The Power of Commitment: Estimating the Effect of a Tuition-Free Promise on College Choices of High-Achieving, Low-Income Students

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Low-income students are unlikely to attend a selective college, even when they have strong academic credentials. We run a randomized, controlled trial among 4,000 students at 600 high schools to test an intervention to increase application and enrollment of low-income students at University of Michigan, a highly selective university. With the school's admission office, we design and deliver mailings to students, parents, and high school principals. Students are promised four years of tuition and fees if admitted, with no requirement to complete aid applications or pay application fees. We target rising seniors eligible for subsidized school meals whose ACT/SAT scores and GPAs make them plausible candidates for admission. Treated students were more than twice as likely to apply (67 percent vs. 26 percent) and enroll (27 percent vs. 12 percent). The intervention produced an additional 150 low-income enrollments in each cohort. The induced enrollees were diverted from community colleges (4 percentage points), less-selective four-year colleges (7 pp), and non-attendance (4 pp); we see zero diversion from other highly selective colleges. Effects persist into two years of follow-up, with treated students 11 and 14 percentage points more likely to spend two years at any college or a highly selective college, respectively. Student selection and follow-up rely on administrative data, and students were promised no more than expected aid, thereby making the intervention and study quite cheap.

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Gaps in educational attainment between low- and high-income students are large and have grown during recent decades. Among children born in the 1980s, those from the bottom quartile of family income were 50 percentage points less likely to attend college as those from the top quartile. While 54 percent of children born into the top income quartile earned a bachelor's degree, only nine percent of those in the lowest quartile did so (Bailey and Dynarski 2011).

These gaps stem in part from disparities in academic preparation. But research shows that even among high-achieving students there are substantial gaps in college attendance and college quality (Hoxby and Avery 2012). Combined with evidence that college quality increases both educational attainment and earnings (Hoekstra 2009, Dillon and Smith 2017), the under-representation of low-income students at selective institutions plausibly intensifies both educational and income inequality.

Among high-achieving students, it is the application margin that appears to drive income differences in college quality. Hoxby and Avery (2012) find that the vast majority of low-income, high-achieving students do not apply to any selective institutions, even though doing so would likely increase their chances of completing a college degree, lower their costs (Cohodes and Goodman 2014), and increase future wages (Hoekstra 2009; Andrews, Li, and Lovenheim 2016).

We use a randomized, controlled trial to test whether a targeted, personalized outreach campaign among low-income, high-achieving students can affect their college decisions. The intervention, the "HAIL (High Achieving Involved Leader) Scholarship," was designed to address three issues research shows affect college application behavior among low-income, high-achieving students: uncertainty about their suitability for an elite school, over-estimates of the net cost of college, and procedural barriers.

In a personalized mailing, students were encouraged to apply to the University of Michigan (the state's most selective college) and promised four years of free tuition and fees if admitted, with no requirement to complete financial aid forms to trigger this offer. Parents and principals of the eligible students were also notified of this offer.

These students would have been eligible for at least free tuition and fees in the absence of this offer. When we examined the aid packages of similar University of Michigan students we found that 90

percent received full tuition scholarships, while average non-loan aid was over $20,000 (in-state tuition is $14,000). The intervention therefore informed students about aid for which they were already eligible and also minimized their uncertainty and transaction costs by making a four-year, early commitment. Previous studies that have provided *only* information about aid eligibility, with no such commitment, have had zero to small effects on behavior (Bettinger et al. 2012; Bergman, Denning, and Manoli 2017).[1]

Target students were identified using administrative data from the state of Michigan. Rising seniors enrolled in Michigan public schools who are eligible for free- or reduced-price school meals and have sufficiently high scores and grades (described in Section V) comprise the sample. Each year, about two thousand students meet these criteria.

We find very large effects of the HAIL scholarship offer on application and enrollment rates at the University of Michigan and more generally on college choice. The likelihood of application to the University of Michigan more than doubled, from 26 percent among controls to 67 percent among treated students. The share enrolling at any highly selective college also more than doubled, from 12 percent to 27, with all of this effect operating through enrollment at University of Michigan.

One-quarter of the enrollment effect (four percentage points) is driven by students who would not have attended *any* college in the absence of the treatment. The remaining enrollees would have attended a community college or a less selective four-year college. The treatment diverted no students from colleges as or more selective than the University of Michigan – that is, there was no "poaching" from similarly (or more) selective schools.[2]

The magnitudes of these effects are much larger than previous interventions intended to simplify the financial aid process or increase awareness of financial aid among low-income students (Hoxby and

[1] Students were encouraged to complete the Free Application for Federal Student Aid (FAFSA) and PROFILE (a supplementary aid application required by many private colleges and a handful of public colleges) so as to maximize their aid. Admissions staff further prodded any admitted students to do so; at least 95 percent ended up completing these forms in each year. It is plausibly easier to assist students in completing such forms after they have applied, been admitted, and have the support of college staff.

[2] Nor was there any increase in attending other selective schools, which could have occurred if the treatment alerted students that they were plausible applicants for highly selective colleges.

Turner 2013; Bettinger et al. 2012; Bergman, Denning, and Manoli 2017; Goldrick-Rab, Kelchen, Harris, and Benson 2016). Several dimensions of the HAIL intervention plausibly explain the size of its effect.

First, the HAIL Scholarship provides an unconditional promise of four years of free tuition. This commitment may reduce uncertainty to students and parents who may know little about aid and doubt an application is worthwhile. Interventions that provide only information about aid eligibility have generated zero to modest changes in college enrollment (Bettinger et al. 2012; Hoxby and Turner 2013).

Second, the intervention notifies parents and school principals, as well as students, about the offer. We see a sharp increase in online activity at the dedicated, online HAIL portal (by students assigned to treatment) when the parent letter is mailed, indicating that communication to parents increases engagement.[3] We cannot pinpoint why these mailings have this effect. The parent and principal mailings may, for example, change the minds of adults initially doubtful that a student can get into or afford a selective school or inspire already supportive adults to assist students in applying.

Third, the University of Michigan is well recognized in the state and the large, brightly-colored mailing made its source clear. Previous interventions note that mailings in sent plain envelopes or from an unrecognized source were ignored or disregarded as fraudulent (Hoxby and Turner 2013; Goldrick-Rab et al. 2016).

Fourth, the University of Michigan is both the highest quality and (for low-income students) the least expensive four-year college in the state. Its spending per pupil and graduation rate are higher than any other college in the state. Its closest competitor in recruitment is Michigan State University, which does not fully meet students' financial need. In other states, by contrast, the flagship public college may be a worse choice than other alternatives. This could reduce the impact of such a promise on enrollment or produce negative attainment effects. Notably, a targeted scholarship in Massachusetts increased enrollment at public colleges but ultimately reduced graduation rates, since it diverted students from

[3] Parents receive a letter about their child's eligibility a few weeks after the student mailing, which contains personalized login information for the portal. Principal communications, by contrast, occur *before* the student mailing, so we can't track its effect on online activity in the same way.

private alternatives of higher quality (Cohodes and Goodman, 2014). Schools and states considering a HAIL-like intervention should carefully consider students' choice sets.[4]

Finally, we hypothesize that Michigan's universal college testing program contributes to the program's large effect. All students in Michigan's public high schools are required to take the SAT (previously the ACT), which is administered at no cost to students, during school hours, in a student's own school. Research shows that universal testing increases the share of disadvantaged students who take college entrance exams, including many who end up scoring quite high (Hurwitz et al. 2015; Bulman 2015; Hyman 2017). In Michigan, specifically, the introduction of universal testing also increased the share of students attending and graduating college (Hyman 2017). It is plausible that the very students who would not sign up for a college entrance exam are those who would tend to be misinformed about their aid eligibility and suitability for a selective college.

Our results show a low-cost intervention can influence student application and enrollment at selective colleges. The use of state administrative data allowed for narrow, accurate targeting of the intervention at low cost. Low-income students were identified using information about their eligibility for reduced-price meals, rather than the self-reported income used by most colleges (and interventions) to identify disadvantaged students.[5] Previous research indicates students are inaccurate in these self-reports and that, more generally, administrative data can be more accurate than surveys (Moore et al. 2000; Meyer, Mok, and Sullivan 2015) It is plausible that the students who would skip or incorrectly answer a question about family income on a survey are those who tend to be misinformed about their aid eligibility.[6]

[4] One option is to have a *set* of selective schools jointly make the tuition offer.
[5] Colleges and outreach programs sometimes use neighborhood characteristics, such as median income, to target students for recruitment.
[6] A similar point applies to grade-point average; we calculate this using state administrative data rather than rely on the self-reported information in the entrance-exam surveys.

In ongoing work, we track the effects of the intervention on college major, persistence, and graduation. In the long term, we hope to examine the effect of the program on earnings and other measures of well-being.

II. Background

Income Gaps in College Quality and Why They Matter

There are two well-studied dimensions of socioeconomic differences in college attendance: differences in *whether* students of different groups go to college and, conditional on attending some college, differences in *where* they go. The first gap is well known and long-standing; we focus our discussion on differences in where low-income and higher-income students attend college.

Low-income students are less likely to attend more selective institutions compared to their higher-income peers. The mostly highly selective institutions in the country have fewer students from the entire bottom half of the income distribution than from families in the top 1 percent of the income distribution (Chetty et al. 2017).[7]

Undermatching, when students attend institutions with average test scores significantly below their own, accounts for some of this gap in college selectivity. Previous work finds that only 38 percent of Chicago Public Schools students who qualified for very selective colleges[8] attended them (Roderick, Coca, and Nagaoka, 2011). This has been corroborated by others (Bowen, Chingos, and McPherson 2009; Smith, Pender and Howell 2013). These studies find that undermatching is substantially more common among low-income students.

Differences in college applications between low- and high-income students explains much of undermatching (Dillon and Smith 2016). Using the entire population of high school students from the top

[7] The authors refer to these institutions as the "Ivy Plus" and include the eight Ivy League schools plus MIT, Stanford, Duke, and the University of Chicago.

[8] Barron's produces a college ranking system that ranks schools from "least competitive" to "most competitive" based on a combination of average GPA, SAT scores, and acceptance rates. "Very competitive" combines the top two categories (highly competitive and most competitive). The University of Michigan, for instance, is in the "highly competitive" category.

10 percent of SAT and ACT test-takers, Hoxby and Avery (2012) show that over half of low-income, high-scoring students don't apply to *any* school with typical scores as high as (or even close to) their own.

As in the US, in Michigan there are large differences in college enrollment between low- and higher-income students. Among students whose academic achievement makes them plausible candidates for University of Michigan, low-income students are four percentage points less likely to attend *any* postsecondary institution than their similarly-qualified, higher-income peers (see Figure 1). And gaps in college selectivity are yet wider than gaps in college attendance: low-income students are 8 percentage points less likely to attend a highly selective (e.g. the University of Michigan) or most selective institution.

[Figure 1 about here]

More selective institutions typically often offer more aid for low-income students, making them cheaper than less selective schools. Students from Michigan families with incomes between $30,000 and $48,000 pay $6,600 out-of-pocket to attend the University of Michigan, compared to $11,900 at Michigan State University and$10,800 at Eastern Michigan University. Only a community college is, at $4,000, a cheaper option than the University of Michigan.

Graduation rates and average salaries in adulthood rise with college selectivity. As we discuss later, research indicates that at least part of this relationship is causal. The University of Michigan has a 90 percent graduation rate (within six years) and an average alumni salary of $60,000 (within ten years of attendance). By contrast, the relevant statistics at nearby Eastern Michigan University are 38 percent and $37,500 (see Table 1).

[Table 1 about here]

Interventions to Reduce Income Gaps in College Choices

Deming & Dynarski (2009) and Dynarski & Scott-Clayton (2013) review evidence on the effect of financial aid on college attendance, while Page and Scott-Clayton (2016) review interventions that operate through informational and behavioral channels.

Researchers have tested the effect of providing students with information about schools that match their achievement, as well as the net cost of those schools. Hoxby and Turner (2014) show that a relatively light-touch intervention informing students of both their qualifications and the cost of attendance increased a student's likelihood of applying to and attending a selective college that matches their qualifications. Sample students scored in the top 10 percent of the ACT or SAT and bottom third of the income. Students received information about colleges that matched their qualifications, including detailed information about how to apply, and expected financial aid. The intervention led to a 12 percentage point increase in applications, and a five percentage point increase in enrollment, at selective schools that matched the qualifications of these high-achieving students.[9]

Carrell and Sacerdote (2017) found that a program that assisted low-income students in choosing and applying to college increased attendance of women by 15 percentage points, with much smaller effects for men. A strand of research investigates the effect of simplifying or assisting with the financial aid application (e.g. Bettinger et al. 2012; Castleman and Page 2016). Bettinger et al. (2012) found that assistance with federal aid forms increases the likelihood of completing two years of college by eight percentage points but that information alone, even if highly personalized, had zero effect.

III. Intervention

Together with administrators at the University of Michigan, we designed the HAIL scholarship as a low-cost way of delivering a commitment to low-income, high-achieving students across the state. The state of Michigan is large, with 1000 public high schools, many in rural areas. HAIL was designed to personally reach out to such students in a cost-effective manner (each packet cost less than $10 to produce and deliver). The message had several goals: simplify the process of applying for financial aid; provide a

[9] Providing students with information about the returns to college has also found success in other evaluations (Oreopoulous and Dunn 2012; College Board 2012).

four-year guarantee of aid; and provide students with a message that they can succeed at an elite school like the University of Michigan.

Students in the treatment group received personally-addressed packets at their homes in the first week of September of their senior year of high school.[10] Graphic designers at the University of Michigan created the materials to be large and noticeable, reducing the likelihood that students would discard the packets without opening them. The packets were roughly 9 inches by 12 inches, and brightly-colored with the university's maize and blue branding (see Appendix B).

