Title:
Simulation Models of the Effects of Race- and Socioeconomic-Based Affirmative Action Policies on Elite College Enrollment Patterns

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Background / Context:
In the wake of the *Fisher* decision, the future of race-based affirmative action remains unclear. The Supreme Court upheld the concept of affirmative action, but issued a challenge to administrators and scholars: In order for affirmative action to remain a viable admissions strategy, they must show "that no workable race-neutral alternatives would produce the educational benefits of diversity" (*Fisher v. the University of Texas*, 2013, p. 11). Because the evaluation of alternative admissions plans has real-world consequences for both students and the postsecondary institutions they attend, this challenge is difficult to meet.

Numerous policies have been proposed and enacted as alternatives. In addition to "Percent Plans" which have been shown to be largely ineffective at increasing racial and ethnic diversity (Bastedo & Jaquette, 2011; Howell, 2010), one potential alternative is class-based affirmative action. Some existing research suggests that class-based affirmative action can at least partly maintain rates of minority enrollment while increasing college access for economically disadvantaged students (Carnevale & Rose, 2004; Gaertner & Hart, 2013; Kahlenberg, 2012). Other research suggests that class is not a sufficiently good proxy for race for class-based policies to be effective at producing substantial racial diversity (Gaertner & Hart, 2013; Reardon & Rhodes, 2011; Reardon, Yun, & Kurlaender, 2006; Kane, 1998, Cancian, 1998).

The creation of racially diverse colleges at all levels of selectivity has proven to be no small task, even with the legal use of race-conscious affirmative action. As evidenced in the postsecondary destinations of the high school class of 2004 (shown in Figure 1), very selective schools (those with Barron's Selectivity rankings of 1, 2 or 3) have many more White, and many fewer Black and Hispanic, students than the population of 18-year-olds overall. However, the trend of decreasing diversity with increasing selectivity is not strictly monotonic: the most selective schools (Barron's 1s) are slightly more diverse than the schools just below them in the selectivity rankings. In these Barron's 1 schools we see suggestive evidence of successful (race-based) affirmative action policies. Given the apparently modest results of explicitly race-based affirmative action, the construction of race-neutral policies that replicate, or even improve upon, these levels of diversity presents a daunting challenge.

Focus of Study:
The goal of our study is to inform the current affirmative action debate with evidence from sophisticated simulation models in which we vary how colleges weigh race and class in the admission decision process. This model is able to take into account many of the complexities and interrelated dynamics of the college admissions process, such as uncertainty over college or student quality, learning over time, and strategic application submission. Results from these models will provide intuition for how different types of admissions preferences would likely affect the racial and socioeconomic composition of colleges.

Research Design:
To understand the effects of different admissions policies, we will use an agent-based-model of the processes of college application, admission, and enrollment. Agent-based models allow us to explore the dynamic interplay of individual student application behaviors and institutional policy changes. By altering the factors that govern students' application behaviors and the policies that schools use to determine student admissions we can use the simulation models to explore the effect of different affirmative action strategies. These simulations do not explain why real-world

enrollment patterns are the way they are, but they do help build intuition about the relative influence of different factors in shaping these patterns.

Our model includes two types of entities: students and colleges. We give each student three attributes: race (White, Black, Hispanic, or Asian), resources, and caliber. Resources represent the socioeconomic capital that a student can tap when engaging in the college application process (e.g. income, parental education, and knowledge of the college application process). Caliber represents the observable markers of academic achievement and potential for future academic success (e.g. grades, SAT scores, and application essay quality) that are valued by colleges in the admissions process. The racial composition of our student cohorts, race-specific distributions of caliber and resources, and race-specific correlations between resources and caliber are specified based on observations of high school seniors in the ELS dataset (i.e. 2004 high school graduates). There are 10,000 simulated students in our model. The only attribute that colleges have is "quality", which operationally represents the average caliber of students enrolled in the school. In the real world, this measure is probably correlated with, but not the same as, the quality of educational experience for students at a given college.

Our model iterates through three stages during each simulated year of its run: application, admission, and enrollment. During the application stage, we introduce a cohort of prospective students who observe (with some uncertainty) the quality of each of the pool of 40 colleges in a given year and select a limited number of colleges to which they apply. In the admission stage, colleges observe the caliber of students in their applicant pools (again, with some uncertainty) and admit the highest caliber students, up to a total number of students that colleges believe will be sufficient to fill their available seats based on yield information from previous years. During this stage, some colleges use affirmative action strategies that take students' race, socioeconomic status, or both into consideration when they evaluate student caliber. In the enrollment stage, students compare the schools to which they have been admitted and enroll in the one which they perceive to be of highest quality. At the end of each simulated year, we store the results of admission and enrollment decisions, and college quality is updated based on the average caliber of students who enrolled in that year. These three stages are repeated in the next year with a new set of 10,000 students and the same set of colleges.

