



Using Big Data to Solve Economic and Social Problems

Professor Raj Chetty

Head Section Leader: Gregory Bruich, Ph.D.

Spring 2019



HARVARD
UNIVERSITY



The Causal Effects of Colleges

Causal Effects of Colleges

- Third factor needed to assess effects of higher education system on mobility:
 - Fraction of earnings variation across colleges due to causal effects
- Why does this matter?
 - Suppose differences in earnings outcomes between students at Harvard and another college were purely driven by selection of who gets in
 - Then reducing segregation across colleges would have no impact on mobility
 - But if differences reflect causal effects, changes in admissions policies could have a big impact on mobility

Estimating the Causal Effects of Colleges

- Ideal experiment to estimate each college's causal effect: compare earnings at age 30 after random assignment of students to colleges
- Lacking such an experiment, need to find quasi-experimental variation that effectively allocates comparable students to different colleges
- Challenging problem because one needs one experiment per college
- Example: Zimmerman (2014) estimates causal effects by exploiting admissions cutoffs at Florida International University

Regression Discontinuity Methods

- Zimmerman compares students just above and just below state-level GPA cutoff for admission to the Florida State University System

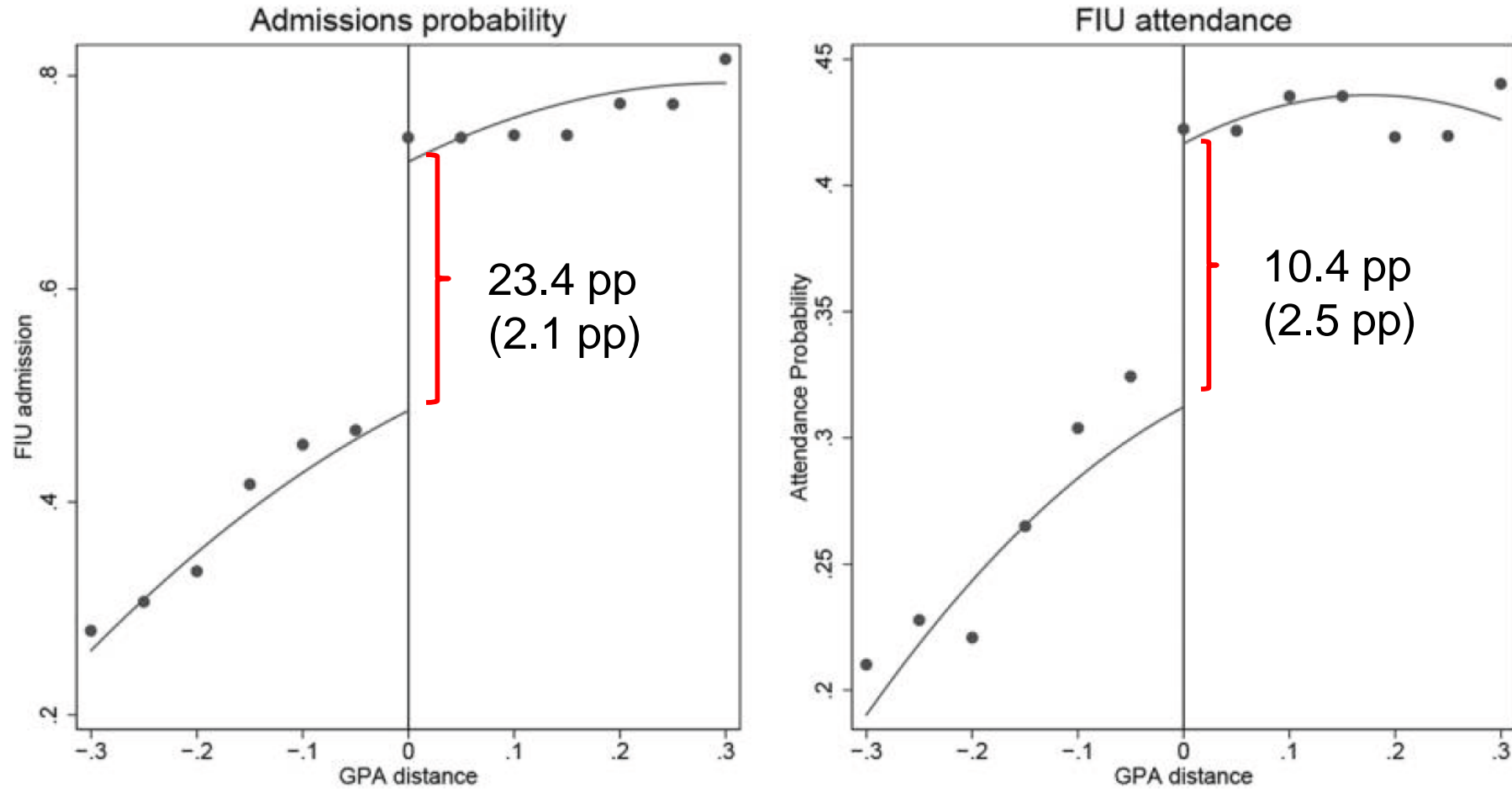
Florida State University System Admissions Rules

SAT	Required GPA	Fraction of Marginal Applicants
1140	2.0	.00
1110	2.1	.00
1090	2.2	.00
1060	2.3	.00
1030	2.4	.01
1010	2.5	.01
1000	2.6	.01
990	2.7	.01
980	2.8	.02
970	2.9	.02
< 970	3.0	.73
Did not take	3.0	.19

SOURCE.—Florida Administrative Rule 6C-6.002.

NOTE.—Sample: marginal applicants are defined as all FIU applicants with FIU-computed GPAs within .3 grade points of their individual-specific cutoff GPA, computed using SAT scores. $N = 6,542$.

Florida International University Admissions and Attendance Rates Around FIU GPA Admissions Cutoffs



Regression Discontinuity Methods

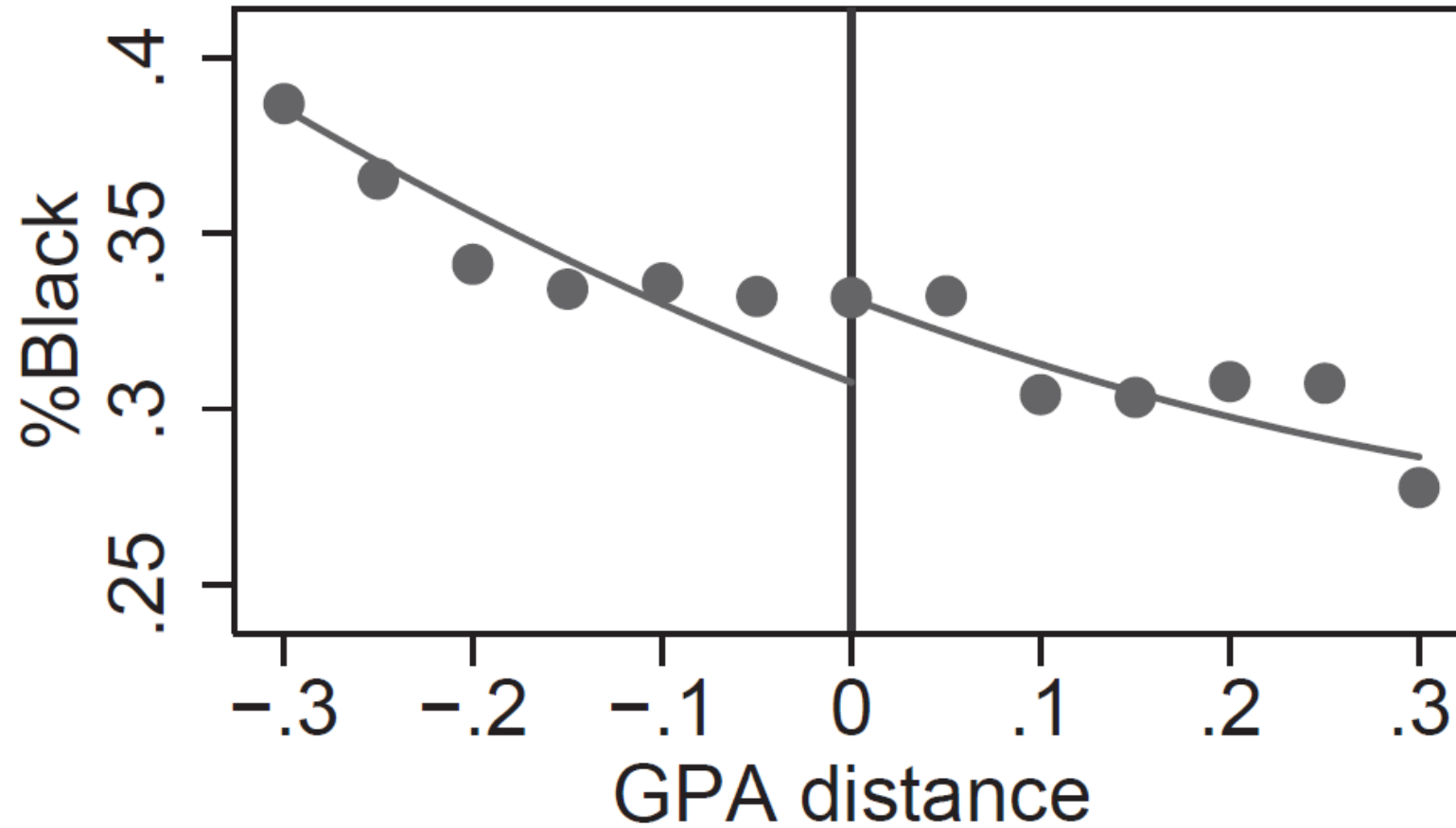
- Zimmerman compares students just above and just below state-level GPA cutoff for admission to the Florida State University System
 - Those with GPA just above cutoff are “treatment” group and those below are “control”
 - Control group typically attends a two-year community college instead of FIU

