than the corresponding probability at UC Riverside. This again occurs despite students at UC Berkeley having stronger academic preparation on other dimensions.[18]

Given the striking results for minorities, one may be concerned that they are driven by the gaming of which major to put on the application to which school. As discussed in the previous section, a small fraction of students report different initial majors for different schools. If, for example, it was easier for minority students to get into top schools by putting down science as their initial major, while intending to switch to non-science, then this could explain the low persistence rates. However, there is no evidence that this is the case: students are if anything more likely to apply to the top schools in the non-sciences. Indeed, in this period it was easier for minority students to get into both UC Berkeley and UCLA by listing a non-science major instead of a science major.[19] Further, given so few minority students switch from non-science to science majors and that those who list science as their initial major are more likely to dropout, it is clear that the initial major is an important determinant of future academic outcomes.

3 Modeling Student Persistence in College Majors and Graduation

The descriptive statistics in Section 2 suggest that the match between the academic preparation and the selectivity of the college may be important, particularly in the science and for minorities. We now propose a model that is flexible enough to capture these matching effects. We model a student's decision regarding whether to graduate from college and, if they do, their final choice of major. In particular, student i attending college k can choose to major and

[18]Switching majors on average delays graduation. While 24% of those who graduated in five years had switched majors, the corresponding share of those who graduated in four years was 20%.

[19]We estimated separate logits on the probability of being admitted conditional on applying. At UC Berkeley and UCLA, the minority in advantage in admissions was cut almost in half if science was listed as the initial major. Similar penalties were not seen at the other schools.

Table 5: Unadjusted Shares of Minority Students Graduating in 4 Years with Science or Non-Science Majors, by Campus, SAT Quartile, and Initial Major

Initial Major	SAT Quartile	Berkeley	UCLA	San Diego	Davis	Irvine	Santa Barbara	Santa Cruz	Riverside	All Campuses
Share Graduating with Science Major:										
Science	Q1	0.6%	2.2%	5.9%	1.4%	4.9%	6.1%	7.7%	8.2%	4.5%
	Q2	5.5%	6.5%	14.7%	5.3%	8.4%	12.8%	11.7%	16.9%	9.0%
	Q3	19.7%	12.3%	18.3%	19.3%	15.4%	21.7%	14.3%	22.2%	17.0%
	Q4	23.1%	20.0%	23.4%	25.4%	28.6%	26.7%	29.4%	50.0%	24.3%
Non-Science	Q1	0.2%	0.3%	1.5%	0.6%	0.0%	0.0%	2.2%	1.7%	0.7%
	Q2	0.8%	0.5%	2.2%	1.7%	0.8%	0.6%	0.6%	1.6%	0.9%
	Q3	1.6%	1.5%	2.5%	2.7%	5.4%	1.3%	1.5%	0.0%	1.8%
	Q4	4.5%	4.0%	11.4%	12.5%	10.0%	5.4%	6.7%	0.0%	6.1%
Share Graduating with Non-Science Major:										
Science	Q1	14.4%	6.5%	13.8%	7.6%	11.8%	12.2%	16.7%	12.7%	11.3%
	Q2	22.4%	11.6%	16.1%	13.2%	9.1%	14.0%	16.7%	16.9%	14.6%
	Q3	12.7%	13.4%	17.1%	10.2%	9.6%	13.0%	10.7%	22.2%	13.1%
	Q4	9.7%	17.3%	12.8%	6.8%	7.1%	26.7%	23.5%	25.0%	12.5%
Non-Science	Q1	27.2%	22.6%	21.7%	16.6%	28.1%	27.2%	36.9%	28.5%	26.3%
	Q2	34.1%	33.2%	38.8%	25.6%	30.9%	32.3%	46.3%	30.5%	33.6%
	Q3	43.5%	35.9%	46.3%	28.8%	37.8%	34.7%	43.3%	37.5%	39.3%
	Q4	41.4%	38.0%	40.0%	30.0%	50.0%	29.7%	56.7%	25.0%	39.5%
Share Graduating, Any Major:										
Science	Q1	14.9%	8.7%	19.7%	9.0%	16.7%	18.3%	24.4%	20.9%	15.7%
	Q2	27.9%	18.1%	30.8%	18.4%	17.5%	26.8%	28.3%	33.7%	23.6%
	Q3	32.5%	25.7%	35.4%	29.5%	25.0%	34.8%	25.0%	44.4%	30.1%
	Q4	32.8%	37.3%	36.2%	32.2%	35.7%	53.3%	52.9%	75.0%	36.8%
Non-Science	Q1	27.4%	22.9%	23.2%	17.2%	28.1%	27.2%	39.1%	30.2%	27.0%
	Q2	34.9%	33.7%	41.0%	27.3%	31.7%	32.9%	46.9%	32.0%	34.6%
	Q3	45.0%	37.4%	48.8%	31.5%	43.2%	36.0%	44.8%	37.5%	41.1%
	Q4	45.9%	42.0%	51.4%	42.5%	60.0%	35.1%	63.3%	25.0%	45.5%

graduate in a science field, m, or in a non-science field, h, or choose to not graduate, n. Denote the student's decision by d_{ik}, $d_{ik} \in \{m, h, n\}$. In what follows, the student's initial choice of a college, k is taken as given. Note that this introduces a selection problem: students at Berkeley are likely strong not only on characteristics observed by the researcher but also along unobserved dimensions. We discuss the selection problem in more detail in section 3.2.

We assume that the utility student i derives from graduating with a major in j from college k depends on three components: (i) the *net returns* she expects to receive from graduating with this major from this college; (ii) the *costs of switching* one's major, if the student decides to change from the one with which she started college; and (iii) other factors which we treat as idiosyncratic and stochastic. The net returns from majoring in field j at college k, R_{ijk}, is just the difference between the expected present value of future benefits, b_{ijk}, of having this major/college combination, less the costs associated with completing it, c_{ijk}, i.e., $R_{ijk} = b_{ijk} - c_{ijk}$.[20] In particular, the benefits would include the expected stream of labor market earnings that would accrue to someone with this major-college combination (e.g., an engineering degree from UC Berkeley), where these earnings would be expected to vary with a student's ability and the quality of training provided by the college.

The costs of completing a degree in field j at k depend on the effort a student would need to exert to complete the curriculum in this major at this college, where this effort is likely to vary with i's academic preparation and the quality of the college and its students. With respect to switching costs, each student arrives on campus with an initial major, j^{int} (as with the college she attends, her initial, or intended, major, j^{int}, is taken as given). The student may remain in and graduate with her initial major or may decide to switch to and graduate with a different major in which case the switching cost, C_{ijk}, is paid. Finally, we allow for an idiosyncratic taste factor, ϵ_{ijk}. It follows that the payoff function for graduating with major j at school k is given by:

$$U_{ijk} = R_{ijk} - C_{ijk} + \epsilon_{ijk} \quad (1)$$

[20]For a similar approach to modeling the interaction between colleges and majors in determining college graduations in particular majors, see Arcidiacono (2004).

for $j \in \{m, h\}$. Below, we characterize the specific functional forms for R_{ijk} and C_{ijk} that we use in estimation.

Since discrete choice models depend on differences in payoffs, without loss of generality we normalize the student's utility of not graduating from college k, denoted as U_{ink}, to zero. It follows that the major/graduation choice of student i attending college k is made according to:

$$d_{ik} = \arg\max_{m,h,n} \{U_{imk}, U_{ihk}, 0\} \tag{2}$$

3.1 Net Returns

We assume that the net returns of a particular major/college combination, R_{ijk}, varies with an index of a student's academic preparation for major j, denoted by AI_{ij}, and that these net returns to AI_{ij} may differ across campuses. In particular, we assume that R_{ijk} is characterized by the linear function:

$$R_{ijk} = \phi_{1jk} + \phi_{2jk} AI_{ij} \tag{3}$$

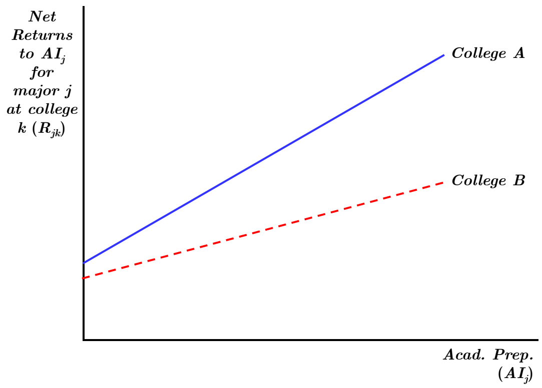
The specification in (3) allows college-major combinations to differ in their net returns to the academic index with higher net returns associated with higher values of ϕ_j. As noted above, such differences in ϕ_{2jk} may result from colleges gearing their curriculum in a particular major to students from a particular academic background which, in turn, produce differences in subsequent labor market earnings. Degrees in various majors from different colleges also may produce differing net returns that do not depend on a student's academic preparation which is reflected in differing values of ϕ_{1jk}. For example, the curriculum in majors at some colleges (e.g., engineering at MIT) may have different course requirements that all students have to meet, regardless of their academic preparation, that impose differing effort and time costs to completing the major.