Inside the packet, a letter from the president of the University of Michigan encouraged the student to apply and offered a promise of a four-year, full-tuition-and-fees scholarship (prominently valued at $60,000, based on in-state tuition) if the student was accepted. The packet also contained a flyer describing the application and admissions processes, as well as coupons for fee waivers for the Common Application, the Free Application for Federal Student Aid (FAFSA), and the CSS profile.[11] Students were told they did not have to complete the FAFSA or the CSS profile to obtain the HAIL scholarship, but were encouraged to do so in order to obtain additional financial aid. The letter encouraged students to apply to University of Michigan by the early action deadline of November 1st, although applicants would still be eligible for the scholarship if they applied by the regular decision deadline of February 1st.[12]

To further reduce concerns that the packets would go unnoticed and to bolster their credibility, we also sent materials to parents and principals of eligible students. Parents received letters reiterating the scholarship information and encouraging parents to help their children apply. The university mailed these letters two weeks after the student packets. Principals of each school in the treatment group received emails and letters explaining the program and providing lists of the eligible students in their schools. The

[10] In the second year of the intervention, student packets were not mailed until early October due to data and printing issues.
[11] Application to the FAFSA is free, and these students would have been eligible for fee waivers regardless of the coupons. We included the coupons to emphasize this point and simplify the process.
[12] University of Michigan admits most of its incoming class through early action, so students have the best chance of being admitted if they apply by November 1.

principal letter also asked the principal and counselors to reach out to eligible students to encourage them to apply.[13] The emails and letters were sent to each principal in late August, just prior to the start of the school year.

Evidence of HAIL Awareness from Internet Activity

We provided students with personalized web addresses where they could claim a free t-shirt and learn more about HAIL. Activity at these web addresses allowed us to track which students logged on, serving as a lower-bound approximation for how many students in the treatment group received and opened the packets. Each year, roughly 40% of each cohort went to the website at least once. Among students who visited their websites, the average number of views was 5.5; the median was 3.

[Figure 2a about here]

As Figure 2a illustrates, the majority of students who visited the websites did so for the first time in the days after the student and parent letters were mailed. The spike following the parent letter mailing suggests that a number of students did not read their HAIL packets carefully—or at least did not visit their websites—until encouraged to do so by their parents. After the University of Michigan early action deadline of November 1 (recall that the HAIL packet urged students to apply by this deadline), only a handful of students (zero to three per day) visited their websites for the first time. Figure 2b shows a qualitatively similar story for the second HAIL cohort. In the second year, due to issues with the printing of the packets, the student and parent letters were sent only three days apart (and in early October rather than mid-September), so it is difficult to observe the effect of the student letter separately from the parent letter.

[Figure 2b about here]

Figures 3a and 3b show the total number of visits to HAIL websites over time for the first and second HAIL cohorts, respectively. As with first-time views, page views spiked following the student and

[13] We excluded four students from the analysis who either left the state or graduated early.

parent letter mailings, and fell significantly after the early action deadline. Although few students visited their websites for the first time after November 1, there was a steady stream of total page views (up to 32 per day in the first year and up to 18 in the second), implying that a number of students returned to the webpage after the deadline had passed.

[Figures 3a and 3b about here]

IV. Data

We select HAIL students using detailed student-level administrative data obtained from the Michigan Department of Education (MDE) and the Michigan Center for Educational Performance and Information (CEPI). We use internal data from the University of Michigan to measure application, admission, and enrollment for the University of Michigan.[14] To investigate where students would have attended college in the absence of the treatment, we also analyze data from the National Student Clearinghouse (NSC), which tracks college attendance nationwide.

The state's student-level, administrative database contains information on students, from kindergarten through high school, in Michigan public schools. These datasets are linked by a common student identifier. The data contain student characteristics, such as race, ethnicity, gender, and eligibility for subsidized meals, as well as school-level characteristics.

As of 2007, all students attending public schools in Michigan take the ACT as part of their 11th grade standardized test. In the 2015-16 school year, which corresponds to the second cohort of our intervention, the state switched to the SAT. Students take the exam in the spring of their junior year. We use scores from this in-school test to assign eligibility for the HAIL Scholarship.

Students' transcripts, which allow the calculation of grade-point average in high school, are available for the two cohorts of HAIL students.[15] We compute GPA using a four-point scale, based on

[14] We are unable to observe application and admission for schools other than University of Michigan.
[15] The state subsequently stopped collecting these data from districts.

their grades at the end of 10th grade (the latest data available to us in the summer after 11th grade, when we randomize).

We match these data to data from the University of Michigan using name, date of birth, and school. The University provides us information on application, admission, and enrollment of the HAIL sample. To track student enrollment at colleges other than University of Michigan, we use data from the National Student Clearinghouse that the state has integrated into its data system. These data provide student-level information on college enrollment nationwide (Dynarski, Hemelt and Hyman 2015), including the school name and dates of attendance.

V. Sample selection and randomization

Students can qualify for HAIL if they are eligible for a free or reduced-price school meal. Eligibility for these programs is contingent upon having family income below 185 percent of the federal poverty line. In 2015, this threshold corresponded to $44,863 for a family of four.[16]

After identifying low-income students, we use high school GPA and score on the college-going exam (ACT or SAT) to select those eligible for the HAIL scholarship. Admissions officials at the University of Michigan set the GPA and score cutoffs. Students with higher test scores faced a lower GPA threshold, and vice versa. Qualifying ACT/SAT scores start at 22/1100 while qualifying GPAs start at 3.3.

Of the 100,000 high school juniors attending Michigan public schools, about 2,000 in 500 high schools met these criteria each year: 2,108 students from 529 schools for the first cohort, and 1,802 students from 497 schools for the second.

Randomization was conducted at the high school level to reduce concerns that students in the control group would learn of the scholarship through a peer in the treatment group. We stratified the

[16] In Michigan, students automatically qualify for subsidized meals if their family receives means-tested benefits such as food stamps or TANF. Qualification occurs through a data match between the education and human services administrative systems.

sample by the number of HAIL-eligible students in the school and randomized within each stratum. For the second cohort, schools that had newly entered the sample (because they had no eligible students in the first cohort, but did in the second) were randomly assigned using the same. method.[17]

For the first cohort, the randomization resulted in 1,057 treated students and 1,051 control students from 262 treated schools and 267 control schools, respectively. In the second cohort, 875 students from 238 high schools were in the treatment group, while 927 students from 259 high schools were in the control group.

[Figure 4 about here]

Schools in the sample were widely dispersed throughout the state. While there were concentrations of students in the major metropolitan areas, there were also many students in the Upper Peninsula and in the rural areas of the state (see Figure 4). Many students in the sample were the only student meeting the HAIL eligibility in their high school. In contrast, one high school in the state had 30 students meeting both income and achievement criteria in the first cohort of the intervention. The median school in our sample had three students meeting the HAIL eligibility criteria, but the most common situation was a single student meeting the criteria in a given school (see Figure 5).

[Figure 5 about here]

Balance Tests

We check for balance within each cohort between the treatment and control groups. We perform t-tests as well as regression balance tests predicting assignment to the treatment group. Table 2 shows results of the two-way t-tests as well as an p-value for joint significance of all covariates.

Forty percent of the schools in the treatment and control groups are in the Southeast region of the state. An additional 46 percent of schools are in the West Central region of the state. The remaining 14 percent of schools are in the Upper Peninsula. A third (35 percent) of schools are in suburbs, 12 percent in cities, and the remaining 54 percent in rural areas.

[17] Some schools that were a part of the intervention in the first cohort had no eligible students in the second cohort. See Appendix Table 1 for more details on how many schools were in the sample for each cohort.

[Table 2 about here]

A majority of HAIL-eligible students are female (59 percent) and white or Asian (84 percent). Nine percent are black and 7 percent were Hispanic, American Indian, or native Hawaiian.[18]

The majority of students in the sample qualified for a free lunch (70 percent) while the remaining 30 percent qualified for a reduced-price lunch. The average student scored a 1257 on the SAT (or ACT equivalent), placing them between the 86th and 87th percentile of the national distribution (College Board 2016), and had a 3.8 GPA.

Just over one-third of the sample sent their ACT/SAT scores to the University of Michigan when they took the exam in school. Just six percent of seniors in the sample schools applied to the University of Michigan in 2015, the last year before the intervention. Treated schools had slightly lower rates of application (5.6 percent compared to 6.7 percent) and were slightly smaller (an average of 175 students in an 11th grade cohort compared to 189 students among control schools). We find no other significant differences in the characteristics of schools in the treatment and control group using two-way t-tests.

An F-test reveals that the coefficients are jointly significant, likely due to the differences in class size and share of prior cohorts applying to the University of Michigan. Given the number of covariates analyzed, the number of significant differences observed in Table 2 is consistent with random chance. Since students in treatment schools were less likely to apply to the University of Michigan in prior cohorts relative to students in control schools, this should bias estimates towards null findings.

[18]We group students into three race/ethnicity categories: white or Asian, black, and other. Race categories are mutually exclusive. Other race/ethnicity includes Hispanic, American Indian or Alaska Native, and Native Hawaiian or other Pacific Islander students. Students are considered Hispanic if they identify as Hispanic, regardless of race. For students of multiple races, a single race category is assigned according to the following hierarchy: black, Native American, Asian, Hawaiian/Pacific Islander, white.

VI. Empirical Strategy

We evaluate the effect of the HAIL scholarship on application, admission, enrollment, and persistence rates, comparing outcomes between students in the treatment and control groups. We estimate the following models by ordinary least squares (OLS):

$$(1)\ Y_{jt} = \beta_0 + \beta_1 D_j + \beta_2 S_{jt} + u_{jt}$$

$$(2)\ Y_{jt} = \gamma_0 + \gamma_1 D_j + \gamma_2 S_{jt} + \gamma_3 Z_{jt} + u_{jt}$$

where Y_{jt} is an outcome of interest at school *j* for cohort *t*. We collapse the individual student data to the school-cohort level and conduct analysis on these means. Y_{jt} is therefore the share of HAIL-eligible students in school *j* in cohort *t* that applied, were admitted, or enrolled. D_j is an indicator variable equal to one if the school is randomized to the treatment group and zero if the school is randomized to the control group (note that schools keep their randomization status from the first cohort in the second cohort). S_{jt} is a vector of strata-by-year dummies; recall we stratified the sample by the number of HAIL-eligible students in the school for each cohort. Z_{jt} is a vector of control variables measured at the school-cohort level.

Following Bruhn and Mckenzie (2009), under pure randomization with strata, we estimate (1) and we additionally consider (2) where the control variables are included, which improves the precision of the estimates.

β_1 and γ_1 are the parameters of interest and measure the causal effect of being randomized into the treatment group, i.e. the estimated effect of the Intent to Treat (ITT). These parameters represent the treatment effect on the outcomes of interest, with schools weighted equally.

Since we observe the outcomes for all students, and therefore all schools, there is no attrition due to non-response. We do observe whether a student actually receives the information packet (i.e. is

effectively treated), and students assigned to the control group cannot be treated, so we do not adjust for non-compliance.

We conduct subgroup analyses to check for heterogeneity in the treatment effect.[19] We evaluate variation in the treatment effect by region (Southeast, West Central, Upper Peninsula), urbanicity (suburb, city, town/rural), number of HAIL students in the school, and the school's baseline application and enrollment rates to University of Michigan. Additionally, we evaluate heterogeneity by gender (male vs. female), race (white/Asian, black, other), whether the student sent test scores to the University of Michigan, and whether the student is eligible for free (rather than reduced-price) meals.

These subgroup analyses shed light on the potential mechanisms through which HAIL affected application and enrollment behavior. Previous research suggests that low-income, high-achieving students who are isolated from other high-achieving, low-income students are less likely to attend selective institutions than those who are surrounded by similar students (Hoxby and Avery 2012). Of particular interest is whether the HAIL scholarship was effective in raising application and enrollment rates among these isolated students, which we evaluate based on the region, urbanicity, the number of HAIL eligible students in the school, and whether the student sent their test scores to University of Michigan.

Similarly, research has shown that whether the high school has prior ties with the university in terms of application and enrollment of students from previous cohorts also predicts whether a student will attend (Hoxby and Avery 2012). We test this hypothesis by evaluating heterogeneous treatment effects as a function of baseline application and enrollment rates at the sample schools.

VII. Results

Application, Admission, and Enrollment at the University of Michigan

Students who received the HAIL scholarship packet were substantially more likely to apply, gain admission, and enroll at the University of Michigan compared to those in the control group (see Table 3

[19] We check for balance in these subgroups in Appendix Table 2.

for regression estimates and Figure 6 for treatment and control means). At control schools, 26 percent of low-income, high-achieving students applied to University of Michigan, compared to 67 percent at treatment schools. Results were virtually identical across the two cohorts.[20]

[Table 3 about here]

These large differences in application translated into large differences in admissions. The unconditional admission rate was 15 percent in control schools and 32 percent in treated schools, a treatment effect of 17 percentage points. This is the net effect of the treatment on the joint likelihood of applying to and being admitted to the University of Michigan.

Note that we do not condition on application when estimating the admissions effect. This is because application is (strongly!) affected by the treatment. As a result, the subset of those in the treatment schools who apply are *not* comparable to those in the control schools who apply. Another way to put this is that treatment is not randomly assigned among *applicants*. This renders uninterpretable a treatment/control contrast among those who apply.

Students in the treatment group were significantly more likely to enroll at University of Michigan than those in the control group. The (unconditional) enrollment rate at control schools is just 12 percent while at treatment schools it is 27 percent. Treatment effects estimated by simple differences in means (shown in Figure 6), a regression controlling for strata (Model 1, shown in the first column of Table 3), and a regression controlling for strata and additional school covariates (Model 2, shown in the second column of Table 3) are virtually identical (within a percentage point).[21]

[Figure 6 about here]

Heterogeneous treatment effects: Region and urbanicity

There were substantial differences in treatment effects across regions of the state and by urbanicity (see Table 4 for regression treatment effect estimates and Figures 7 and 8 for treatment and

[20] We present all results pooling the two cohorts; results are very similar between each cohort and available upon request.