Regression Discontinuity Methods

- Key identification assumption to estimate causal effects: all other determinants of earnings are balanced on either side of the cutoff
 - Any difference in earnings at the threshold must then be due to the discrete jump in chance of attending FIU instead of community college
- Assumption is plausible because admission threshold was not publicized
 - If cutoffs were well publicized, may worry that students just above cutoff are different from those below (“manipulation” of running variable)
- Evaluate validity of assumption by making sure observable characteristics are similar on both sides of cutoff

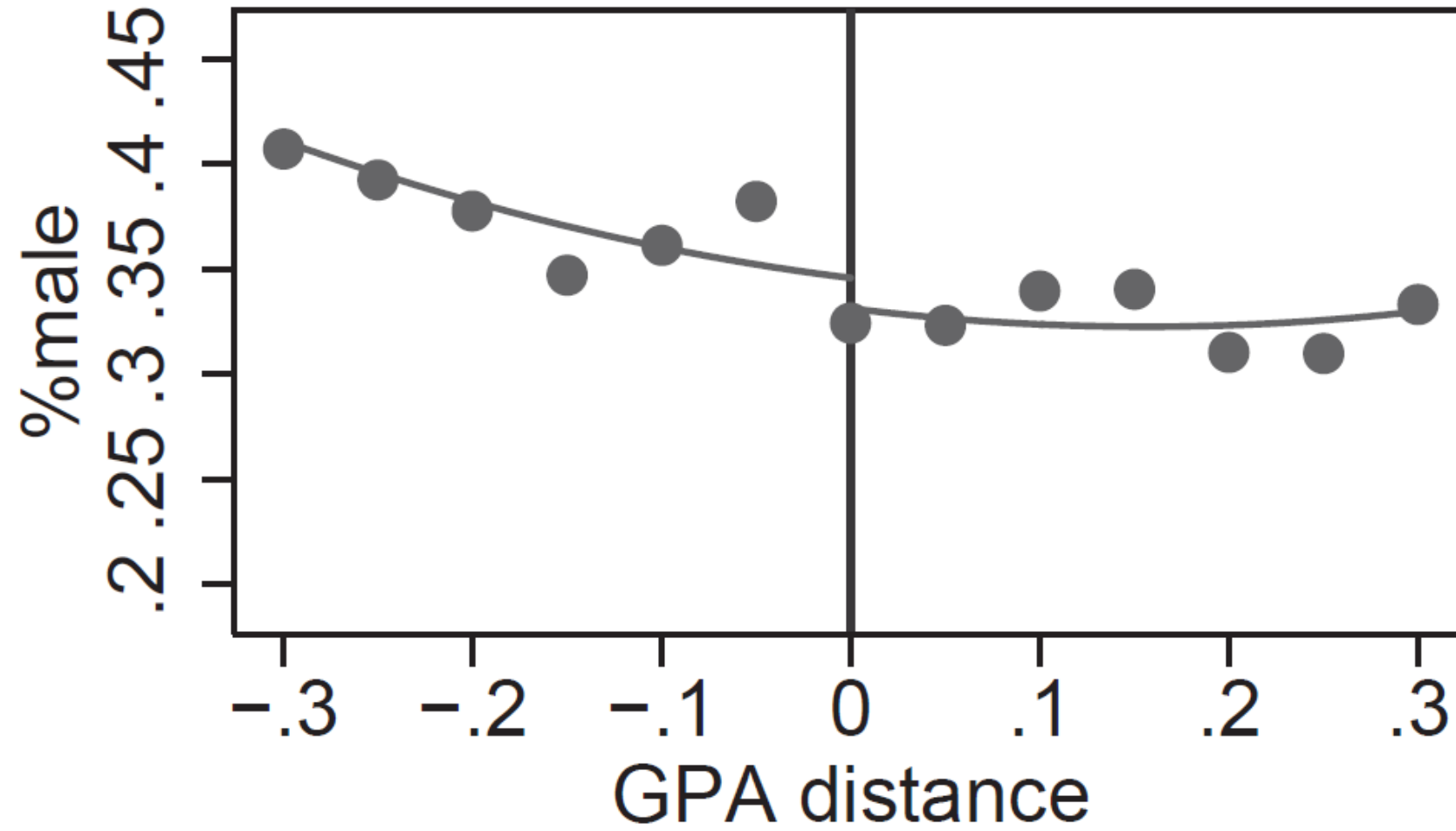
Tests for Covariate Balance Around GPA Admissions Cutoffs

Racial Shares

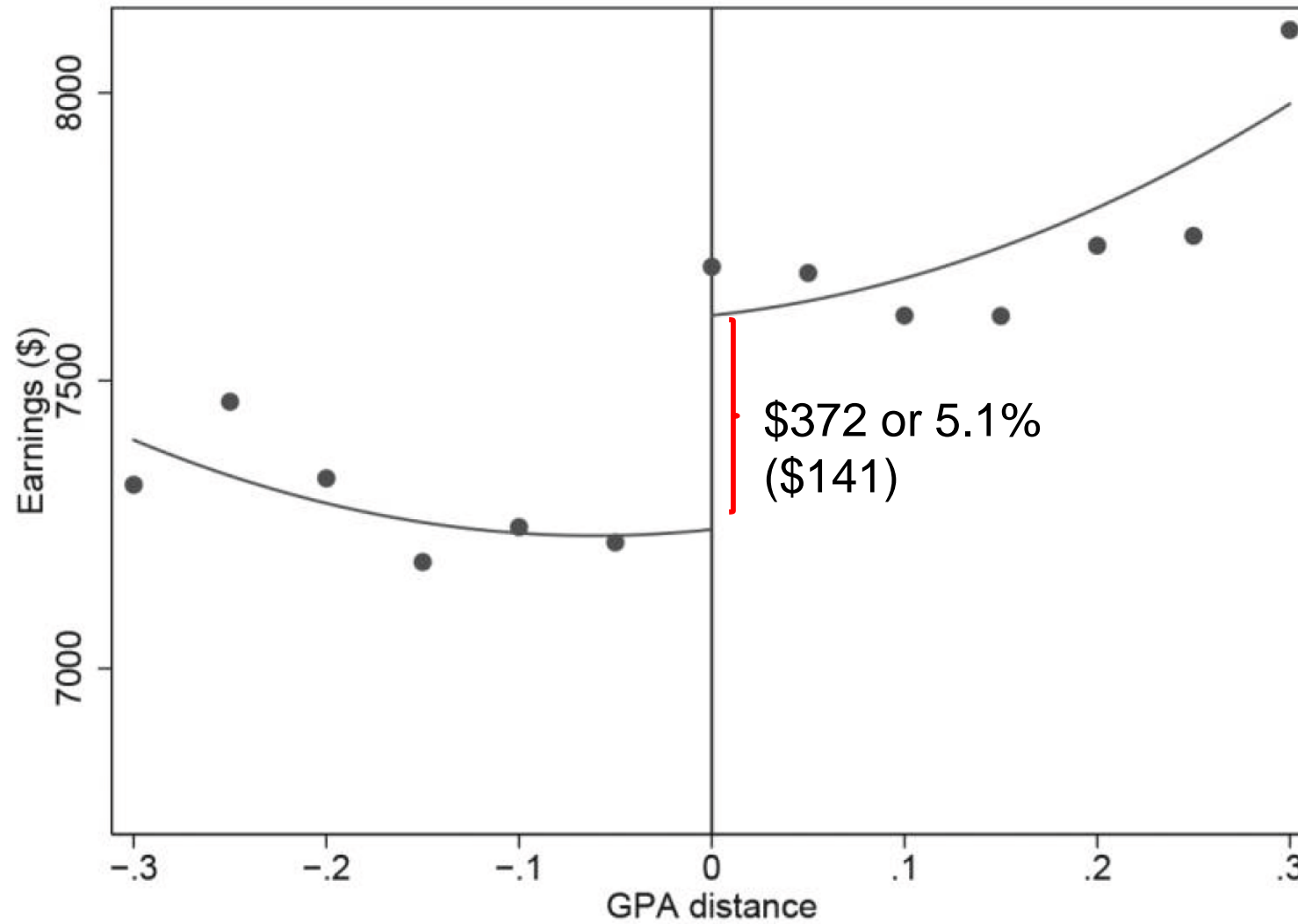


Tests for Covariate Balance Around GPA Admissions Cutoffs

Gender



Mean Quarterly Earnings 8-14 Years after HS Graduation Around FIU GPA Admissions Cutoffs