We are interested in how differences across colleges of differing quality, or selectivity, differ in their ability to educate and graduate students of differing academic preparation in various majors. To see how the specification of the net returns functions in (3) capture such differences, suppose that College A is an elite, selective college (e.g., UC Berkeley, UCLA or UC San Diego), while College B is a less selective one (e.g., UC Santa Cruz or UC Riverside). One possibility is that highly selective colleges (A) have an *absolute advantage* relative to less selective ones (B) in the net returns students from any level of academic preparation would receive and that such advantage is true for all majors. This case is illustrated in Panel (a) of Figure 1, where the absolute advantage holds for *all* majors. Alternatively, selective colleges may not generate higher net returns for students with all levels of academic preparation in all fields. For example, selective colleges may have an absolute advantage in moving all types of students through its science curriculum, whereas less selective colleges (B) may have an absolute advantage in training students in the humanities. This case is characterized by Panels (a) and (b) in which elite colleges (A) have absolute advantage in getting students through major j, while less selective colleges (B) have an absolute advantage in graduating all students from major (j'). This second case might arise if colleges develop faculties and facilities to educate students in some majors, but not others, such as "technology institutes" (e.g., Caltech, Georgia Tech) which focus on their curriculum and research in science and technology.

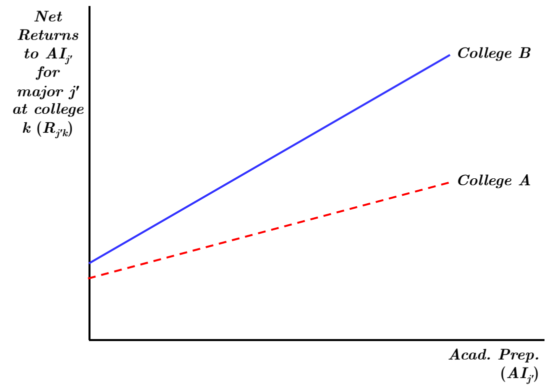
But some colleges may produce higher net returns in some major j for less-prepared students, while others are geared to better-prepared students and produce higher net returns for the latter type of student. This case is illustrated in Panel (c) for major j. At first glance, this differences-in-relative-advantage between highly selective and less selective colleges may account for the differential success UC Berkeley and UCLA had in graduating minorities versus non-minorities with STEM majors compared to lesser-ranked UC campuses, like UC Santa Barbara and UC Riverside. Below, we examine the empirical validity of this latter explanation, after explicitly accounting for differences in student preparation and student persistence in majors across the UC campuses.

3.2 Academic Preparation for Majors

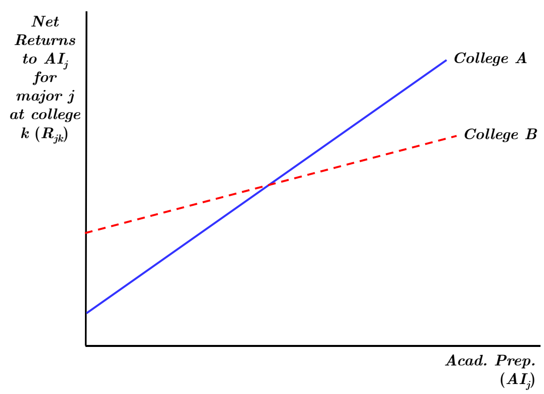
We now specify how the student's academic index is constructed. We assume that the various abilities of the student can be characterized by a set of characteristics X_i. These characteristics are then rewarded in majors differently. For example, math skills may be rewarded more in the



(a) Net Returns to AI of graduating in major j from College A is *greater* than from B for *all* AI_j.



(b) Net Returns to AI of graduating in major j' from College B is *greater* than from A for *all* $AI_{j'}$.



(c) Net Returns to AI of graduating in major j from College A is *greater* than B for *better prepared* students, but *greater* from B than A for *less prepared* ones.

Figure 1: Differences in Net Returns to Student Academic Preparation (AI) by Major at Selective (A) and Non-Selective (B) Colleges

sciences while verbal scores may be more rewarded outside of the sciences. The academic index for major $j \in \{m, h\}$, AI_{ij}, is then given by:

$$AI_{ij} = X_i \beta_j \tag{4}$$

where β_j allows for the weights on the various measures of preparation to vary by major.

Our estimation problem is analogous to that in the literature concerning the effects of college quality on graduation and later-life outcomes. In particular, whether a student remains in a major and graduates from a particular college is the result of student decisions that are influenced by the quality of the campus – in our case the campus-specific net returns to graduating with a major and the costs of switching a major – and by observed and unobserved dimensions of her academic preparation. To account for the selection effects in our context, we employ the approach used by Dale and Krueger (2002) by constructing a set of academic indices for each student that depend not only on observables, such as SAT math and verbal scores, but also on dimensions not fully captured by such measures but that are reflected in where a student applied and the rankings/quality of UC campuses to which she was admitted. The full set of characteristics, X_i, is given by: observed measures of academic preparation (H_i), which includes high school GPA, and SAT math and verbal scores; parental background (B_i), which includes dummy variables for each family income category and each parental education category; dummy variables for each of the schools in the UC system where the individual submitted an application, where $s_{ik} = 1$ if the individual submitted an application to school k and zero otherwise; and an indicator variable of whether the individual was admitted to school k, a_{ik}. That is:

$$X_i = \begin{bmatrix} H_i & B_i & S_i & A_i \end{bmatrix}$$

where:

$$\begin{aligned} S_i &= \begin{bmatrix} s_{i1} & \cdots & s_{iK} \end{bmatrix} \\ A_i &= \begin{bmatrix} a_{i1} & \cdots & a_{iK} \end{bmatrix} \end{aligned}$$

The academic index for individual i in major j, AI_{ij}, is then given by a major-specific weighted average of the characteristics in X_i as in (4). In this way, we allow the possibility that characteristics such as SAT math may be more important for science majors than non-science majors.

3.3 Costs of Switching Majors

Finally, we specify the cost of switching majors, C_{ijk}. We allow these costs to depend on the individual's academic index (AI_{ij}), a set of variables, B_i, that contain measures of parental support such as parental income and education, and a college specific component, α_{3k}.

$$C_{ijk} = \begin{cases} AI_{ij}\alpha_{1j} + B_i\alpha_2 + \alpha_{3k} & \text{if } j^{int} \neq j \\ 0 & \text{if } j^{int} = j \end{cases} \tag{5}$$

3.4 Estimation

We specify the error structure such that it has a nested logit form, allowing the errors to be correlated among the two graduation options, i.e., graduating with a science major (m) and graduating with a non-science degree (h). In this way we account for shocks after the initial choice of school and major that may influence the value of continuing one's education. For example, a shock to one's finances or personal issues may make college in general unattractive. Given our assumption regarding the error distribution, the probability of choosing to graduate from k with major j, conditional on X and B (but not ϵ), is given by:

$$p_{ijk} = \frac{\left(\sum_{j'} \exp\left(\frac{u_{ij'k}}{\rho}\right)\right)^{\rho-1} \exp\left(\frac{u_{ijk}}{\rho}\right)}{\left(\sum_{j'} \exp\left(\frac{u_{ij'k}}{\rho}\right)\right)^{\rho} + 1} \tag{6}$$

for $j = m, h$ and where the probability of choosing not to graduate from k is given by:

$$p_{i0k} = \frac{1}{\left(\sum_{j'} \exp\left(\frac{u_{ij'k}}{\rho}\right)\right)^{\rho} + 1} \tag{7}$$

We estimate separate nested logit models for minority and non-minority students, as well as separate models for 4- and 5-year graduation outcomes.

4 Results

In this section we present estimates of the model of graduation/major choices. By modeling these choices, we attempt to account for cross-campus differences in academic preparation. To assess the consequences of adjusting for selection, we then examine how persistence in majors and overall graduation rates would differ from the rates presented in Section 2 if student academic preparation were equalized across the UC campuses. Finally, we calculate changes in STEM graduations for minority (and non-minority) students from reallocating students across the UC campuses. As we show below, these exercises imply sizeable gains in STEM major graduations among minorities from reallocating students, especially less-prepared ones, from higher-ranked UC campuses to lower-ranked ones.

Estimates of the key parameters of based on graduation in 5 or less years for minorities and non-minorities are given in Table 6.[21] We present estimates for the parameters of the net return functions in (3), the switching majors cost function in (5) and some of the indices of students' academic preparation from (4) for science and non-science majors.[22]

Consider first the estimates for the indices of academic preparation found in Table 6. Among non-minorities, there are notable differences in the relative importance of particular measures of academic preparation across the two majors, with the SAT Math score being important for Science majors, while SAT verbal is more important for the non-sciences. A student's high school GPA is important for both majors, but is relatively more important for Science than non-science. Similar patterns hold for minorities, although only the positive effect of SAT Math scores on the preparation index for science majors is precisely estimated.[23]

The coefficient estimates for the net returns function are displayed in Table 6. Note that the estimated campus intercepts and slope coefficients for the specification in (3) are measured relative to those for UC Berkeley (the slope for UC Berkeley is normed to one). We make three points about how the net returns functions vary with student academic preparation (AI_j). First, not surprisingly, the net returns to graduating with either major increase with AI_j for minorities and non-minorities.[24] Second, the net returns to academic preparation (the ϕ_{2jk}s)

[21] The corresponding parameter estimates for data on four-year graduation rates are found in Table 15 in the Appendix and show similar patterns.

[22] The full model has 144 parameters. For ease of exposition, we do not report the coefficients in the academic index or the switching costs for each family income and parental education category. Nor do we report the Dale and Krueger controls.

[23] The lack of precision is driven by the flexibility of our specification. For example, using a less flexible function for the returns to parental income education, as opposed to dummying out each category, results in statistically significant effects for the main academic measures.