Although our simulations are highly stylized, we do introduce several elements into our model that are intended to mimic real-world college selection and enrollment processes. The first is "noise:" students and colleges imperfectly observe each others' caliber and quality. This represents the presence of idiosyncratic preferences (e.g. a student might be impressed by a college's dormitories or a college might place a premium on talented tuba players) as well as imperfect information. Second, students do not apply to every college, but instead strategically engage in the application process. Using admissions from prior years, students estimate their probability of admission to each college based on their imperfect perception of college quality and their own caliber; in some versions of the model, students take the presence of affirmative action policies at particular colleges into consideration in this estimation. In other versions, we allow colleges to make themselves more attractive to specific sets of potential applicants through targeted recruitment strategies. Using estimated admission probabilities and a utility function based on perceived school quality, students determine the expected utility of applying to each college and select a set of applications that maximizes their expected utility. Finally, we allow students' resource level to influence the college selection process in four ways. First, we use race-specific correlations between resources and caliber when creating each year's cohort of prospective college enrollees. Second, students with more resources submit more applications

than their lower-resource peers. Third, students with higher resources have less noisy information both about college quality and their own caliber relative to other students. And finally, higher resource students are able to enhance their apparent caliber (analogous to engaging in test preparation or other private tutoring, obtaining help writing college essays, or strategically participating in extracurricular activities). We base the strength of these socioeconomic influences on ELS data and empirical testing using a previous version of the model (Reardon et al., 2013). Taken together, noise, strategic application behavior, and socioeconomic influence create patterns of college selection and enrollment that are similar to those in the real world; low-resource students tend to apply to a limited set of lower-quality colleges, while their high-resource counterparts tend to create larger application portfolios with "safeties," "targets," and "reaches" that increase their chances of attending a high-quality college.

In order to examine the influence of affirmative action strategies, we conduct eighteen simulations, each with a different set of affirmative action conditions. In each scenario, we restrict the use of affirmative action strategies to the top 10% of colleges and run our model for 30 years, with our top-tier colleges starting to use affirmative action strategies after a "burn-in" period of 15 years. We base our restriction of affirmative action to "elite" institutions on empirical observation of college admissions in the ELS dataset. We use three racial affirmative action magnitudes (0, 150, and 300). These values are the bumps in perceived caliber that colleges employing affirmative action strategies give to Black and Hispanic students. We use three socioeconomic affirmative action magnitudes (0, 75, and 150). These values are bumps in perceived caliber associated with a decrease of one standard deviation in resources. We run two simulations for every combination of racial and socioeconomic affirmative action magnitude. In the first set, students estimate their admission probabilities using only the difference between their perceptions of their own caliber and college quality. In the second set, students are aware of which colleges employ affirmative action, and take this knowledge and their race and socioeconomic status into consideration when estimating their probabilities of admission to those schools.

In addition to affirmative action strategies, we will also assess the potential of recruitment policies. We will run additional simulations where we allow some colleges to engage in "targeted recruitment." In these simulations, a specified set of schools (e.g. the top 10%) make themselves look more appealing to targeted students by giving recruitment "bumps" of varying size. Students are targeted based on racial minority status, low-income status, or both. These students will have a higher perception of the caliber of recruiting schools and will be more likely to apply. Since low-income students in our model are apt to under apply, this recruitment corrects for some imperfect application behavior and leads to more optimal application sets, and thus better matched enrollment. We will run simulations testing the effects of affirmative action alone, recruitment strategies alone, and affirmative action in conjunction with recruitment.

At the end of each model run, we have highly detailed information of student and college behavior in each year of the simulation. Thus, we are able to examine how affirmative action strategies (and students' awareness of affirmative action) and recruitment strategies influence application behavior, the resulting racial and SES composition of colleges, and the quality of schools that students with different racial and socioeconomic statuses attend.