Causal Effects of Colleges

- Ideally, we would estimate causal effect of *every* college relative to every other college using a method analogous to the one we just discussed
- This is infeasible in practice → use earnings controlling for SAT scores and parent income as an estimate of each college's causal effect
- At least in case of Florida International University, this simple regression estimate matches quasi-experimental estimate
- Therefore use these estimates to gauge portion of variation in earnings that is due to colleges' causal effects when analyzing impacts on mobility

Effects of Higher Education System on Mobility: Counterfactual Simulations

Impact of Higher Education on Mobility

- Combine three sets of estimates (parent income distributions, students' earnings outcomes, causal effects) to analyze impacts of higher education system on mobility
- Focus on how changes in where students go to college (application and admissions) would affect mobility, taking students' earnings outcomes as given
 1. How would changes in application/admissions policies affect degree of income segregation across colleges ?
 2. How would such changes affect overall intergenerational mobility in the U.S.?

Preserving College Selectivity

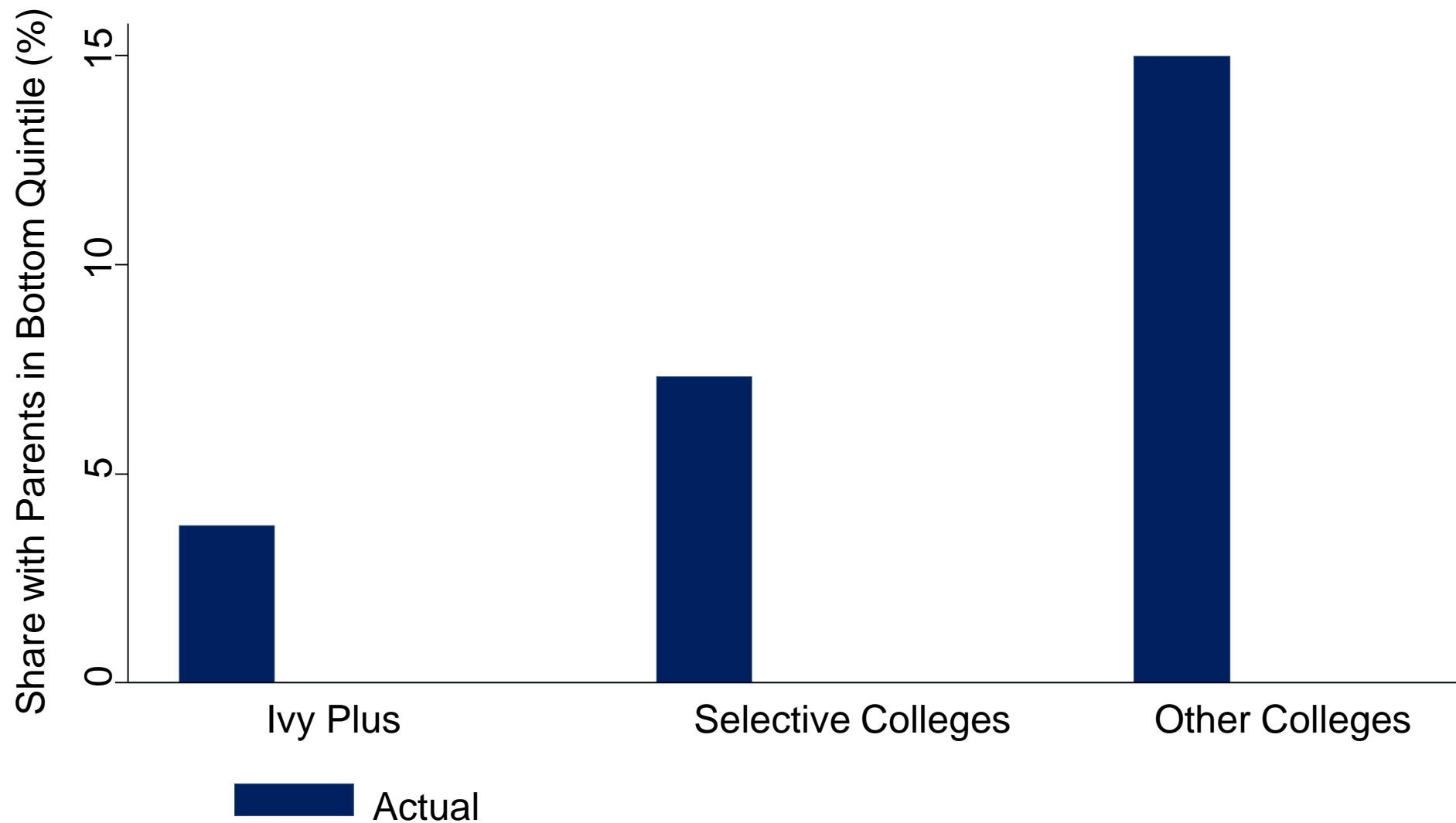
- Consider alternative admissions rules that preserve the **selectivity** of each college
 - Unrealistic to consider counterfactual policies where e.g. Harvard becomes an unselective college
- Use **SAT scores** to proxy for student's qualifications at time of application
 - Imperfect but scalable metric that is highly correlated with other elements of students' records
- Preserve selectivity by maintaining the same distribution of SAT scores at every college while simulating alternative admissions policies

Alternative Admissions Rules

- Consider two alternative admissions rules:
 1. SAT-based admissions: colleges admit and enroll students purely based on their SAT scores, ignoring parent income and all other factors
 - Hypothetical policy that eliminates all differences in application, admission, and enrollment decisions that are influenced by parent income
 - Ex: eliminates any differences that arise from admissions rules that may favor students who can pay full tuition or differences in attendance rates due to costs

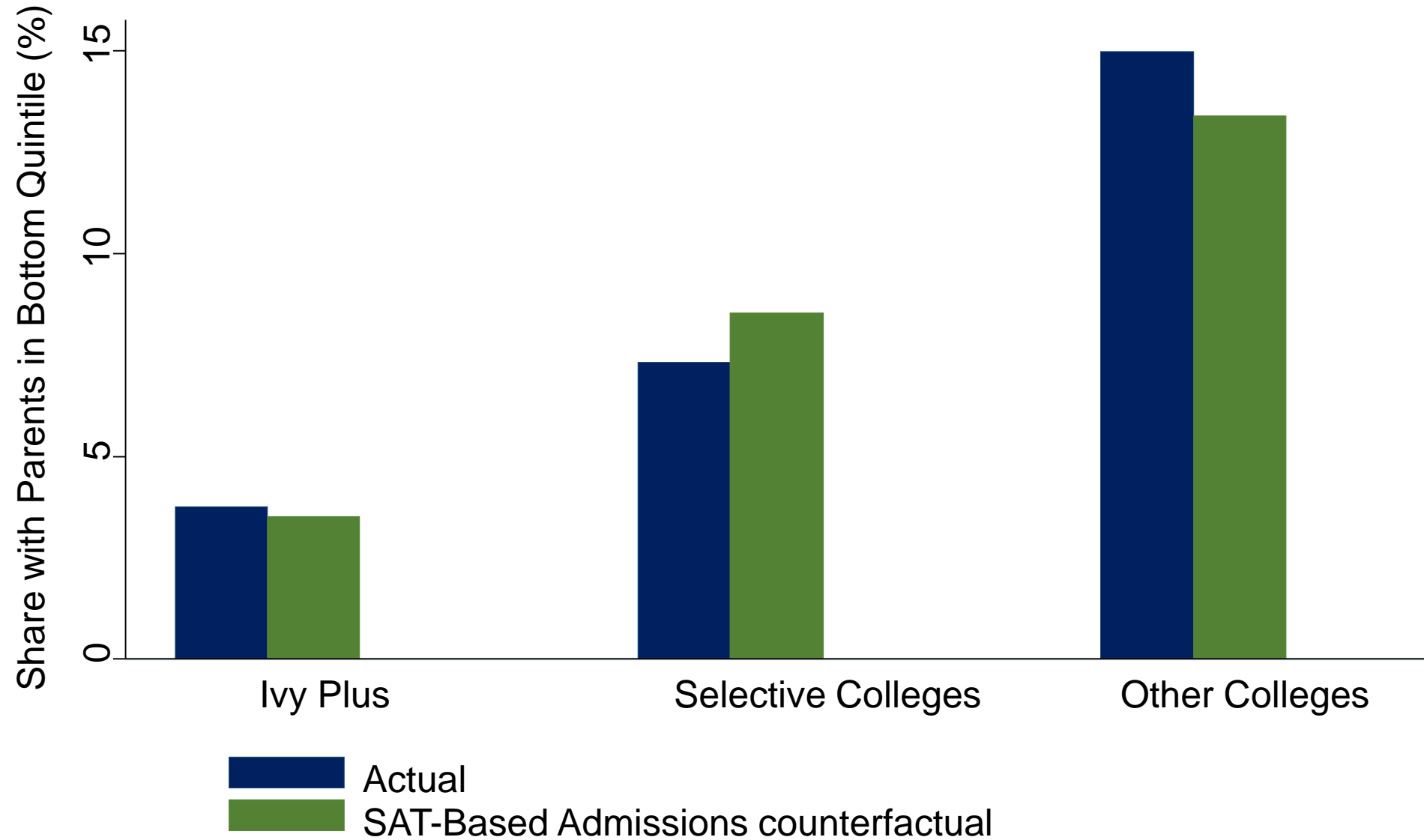
Parental Income Distributions Under Alternative Admissions Rules