[24] The average of the campus-specific slopes of the net returns functions are remarkably similar, with 0.87 being the average for minorities of graduating with a science major and 0.77 for non-minorities and 0.89 being

Table 6: Nested Logit Coefficients for Choice of Final Major based on 5-year Graduation Criteria†

	Non-Minority		Minority	
	Science	Non-Science	Science	Non-Science
Net Returns Function:				
UCLA	-0.061	-0.671**	-0.059	-0.405
	(0.482)	(0.305)	(0.605)	(0.554)
San Diego	1.310***	0.043	1.029	0.562
	(0.441)	(0.290)	(0.879)	(0.856)
Davis	1.299***	0.178	-0.003	-0.321
	(0.418)	(0.271)	(0.609)	(0.555)
Irvine	1.555***	0.304	0.718	0.385
	(0.433)	(0.282)	(0.728)	(0.682)
Santa Barbara	2.249***	0.644**	0.802	0.568
	(0.460)	(0.323)	(0.767)	(0.737)
Santa Cruz	3.214***	0.711*	1.656	0.912
	(0.513)	(0.375)	(1.180)	(1.174)
Riverside	2.651***	0.585*	1.273	0.995
	(0.475)	(0.336)	(1.121)	(1.078)
UCLA $\times AI_j$	0.996***	1.136***	1.002***	1.076***
	(0.063)	(0.076)	(0.104)	(0.116)
San Diego $\times AI_j$	0.823***	0.913***	0.792***	0.817***
	(0.054)	(0.067)	(0.117)	(0.139)
Davis $\times AI_j$	0.821***	0.879***	0.972***	1.012***
	(0.051)	(0.061)	(0.109)	(0.125)
Irvine $\times AI_j$	0.756***	0.835***	0.880***	0.905***
	(0.050)	(0.064)	(0.115)	(0.135)
Santa Barbara $\times AI_j$	0.663***	0.766***	0.845***	0.838***
	(0.050)	(0.062)	(0.101)	(0.118)
Santa Cruz $\times AI_j$	0.484***	0.678***	0.695***	0.763***
	(0.055)	(0.073)	(0.125)	(0.146)
Riverside $\times AI_j$	0.583***	0.683***	0.761***	0.723***
	(0.052)	(0.070)	(0.111)	(0.129)
Switching Majors Cost Function:				
UCLA	-0.003		0.019	
	(0.021)		(0.018)	
San Diego	-0.087***		-0.001	
	(0.021)		(0.021)	
Davis	-0.152***		-0.035*	
	(0.021)		(0.020)	
Irvine	-0.066**		-0.007	
	(0.026)		(0.023)	
Santa Barbara	0.026		0.082***	
	(0.027)		(0.025)	
Santa Cruz	-0.136***		-0.005	
	(0.032)		(0.025)	
Riverside	-0.159***		-0.017	
	(0.033)		(0.023)	
Academic Preparation Index Function:				
HS GPA	1.128***	0.767***	0.975	0.826
	(0.151)	(0.147)	(0.846)	(0.789)
SAT Math	3.567***	-0.684***	1.433***	0.073
	(0.279)	(0.206)	(0.455)	(0.425)
SAT Verbal	-0.849***	0.565***	0.343	0.627
	(0.194)	(0.177)	(0.679)	(0.626)
Nesting parameter				
ρ	0.453***		0.143	
	(0.072)		(0.134)	

† All campus dummies are measured relative to UC Berkeley (the omitted category). The coefficient on AI for Berkeley is normalized to one.

are larger for higher-ranked campuses, such as UC Berkeley and UCLA, compared to those for lower-ranked ones. This "return to college quality" holds for graduating with either a science or non-science major and for minorities and non-minorities. Third, our estimates for the net returns functions imply that, while higher ranked UC campuses like UC Berkeley and UCLA have a comparative advantage in graduating better prepared minority or non-minority students in either science or non-science majors relative to lower-ranked campuses, like UC Santa Cruz and UC Riverside, the lower-ranked campuses have a comparative advantage in graduating less-prepared students especially in the sciences. This is reflected in the positive intercept terms in the first panel when comparing all campuses except UCLA to UC Berkeley. This pattern is consistent with the relationship among colleges of different ranks illustrated in Panel (c) of Figure 1. Moreover, although not obvious from the coefficients themselves, the range of AI_j scores for which lower-ranked campuses have this comparative advantage is greater in the sciences than in the non-sciences. These final two patterns suggest the potential for improving persistence rates of minorities in the sciences by re-allocating students from higher ranked to lower-ranked campuses. We develop this point in Section 4.2.

Finally, we turn to the estimates of the campus-specific components of the switching majors cost function in Table 6. Again these campus components are measured relative to those for UC Berkeley, which is normalized to zero. In contrast to the net returns, the costs of switching majors are not ordered according to campus rankings and differ by minority status. Among non-minorities, the costs of switching majors is highest at UC Berkeley but there is no pattern to the remaining coefficients. In contrast, minorities at Berkeley have similar switching costs to those at other campuses. Those only exception is UC Santa Barbara, which has slightly higher switching costs.

4.1 Adjusting for Selection and Equalizing Across-Campus Student Differences

To further characterize the consequences of adjusting for selection for the across-campus

the average for minorities of graduating with a non-science major and 0.86 for non-minorities.

differences in persistence and graduation rates of minorities and minorities, we use the parameters of our model to predict these campus-specific rates for a common set of students, with the predictions then purged of selection. More precisely, we use the parameter estimates in Tables 6 and 15 to predict the shares of students who would graduate, in 5 and 4 years or less respectively, with a science major ($d_i = m$), a non-science major, ($d_i = h$), and any major ($d_i = m$ or $d_i = h$) at each UC campus for each initial-major (j^{int}) and SAT score quartile (Q) "cell." Here we use *all* students who enrolled at one of the UC campuses and who are of that particular initial major and SAT score quartile. By using the same students in each cell to predict these shares for each campus, the resulting estimates are purged of the within-pair differences in students' observed measures of academic preparation and family background that characterized the actual shares found in Tables 4 and 5, respectively. The selection-adjusted predicted shares based on a 5-year graduation criteria are found in Table 7 and in Table 8 for the 4-year graduation criteria. To facilitate their comparison with the observed (unadjusted) shares, the results in these tables are displayed in much the same format as is used in Tables 4 and 5.

We focus initially on the selection-adjusted shares for minorities in Table 7 that are based on the 5-year graduation criteria. In addition to the predicted shares by initial major and SAT quartile, we include in this table tabulations of the average differences in the selection-adjusted versus actual shares for each UC campus ("Ave. Diff.") and of a measure of the differences in the across-campus heterogeneity of the shares ("Diff. in Across-Campus Hetero.") for each quartile of the distribution of SAT scores.[25] For almost every initial-major–SAT-quartile cell, adjusting for selection and equalizing the within initial-major–SAT-quartile cells student characteristics results in less across-campus heterogeneity in minority persistence rates in the sciences and non-sciences and in overall graduation rates compared to the shares actually observed at the UC campuses. More precisely, equalizing the within-cell differences in student academic preparation and family background would tend to *reduce* the persistence rates at the higher ranked campuses and to *increase* them at the lower-ranked campuses. There are two notable exceptions to this pattern. Equalizing student preparation and family background of minorities would actually

[25] We use the coefficient of variation of shares for each SAT quartile to measure across-campus heterogeneity. Note that this does not take into account differences in the size of the quartiles in the actual data.

increase the across-campus heterogeneity in science persistence rates and the share of students switching into the sciences for those students in the bottom SAT quartile. This is due to the strong comparative advantage that less-selective campuses (i.e., UC Santa Barbara, UC Santa Cruz and UC Riverside) have over higher ranked ones (i.e., UC Berkeley and UC San Diego) in the net returns to graduating less-prepared minority students in the sciences.

The selection-adjusted shares based on a 4-year graduation criteria are displayed in Table 8. There are several points to make about these estimates. First, as we found when comparing the actual persistence and graduation rates for minorities across the two graduation criteria (see Tables 4 and 5), the predicted science persistence and overall graduation rates for minorities are much lower when one uses a 4-year graduation criteria compared to the 5-year one. Furthermore, using the 4-year graduation criteria magnifies the comparative advantage that lesser-ranked campuses have over higher ones in graduating minorities in the sciences that would occur if minority student preparation and backgrounds were equalized across campuses. As seen in Table 8, our measure of across-campus heterogeneity increases with such equalization among students who initially select a STEM major for all but those in the top SAT quartile. While somewhat weaker, the same increase in across-campus differentiation would occur in the the non-STEM fields with such equalization. These findings suggest that the comparative advantage of lower-tiered campuses over higher-ranked ones in the net returns to minorities of persisting in the sciences is much stronger for “on-time” graduations.