[21] Regression results including all controls available in Appendix Tables 3 through 8.

control means). Among control schools, application, admission, and enrollment rates were approximately twice as high in the Southeast (which includes Detroit and Ann Arbor, where the University of Michigan is located), compared to the West Central (a mix of rural and urban areas such as Grand Rapids) and the Upper Peninsula (a rural area).

HAIL served to equalize outcomes across regions and urbanicity, with the largest treatment effects in the places with the lowest control means. On the application margin, treatment effects were largest in the West Central region (46 percentage points) and smallest, though still quite substantial, in the Southeast (37 percentage points). Admission and enrollment effects were also largest in the West Central and Upper Peninsula regions.

[Table 4 about here]

[Figure 7 about here]

Reflecting the regional pattern, effects were largest in the rural areas, where control means are largest. In the control group, the enrollment rate is 22 percent in the urban areas and 8 percent in rural schools. HAIL boosts enrollment by 11 and 18 percentage points, respectively. As a result, the gap in enrollment rates between urban and rural schools was reduced from 14 percentage points in the control group to 7 percentage points in the treatment group (among treated schools, 32 percent enrolled in urban schools compared to 26 percent in rural schools). The outsized impact of the treatment on students in more rural areas of the state as well as locales farther from University of Michigan is broadly consistent with the treatment compensating for student isolation, a potential mechanism we test in greater depth below.

[Figure 8 about here]

Heterogeneous treatment effects: student characteristics

We also find differences in treatment effects according to student characteristics: gender, race, income (proxied by eligibility for a free versus a reduced-price meal), and ACT/SAT score sending (see Table 5 and Figures 9 and 10). Women in the control group were five percentage points less likely to apply compared to men (24 and 29 percent, respectively), but were slightly more likely to enroll at University of Michigan (12 and 11 percent, respectively), suggesting that the pool of women applying to

University of Michigan from the control group was, on average, more qualified than the men. This is consistent with a large literature showing that men are more confident about their skills and qualifications than are women. The HAIL treatment narrowed the gender gap in application (66 percent of women and 69 percent of men applied to University of Michigan from the treatment group) and widened the female advantage in enrolling at University of Michigan. These results are consistent with HAIL compensating for women's lower levels of confidence about applying to a highly selective school.

[Table 5 about here]

[Figure 9 about here]

We also find substantial differences in treatment effects across race and ethnic groups. In the control group, low-income minority students were much more likely to attend University of Michigan than low-income white students, though minority students make up just 23 percent of the sample. Nearly half of black students in the control group applied to University of Michigan (48 percent), and about a quarter enrolled (23 percent). In contrast, only 23 percent of white and Asian students in the control group applied, and just 10 percent enrolled at University of Michigan.

These differences reflect differences in the geographic distribution of racial groups in Michigan. Black students are much more likely to live in the urban areas of the Southeast region of the state, such as Detroit, which has stronger connections to the University of Michigan. On the other hand, the more rural, West Central and Upper Peninsula, which tend to have very low enrollment rates, are largely white.

The treatment again appears to have an equalizing effect: treatment effects on enrollment are largest for whites and Asians (15 percentage points) and smaller (and imprecise) for other minority students (7 percentage points) and black students (3 percentage points).

[Figure 10 about here]

We also compare treatment effects for students eligible for a free vs. reduced-price lunch. Students who receive free lunch are of lower income than those who receive subsidized lunch, as the income threshold for free lunch eligibility is 130 percent of the federal poverty line, compared to 185 percent of the federal poverty line for a reduced-price lunch (this difference corresponds to about $13,000

for a family of four in 2015). The majority of students in our sample received a free lunch (70 percent) compared to a reduced-price lunch (30 percent). Treatment effects were similar between the two groups.

Finally, we also compare treatment effects for students who did and did not send their ACT/SAT test scores to University of Michigan at the time of test-taking (Panel D of Table 5). Score-sending in the control group was predictive of application and enrollment to University of Michigan: 42 (20) percent of students who sent their scores to University of Michigan subsequently applied (enrolled), compared to 16 (6) percent of students who did not send their scores. Proportionally, treatment effects were much larger among students who had not sent in their scores, resulting in a roughly tripling of their application and enrollment rates.

Mechanisms: Isolation and Disconnection

One of the motivations for the HAIL intervention was the concern that low-income, high-achieving students in the rural regions of the state are not reached by college recruiters as well as low-income, high-achieving students from the urban areas of the state. Research by Hoxby and Avery (2012) also suggests that these more isolated students are least likely to apply to selective institutions.

We formally test how HAIL affected these more isolated students by estimating variation in the treatment effects as a function of school-level application and enrollment rates to University of Michigan at baseline. We also estimate heterogeneity by the number of HAIL-eligible students in the school (see Tables 6 and Figures 11 and 12).[22]

Heterogeneity is estimated by interacting the treatment indicator with linear terms for the prior University of Michigan application rates, prior University of Michigan enrollment rates, and number of HAIL students in the school, respectively. For ease of interpretation, we present treatment effects in Table 6 calculated for the 25th percentile, median, and 75th percentile of the measure of isolation or connection.[23]

[22] Prior University of Michigan application and enrollment rates are for the graduating class of 2015. The number of HAIL-eligible students in each high school is cohort-specific.
[23] For estimated regression coefficients, see Appendix Table 9.

Results are consistent with isolation being an important factor: treatment effects are largest in schools that previously had no students apply to or enroll at the University of Michigan. The effect on application is 46 percentage points for high schools at the 25th percentile of baseline application rates (this is a school where less than 2 percent of students applied at baseline). For high schools at the 75th percentile (where 7 percent applied) the effect is 41 percentage points.

We find similar patterns at the admission and enrollment margin: treatment effects were largest in schools with the lowest baseline application rates, though effects were substantial across the distribution of high schools. The effects are smallest at schools that had very high application rates in pre-treatment years. Results are quite similar when we use prior enrollment rates rather than prior application rates (Panel B, Table 6).

[Table 6 about here]

[Figure 11 about here]

Finally, we examine heterogeneity based on the number of HAIL students in the school. The results (Panel C of Table 6, Figure 12) suggest isolation plays an important role in undermatch: treatment effects are largest among schools with fewest HAIL-eligible students. For a school at the 25th percentile of HAIL-eligible students (that is, two), the effect on application is 44.5 percentage points. For a school at the 75th percentile (five HAIL-eligible students), the effect is 40 percentage points. Together, these results suggest that the HAIL scholarship had the largest effect on students who were the sole recipient of the HAIL scholarship in their schools and among students who attended high schools with no prior connection to the University of Michigan.

[Figure 12 about here]

Effects on College Choice

Did HAIL increase the share of low-income students attending highly selective colleges, or did University of Michigan simply poach students from its competitors? To answer this question, we need national data on college attendance. Our data from the National Student Clearinghouse track college

enrollment by the fall after a student's senior year for both cohorts in the study.[24] For the first cohort of HAIL, we can track students across two falls.

We find no diversion from colleges at least as selective as the University of Michigan (Table 7 and Figure 13). The offer of the HAIL scholarship increased enrollment at a highly (or most) selective college by 14.6 percentage points. This is identical to the effect on attendance at University of Michigan.[25] We find no evidence that HAIL induced students to attend (or not attend) other highly selective institutions (point estimate is 0.000). The standard error of this estimate rules out a decrease (or increase) of more than 1.4 percentage points in enrollment at other highly or most-selective colleges.[26]

The offer of HAIL increased the share of students enrolling at any four-year college (7.4 percentage points) and decreased the share enrolling at two-year colleges (3.5 percentage points). Surprisingly (at least to us), the likelihood of enrolling at *any* college increased by 3.9 percentage points. That is, roughly one quarter of the treatment effect on enrollment at University of Michigan is driven by students who would not have attended college at all in the absence of the treatment.

Together, these results show that nearly half of HAIL's effect is driven by students who would have attended a two-year college, or would not have attended college at all, in the absence of the intervention. The other half of HAILs effect is driven by students who shifted from less selective four-year colleges to a highly selective university: University of Michigan.

[Table 7 about here]

These results are consistent with responses from focus groups held among students from the treatment group who enrolled in University of Michigan. Of the 15 students interviewed in the focus group, 12 had no intention of applying to University of Michigan before the intervention. Among the institutions mentioned by the students as places they had applied to were regional four-year institutions

[24] A small number of students reports attending multiple colleges. We focus on the first institution.
[25] This estimate (which uses National Student Clearinghouse data) and the previously discussed estimate (based on University of Michigan data, Table 3) are nearly identical: 14.6 versus 14.9 percentage points. The minor difference is attributable to differences in the dates on which NSC and University of Michigan record enrollment.
[26] We are unable to observe whether students applied but did not gain admission to other highly selective institutions.

such as Grand Valley State, Ferris State, Central Michigan University, Wayne State University, and Eastern Michigan University. One student in the focus group had been contemplating a two-year school, while another explained that s/he "didn't count on going to college at all until I got the packet."

We also examine these effects by geographic region, urbanicity, race, and gender (Table 8). The largest effects, as found earlier, are in the West Central and Upper Peninsula regions and in rural areas. The offer of the HAIL scholarship increased the likelihood of enrolling at a four-year institution by 11 percentage points among students in the West Central region, nearly three times the treatment effect among students in the Southeast (4 percentage points, not significant).

[Table 8 about here]

HAIL substantially narrowed urban/rural gaps in enrollment: in rural areas the effect is an 18 percentage point increase in the likelihood of enrolling at an school at least as selective as the University of Michigan, compared to 8 percentage points in urban areas. These results are consistent with Hoxby and Avery (2012), who find that low-income, high-achieving students concentrated in more urban areas are more likely to attend highly selective institutions.

HAIL had a larger effect on the college choices of women than men, particularly on the margin of attending any college. Treatment effects for attending any highly selective institution were largest among white and Asian students, while treatment effects on four-year and any college attendance were larger among non-black, minority students. This suggests that, in the absence of the treatment, white and Asian treated students would have attended less selective four-year institutions, while other minority treated students would not have gone to college at all or would have attended two-year institutions.

Persistence in College

Did those induced into University of Michigan by HAIL stay in college, or drop out? Table 9 presents results for two-year persistence rates for the first cohort, for which we have two years of NSC enrollment data. We find that the HAIL effect persists into the second year. Students offered the HAIL Scholarship are 13.5 percentage points more likely than controls to be enrolled in a highly (or most)

selective college for two years. That is, the two-year effect on attending such a selective college is 92.5 percent (=13.5/14.6) of the one-year effect.

[Table 9 about here]

On all other measures, we find larger treatment effects on two-year enrollment than on one-year enrollment alone. That is, the effect of HAIL increases with time, as students in the control group drop out of their colleges at a higher rate than those in the treatment group. This is consistent with the hypothesis that students induced into more selective schools, with better-prepared peers and more resources, are more likely to stay in school and graduate.

Students offered HAIL are 11 percentage points more likely than controls to be enrolled in a four-year college for two years; the one-year effect is 9.1 percentage points. Further, students offered HAIL are eight percentage points more likely than controls to enroll in *any college* for two consecutive years. Part of this effect is driven by HAIL getting students into college in the first place (4 percentage points), while the balance is due to students attending a more selective college with a higher retention rate.

We break out these effects by school and student characteristics in Table 10. The largest effect on persistence are in the West Central region and in the suburban and rural areas of the state. Many of the persistence effects in the urban areas, in fact, small and insignificant. Persistence effects are larger for female students, with an11 percentage point increase in persisting through two years of college (the effect is insignificant 3 percentage points for males).

[Table 10 about here]

Spillover Effects

The HAIL initiative may have influenced the classmates of those offered the HAIL scholarship. These classmates were ineligible because of high income and/or low academic achievement. The effect is theoretically ambiguous. Seeing a peer offered the HAIL scholarship may make University of Michigan seem more accessible to students (or adults around them), thereby increasing the likelihood of application. Or, seeing a peer offered the HAIL Scholarship may be taken by a student as a signal that he is not

University of Michigan material, thereby decreasing the likelihood of application. Finally, the University of Michigan may have informal quotas for each school (they deny this).

We replicate our analysis among students who are not eligible for HAIL, with the treatment dummy indicating that their school is in the HAIL treatment group (Table 11). We find the application rate is 1.1 percentage points lower for non-HAIL student at treatment schools than at control schools. But after we control for baseline application rates this negative spillover effect disappears. Thus we find no evidence that the HAIL scholarship had any negative (or posit8ive) spillover effects on non-HAIL peers.

[Table 11 about here]

Randomization-based inference

We next conduct a simulation exercise to illustrate the robustness of our findings to the assignment of treatment and control groups. Athey and Imbens (2016) recommend randomization-based inference analysis to illustrate the likelihood of obtaining the observed treatment effects by random chance, where the randomness comes from treatment assignment of a fixed number of units (in our case, high schools) rather than from sampling from a larger population.

Using the first and second cohorts of 1,026 schools, we re-assign treatment status using the same procedure used in the original randomization. We then estimate "treatment effects" based on these reassignments. We repeat this procedure 10,000 times to generate the distribution of potential treatment effects that could be due to random differences between schools assigned to the treatment and control groups. For each outcome, we calculate the share of the 10,000 simulated treatment-control differences that is larger in absolute value than the difference observed in the actual random assignment discussed throughout the paper. This proportion represents the randomization-based, or exact, p-value.

Results of the randomization-based inference, presented in Table 12, indicate that our findings cannot be explained by random differences between the treatment and control schools. As we would expect under true randomization, for each outcome the average simulated treatment effect is zero,

indicating no difference between the randomly-assigned treated and control schools in average outcomes over 10,000 iterations.