Bottom Quintile Shares across College Tiers

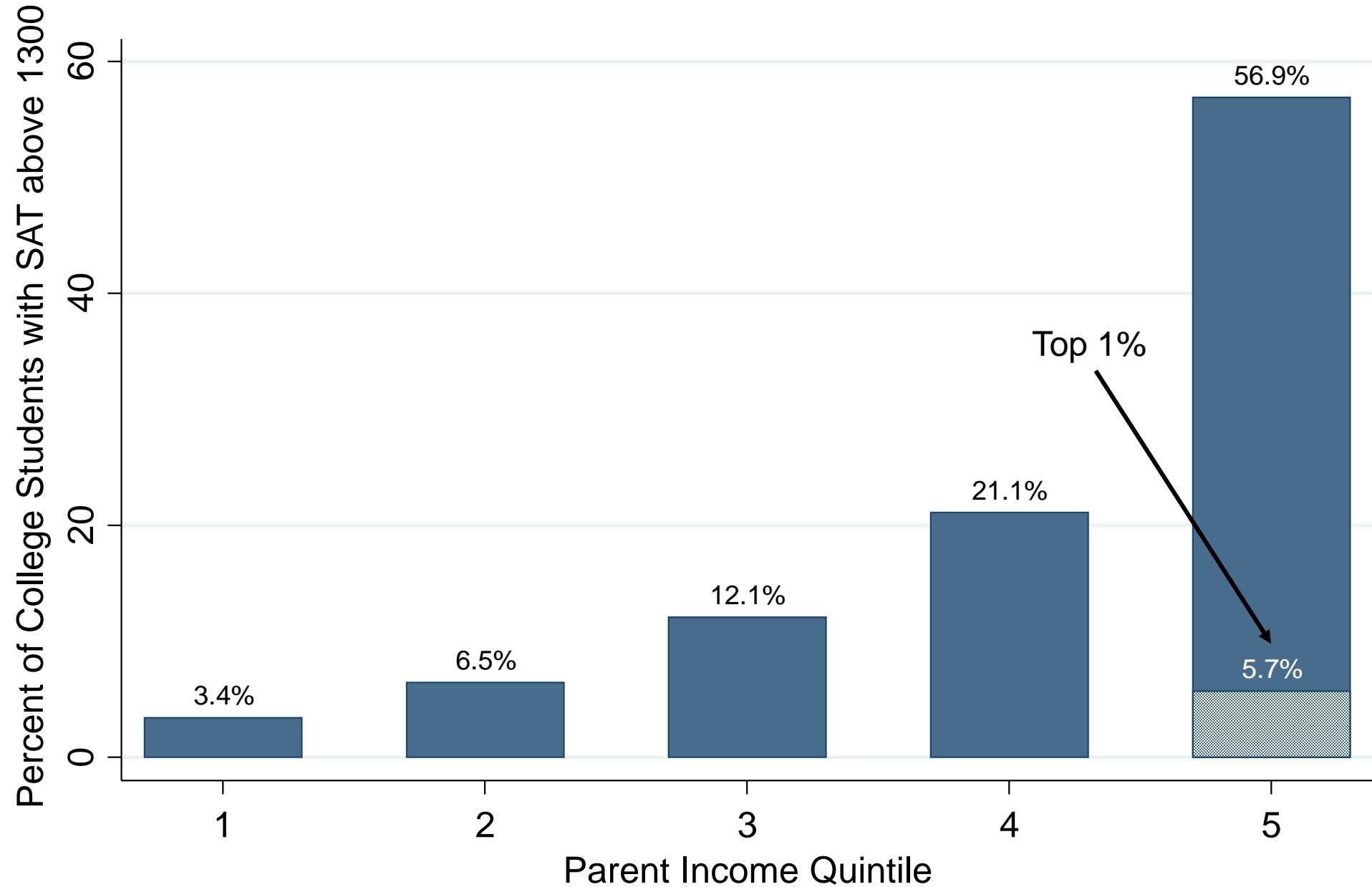


Parental Income Distributions Under Alternative Admissions Rules

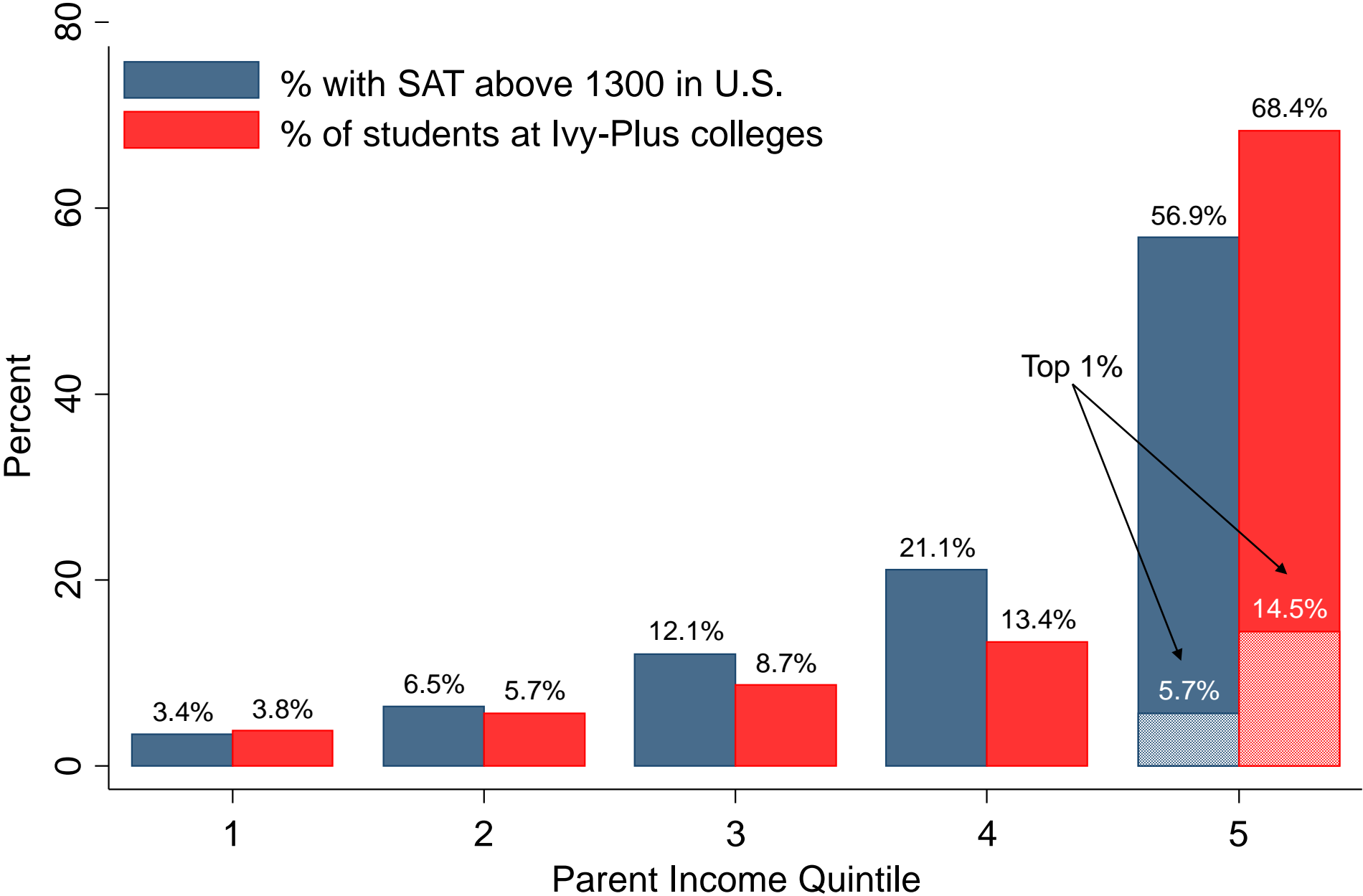
Bottom Quintile Shares across College Tiers