Finally, the consequences of equalizing across-campuses differences in student preparation and family background within the initial-major–SAT-quartile cells for non-minorities are displayed in Tables 16 and 17 for 5- and 4-year graduation outcomes, respectively. While the differences between the selected adjusted and unadjusted shares are qualitatively similar to those for minorities, the increase in heterogeneity is only found in the bottom quartile. The cross-race differences reflect in part the large differences between minorities and non-minorities across other dimensions besides SAT, such as parental income and education, and differences in unobserved preparation captured by the Dale-Krueger measures. Note that these cross-race differences in preparation appear to be a result, in part, of the affirmative action admissions

Table 7: Selection-Adjusted Shares of Minority Students Graduating in 5 Years with Science or Non-Science Majors, by Campus, SAT Quartile, and Initial Major

Initial Major (j^{int})	SAT Quartile	Berkeley	UCLA	San Diego	Davis	Irvine	Santa Barbara	Santa Cruz	Riverside	Diff. in Across-Campus Hetero.†
Share Graduating with Science Major										
Science	Q1	9.3%	13.5%	17.6%	13.8%	15.3%	19.8%	19.0%	18.4%	3.5%
	Q2	19.6%	24.6%	28.5%	25.3%	26.8%	32.9%	27.5%	30.7%	-6.8%
	Q3	28.9%	33.6%	36.5%	34.6%	35.7%	42.2%	33.6%	39.6%	-12.2%
	Q4	40.3%	43.9%	45.5%	45.2%	45.8%	52.2%	40.4%	49.3%	-10.1%
Ave. Diff.‡		-2.5%	-0.5%	-4.4%	0.4%	0.2%	5.0%	8.7%	3.9%	
Non-Science	Q1	1.1%	1.6%	3.0%	3.3%	2.5%	1.2%	3.7%	3.7%	3.7%
	Q2	2.7%	3.2%	5.4%	6.7%	4.9%	2.4%	5.4%	7.2%	-12.5%
	Q3	4.6%	4.9%	7.7%	10.4%	7.4%	3.9%	6.9%	11.0%	-11.2%
	Q4	7.2%	7.1%	10.5%	15.0%	10.5%	5.7%	8.5%	15.4%	-18.3%
Ave. Diff.‡		-0.1%	-0.6%	0.2%	-0.8%	0.4%	0.0%	1.5%	5.7%	
Share Graduating with Non-Science Major										
Science	Q1	45.0%	38.0%	35.0%	35.4%	40.6%	33.0%	37.4%	36.8%	-4.5%
	Q2	43.0%	35.8%	31.4%	32.6%	36.8%	27.6%	35.4%	31.1%	-2.3%
	Q3	38.9%	32.5%	28.0%	28.9%	32.7%	23.2%	33.4%	26.5%	-1.9%
	Q4	32.4%	27.5%	23.5%	23.7%	27.1%	18.0%	30.4%	20.9%	-1.9%
Ave. Diff.‡		1.9%	-1.3%	-2.8%	3.8%	1.8%	-5.7%	-0.9%	-2.8%	
Non-Science	Q1	60.0%	56.4%	56.6%	51.6%	60.0%	60.2%	59.7%	58.5%	-3.8%
	Q2	66.8%	63.9%	61.4%	57.2%	65.2%	66.0%	64.4%	61.3%	-2.9%
	Q3	69.9%	67.8%	63.6%	59.2%	67.3%	69.0%	67.0%	61.5%	-5.2%
	Q4	70.4%	69.1%	63.6%	58.2%	67.0%	69.9%	67.8%	59.7%	-5.0%
Ave. Diff.‡		-0.6%	-2.1%	-2.2%	3.6%	0.3%	3.6%	1.6%	-0.6%	
Share Graduating with Any Major										
Science	Q1	54.4%	51.4%	52.6%	49.2%	55.9%	52.8%	56.4%	55.1%	-5.3%
	Q2	62.6%	60.4%	59.9%	57.9%	63.6%	60.5%	62.9%	61.8%	-2.5%
	Q3	67.8%	66.0%	64.5%	63.5%	68.4%	65.4%	67.0%	66.1%	-8.7%
	Q4	72.7%	71.4%	69.0%	68.9%	72.9%	70.1%	70.8%	70.2%	-6.2%
Ave. Diff.‡		-0.6%	-1.8%	-7.3%	4.2%	2.0%	-0.7%	7.8%	1.1%	
Non-Science	Q1	61.2%	58.0%	59.7%	54.8%	62.6%	61.4%	63.5%	62.2%	-3.4%
	Q2	69.4%	67.1%	66.8%	63.9%	70.1%	68.5%	69.8%	68.5%	-4.4%
	Q3	74.5%	72.7%	71.3%	69.6%	74.7%	72.9%	73.8%	72.4%	-6.2%
	Q4	77.6%	76.2%	74.2%	73.2%	77.6%	75.7%	76.3%	75.0%	-4.4%
Ave. Diff.‡		-0.7%	-2.7%	-2.0%	2.8%	0.7%	3.7%	3.1%	5.1%	

† The "difference in across-campus heterogeneity" is the difference, for each SAT quartile, in the coefficients of variation for the selection-adjusted *row* entries and the corresponding unadjusted entries in Table 4.

‡ The "average difference" the average difference between the selection-adjusted *column* entries in this table and the corresponding unadjusted entries from Table 4.

Table 8: Selection-Adjusted Shares of Minority Students Graduating in 4 Years with Science or Non-Science Majors, by Campus, SAT Quartile, and Initial Major

Initial Major (j^{int})	SAT Quartile	Berkeley	UCLA	San Diego	Davis	Irvine	Santa Barbara	Santa Cruz	Riverside	Diff. in Across-Campus Hetero.†
Share Graduating with Science Major										
Science	Q1	1.3%	1.6%	4.9%	2.8%	3.9%	6.5%	11.2%	8.9%	6.1%
	Q2	5.5%	5.6%	11.9%	8.4%	9.5%	14.8%	19.2%	19.2%	3.7%
	Q3	12.3%	11.4%	19.5%	15.7%	15.8%	23.2%	25.9%	29.1%	13.8%
	Q4	24.6%	21.4%	29.9%	27.0%	24.9%	34.2%	33.9%	41.2%	-10.9%
Ave. Diff.‡		-1.3%	-0.3%	1.0%	0.6%	-0.8%	2.9%	6.8%	0.3%	
Non-Science	Q1	0.1%	0.1%	0.7%	0.4%	0.3%	0.6%	1.5%	1.4%	-14.2%
	Q2	0.6%	0.5%	2.2%	1.7%	0.8%	1.7%	3.1%	4.0%	10.1%
	Q3	1.6%	1.2%	4.2%	3.9%	1.6%	3.3%	4.7%	7.4%	-15.9%
	Q4	4.2%	2.6%	7.5%	8.1%	2.9%	5.9%	6.9%	12.6%	-10.1%
Ave. Diff.‡		-0.2%	-0.5%	-0.8%	-0.9%	-2.7%	1.0%	1.3%	5.5%	
Share Graduating with Non-Science Major										
Science	Q1	12.6%	8.0%	11.6%	9.5%	10.9%	10.7%	18.9%	15.7%	0.2%
	Q2	15.7%	11.1%	14.3%	11.3%	12.9%	11.7%	20.5%	16.5%	-4.1%
	Q3	16.2%	12.4%	15.0%	11.5%	13.3%	11.3%	20.6%	15.5%	-9.6%
	Q4	14.7%	12.6%	14.6%	10.5%	12.9%	10.2%	19.9%	13.5%	-28.4%
Ave. Diff.‡		0.0%	-1.2%	-1.1%	1.3%	3.1%	-5.5%	3.1%	-3.9%	
Non-Science	Q1	24.9%	18.4%	22.9%	17.8%	27.5%	27.6%	39.8%	31.5%	4.4%
	Q2	34.1%	28.6%	32.2%	24.9%	36.3%	35.7%	47.6%	39.0%	1.4%
	Q3	40.0%	36.1%	38.2%	29.3%	42.1%	40.6%	51.9%	42.6%	1.2%
	Q4	43.2%	41.3%	41.3%	31.1%	45.7%	43.1%	54.1%	43.1%	-12.9%
Ave. Diff.‡		-1.0%	-1.3%	-3.1%	0.5%	1.2%	5.8%	2.6%	8.7%	
Share Graduating with Any Major										
Science	Q1	14.0%	9.6%	16.6%	12.2%	14.8%	17.2%	30.1%	24.6%	5.5%
	Q2	21.2%	16.7%	26.2%	19.7%	22.4%	26.4%	39.7%	35.7%	5.6%
	Q3	28.5%	23.8%	34.5%	27.2%	29.1%	34.5%	46.5%	44.6%	3.2%
	Q4	39.2%	34.0%	44.6%	37.5%	37.7%	44.4%	53.7%	54.6%	-16.0%
Ave. Diff.‡		-1.3%	-1.4%	0.0%	1.9%	2.3%	-2.7%	9.9%	-3.6%	
Non-Science	Q1	25.0%	18.5%	23.6%	18.3%	27.8%	28.2%	41.3%	33.0%	4.5%
	Q2	34.7%	29.1%	34.4%	26.6%	37.1%	37.4%	50.7%	43.0%	3.3%
	Q3	41.7%	37.3%	42.4%	33.3%	43.6%	43.9%	56.6%	50.0%	2.2%
	Q4	47.4%	43.9%	48.8%	39.3%	48.6%	49.0%	61.0%	55.8%	-14.0%
Ave. Diff.‡		-1.1%	-1.8%	-3.8%	-0.2%	-1.5%	6.8%	3.9%	14.3%	

† The "difference in across-campus heterogeneity" is the difference, for each SAT quartile, in the coefficients of variation for the selection-adjusted *row* entries and the corresponding unadjusted entries in Table 5.

‡ The "average difference" the average difference between the selection-adjusted *column* entries in this table and the corresponding unadjusted entries from Table 5.

policies in effect during our sample period.