Findings / Results:

Figures 2 and 3 show the racial and socioeconomic composition, respectively, among schools

that use affirmative action by simulated condition. The three rows of labels at the bottom of the graph describe the affirmative action strategies employed in each model. Figure 2 shows that both race- and class-based affirmative action strategies leads to more racial diversity, though race-based affirmative action is much more effective at creating racially diverse classes. Of the class bumps that we test, none produces a class as racially diverse as even our lowest race bump. Figure 3 shows that the inverse is true: both race- and class-based affirmative action strategies lead to more income diversity, but class-based affirmative action is much more effective. Race bumps alone have very little effect on income diversity. Both figures show that the effects of affirmative action policies are more pronounced when students are aware of which colleges are using affirmative action policies; these results suggest the powerful synergistic potential of affirmative action policies coupled with student information.

Conclusions:

The results of our simulations suggest at least three important patterns. First, our simulations suggest that unless SES-based affirmative action policies use a very large bump, these policies are unlikely to result in the same racial composition in colleges as under current race-based affirmative action policies. Second, our models suggest that socioeconomic affirmative action results in a moderate-to-substantial reduction in the average resources of students enrolled at elite colleges, and are thus effective at increasing socioeconomic diversity. Finally, it is clear that information plays a large, and perhaps previously unrecognized, role in the sorting of minority students into colleges; the application behavior of students responded much more effectively to affirmative action policies when those policies were made explicit to students. This insight has important real-world ramifications. Students may have a vague sense that some schools use affirmative action when choosing which students to admit, but given that even scholars have a hard time quantifying exactly how much of advantage these polices give students, it is unlikely that students are able to use this information as effectively as they are in our models. If colleges use affirmative action policies to encourage a diverse pool of applicants and enrollees, those policies appear to be much more effective when those policies are made public—students respond to additional information that helps them more effectively allocate their applications. While such transparency is politically improbable in today's climate, the importance of information for students should play a larger role in policy conversations.

Appendix A. References

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Appendix B. Tables and Figures