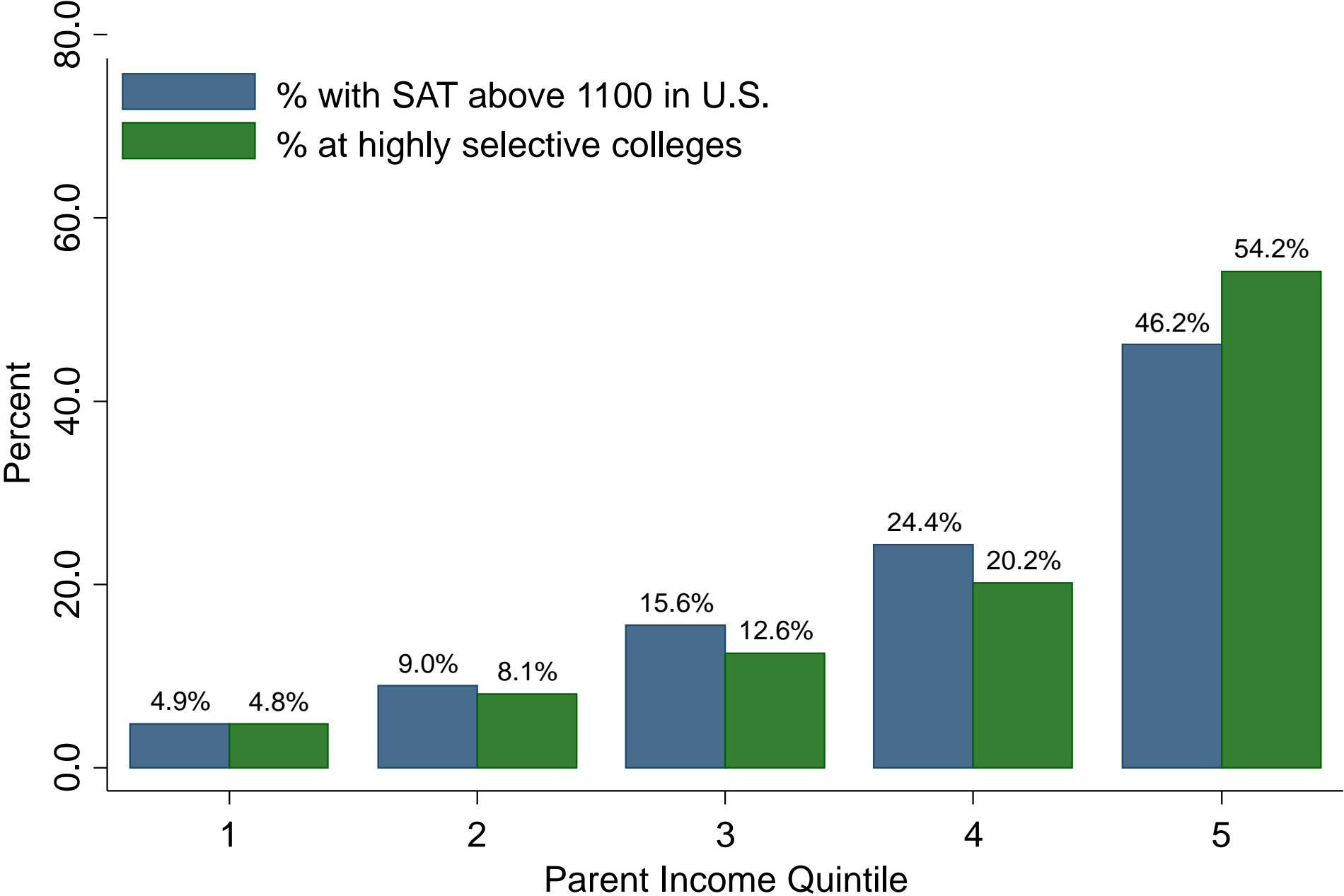
Parental Income Distribution for Children with SAT Scores Above 1300 (Top 7%)



Parental Income Distribution for Children with High SAT Scores
Vs. Students at Ivy-Plus Colleges



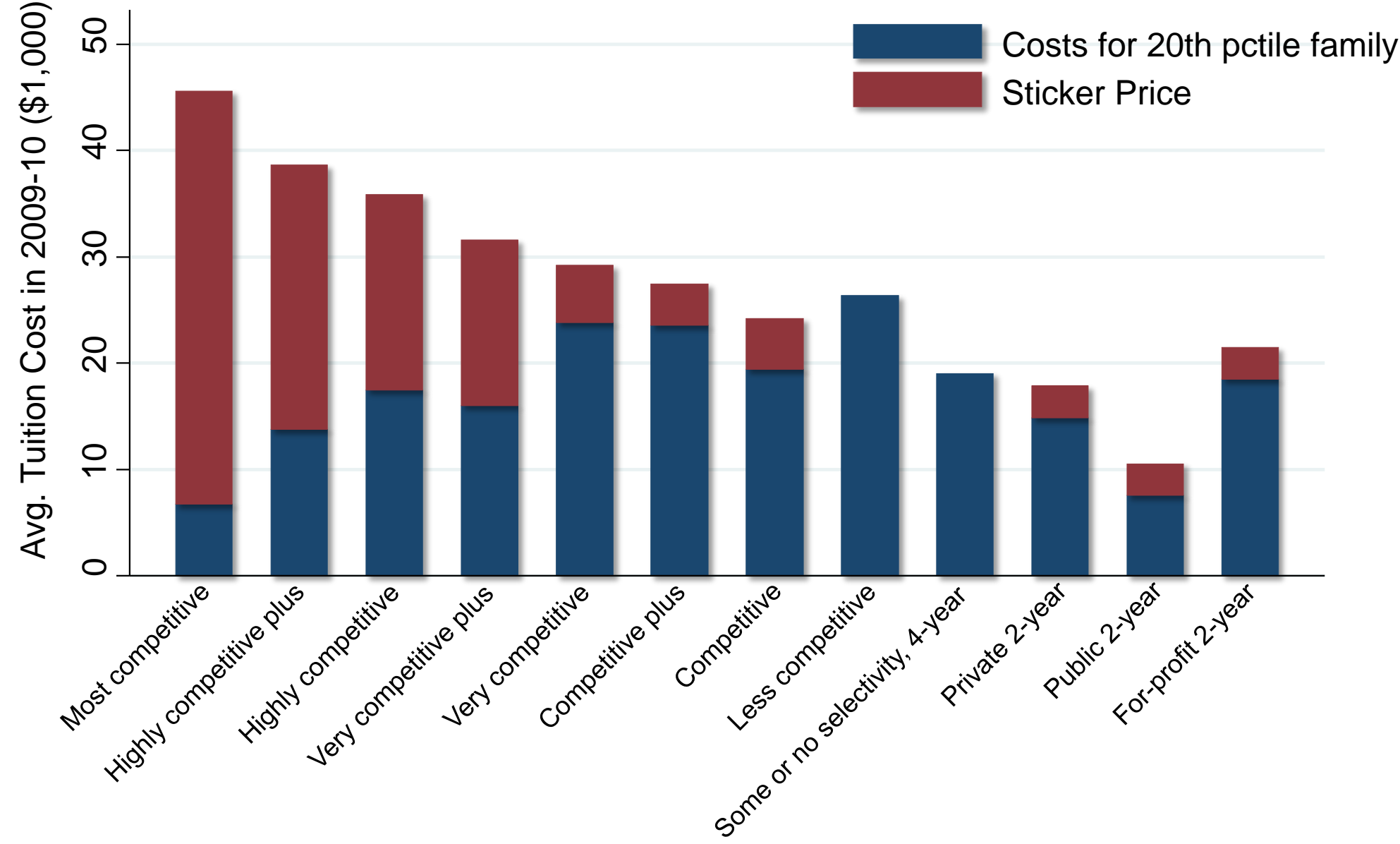
Parental Income Distribution for Children with High SAT Scores
and for Students at Highly Selective Colleges



Increasing Applications from High-Achieving, Low-Income Students

- There is some scope to increase low and middle-income shares at highly selective colleges by admitting and enrolling more high-achieving, lower-income students
- Under-representation of low-income students at these colleges is partly driven by lower **application rates** of well qualified low-income students
- This “undermatching” phenomenon is not simply explained by differences in **costs** of attendance [Hoxby and Avery 2013]

Costs of Attending Colleges by Selectivity Tier for Low-Income Students



University of Michigan HAIL Experiment

- Alternative hypothesis: lack of information or application support for low-income students limits their applications even when tuition cost is low [Hoxby and Turner 2013]
- Dynarski et al. (2018) test this hypothesis in a recent experiment at the University of Michigan that exploits big data for targeting
 - Provide information about applying to U of M to high-achieving ($\text{GPA} > 3.3$, $\text{SAT} > 1100$) students from low-income families (incomes $< \$47\text{K}$)
 - Identify all such students in the state of Michigan using administrative data from schools on GPAs, SAT scores (mandatory in Michigan), and eligibility for free/reduced price lunch
 - 2,000 students meet these criteria each year; 50% randomly assigned to receive treatment of additional information and support