4.2 Gains from Re-Allocating Students to Counterfactual Campuses

The across-campus differences in persistence and graduation rates in the sciences for minorities and non-minorities when academic preparation and family backgrounds are equalized suggest that there may be gains from re-allocating students across campuses, especially less-prepared ones and ones from less-advantaged backgrounds. In this section we use the estimates from our model to assess these potential gains. In particular, we estimate the proportion of students enrolled at a particular campus who would have a higher probability of (i) persisting and graduating in the sciences, (ii) persisting and graduating in the non-sciences, and (iii) graduating with any major at each of the other UC campuses. Unlike in the previous section, in this exercise the characteristics of students are not equalized at all campuses but are fixed according to the campus the students actually attended.[26]

Table 9 displays the proportion of non-minority students that are enrolled at campus A ("Actual Campus") who would be predicted to have higher persistence rates if they had enrolled at each other UC campus ("Counterfactual Campus") for each of the graduation outcomes noted above. Consider the gains from these counterfactual reallocations for graduating with a science degree, conditional on science being a student's initial major. A number of patterns stand out for non-minority students. First, with respect to persisting in the sciences, UC San Diego is very strong. Among initial science majors who attended one of the top five UC campuses, virtually all of them would have higher net returns to graduating in the sciences if they were enrolled at UC San Diego, and a majority of students enrolled at the bottom three UC campuses would have higher net returns in the sciences at UC San Diego. Second, UC Davis and UC Riverside appear to have strong relative advantages for graduating students from top-five and bottom-three UC campuses, respectively, in the sciences. For example, science students at UC Berkeley or UCLA would have higher persistence rates in the sciences at UC Davis, less than a third of the science students at UC Santa Barbara, or UC Riverside would be better off at Davis. Third, aside from these three "science" schools, re-allocating science students from the

[26] We note that this case is almost equivalent to graduating in the non-sciences conditional on not beginning in the sciences as we have seen that switch rates from non-science majors to science majors are rare.

campus they enrolled at to the other campuses tends to produce improvements persistence rates in the sciences for less than half of the non-minority students. In short, among non-minorities, students in the sciences appear to be relatively well-matched to campuses, although there would be gains if more of them had gone, or could have gone, gone to UC San Diego.

The pattern for the gains from these hypothetical re-allocations of non-minority students across the UC campuses with respect to graduation outside of the sciences are quite different from the persistence-in-the-sciences outcome. Our estimates imply that most non-minority students at a particular UC campus (e.g., UC Berkeley) would not gain from moving to lesser-ranked one. (Note the greater proportions of gainers above the diagonal in the bottom two panels of Table 9 compared to those below the diagonal.) This pattern is especially true for students who start out in the non-sciences, where almost every non-minority student enrolled at a campus other than UC Berkeley would gain in terms of graduation if they were allowed to go to UC Berkeley. Thus, while which campus one is matched to appears to be particularly important for the persistence in the sciences, being allocated to a more-selective campus improves overall graduation rates, especially for non-minority students who start out in the non-sciences.

The corresponding results for minority students are presented in Table 10. They are very different from those for non-minorities. First, almost all minorities that were enrolled at a UC campus would have higher persistence rates in the sciences if they we reallocated to a lesser-ranked campus. (The percentages above the diagonal in the first panel of Table 10 are generally close to 100% and are much larger than those below the diagonal.) The one exception is again UC San Diego where relatively strong minority students would have higher persistence rates in the sciences. This stronger pattern of the relative advantage in persistence in the sciences for minorities at lower-ranked campuses results in large part from the large differences in academic preparation between the minorities and non-minorities.

Turning to the gains from re-allocating students in the bottom two panels of Table 10, one continues to see high proportions of minorities gaining from the hypothetical moves to lower-ranked campuses, though there are exceptions. Namely, over half of minority students at UC Berkeley would see decreases in their overall graduation rates if they moved to any of the lower-ranked campuses with the exception of UC Irvine. Further, while UC San Diego and UC Davis

Table 9: Estimated Proportions of Non-Minority Students who would Increase their Payoffs to Graduating if they had been at a Different (Counterfactual) UC Campus

Campus Enrolled at:	Counterfactual Campus: UC Berkeley	UCLA	San Diego	Davis	Irvine	Santa Barbara	Santa Cruz	Riverside
Graduating with Science Major, Conditional on Initial Major = Science:								
Berkeley	–	45%	100%	98%	32%	42%	9%	34%
UCLA	46%	–	100%	99%	52%	66%	14%	56%
San Diego	0%	0%	–	0%	0%	4%	2%	9%
Davis	0%	0%	100%	–	1%	45%	17%	46%
Irvine	10%	18%	100%	99%	–	99%	48%	91%
Santa Barbara	3%	2%	63%	22%	0%	–	27%	83%
Santa Cruz	11%	14%	55%	36%	26%	59%	–	84%
Riverside	12%	14%	55%	33%	11%	35%	18%	–
Graduating with Any Major, Conditional on Initial Major = Science:								
Berkeley	–	0%	9%	11%	1%	3%	1%	1%
UCLA	100%	–	61%	59%	11%	15%	5%	5%
San Diego	84%	27%	–	66%	0%	5%	3%	1%
Davis	59%	13%	24%	–	0%	7%	4%	2%
Irvine	83%	31%	98%	100%	–	93%	35%	27%
Santa Barbara	60%	29%	56%	76%	11%	–	12%	0%
Santa Cruz	57%	32%	56%	72%	42%	80%	–	20%
Riverside	65%	41%	70%	83%	60%	99%	62%	–
Graduating with Any Major, Conditional on Initial Major = Non-Science:								
Berkeley	–	0%	0%	0%	0%	2%	0%	0%
UCLA	100%	–	15%	19%	11%	19%	6%	3%
San Diego	100%	84%	–	82%	5%	44%	3%	1%
Davis	99%	53%	6%	–	2%	67%	5%	1%
Irvine	100%	38%	54%	92%	–	100%	20%	2%
Santa Barbara	84%	35%	13%	16%	0%	–	0%	0%
Santa Cruz	97%	57%	75%	87%	86%	100%	–	0%
Riverside	95%	48%	78%	91%	93%	100%	100%	–

Results based on criteria of graduating in 5 years or less.

do well in the sciences, their overall graduation rates tend to be lower. Besides these exceptions, the general pattern is that moving minorities to less-selective campuses results in increases in overall graduation rates.

To get a better sense of how the graduation rates of students with differing academic backgrounds would fare by moving to different campuses, Table 11 displays, for the 5-year graduation criteria, the gains (losses) of moving minority and non-minority students enrolled at the three highest ranked campuses (UC Berkeley, UCLA, and UC San Diego) to the two lowest-ranked ones (UC Santa Cruz and UC Riverside). Here, we report results by SAT quartiles in order to capture, in part, the differences in the academic preparation of (minority and non-minority) students across the various campuses. We continue to focus on the same graduation outcomes as we considered in Tables 9 and 10.

The first three panels of Table 11 give the results for non-minority students enrolled at UC Berkeley, UCLA and UC San Diego. Non-minority students in the bottom quartile of the SAT distribution at UC Berkeley or UCLA would see a higher probability of graduating the sciences had they instead attended UC Santa Cruz or UC Riverside. Recall that not many non-minority students are in the bottom quartile of the total SAT score distribution at these campuses (see Table 3). As we move to higher SAT quartiles, the comparative advantage of lower-ranked campuses in graduating non-minority students in the sciences diminishes and then flips, i.e., moving non-minority students in higher SAT quartiles to the lower-ranked campuses would result in losses, not gains, in persistence rates in the sciences. As noted above, non-minority students at UC San Diego were more likely to persist and graduate in the sciences, on average, than if they moved to any other UC campus. We see from Table 11 this holds within each SAT quartile, at least when UC Santa Cruz and UC Riverside are the counterfactual campuses. And, consistent with our more aggregated results in Table 17, non-minority students enrolled at UC Berkeley, UCLA or UC San Diego for each SAT quartile would be *less* likely to graduate overall if they were switched to either of the lower-ranked campuses, regardless of their initial major.

The gains and losses of moving minority students from top- to lower-ranked campuses are found in the bottom three panels of Table 11. As before, the patterns for gains and losses for minority students differ from those for non-minorities, but now we see how they differ by a

Table 10: Estimated Percentages of Minority Students who would Increase their Payoffs to Graduating if they had been at a Different (Counterfactual) UC Campus

Campus Enrolled at:	Counterfactual Campus: UC Berkeley	UCLA	San Diego	Davis	Irvine	Santa Barbara	Santa Cruz	Riverside
Graduating with Science Major, Conditional on Initial Major = Science:								
UC Berkeley	–	94%	97%	100%	100%	100%	77%	100%
UCLA	3%	–	95%	70%	100%	100%	73%	100%
San Diego	1%	3%	–	10%	13%	98%	34%	86%
Davis	0%	52%	92%	–	96%	100%	78%	100%
Irvine	0%	0%	92%	2%	–	100%	71%	97%
Santa Barbara	0%	0%	20%	0%	0%	–	51%	1%
Santa Cruz	3%	7%	20%	9%	12%	36%	–	28%
Riverside	0%	1%	44%	0%	2%	98%	63%	–
Graduating with Any Major, Conditional on Initial Major = Science:								
UC Berkeley	–	0%	8%	0%	68%	8%	39%	28%
UCLA	100%	–	32%	0%	95%	40%	65%	53%
San Diego	96%	73%	–	33%	100%	93%	100%	100%
Davis	100%	100%	86%	–	100%	96%	95%	94%
Irvine	14%	3%	0%	0%	–	0%	43%	22%
Santa Barbara	80%	32%	36%	4%	100%	–	97%	93%
Santa Cruz	19%	9%	0%	2%	31%	3%	–	0%
Riverside	44%	21%	0%	3%	65%	6%	100%	–
Graduating with Any Major, Conditional on Initial Major = Non-Science:								
UC Berkeley	–	0%	9%	0%	65%	26%	50%	32%
UCLA	100%	–	36%	0%	90%	60%	68%	54%
San Diego	98%	75%	–	19%	100%	100%	100%	91%
Davis	100%	100%	93%	–	100%	99%	99%	94%
Irvine	18%	2%	0%	0%	–	0%	58%	33%
Santa Barbara	48%	18%	0%	0%	98%	–	97%	68%
Santa Cruz	23%	11%	0%	0%	32%	3%	–	0%
Riverside	36%	14%	0%	1%	48%	24%	100%	–