[Table 12 about here]

For our first key outcome, enrollment at University of Michigan, we never observe a simulated treatment effect as large as the actual treatment effect in any of the 10,000 iterations. In other words, the randomization-based p-value is precisely zero, meaning there is less than a 1 in 10,000 chance that the difference we observe is due to the particular set of schools assigned to HAIL treatment.

For the other outcomes of interest, which have smaller treatment effects, the randomization-based p-values are comparable to the sampling-based p-values earlier in the paper. For example, the true treatment effect suggests that college enrollment rates among HAIL scholarship recipients increased by 3.9 percentage points relative to control schools, with a sampling-based p-value of 0.031. In the simulations, we observe a treatment effect this large 385 times out of 10,000, or 3.9 percent of the time (randomization-based p-value of 0.039).

This pattern is also illustrated in Figure 14, where we plot the distribution of treatment effects from the 10,000 iterations for a selection of outcomes. The dashed vertical line in each graph illustrates the actual treatment effect observed. As illustrated in the tables, there is strong support that the actual treatment effects are not due to random chance for: enrollment at University of Michigan, enrollment at any highly selective institution, enrollment at a four-year institution, and enrollment at any college. For each of those outcomes, there is less than a 4 percent chance of observing an effect at least as large as the actual treatment effect in the 10,000 simulated effects. Although they represent different conceptual approaches, the sampling-based and randomization-based analyses produce virtually identical conclusions about the effects of the HAIL intervention.

[Figure 14 about here]

VIII. Conclusion

We close the paper with statistics that motivated it: gaps in college choice between low-income students and their higher-income peers in Michigan (Figure 15). Overall, HAIL closed by half the income gap in college attendance among high-achieving students: the college attendance rate is 88 percent among upper-income students, and 85 (81) percent among treated (untreated) low-income students.

HAIL also narrowed, eliminated, and even *reversed* income-based gaps in college selectivity. The gap in attending an institution considered "selective" or above was reduced from 12 percentage points to 4 percentage points, and the income gap in attending an institution considered "very selective" or above was eliminated. Finally, HAIL treatment group students were *more* likely to attend a university at least as selective as the University of Michigan, with 26 percent of students doing so, compared to 20 percent of upper-income students of similar achievement levels.

[Figure 15 about here]

Results from the first two years of the HAIL scholarship intervention reveal the power of personalized, targeted outreach campaigns in raising the application and enrollment rates of low-income, high-achieving students to highly selective institutions. Students offered HAIL were more than twice as likely to apply and enroll at University of Michigan compared to control students. This effect held across the first two cohorts of the intervention.

The large enrollment effect that we uncover is driven by shifting students away from two-year and less selective four-year colleges, as well inducing students to attend any college at all. We find no evidence that HAIL diverted students away from other highly selective institutions. Students offered the HAIL Scholarship persisted in college at substantially higher rates than students in the control group.

The HAIL scholarship had an equalizing effect, increasing application and enrollment rates among those least likely to apply to a highly selective college. Though the magnitude of the effect varies across student and school types, the treatment had a strong, positive effect across most subgroups we

studied. Treatment effects were particularly large among students at schools that historically had no students apply to or enroll at the University of Michigan.

Since all students assigned to the treatment group were mailed the same packet, it is difficult to determine which elements of the intervention were most important in producing these large effects. Focus groups with HAIL Scholars who enrolled at University of Michigan suggest the importance of *personalized*, eye-catching packaging. Many students also mentioned the importance of the promise of a full tuition scholarship in alleviating the stress associated with applying to college.

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Appendix: HAIL Materials

A. Student Packet



Exhibit 1: Front view of packet



Exhibit 2: Back view of packet



Exhibit 3: Inside flap of packet



Exhibit 4: Open view of packet; insert materials



Exhibit 5: Packet insert: Becoming a Wolverine Guide

B. Parent Letter

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

Success in life is due, in part, to seizing opportunities as they are presented. 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.

The ability to pay for college shouldn't determine whether or not a child attends. All academically high-achieving seniors, like <<first name>>, have worked hard and challenged themselves throughout high school, and deserve access to an outstanding college experience. A world of opportunity is within reach in Ann Arbor - relatively close to home - where one of the top 25 universities in the world offers the resources and support that enables our students to stay in school, graduate, and achieve great things.

<<first name>> should have recently received a separate packet in the mail with more information on applying to Michigan. We know the process can be challenging, and we want to assure you that we're here to support <<first name>> and make it as easy as possible.

We encourage your student to apply for admission by our November 1 Early Action deadline, or no later than our February 1 Regular Decision deadline. Our brochure shows the steps to applying through the Common Application, with the $75 fee waived. We will also waive the $25 application fee for the CSS/Profile, which is available October 1 and will enable your student to be considered for additional aid from U-M. The Free Application for Federal Student Aid (FAFSA) will be open January 1, 2016, and will likely provide your student additional federal aid to cover other costs.

You and <<first name>> can also visit a special website together to find out more information about how your student was selected for this scholarship, as well as contact information for personal U-M admissions and financial aid counselors, and a place to sign up for a free U-M t-shirt. Your student's packet contains their personalized website address.

At Michigan, we're deeply committed to college access and equity for Michigan high school students. I'm excited to offer this unique opportunity to attend one of the world's premier universities with tuition and fees completely covered, should your student apply and be admitted.

If you have any questions, do not hesitate to contact Jody Gore in our Office of Undergraduate Admissions at 734-764-7433, or Steven Foster in our Office of Financial Aid at 734-763-2941.

Sincerely,

Kedra Ishop, PhD
Associate Vice President
Office of Enrollment Management

C. Principal Letter

Dear {PRINCIPAL FIRST} {PRINCIPAL LAST},

I'm delighted to inform you that several seniors in your school are eligible for our pilot HAIL Scholarship, an outstanding offer of four years of free in-state tuition and fees at the University of Michigan - Ann Arbor, a value of about $60,000 per student. Furthermore, they will likely qualify for more aid to cover additional expenses such as housing and textbooks if they apply for aid.

As a public institution committed to the well-being of the residents of the state of Michigan, we want to increase academic opportunities among Michigan's high-achieving, low-income teens. The HAIL Scholarship is a unique effort to show talented seniors who qualify for free or reduced lunch that a world of opportunity is accessible relatively close to home.

The list of your students who qualify for the scholarship is attached. We hope you might meet with them and tell them a little about the University of Michigan, our stellar academic ranking, renowned professors, and near-limitless list of majors. You can see more at admissions.umich.edu.

The students will receive an information packet from us, which outlines how they apply to Michigan through the Common Application - with their $75 admissions fee waived - and instructions on how to file the correct forms and documentation for additional financial aid. Students will need to file the Free Application for Federal Student Aid (FAFSA) when it opens Jan. 1, and the CSS/Profile, which opens Oct. 1, to receive likely additional aid to cover other expenses. We will waive the $25 CSS/Profile processing fee.

Students will also be given a link to a personalized scholarship website, which provides even more clarification about the scholarship, and a connection to personal U-M admissions and financial aid counselors.

We are excited to offer this special scholarship opportunity, and we hope your eligible students take advantage of it by applying before our Early Action deadline of November 1, or no later than our Regular Decision deadline of February 1.

If you have any questions, please feel free to contact Jody Gore in the Office of Undergraduate Admissions at 734-764-7433, Steven Foster in the Office of Financial Aid at 734-763-2941, or your school's U-M admissions counselor, who can be found here: http://admissions.umich.edu/contact-us Go Blue!

Sincerely,

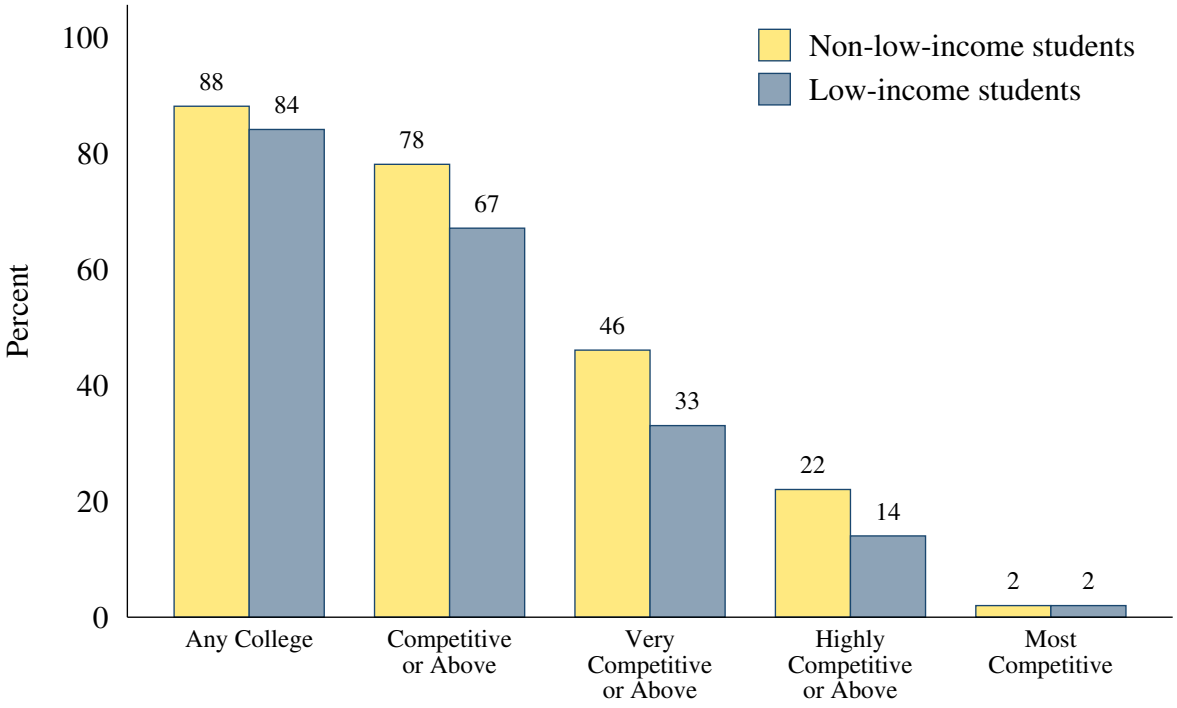
Kedra Ishop, PhD
Associate Vice President
Office of Enrollment Management

University of Michigan - Ann Arbor HAIL Scholarship-eligible students
Please inform your University of Michigan - Ann Arbor admissions counselor if a student no longer attends your school.

{STUDENT FIRST} {STUDENT LAST}, {BIRTHDATE}

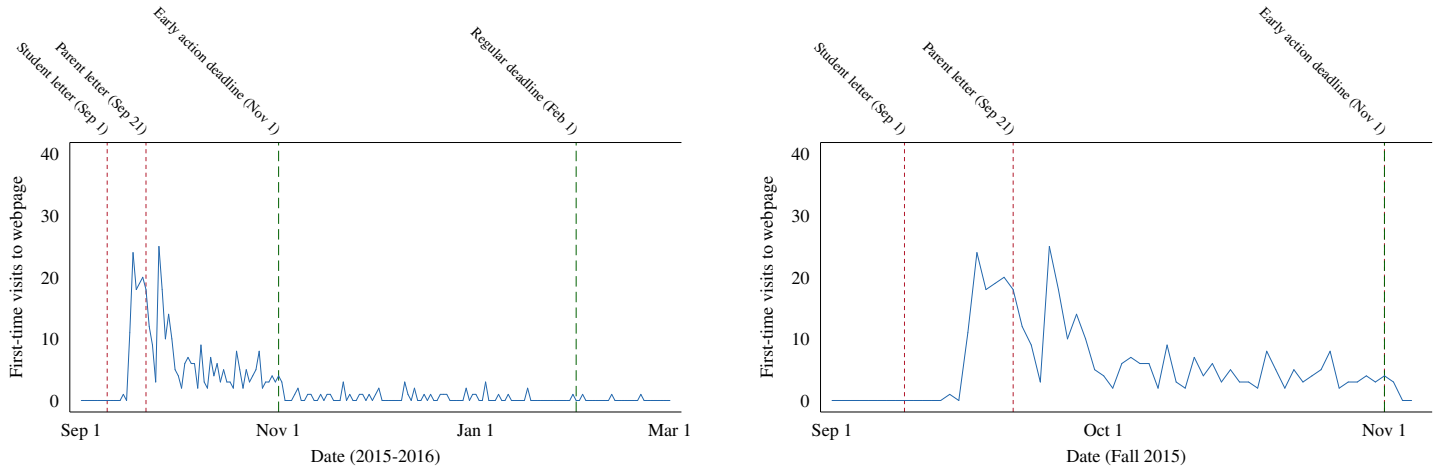
Figure 1

Selectivity of Colleges Attended by High-Achieving Michigan Students, by Income

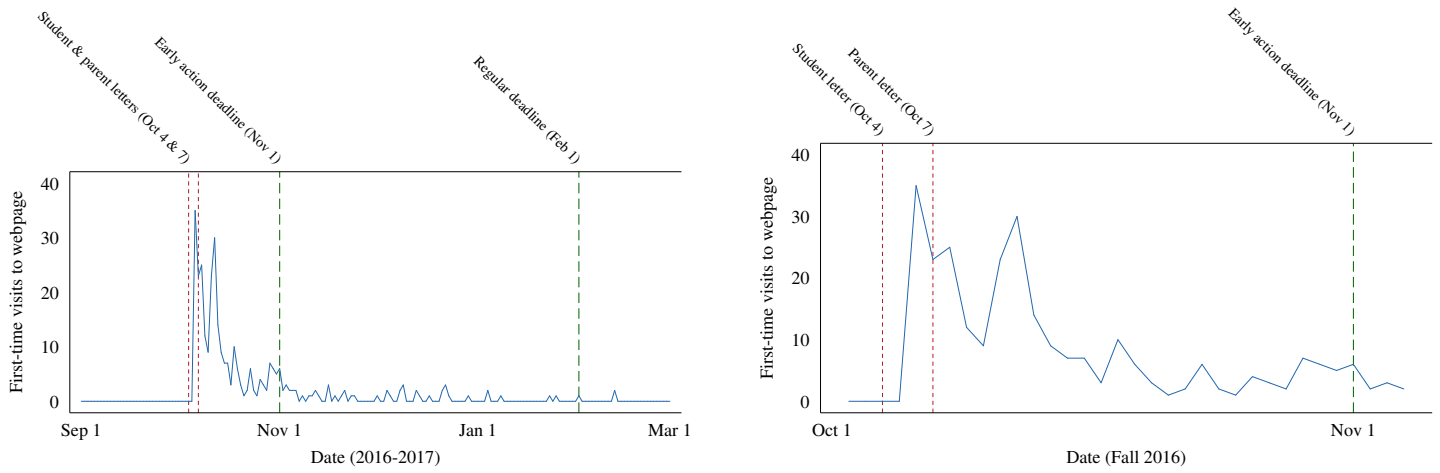


Source: Michigan administrative data and National Student Clearinghouse data.
Notes: Sample is 11th grade students in Michigan public schools in 2013 who meet HAIL GPA and ACT criteria. College enrollment measured at first institution attended in fall 2014. Low-income means eligible for free or reduced-price lunch in 11th grade. Selectivity categories from Barron's selectivity index.