HAIL Scholarship Mailings Sent to Students in the Treatment Group



Source: Dynarski et al. (2018)

Excerpt of HAIL Scholarship Mailings Sent to Parents of Students in the Treatment Group

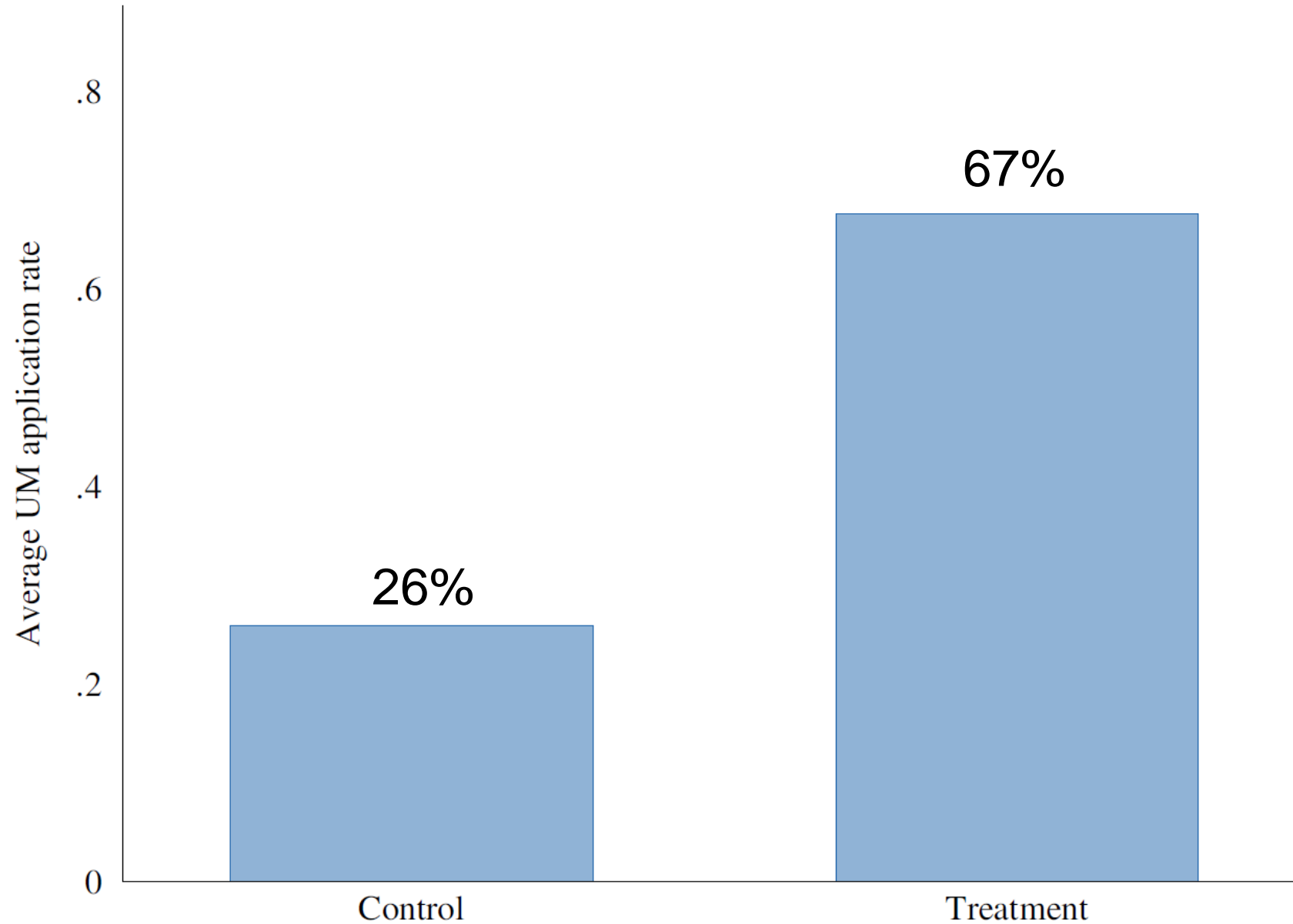
Dear Parent or Guardian of <<first name>> <<last name>>:

Since your child is an excellent student, we want to offer a potentially transformative college opportunity:

If <<first name>> applies and is admitted to the University of Michigan - Ann Arbor, your child will be awarded the HAIL Scholarship covering the entire cost of U-M tuition and fees for four years. This is an offer we are delighted to make, worth approximately \$60,000. Furthermore, after a review of their financial aid applications, your student will likely be eligible for additional aid to cover other costs such as housing and textbooks.

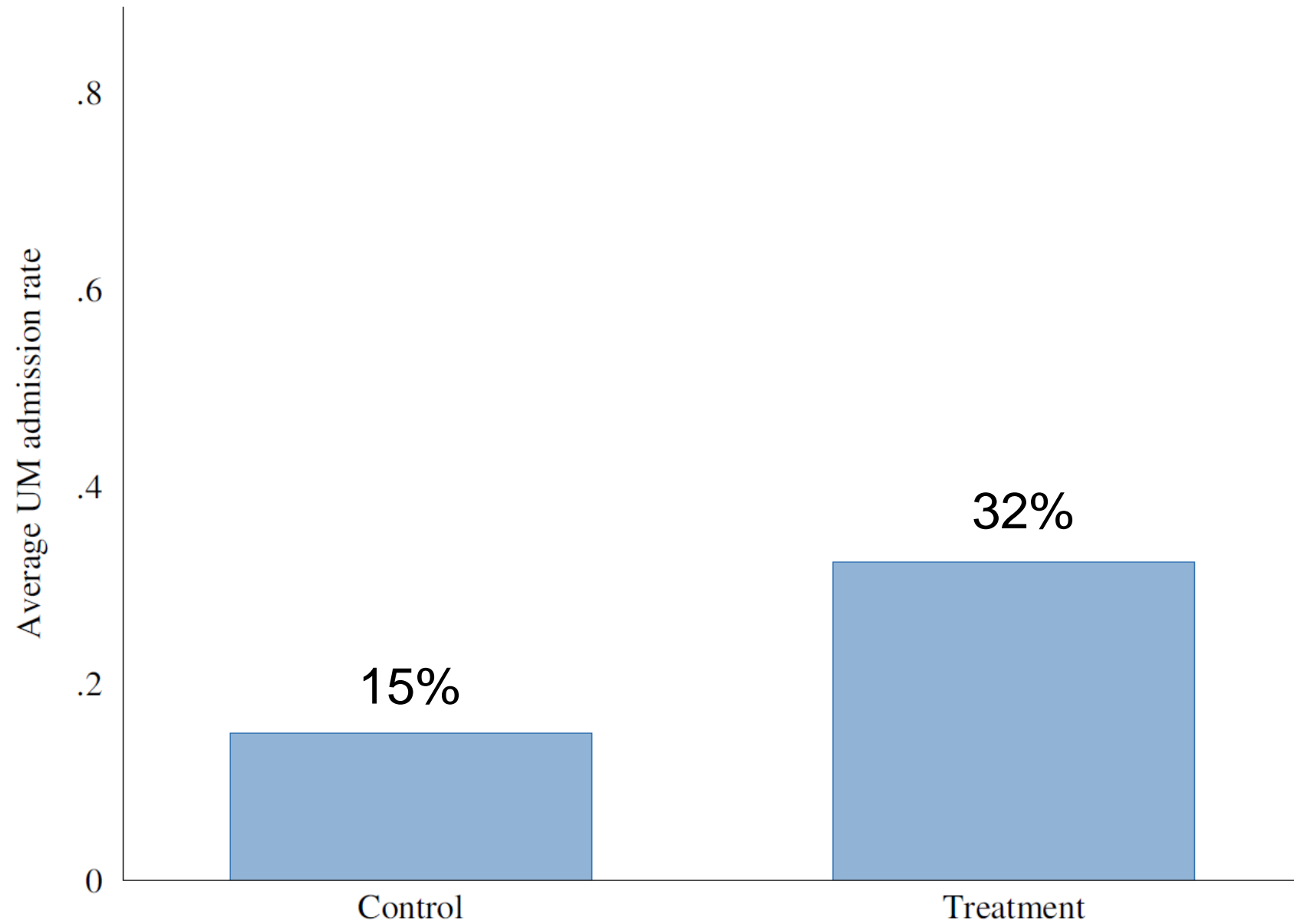
Sincerely,
Kedra Ishop, PhD
Associate Vice President
Office of Enrollment Management