Results based on criteria of graduating in 5 years or less.

major of academic preparation. With the exception of switching students from UC San Diego to UC Santa Cruz, minority students in the bottom two SAT quartiles who attended one of the top three campuses would have higher persistence rates in the sciences had they instead attended either lower-ranked campus. Recall from Table 3 that the share of minority students in these bottom two quartiles range from a low of 66.8% (= 34.5% + 32.3%) at UC Berkeley to a high of 77.5% (= 37.1% + 40.4%) UCLA for the top three campuses. UC Riverside seems especially good at graduating minority students in the sciences as minority students from each quartile that were enrolled at any of the top three campuses would have higher net returns to graduating in the sciences if they had enrolled at UC Riverside. In contrast, UC Santa Cruz tends to be better at graduating students overall. Finally, we note that the apparent gains of re-allocating minority students are lower in terms of graduating with any major than they are for graduating in the sciences, again stressing that the match between the school and the student is especially important in the sciences.

This potential for sizeable gains in minorities graduating with science degrees by re-allocating less-prepared students from higher- to lower-ranked campuses raises the obvious question of why these gains are not being realized. That is why are minority students beginning in sciences at selective colleges when their chances of graduating in the sciences would be higher elsewhere? There are at least two potential answers to this questions. First, students may not be maximizing their probabilities of graduating in the sciences when deciding where to enroll. Our results show that while many minority students would see their science graduation probabilities significantly rise by attending a less-selective school, the rise in their overall graduation probability would be much smaller.[27] Second, students may be ill-informed about their success probabilities in various fields. Arcidiacono, Aucejo, Fang, and Spenner (2012) show that affirmative action can result in welfare losses for minority students if universities have private information about how well the student will perform at their school. Both Bettinger et al. (2009) and Hoxby and Avery (2012) show that information may be a serious concern among low income students.

[27] Arcidiacono, Aucejo, Coate and Hotz (2012) examine UC graduation rates before and after Proposition 209, which banned the use of racial preferences in admission. They find that better matching of minority students to schools as a result of Proposition 209 and that it had a positive effect on minority graduation rates, regardless of major, although the effect was small.

Table 11: Estimated Gains (Losses) in 5-Year Graduations Moving from More Selective to Less Selective UC Campuses

SAT Quartile	Berkeley Base Grad Rate	Gain (Loss) from switch to: Santa Cruz	Gain (Loss) from switch to: Riverside	UCLA Base Grad Rate	Gain (Loss) from switch to: Santa Cruz	Gain (Loss) from switch to: Riverside	UCSD Base Grad Rate	Gain (Loss) from switch to: Santa Cruz	Gain (Loss) from switch to: Riverside
Non-Minority:									
Share Graduating in Sciences, Conditional on Initial Major = Science:									
Q1	28.2%	3.2%	9.3%	27.7%	2.0%	7.8%	36.1%	-6.9%	-1.6%
Q2	47.0%	-7.1%	1.9%	42.2%	-5.4%	3.4%	46.7%	-12.3%	-4.4%
Q3	53.9%	-11.9%	-1.0%	48.7%	-9.2%	1.3%	52.0%	-15.1%	-5.9%
Q4	56.5%	-14.0%	-2.0%	52.2%	-11.3%	0.1%	57.3%	-18.0%	-7.4%
Share Graduating with Any Major, Conditional on Initial Major = Science:									
Q1	72.6%	-4.2%	-4.3%	69.4%	-1.0%	-1.2%	70.5%	-3.2%	-3.5%
Q2	79.9%	-6.8%	-5.9%	77.7%	-4.7%	-3.9%	77.0%	-5.4%	-5.0%
Q3	84.4%	-8.1%	-6.8%	81.8%	-6.3%	-5.2%	79.8%	-6.2%	-5.5%
Q4	86.1%	-8.5%	-7.1%	83.9%	-7.0%	-5.7%	82.4%	-6.8%	-5.7%
Share Graduating with Any Major, Conditional on Initial Major = Non-Science:									
Q1	75.4%	-5.1%	-6.8%	71.9%	-1.1%	-2.9%	76.8%	-2.6%	-4.1%
Q2	82.1%	-6.3%	-7.4%	81.3%	-4.1%	-5.3%	81.6%	-3.6%	-4.8%
Q3	86.6%	-6.8%	-7.5%	86.0%	-5.4%	-6.2%	82.5%	-3.8%	-4.9%
Q4	88.8%	-7.0%	-7.5%	87.6%	-5.8%	-6.4%	83.1%	-3.9%	-4.8%
Minority:									
Share Graduating in Sciences, Conditional on Initial Major = Science:									
Q1	11.0%	9.3%	10.1%	16.1%	4.9%	5.6%	22.2%	-0.2%	2.0%
Q2	20.8%	7.5%	11.2%	26.8%	2.2%	6.7%	29.6%	-2.2%	3.2%
Q3	33.6%	2.4%	10.6%	35.2%	-0.6%	6.6%	37.3%	-3.3%	3.3%
Q4	42.9%	-0.8%	8.3%	44.5%	-3.9%	5.8%	45.5%	-5.7%	4.4%
Share Graduating with Any Major, Conditional on Initial Major = Science:									
Q1	58.1%	1.2%	-0.1%	55.3%	3.9%	2.6%	59.4%	3.2%	1.9%
Q2	63.6%	0.1%	-1.0%	63.3%	1.7%	0.6%	63.6%	2.6%	1.6%
Q3	71.1%	-1.6%	-2.3%	68.7%	0.1%	-0.7%	65.4%	2.3%	1.5%
Q4	73.2%	-2.0%	-2.5%	72.7%	-0.9%	-1.5%	70.5%	1.6%	1.1%
Share Graduating with Any Major, Conditional on Initial Major = Non-Science:									
Q1	63.8%	1.7%	0.3%	62.5%	4.1%	2.7%	66.1%	3.1%	1.7%
Q2	70.5%	0.1%	-1.2%	69.4%	2.0%	0.6%	71.2%	2.5%	1.1%
Q3	74.9%	-0.8%	-2.2%	74.9%	0.4%	-1.0%	73.5%	2.2%	0.9%
Q4	77.6%	-1.3%	-2.6%	77.4%	-0.2%	-1.5%	74.1%	2.1%	0.8%

5 Conclusion

Our evidence suggests significant heterogeneity in how campuses produce college graduates in science and non-science fields. The most-selective UC campuses have a comparative advantage in graduating the most academically-prepared students while less selective campuses have a comparative advantage in graduating the least academically-prepared students. Further, some campuses, such as UC San Diego and UC Davis, are particularly good at graduating students in sciences but perform poorly when looking at overall graduation rates.

We find evidence that the match between the college and the student is particularly important in the sciences. Our evidence suggests that, in a period when racial preferences in admissions were strong, minority students were in general over-matched, resulting in low graduation rates in the sciences and a decreased probability of graduating in four years. In contrast, non-minority students are generally well-placed for graduating in the sciences. Policies which lead to a better match between the student and college – at least when the student is interested in the sciences – have the potential to mitigate some of the under-representation of minorities in the sciences.

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A Appendix

Table 12: Classification of Majors at UC Campuses

Science (STEM)	Humanities		Social Science
Aerospace Engineering	American Culture	Naval Architect & Marine En	Anthropology
Biochemistry	Architecture	Nursing	Anthropology-Zoology
Biology	Asian Studies	Performance	Business Administration
Bio-psychology & Cognitive	Creative Writing - Lit	Philosophy	Economics
Cellular & Molecular Biol	Dance	Resid College Lower Div.	Environ Policy & Behavior
Chemical Engineering	Education - Secondary	Spanish	History
Chemistry	Elementary Education	Sport Management & Comm	Organizational Studies
Civil Engineering	English	Theatre	Political Science
Computer Science	Film & Video Studies	Undertermined	Resource Ecology & Managemnt
Electrical Engineering	French		Sociology
Engineering: First Year	General Studies		Women's Studies
General Biology	German		
Industrial & Operations Eng	Graphic Design		
Materials Science & Engin	History of Art		
Mathematics	Individualized Concentrnt		
Mechanical Engineering	Industrial Design		
Microbiology	Japanese		
Movement Science	L S & A Undeclared		
Nuc Eng & Radiol Sciences	Linguistics		
Pharmacy	Music Education		
Statistics	Music Theatre		

Table 13: Unadjusted Shares of Non-Minority Students Graduating in 5 Years with Science or Non-Science Majors, by Campus, SAT Quartile, and Initial Major