Figure 2
First-Time Visits to HAIL Webpages



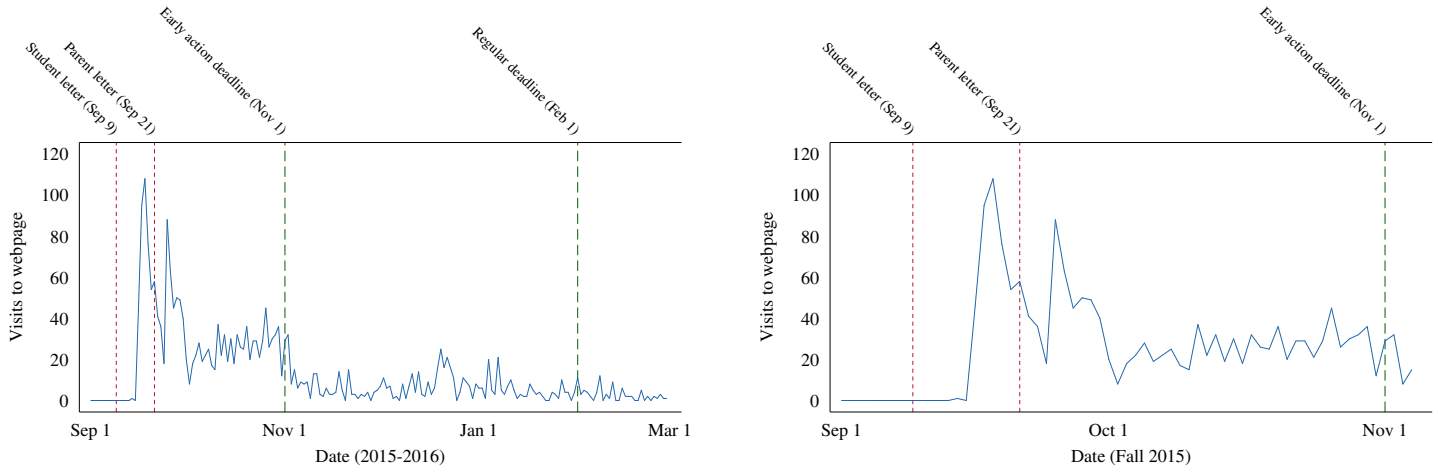
(a) First HAIL Cohort



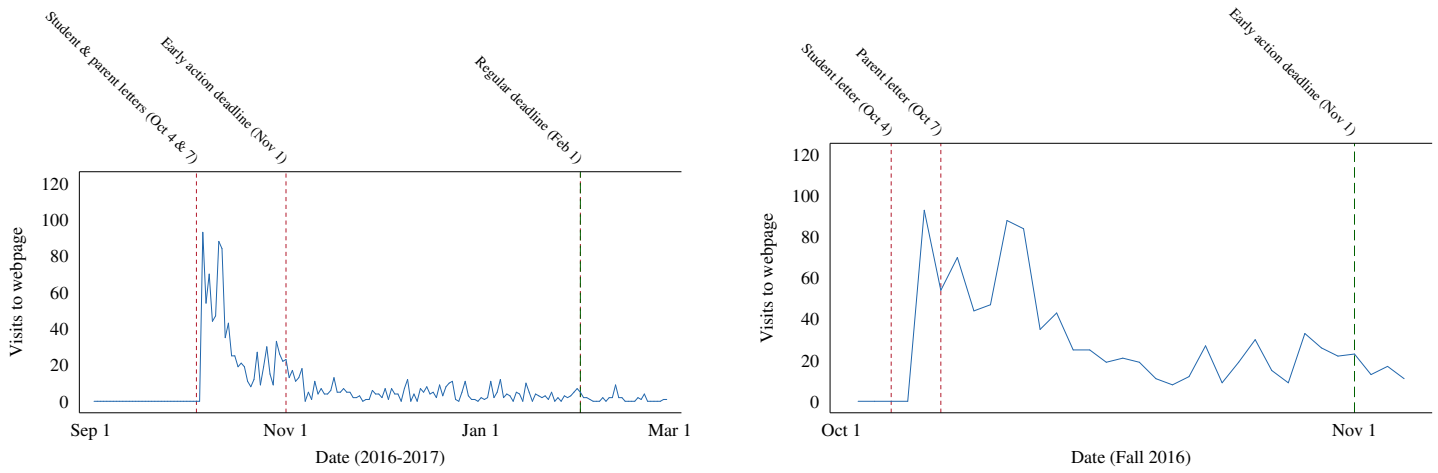
(b) Second HAIL Cohort

Source: University of Michigan Office of Enrollment Management data.
Notes: Unit of analysis is a first-time visit to the personalized URL associated with a treated HAIL student, aggregated by date.

Figure 3
Visits to HAIL Webpages



(a) First HAIL Cohort



(b) Second HAIL Cohort

Source: University of Michigan Office of Enrollment Management data.
Notes: Unit of analysis is a visit to a personalized URL associated with a treated HAIL student, aggregated by date.

Figure 4

HAIL Students Are Widely Dispersed Across Michigan (First and Second HAIL Cohorts)

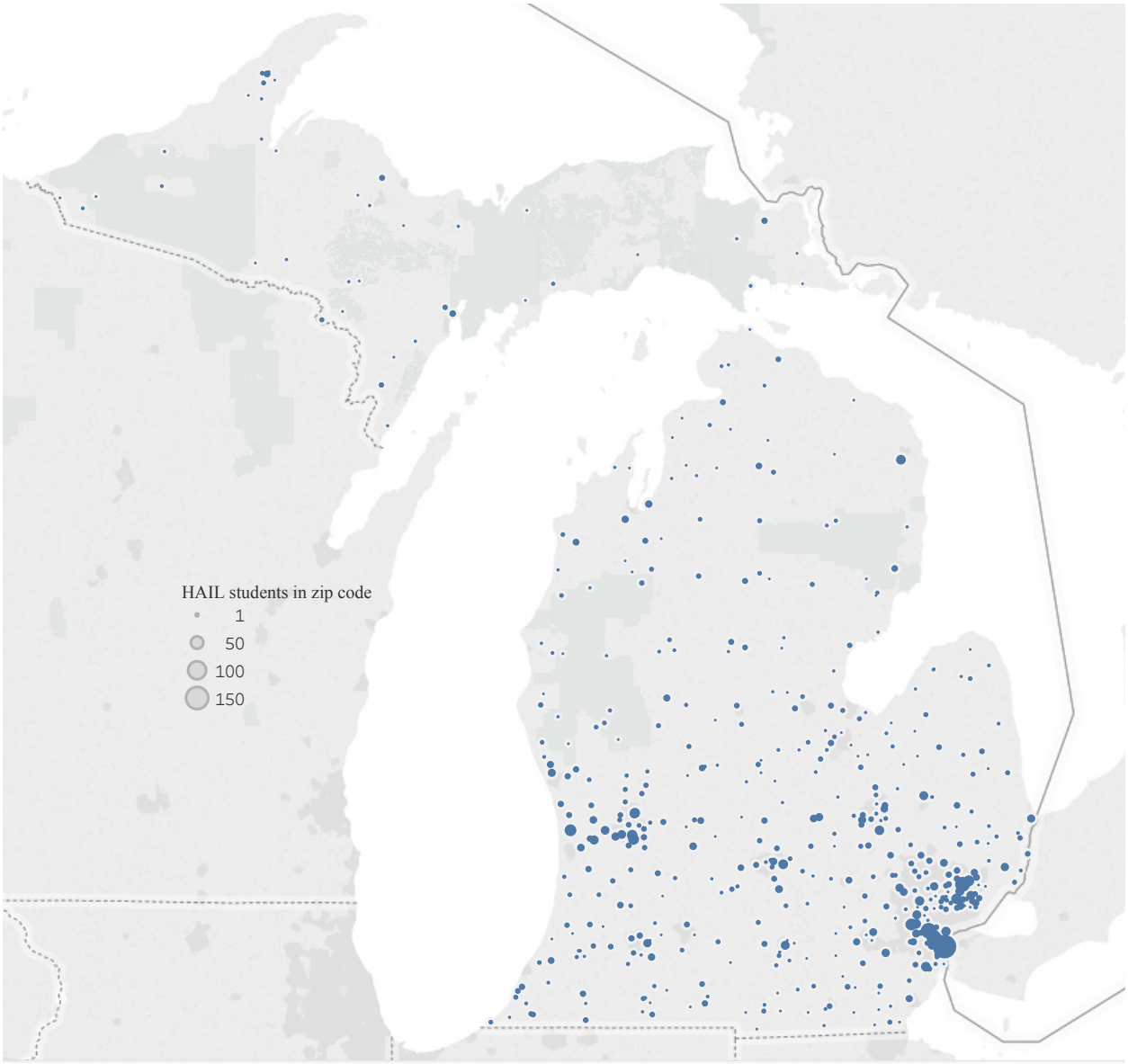
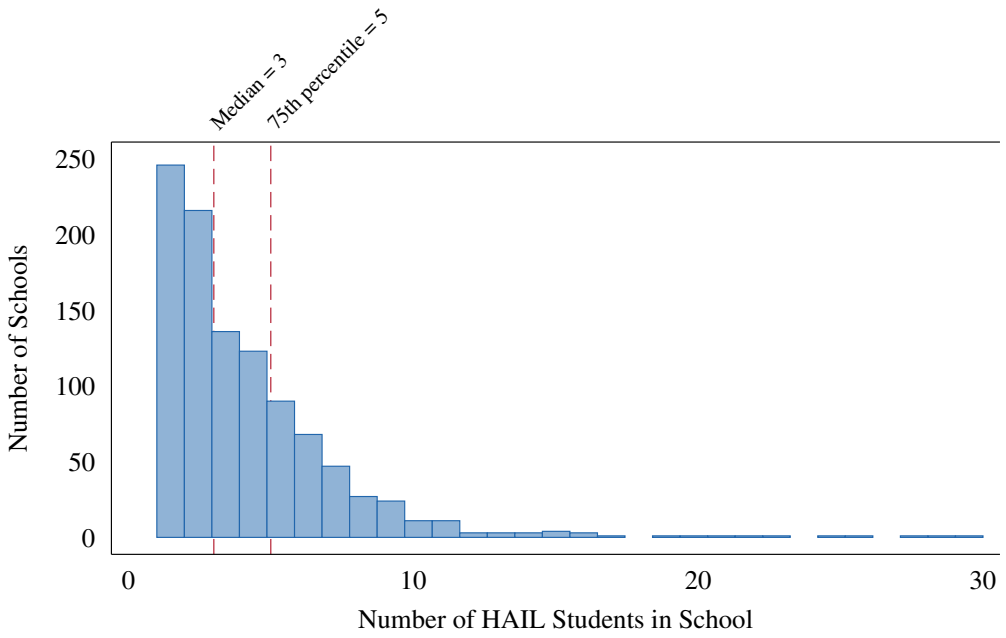
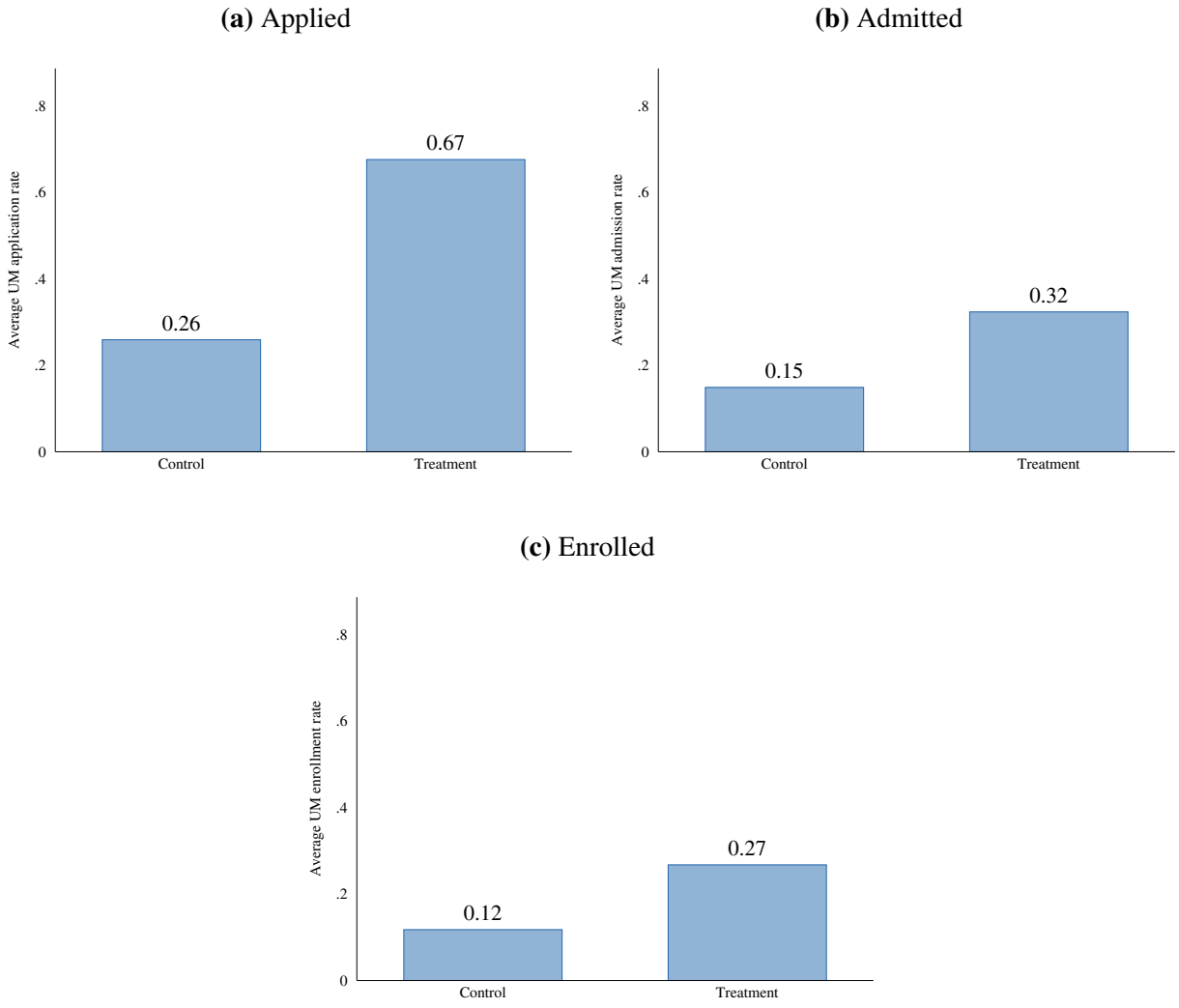