Effect of HAIL Scholarship on Application to University of Michigan



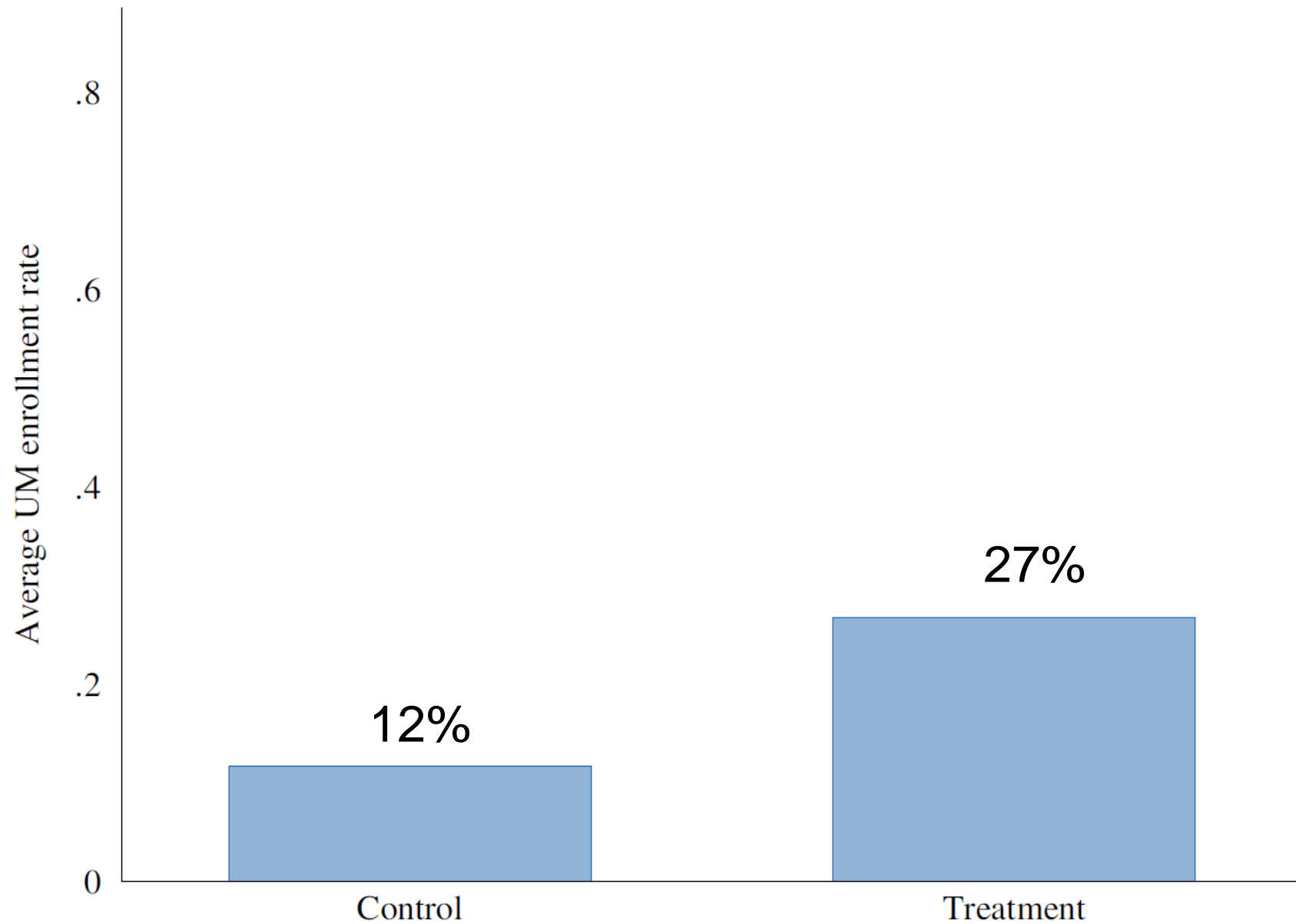
Source: Dynarski et al. (2018)

Effect of HAIL Scholarship on Admission to University of Michigan



Source: Dynarski et al. (2018)

Effect of HAIL Scholarship on Enrollment at University of Michigan



Source: Dynarski et al. (2018)

SAT-Based Admissions: Implications

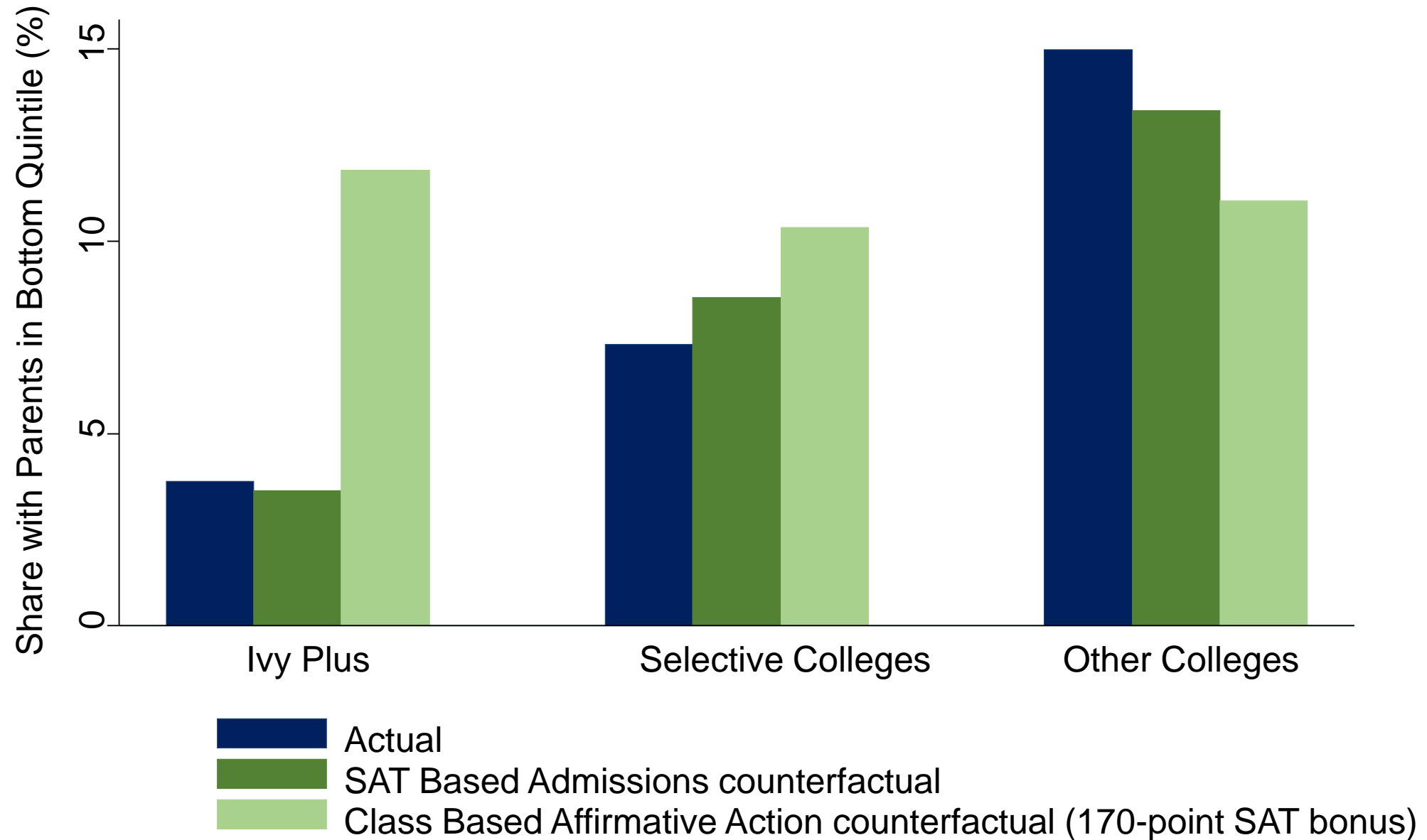
- Main lesson: removing cost and informational barriers for high-achieving, low-income students can increase their access to highly selective colleges appreciably
- But such policies are insufficient to desegregate higher education system by themselves
 - Even shifting to pure SAT-based enrollment would not change low-income shares appreciably at Ivy league institutions

Alternative Admissions Rules

- Consider two alternative admissions rules:
 1. SAT-based admissions: colleges admit students purely based on their SAT scores, ignoring parent income and all other factors
 2. **Class-based affirmative action:** colleges give a SAT test score boost to children from low-income families
 - Implicit boost given to legacy students (whose parents attended the same college) is approximately 170 points at elite private colleges [Espenshade et al. 2004]
 - What is the effect of adding 170 points to SAT scores of low-income students?