Initial Major	SAT Quartile	Berkeley	UCLA	San Diego	Davis	Irvine	Santa Barbara	Santa Cruz	Riverside	All Campuses
Share Graduating with Science Major:										
Science	Q1	25.0%	28.0%	33.7%	31.2%	25.1%	23.8%	22.3%	23.8%	26.4%
	Q2	42.4%	44.2%	45.9%	40.2%	35.5%	32.2%	28.7%	38.8%	38.7%
	Q3	51.0%	49.4%	51.0%	45.0%	39.6%	36.8%	30.0%	44.8%	46.2%
	Q4	59.1%	50.3%	57.7%	51.8%	43.8%	38.0%	33.3%	44.0%	53.5%
Non-Science	Q1	5.1%	5.3%	13.2%	10.8%	5.5%	3.5%	5.2%	7.7%	6.5%
	Q2	5.0%	6.5%	12.1%	11.2%	7.6%	3.8%	6.4%	10.0%	7.6%
	Q3	12.2%	9.9%	15.2%	14.8%	6.8%	5.0%	5.7%	17.3%	10.5%
	Q4	13.2%	11.3%	18.2%	17.7%	8.2%	5.9%	9.3%	14.2%	12.8%
Share Graduating with Non-Science Major:										
Science	Q1	34.6%	36.4%	31.4%	36.2%	34.3%	37.9%	35.5%	30.3%	34.5%
	Q2	41.6%	33.6%	30.3%	34.5%	32.7%	37.2%	34.4%	23.0%	33.4%
	Q3	36.3%	33.6%	27.4%	32.9%	28.2%	33.3%	39.5%	23.6%	31.9%
	Q4	27.3%	32.2%	24.7%	22.4%	29.7%	29.5%	39.2%	33.9%	28.1%
Non-Science	Q1	63.4%	63.9%	63.2%	59.1%	62.7%	68.2%	60.6%	53.6%	61.8%
	Q2	79.0%	75.9%	72.0%	69.5%	63.8%	71.3%	65.5%	54.6%	69.0%
	Q3	74.6%	77.4%	69.3%	64.3%	62.4%	71.1%	62.5%	49.0%	69.4%
	Q4	73.9%	75.4%	63.5%	59.9%	67.6%	69.9%	56.9%	51.7%	69.9%
Share Graduating, Any Major:										
Science	Q1	59.6%	64.5%	65.0%	67.4%	59.4%	61.7%	57.8%	54.1%	60.9%
	Q2	83.9%	77.8%	76.2%	74.8%	68.2%	69.4%	63.1%	61.8%	72.1%
	Q3	87.3%	83.0%	78.4%	77.9%	67.8%	70.1%	69.6%	68.5%	78.0%
	Q4	86.4%	82.5%	82.4%	74.2%	73.4%	67.5%	72.5%	78.0%	81.6%
Non-Science	Q1	68.6%	69.2%	76.4%	69.9%	68.2%	71.7%	65.9%	61.3%	68.3%
	Q2	83.9%	82.4%	84.1%	80.7%	71.5%	75.2%	71.9%	64.6%	76.6%
	Q3	86.9%	87.3%	84.5%	79.2%	69.2%	76.1%	68.2%	66.3%	79.9%
	Q4	87.2%	86.7%	81.7%	77.6%	75.8%	75.7%	66.1%	65.8%	82.7%

Table 14: Unadjusted Shares of Non-Minority Students Graduating in 4 Years with Science or Non-Science Majors, by Campus, SAT Quartile, and Initial Major

Initial Major	SAT Quartile	Berkeley	UCLA	San Diego	Davis	Irvine	Santa Barbara	Santa Cruz	Riverside	Overall
Share Graduating with Science Major:										
Science	Q1	9.6%	14.0%	14.5%	9.2%	10.2%	10.3%	10.7%	11.6%	10.8%
	Q2	26.3%	17.9%	26.1%	16.6%	16.2%	16.9%	17.3%	24.6%	19.3%
	Q3	34.4%	24.4%	29.9%	20.5%	21.0%	21.5%	18.6%	30.0%	25.6%
	Q4	42.4%	28.2%	38.9%	27.6%	31.3%	23.7%	22.9%	35.8%	35.3%
Non-Science	Q1	0.6%	0.0%	4.3%	3.6%	2.3%	1.1%	2.6%	2.6%	2.2%
	Q2	2.2%	2.5%	5.7%	4.4%	2.2%	1.5%	3.1%	5.6%	3.1%
	Q3	7.0%	4.9%	8.6%	6.1%	2.7%	2.0%	2.9%	12.4%	5.3%
	Q4	8.2%	6.4%	10.5%	7.8%	4.1%	2.9%	5.2%	12.5%	7.4%
Share Graduating with Non-Science Major:										
Science	Q1	9.6%	11.2%	12.9%	11.6%	14.0%	15.8%	22.0%	16.3%	14.7%
	Q2	21.8%	13.9%	16.9%	15.8%	11.7%	19.5%	19.4%	11.6%	15.7%
	Q3	19.6%	17.2%	15.1%	14.9%	10.2%	18.8%	27.7%	14.3%	16.5%
	Q4	15.0%	16.5%	14.0%	11.5%	16.1%	17.9%	25.5%	28.9%	15.7%
Non-Science	Q1	34.3%	30.1%	38.0%	25.9%	30.8%	44.7%	41.7%	32.2%	35.3%
	Q2	44.1%	44.0%	48.7%	39.3%	34.6%	46.7%	47.8%	36.5%	42.9%
	Q3	49.7%	52.4%	48.5%	38.2%	33.8%	48.0%	45.5%	29.2%	45.8%
	Q4	52.5%	53.6%	41.7%	38.6%	36.1%	47.5%	41.3%	35.8%	48.4%
Share Graduating, Any Major:										
Science	Q1	19.2%	25.2%	27.4%	20.7%	24.2%	26.1%	32.7%	27.8%	25.4%
	Q2	48.2%	31.8%	43.0%	32.4%	27.9%	36.4%	36.7%	36.2%	35.0%
	Q3	54.0%	41.6%	45.0%	35.4%	31.2%	40.2%	46.2%	44.3%	42.1%
	Q4	57.4%	44.7%	52.9%	39.1%	47.4%	41.6%	48.4%	64.7%	50.9%
Non-Science	Q1	34.9%	30.1%	42.2%	29.4%	33.1%	45.7%	44.3%	34.8%	37.5%
	Q2	46.3%	46.5%	54.4%	43.7%	36.7%	48.2%	51.0%	42.2%	46.0%
	Q3	56.7%	57.3%	57.2%	44.3%	36.4%	50.0%	48.5%	41.6%	51.0%
	Q4	60.7%	60.0%	52.1%	46.5%	40.2%	50.4%	46.5%	48.3%	55.8%

Table 15: Nested Logit Coefficients for Choice of Final Major based on 4-year Graduation Criteria

	Non-Minority		Minority	
	Science	Non-Science	Science	Non-Science
Net Returns Function:				
UCLA	-0.174	-1.657***	0.818	-1.440**
	(0.728)	(0.361)	(1.672)	(0.685)
San Diego	2.368***	-0.299	3.958	-0.492
	(0.595)	(0.327)	(1.641)	(0.742)
Davis	2.006***	-0.506*	2.193	-0.422
	(0.587)	(0.305)	(1.615)	(0.630)
Irvine	1.902***	-0.313	4.129**	0.412
	(0.607)	(0.311)	(1.870)	(0.669)
Santa Barbara	3.517***	0.188	4.632***	0.557
	(0.609)	(0.317)	(1.603)	(0.559)
Santa Cruz	5.079***	1.046***	7.256***	1.453*
	(0.671)	(0.340)	(1.772)	(0.626)
Riverside	3.584***	0.139	5.143***	0.830
	(0.627)	(0.340)	(1.772)	(0.626)
UCLA $\times AI_j$	0.997***	1.404***	0.917***	1.319***
	(0.074)	(0.113)	(0.133)	(0.171)
San Diego $\times AI_j$	0.786***	1.055***	0.709***	1.124***
	(0.055)	(0.093)	(0.121)	(0.202)
Davis $\times AI_j$	0.778***	1.029***	0.828***	0.998***
	(0.054)	(0.088)	(0.123)	(0.168)
Irvine $\times AI_j$	0.803***	1.036***	0.670***	0.916***
	(0.058)	(0.095)	(0.130)	(0.182)
Santa Barbara $\times AI_j$	0.647***	0.970***	0.661***	0.875***
	(0.054)	(0.088)	(0.112)	(0.141)
Santa Cruz $\times AI_j$	0.473***	0.706***	0.472***	0.779***
	(0.057)	(0.090)	(0.101)	(0.119)
Riverside $\times AI_j$	0.670***	0.972***	0.654***	0.858***
	(0.057)	(0.102)	(0.119)	(0.167)
Switching Majors Cost Function:				
UCLA	-0.009		0.133	
	(0.036)		(0.116)	
San Diego	-0.120***		-0.127	
	(0.036)		(0.124)	
Davis	-0.191***		-0.176	
	(0.038)		(0.135)	
Irvine	-0.020		0.186	
	(0.047)		(0.157)	
Santa Barbara	0.086*		0.122	
	(0.047)		(0.136)	
Santa Cruz	-0.184***		-0.056	
	(0.052)		(0.148)	
Riverside	-0.254***		-0.146	
	(0.054)		(0.143)	
Academic Preparation Index Function:				
HS GPA	1.317***	0.618***	1.405***	0.647***
	(0.104)	(0.082)	(0.305)	(0.193)
SAT Math	5.475***	-0.765***	7.404***	-0.466
	(0.371)	(0.158)	(1.040)	(0.329)
SAT Verbal	-0.151	1.405***	1.663*	1.895***
	(0.224)	(0.186)	(0.973)	(0.598)
Nesting parameter				
ρ	0.593***		0.611***	
	(0.052)		(0.160)	

† All campus dummies are measured relative to UC Berkeley (the omitted category). The coefficient on AI for Berkeley is normalized to one.