Figure 5
Typical School Has Few HAIL Students (First and Second HAIL Cohorts)



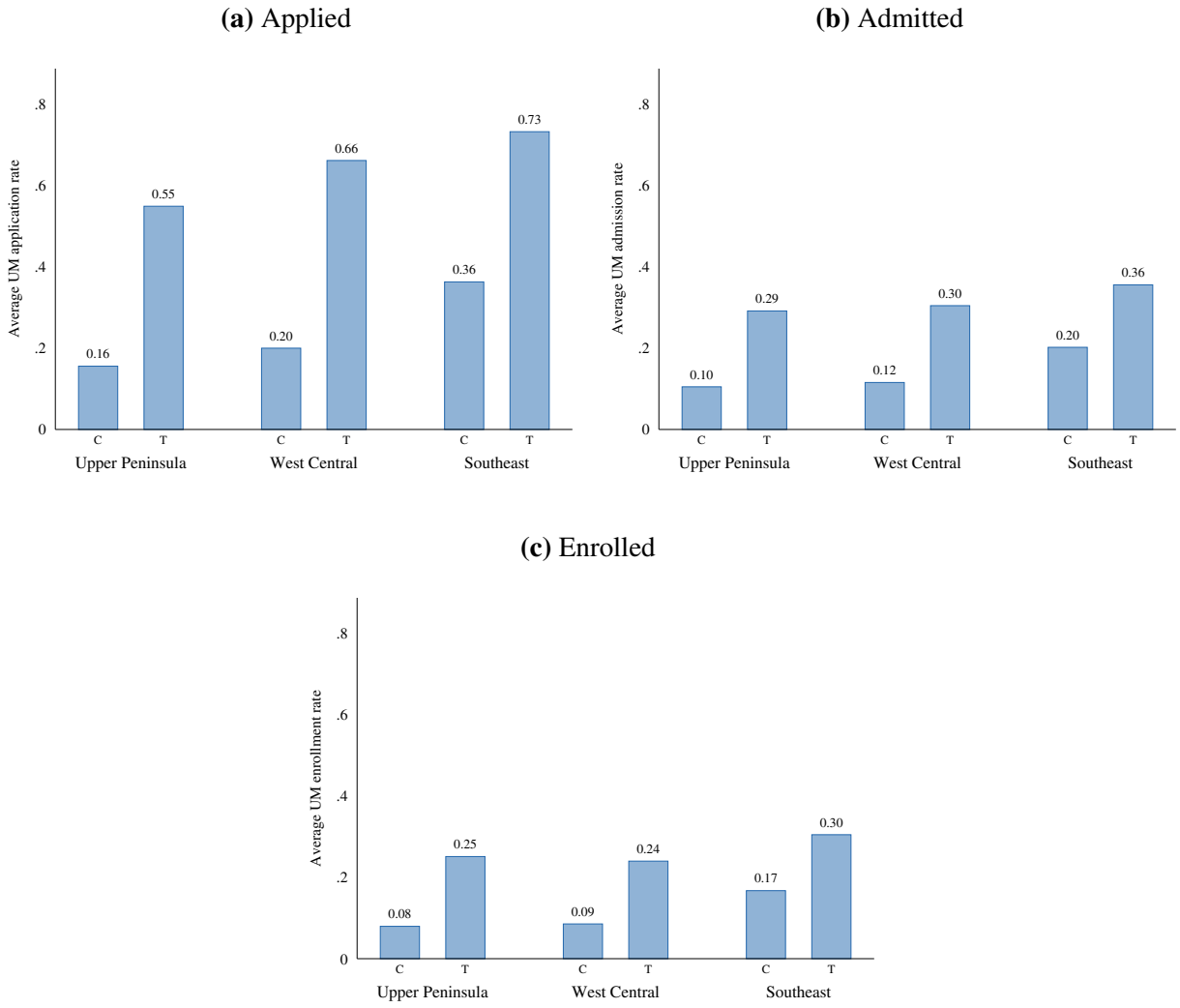
Source: Michigan administrative data.
Notes: Unit of analysis is the school-year.

Figure 6
Estimated Effect of HAIL Scholarship on Application, Admission, and Enrollment to UM (First and Second HAIL Cohorts)



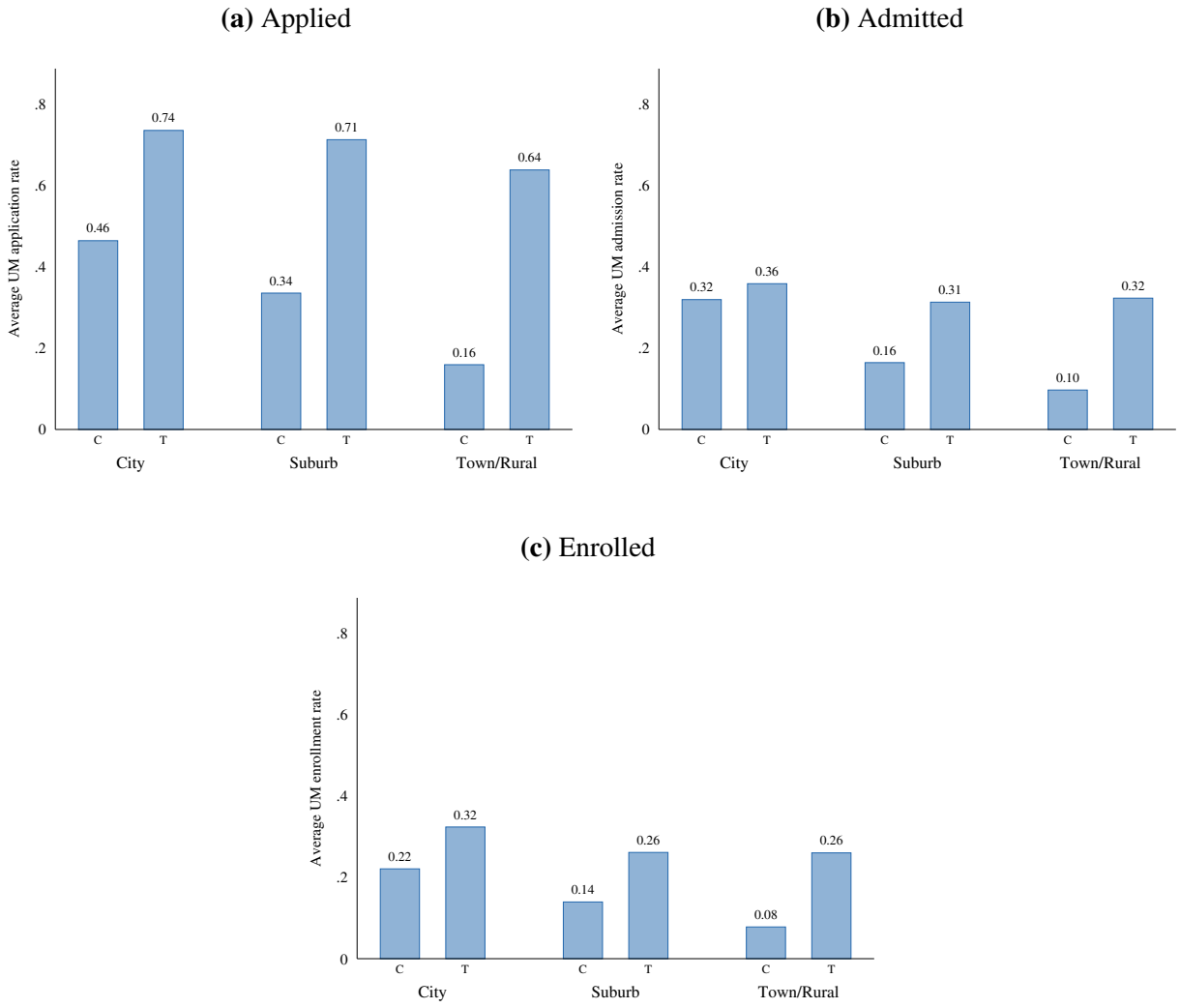
Source: Michigan administrative data and University of Michigan Office of Enrollment Management data.
Notes: All analyses done at the school-year level. Application, admission and enrollment measured in the summer and fall following expected high school graduation. Admission and enrollment are unconditional on application.

Figure 7
Estimated Effect of HAIL Scholarship on Application, Admission, and Enrollment to UM by Region (First and Second HAIL Cohorts)



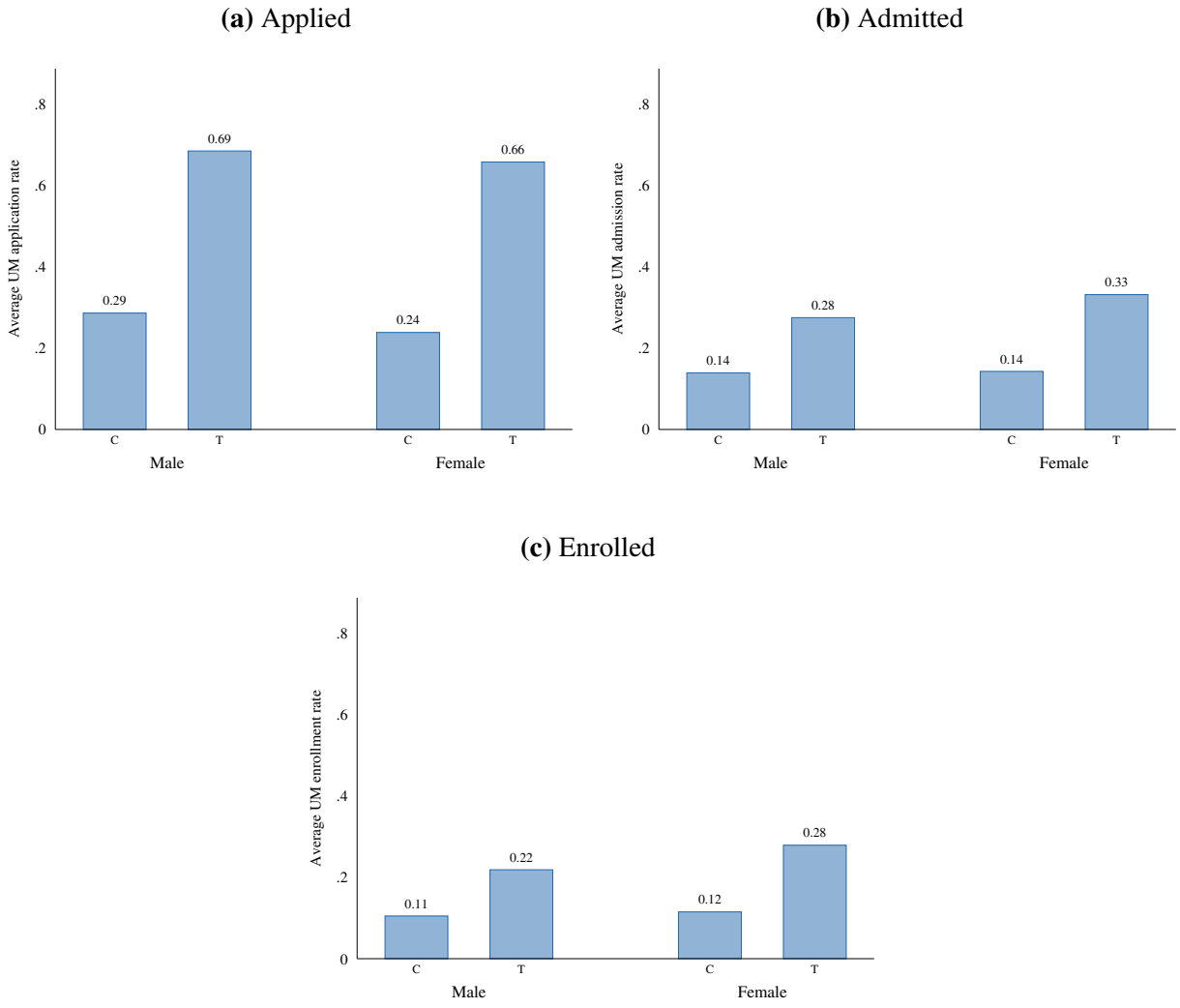
Source: Michigan administrative data and University of Michigan Office of Enrollment Management data.
Notes: All analyses done at the school-year level. Application, admission and enrollment measured in the summer and fall following expected high school graduation. Admission and enrollment are unconditional on application. Schools in the UP make up 14% of sample, while schools in West Central and Southeast Michigan represent 46% and 40% of the sample, respectively.