Parental Income Distributions Under Alternative Admissions Rules

Bottom Quintile Shares across College Tiers



Class-Based Affirmative Action: Implications

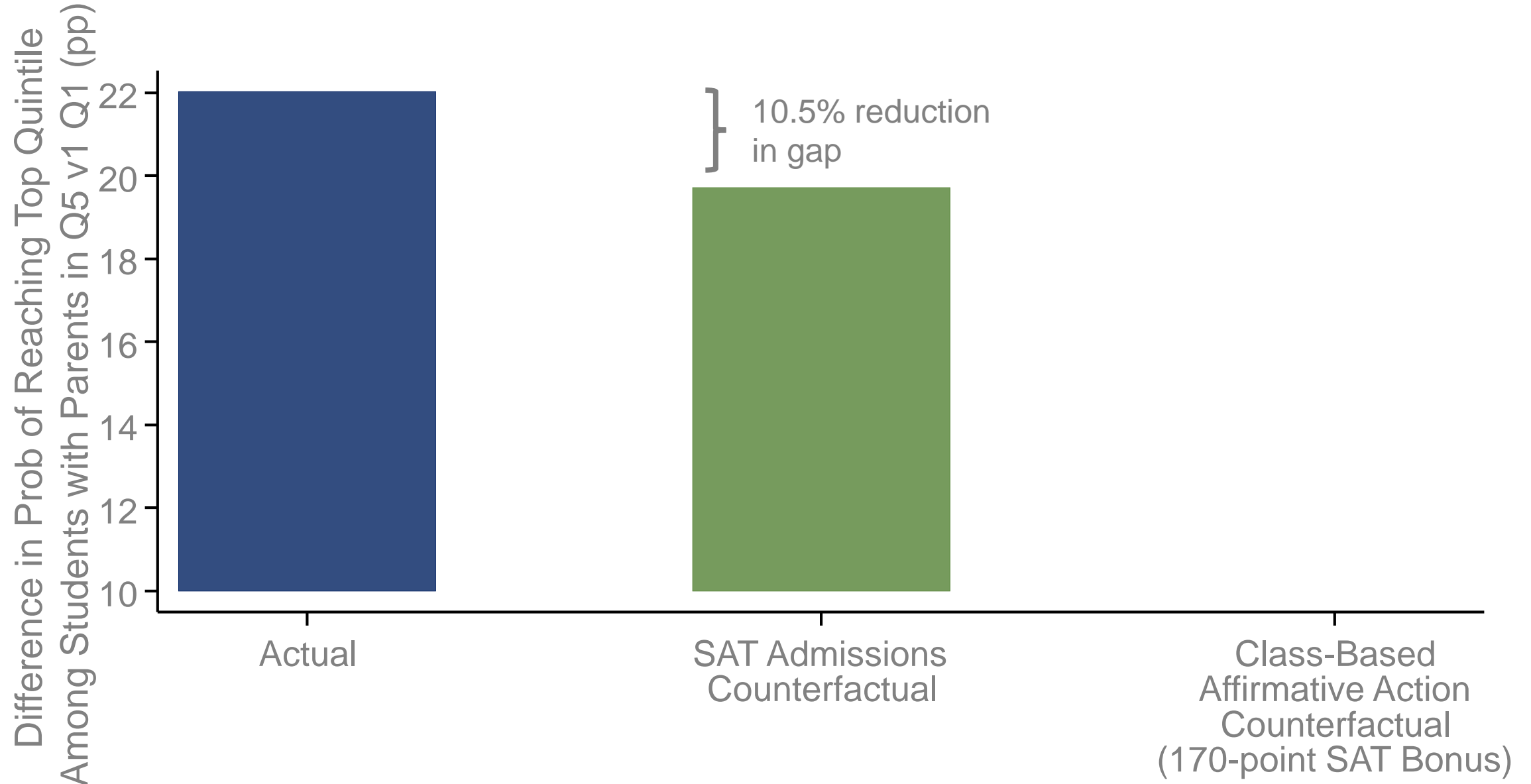
- Class-based affirmative action of a magnitude comparable to the implicit boost given to legacy students would essentially desegregate the higher education system
- But could come at a cost in terms of reducing selectivity and average student performance

Impact of Alternative Admissions Rules on Mobility

- Now analyze impacts of same alternative admissions rules on mobility rates
- Measure “mobility” as difference in chance of reaching top fifth of income distribution for children from families in bottom fifth vs. top fifth
- Important assumption: causal effects of colleges are unaffected by changes in composition of student body

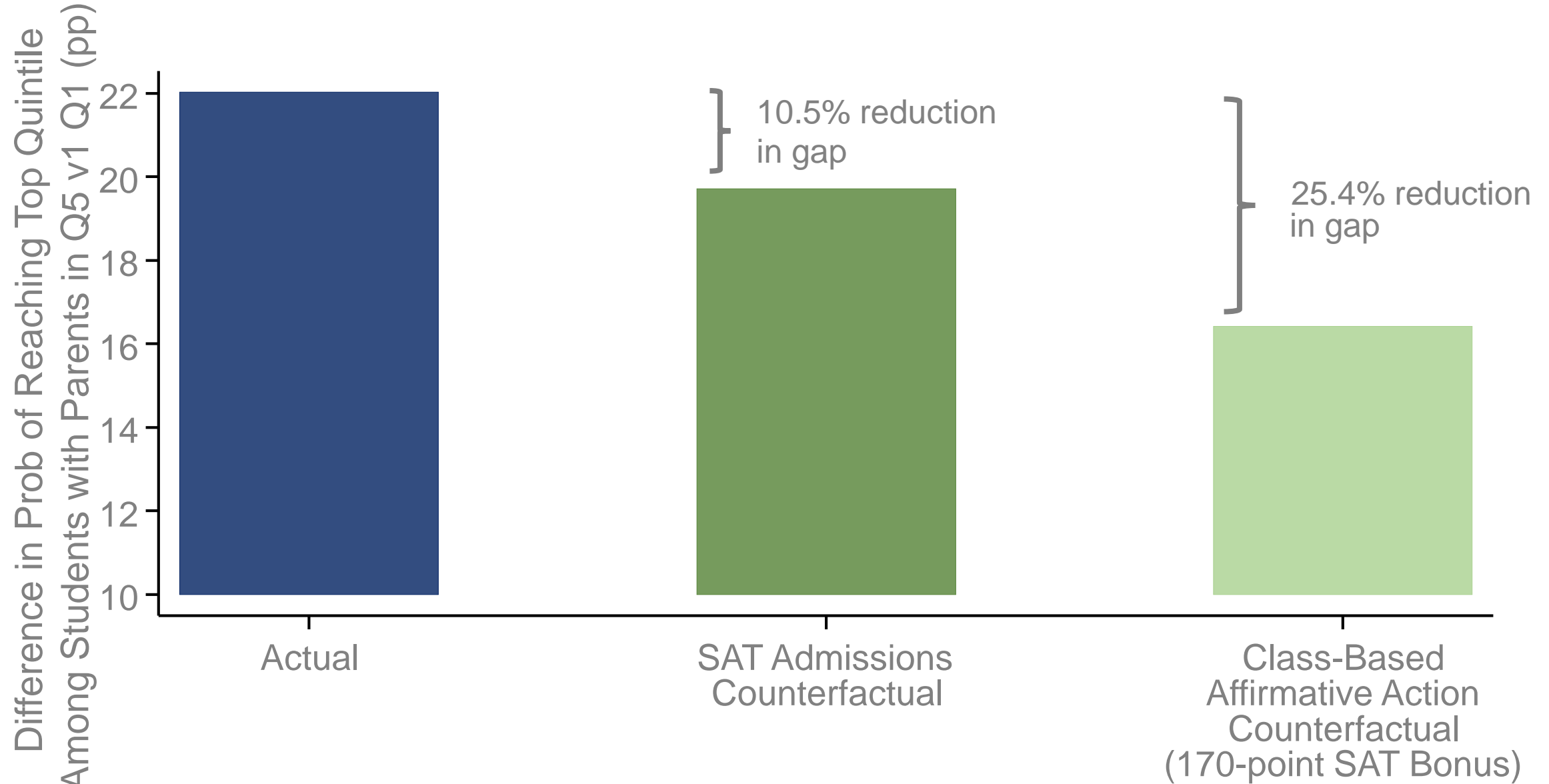
Mobility Rates Under Alternative Admissions Rules

Difference in Chance of Reaching Top Quintile for Students from Low vs. High Income Families



Mobility Rates Under Alternative Admissions Rules

Difference in Chance of Reaching Top Quintile for Students from Low vs. High Income Families



Effects of Higher Education on Mobility: Summary

- Higher education system can play a significant role in increasing social mobility, but requires active effort to undo disparities that emerge before college
- Admissions based purely on academic qualifications (as proxied for by SAT scores) would reduce segregation across colleges, but have little impact at elite colleges
 - Pre-college differences in environment create large gaps in achievement → few students from low-income families have sufficiently strong qualifications to get in to elite colleges
- But colleges can still actively counter these disparities and increase upward-mobility for children from low-income backgrounds if they wish to do so
 - Class-based affirmative action would eliminate income segregation across colleges and increase mobility significantly

Meritocracy vs. Equality of Opportunity in Higher Education

- Unlike other examples we have discussed (e.g., exposure to innovation), there may be a tradeoff between principles of meritocracy and equal opportunity here
- Best (“optimal”) policy therefore may require a value judgement on what colleges’ goals should be
 - Economists typically view such value judgements as outside our field’s domain and leave this to the public to decide