Table 16: Selection-Adjusted Shares of Non-Minority Students Graduating in 5 Years with Science or Non-Science Majors, by Campus, SAT Quartile, and Initial Major

Initial Major (j^{int})	SAT Quartile	Berkeley	UCLA	San Diego	Davis	Irvine	Santa Barbara	Santa Cruz	Riverside	Diff. in Across-Campus Hetero.†
Share Graduating with Science Major										
Science	Q1	18.0%	20.3%	29.7%	26.3%	24.4%	28.8%	26.7%	30.0%	2.2%
	Q2	30.6%	32.5%	42.1%	38.5%	35.3%	38.9%	33.0%	39.1%	-4.5%
	Q3	41.1%	42.0%	51.3%	47.6%	43.5%	46.1%	37.1%	45.6%	-7.4%
	Q4	50.9%	50.8%	59.3%	55.8%	50.8%	52.4%	40.5%	51.3%	-8.9%
Ave. Diff.‡		-9.2%	-6.6%	-1.5%	0.0%	2.5%	8.9%	5.8%	3.7%	
Non-Science	Q1	2.2%	2.8%	6.5%	6.7%	4.5%	4.1%	7.0%	8.9%	-4.1%
	Q2	3.8%	4.5%	9.7%	10.1%	6.7%	5.7%	8.4%	11.8%	-0.4%
	Q3	6.3%	6.9%	14.1%	14.8%	9.6%	7.8%	10.3%	15.5%	-8.9%
	Q4	10.5%	10.8%	20.6%	21.8%	14.1%	11.0%	12.8%	20.8%	-3.8%
Ave. Diff.‡		-0.7%	1.0%	4.4%	5.2%	5.0%	4.4%	5.9%	6.4%	
Share Graduating with Non-Science Major										
Science	Q1	45.5%	38.8%	33.8%	38.2%	37.6%	35.1%	35.7%	31.6%	3.8%
	Q2	41.1%	36.1%	29.4%	33.6%	34.0%	31.6%	34.7%	28.6%	-4.3%
	Q3	37.2%	34.0%	26.4%	30.3%	31.7%	29.6%	35.1%	27.1%	-4.0%
	Q4	32.5%	31.0%	23.3%	26.8%	29.1%	27.5%	35.2%	25.5%	-4.3%
Ave. Diff.‡		4.1%	1.0%	-0.2%	0.7%	1.9%	-3.5%	-2.0%	0.5%	
Non-Science	Q1	70.3%	64.6%	62.3%	62.8%	64.5%	67.5%	61.0%	57.1%	-0.6%
	Q2	74.1%	69.6%	64.8%	64.9%	67.5%	70.4%	63.9%	58.9%	-4.1%
	Q3	76.0%	72.6%	65.1%	64.7%	68.8%	72.0%	65.8%	59.3%	-5.6%
	Q4	75.6%	73.5%	62.9%	61.9%	68.3%	72.2%	66.7%	58.0%	-3.7%
Ave. Diff.‡		1.3%	-3.1%	-3.2%	0.4%	3.2%	0.4%	3.0%	6.1%	
Share Graduating with Any Major										
Science	Q1	63.5%	59.1%	63.5%	64.5%	62.1%	63.9%	62.4%	61.5%	-4.3%
	Q2	71.7%	68.6%	71.6%	72.0%	69.4%	70.5%	67.7%	67.8%	-8.0%
	Q3	78.2%	76.0%	77.7%	77.9%	75.2%	75.7%	72.1%	72.8%	-6.8%
	Q4	83.4%	81.8%	82.6%	82.6%	79.9%	79.9%	75.7%	76.9%	-4.7%
Ave. Diff.‡		-5.1%	-5.6%	-1.7%	0.7%	4.5%	5.3%	3.7%	4.2%	
Non-Science	Q1	72.5%	67.4%	68.8%	69.5%	69.0%	71.6%	68.0%	66.0%	-3.2%
	Q2	77.9%	74.1%	74.4%	74.9%	74.1%	76.1%	72.3%	70.7%	-6.3%
	Q3	82.3%	79.5%	79.2%	79.5%	78.5%	79.8%	76.0%	74.8%	-8.2%
	Q4	86.2%	84.3%	83.5%	83.7%	82.4%	83.2%	79.5%	78.7%	-7.6%
Ave. Diff.‡		-1.9%	-5.1%	-5.2%	0.0%	4.8%	3.0%	5.9%	8.1%	

† The "difference in across-campus heterogeneity" is the difference, for each SAT quartile, in the coefficients of variation for the selection-adjusted *row* entries and the corresponding unadjusted entries in Table 13.

‡ The "average difference" the average difference between the selection-adjusted *column* entries in this table and the corresponding unadjusted entries from Table 13.

Table 17: Selection-Adjusted Shares of Non-Minority Students Graduating in 4 Years with Science or Non-Science Majors, by Campus, SAT Quartile, and Initial Major

Initial Major (j^{int})	SAT Quartile	Berkeley	UCLA	San Diego	Davis	Irvine	Santa Barbara	Santa Cruz	Riverside	Diff. in Across-Campus Hetero.†
Share Graduating with Science Major										
Science	Q1	5.8%	5.7%	13.2%	8.8%	9.7%	13.8%	14.4%	15.8%	18.6%
	Q2	13.3%	12.3%	22.7%	15.9%	17.6%	21.6%	20.4%	24.7%	1.8%
	Q3	22.3%	20.1%	31.8%	23.3%	25.8%	28.7%	25.4%	32.7%	-5.6%
	Q4	34.1%	30.2%	42.2%	32.2%	35.6%	36.8%	30.9%	41.4%	-9.9%
Ave. Diff.‡		-9.3%	-4.1%	0.1%	1.6%	2.5%	7.1%	5.4%	3.2%	
Non-Science	Q1	0.6%	0.7%	2.6%	1.9%	1.4%	1.6%	3.3%	4.3%	-6.6%
	Q2	1.4%	1.5%	4.5%	3.4%	2.5%	2.5%	4.4%	6.6%	4.7%
	Q3	3.0%	2.9%	7.5%	5.8%	4.4%	3.8%	6.0%	9.9%	-15.7%
	Q4	6.6%	5.7%	12.9%	10.3%	8.0%	6.0%	8.6%	15.5%	-6.9%
Ave. Diff.‡		-0.9%	-0.1%	2.1%	1.9%	2.4%	2.3%	3.6%	2.9%	
Share Graduating with Non-Science Major										
Science	Q1	18.2%	12.1%	14.7%	13.6%	13.8%	14.9%	20.4%	18.5%	
	Q2	18.9%	14.2%	14.9%	14.4%	14.4%	15.4%	20.6%	18.7%	-9.1%
	Q3	18.8%	15.8%	14.8%	15.0%	14.6%	15.9%	21.1%	18.7%	-7.7%
	Q4	17.1%	16.3%	13.9%	14.8%	14.1%	15.8%	21.3%	18.1%	-15.7%
Ave. Diff.‡		1.8%	-0.1%	-0.2%	1.0%	1.2%	-2.5%	-2.8%	0.7%	-17.9%
Non-Science	Q1	38.7%	28.5%	34.4%	28.9%	33.7%	40.5%	41.9%	37.7%	
	Q2	44.9%	36.3%	40.0%	34.2%	39.6%	46.4%	45.9%	42.6%	-4.0%
	Q3	49.4%	42.7%	43.7%	38.1%	44.0%	51.0%	48.7%	45.5%	-1.5%
	Q4	52.6%	48.7%	45.7%	40.9%	47.4%	54.9%	51.0%	46.8%	-10.2%
Ave. Diff.‡		1.3%	-6.0%	-3.3%	0.0%	7.4%	1.5%	2.8%	9.7%	-7.2%
Share Graduating with Any Major										
Science	Q1	24.0%	17.9%	27.9%	22.4%	23.5%	28.7%	34.8%	34.4%	5.4%
	Q2	32.3%	26.6%	37.5%	30.3%	32.0%	37.0%	41.0%	43.4%	-1.4%
	Q3	41.1%	35.8%	46.6%	38.2%	40.4%	44.6%	46.5%	51.4%	-4.6%
	Q4	51.2%	46.5%	56.1%	47.0%	49.7%	52.6%	52.1%	59.5%	-8.7%
Ave. Diff.‡		-7.6%	-4.1%	0.0%	2.6%	3.7%	4.7%	2.6%	3.9%	
Non-Science	Q1	39.4%	29.3%	37.0%	30.9%	35.1%	42.1%	45.1%	42.0%	-2.5%
	Q2	46.3%	37.8%	44.5%	37.6%	42.1%	48.9%	50.3%	49.2%	-0.5%
	Q3	52.4%	45.6%	51.1%	43.9%	48.4%	54.7%	54.8%	55.5%	-7.3%
	Q4	59.2%	54.4%	58.7%	51.2%	55.4%	60.9%	59.6%	62.3%	-7.3%
Ave. Diff.‡		-0.3%	-6.7%	-3.7%	-0.1%	8.7%	3.1%	4.9%	10.5%	

† The "difference in across-campus heterogeneity" is the difference, for each SAT quartile, in the coefficients of variation for the selection-adjusted *row* entries and the corresponding unadjusted entries in Table 14.

‡ The "average difference" the average difference between the selection-adjusted *column* entries in this table and the corresponding unadjusted entries from Table 14.

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