Figure 1

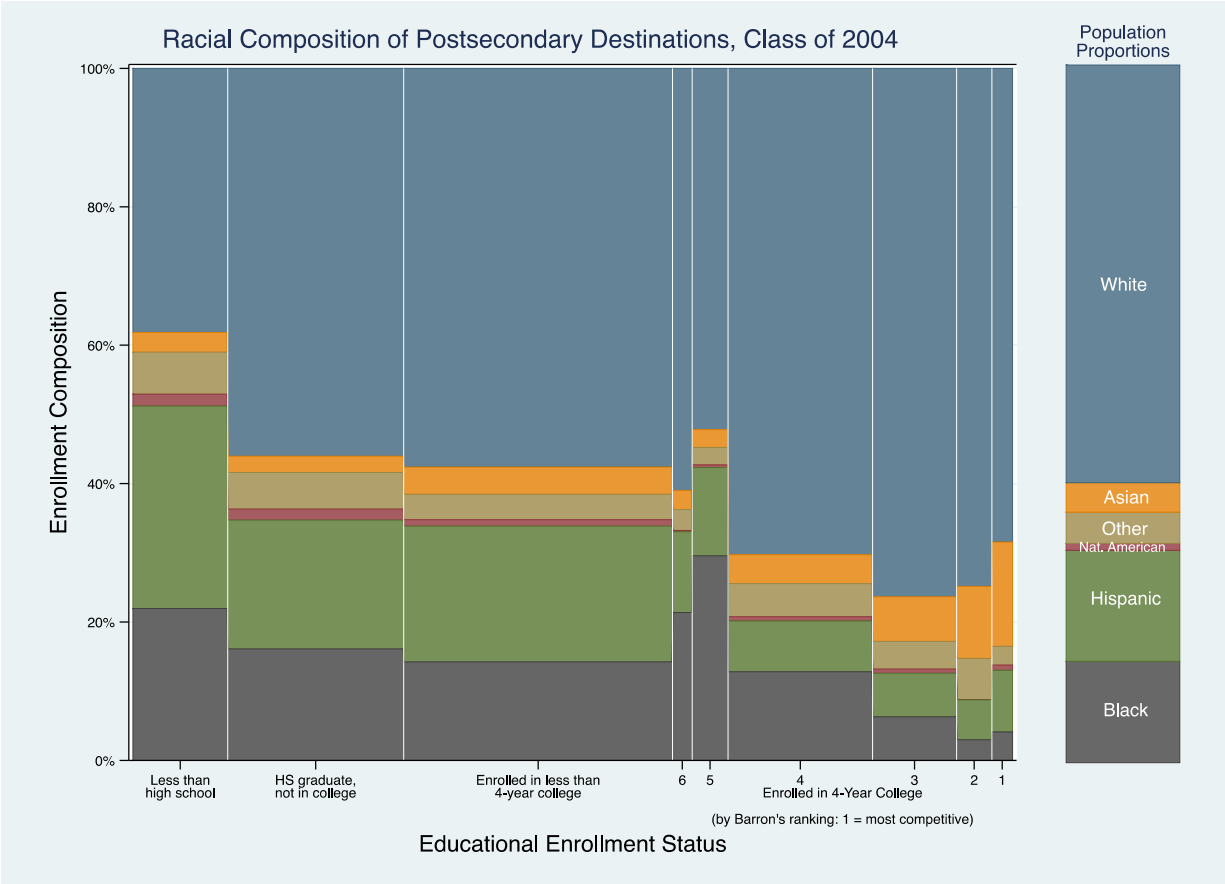


Figure 2

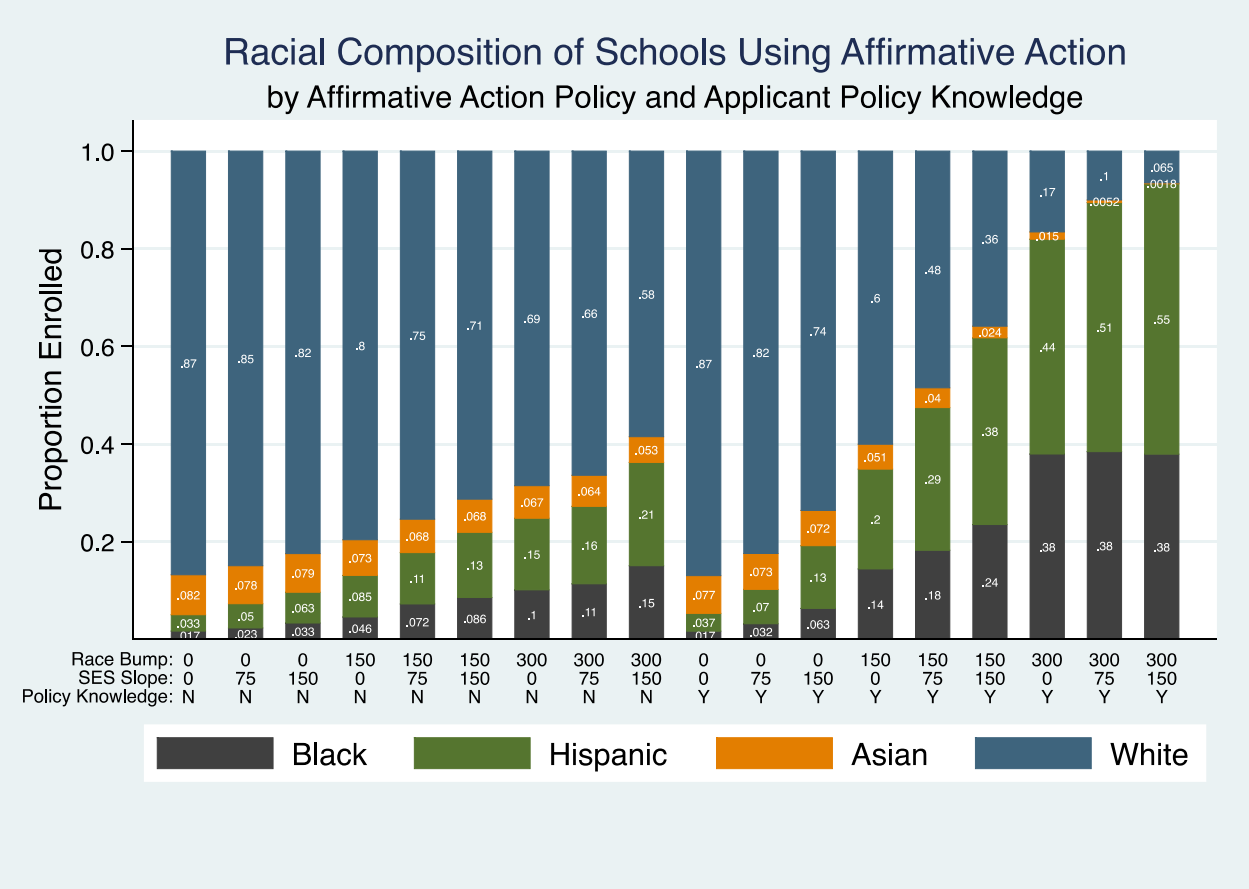
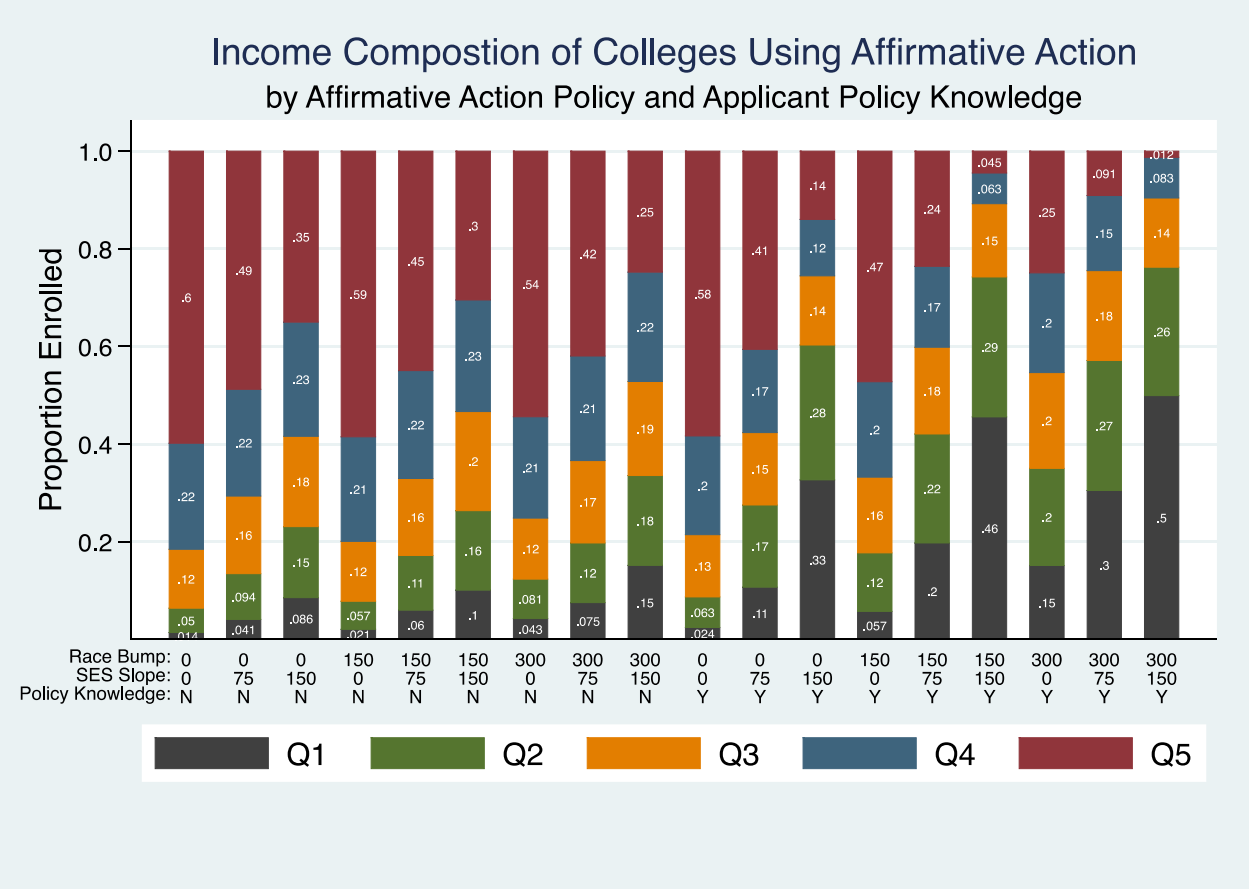

Racial Composition of Schools Using Affirmative Action
by Affirmative Action Policy and Applicant Policy Knowledge
Proportion Enrolled
1.0
0.8
0.6
0.4
0.2
Race Bump: 0 0 0 150 150 150 300 300 300 0 0 0 150 150 150 300 300 300
SES Slope: 0 75 150 0 75 150 0 75 150 0 75 150 0 75 150 0 75 150
Policy Knowledge: N N N N N N N N N Y Y Y Y Y Y Y Y Y
Black
Hispanic
Asian
White

Figure 3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Race Bump: 0 0 0 150 150 150 300 300 300 0 0 150 150 150 300 300 300
SES Slope: 0 75 150 0 75 150 0 75 150 0 75 150 0 75 150 0 75 150
Policy Knowledge: N N N N N N N N N Y Y Y Y Y Y Y Y Y
Q1
Q2
Q3
Q4
Q5