Figure 8
Estimated Effect of HAIL Scholarship on Application, Admission, and Enrollment to UM by Urbanicity (First and Second HAIL Cohorts)



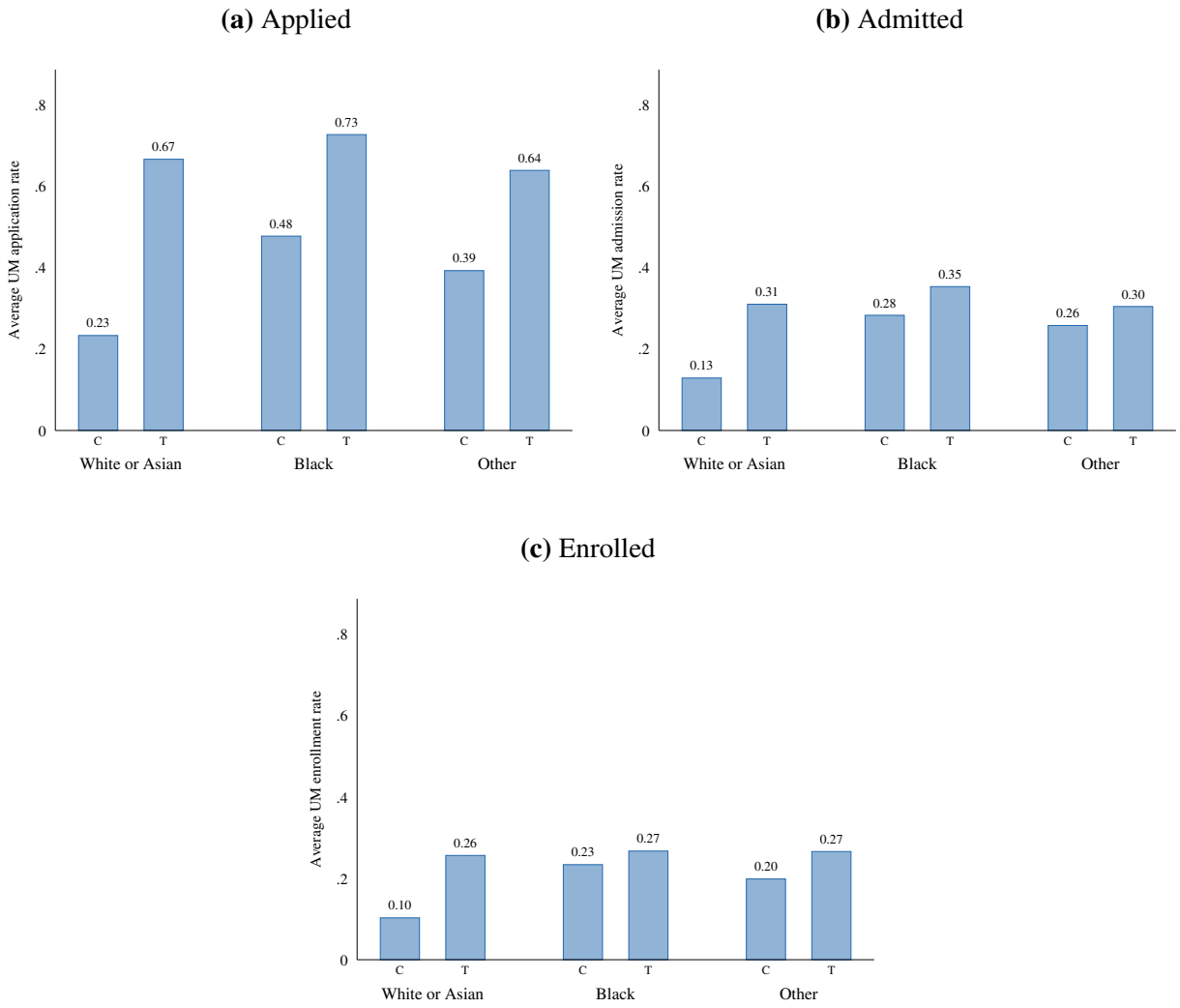
Source: Michigan administrative data and University of Michigan Office of Enrollment Management data.
Notes: All analyses done at the school-year level. Application, admission and enrollment measured in the summer and fall following expected high school graduation. Admission and enrollment are unconditional on application tab.Schools in suburban areas make up 35% of sample, while schools in cities and town or rural areas represent 12% and 54% of the sample, respectively.

Figure 9
Estimated Effect of HAIL Scholarship on Application, Admission, and Enrollment to UM by Gender (First and Second HAIL Cohorts)



Source: Michigan administrative data and University of Michigan Office of Enrollment Management data.
Notes: Rates are gender-specific school-year averages. Application, admission and enrollment measured in the summer and fall following expected high school graduation. Admission and enrollment are unconditional on application.83% of HAIL schools have at least one female HAIL student; 71% have at least one male. Female students represent 58% of the sample and male students represent 42%.

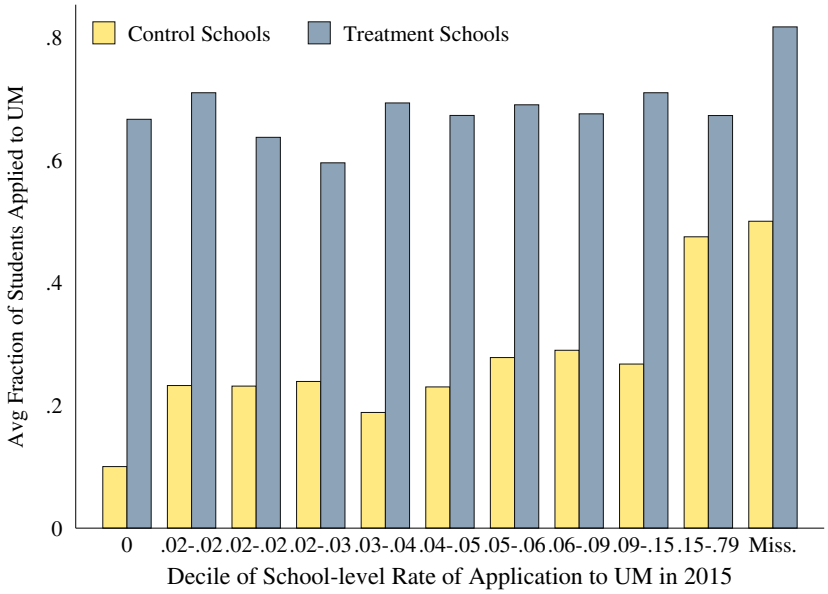
Figure 10
Estimated Effect of HAIL Scholarship on Application, Admission, and Enrollment to UM by Race/Ethnicity (First and Second HAIL Cohorts)



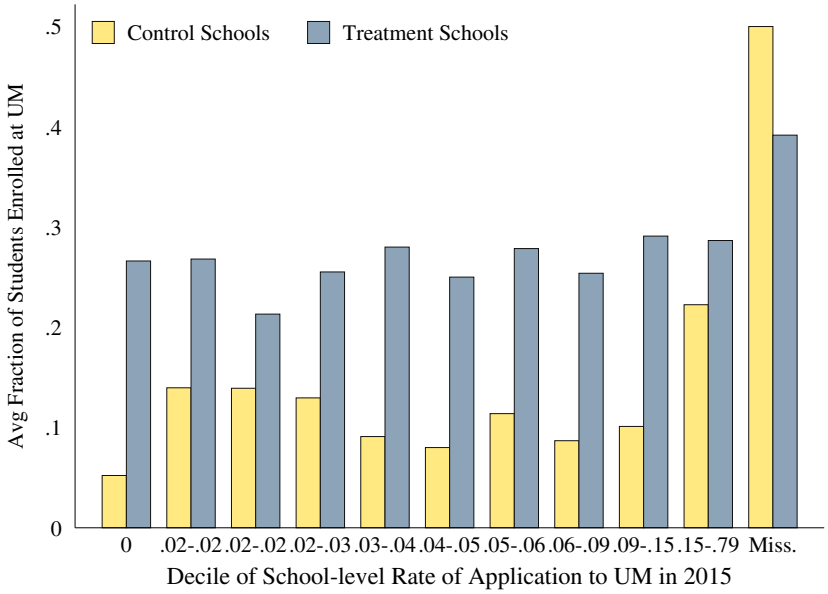
Source: Michigan administrative data and University of Michigan Office of Enrollment Management data.
Notes: Rates are race-specific school-year averages. Application, admission and enrollment measured in the summer and fall following expected high school graduation. Admission and enrollment are unconditional on application. 92% of HAIL schools have at least one white or Asian HAIL student; 20% have at least one black student and 19% have at least one student of another race or ethnicity. White and Asian students represent 85% of the sample; black students and students of another race or ethnicity represent 8% and 7%, respectively.

Figure 11
Estimated Effect of HAIL Scholarship on Application and Enrollment to UM by Prior School-Level Application Rate to UM (First and Second HAIL Cohorts)

(a) Applied



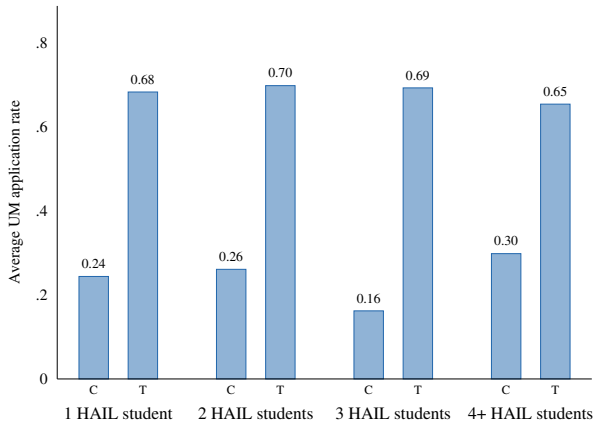
(b) Enrolled



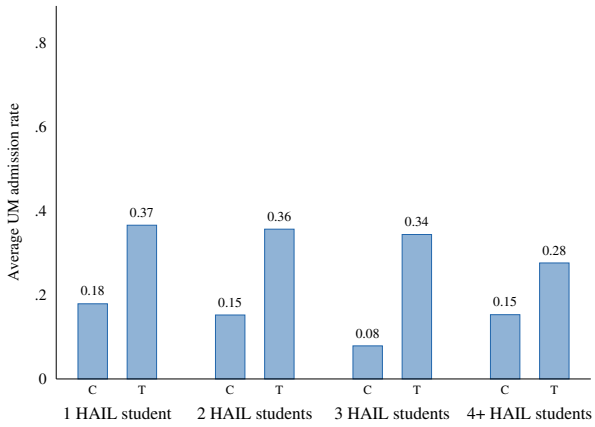
Source: Michigan administrative data and University of Michigan Office of Enrollment Management data.
Notes: All analyses done at the school-year level. Application and enrollment measured in the summer and fall following expected high school graduation. Enrollment is unconditional on application.

Figure 12
Estimated Effect of HAIL Scholarship on Application, Admission, and Enrollment to UM by Number of HAIL Students in School (First and Second HAIL Cohorts)

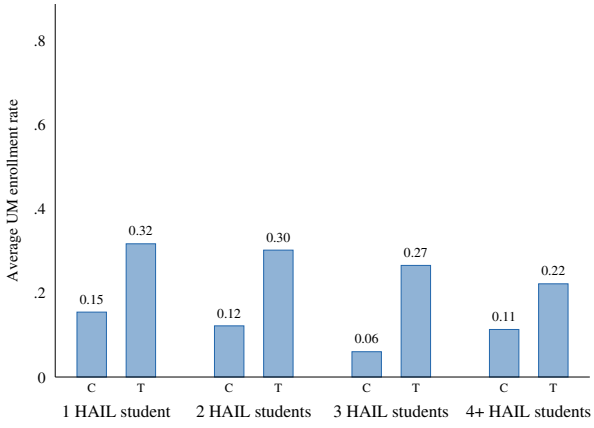
(a) Applied



(b) Admitted



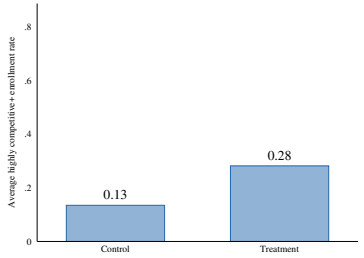
(c) Enrolled



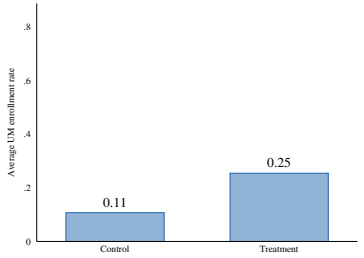
Source: Michigan administrative data and University of Michigan Office of Enrollment Management data.
Notes: All analyses done at the school-year level. Application, admission and enrollment measured in the summer and fall following expected high school graduation. Admission and enrollment are unconditional on application. Schools with 1 HAIL student make up 24% of sample, while schools with 2, 3, and 4 or more HAIL students represent 21%, 13%, and 42% of the sample, respectively.

Figure 13
Estimated Effect of HAIL Scholarship on College Choice (First and Second HAIL Cohorts)

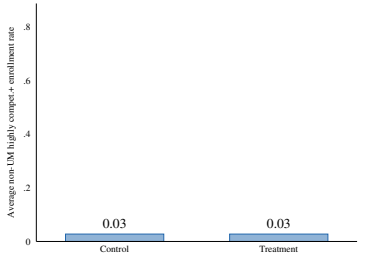
(a) Highly competitive or above



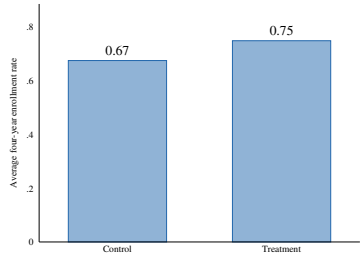
(b) UM



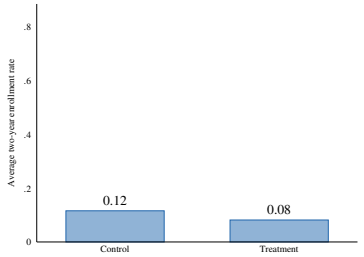
(c) Highly competitive or above other than UM



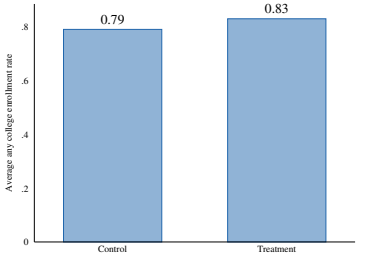
(d) Four-year



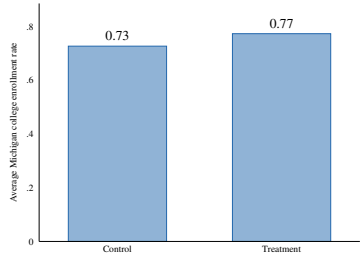
(e) Two-year



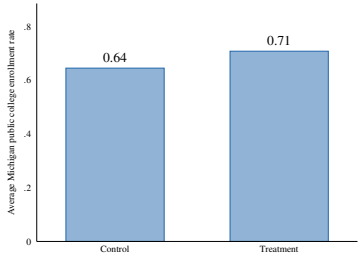
(f) Any



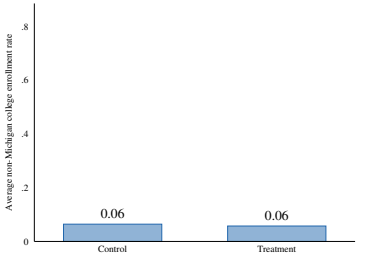
(g) In Michigan



(h) Michigan Public

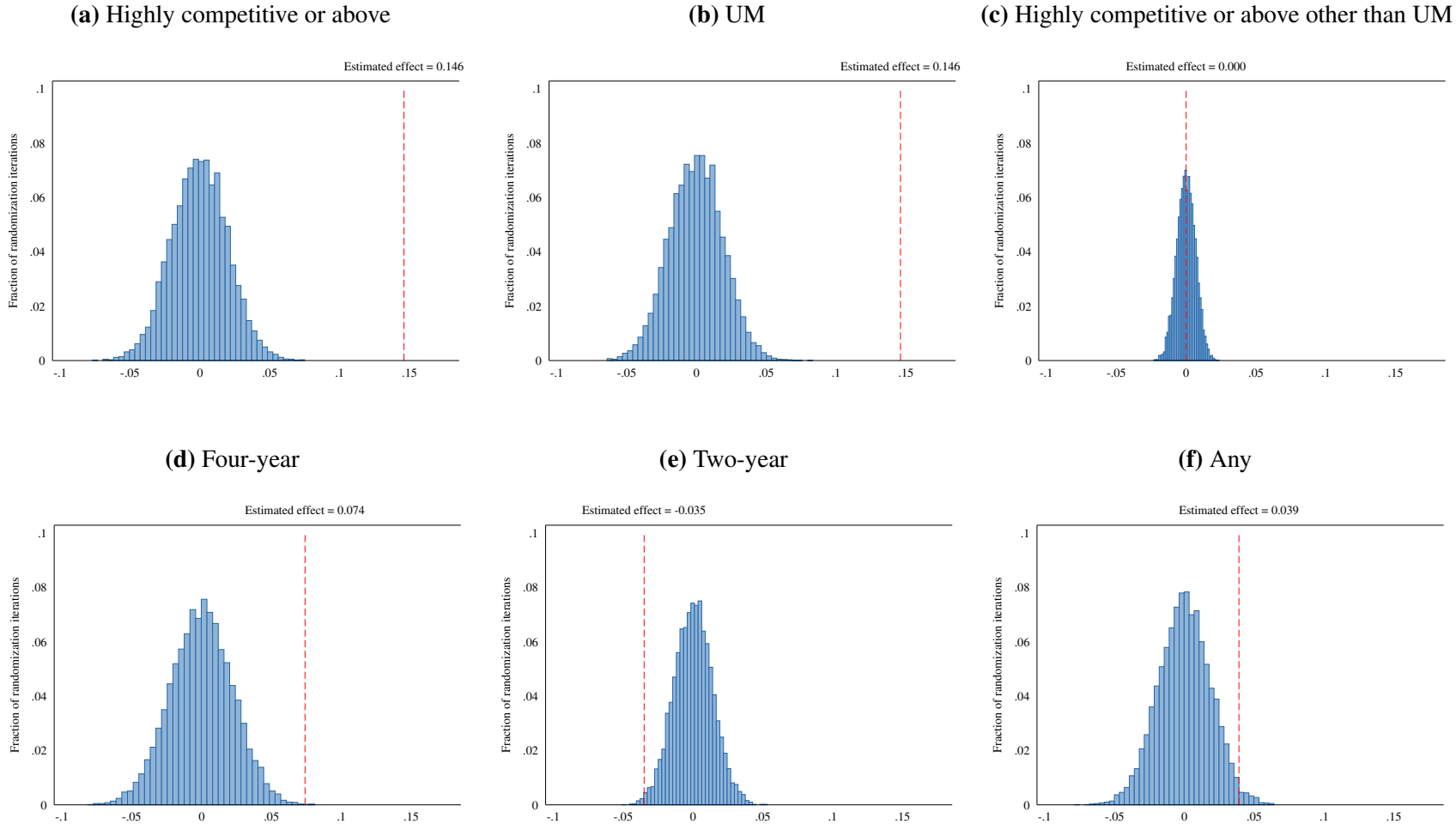


(i) Not in Michigan



Source: Michigan administrative data and National Student Clearinghouse data.
Notes: All analyses done at the school-year-level. Enrollment measured at the first institution attendend in the fall following expected high school graduation. Enrollment unconditional on any college enrollment.

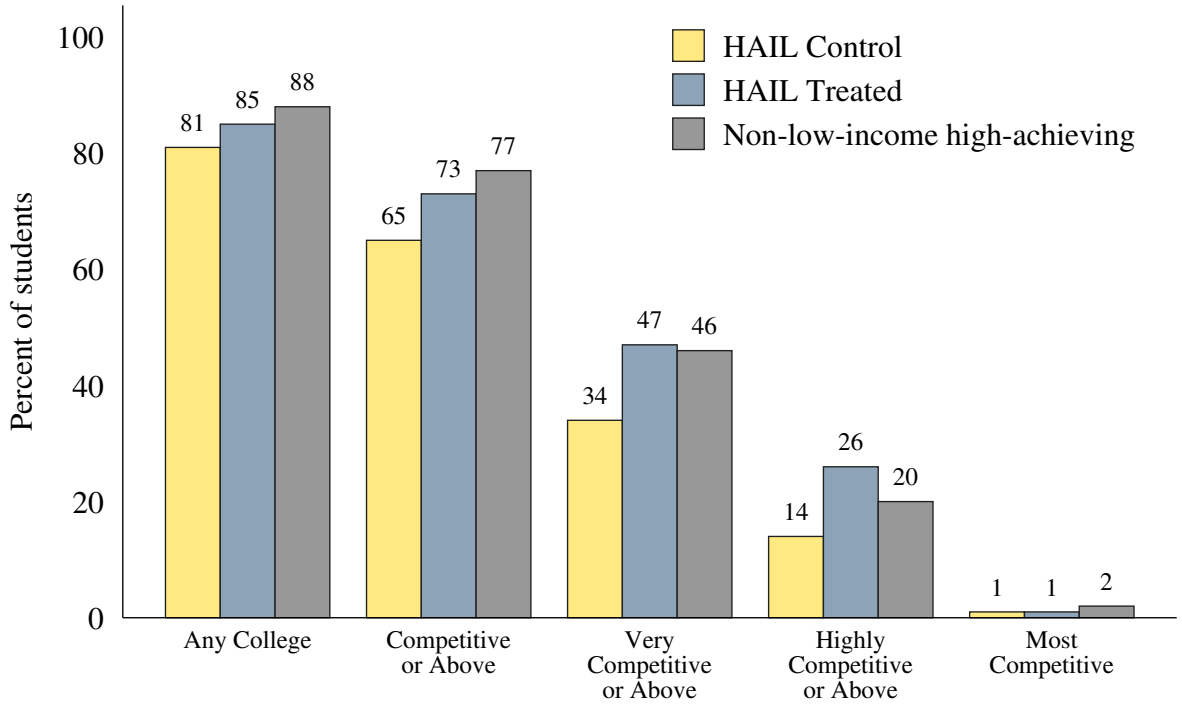
Figure 14
Randomization-Based Inference



Notes: Each simulated treatment effect comes from first randomly assigning schools to treatment using the same randomization algorithm used for true assignment, then running a regression of the outcome on ”treatment” status, including controls for strata. Exact p-value is calculated as the number of simulated effects greater in absolute value than the estimated effect.

Figure 15

Selectivity of Colleges Attended by High-Achieving Michigan Students, by Income and HAIL Treatment Status (First and Second HAIL Cohorts)



Source: Michigan administrative data and National Student Clearinghouse data.
Notes: Sample is 11th grade students in Michigan public schools in 2015 and 2016 who meet HAIL GPA and ACT/SAT criteria. College enrollment measured at first institution attended in fall following expected high school graduation. Low-income means eligible for free or reduced-price lunch in 11th grade. Selectivity categories from Barron's selectivity index.

Table 1

Characteristics of Selected Universities in Michigan

	University of Michigan	Michigan State University	Eastern Michigan University	Washtenaw Community College
Average annual cost for in-state students				
All students	$14,521	$16,788	$12,675	$6,148
Students with family income $30-48K	$6,561	$11,872	$10,791	$3,954
Graduation rate	0.90	0.78	0.38	0.16
Median salary after attending	$60,100	$51,500	$37,500	$27,200

Source: College Scorecard, https://collegescorecard.ed.gov, accessed May 31, 2018.

Notes: University of Michigan refers to the Ann Arbor campus. According to the Barron's selectivity index, University of Michigan is highly competitive, Michigan State is very competitive, Eastern Michigan is competitive, and Washtenaw Community College is not rated. Average annual cost represents "the average annual net price for federal financial aid recipients, after aid from the school, state, or federal government." The graduation rate for the four-year schools is proportion of first-time, full-time students who complete a bachelor's degree within six years; for Washetenaw Community College it is the proportion of first-time, full-time students who complete a two-year degree within three years. Median salary represents "the median earnings of former students who received federal financial aid, at 10 years after entering the school." (All quotes from College Scorecard).

Table 2

Balance Table: School Characteristics (First and Second HAIL Cohorts)

Characteristic	Mean		P-value
	Control schools	Treated schools	
Region, urbanicity, and distance			
Upper Peninsula	0.150	0.130	0.344
	(0.016)	(0.015)	
West Central	0.449	0.476	0.359
	(0.022)	(0.022)	
Southeast	0.401	0.394	0.788
	(0.021)	(0.022)	
Suburban	0.340	0.360	0.537
	(0.021)	(0.021)	
City	0.129	0.100	0.148
	(0.015)	(0.013)	
Rural	0.530	0.540	0.718
	(0.022)	(0.022)	
Distance from UM	93.2	96.4	0.529
	(3.545)	(3.673)	
Student demographic characteristics			
Proportion female	0.571	0.605	0.112
	(0.015)	(0.015)	
Proportion white or Asian	0.834	0.844	0.576
	(0.013)	(0.012)	
Proportion black	0.094	0.087	0.618
	(0.011)	(0.010)	
Proportion other race/ethnicity	0.072	0.069	0.803
	(0.009)	(0.008)	
Proportion free lunch eligible	0.709	0.692	0.459
	(0.014)	(0.015)	
Proportion reduced-price lunch eligible	0.291	0.308	0.459
	(0.014)	(0.015)	

Source: Michigan administrative data and University of Michigan Office of Enrollment Management data.

Notes: All analyses done at the school-year level. P-values are from a t-test of the coefficient on treatment status from a regression of the characteristic on treatment and strata dummies. F-test p-value is from a regression of treatment status on all characteristics and strata dummies; F-test tests all the school characteristics (not including strata) jointly. Robust standard errors reported. "Other race/ethnicity" includes Hispanic, American Indian or Alaska Native, and Native Hawaiian or other Pacific Islander students.

Table 2 (cont.)

Balance Table: School Characteristics (First and Second HAIL Cohorts)

	Mean		
	Control schools	Treated schools	P-value
Student academic characteristics			
Average SAT (or equivalent)	1254	1260	0.194
	(2.690)	(2.896)	
Average GPA	3.823	3.833	0.208
	(0.006)	(0.006)	
Proportion limited English proficie	0.002	0.004	0.410
	(0.001)	(0.001)	
Proportion special ed	0.009	0.013	0.367
	(0.003)	(0.004)	
Proportion who sent ACT/SAT	0.365	0.377	0.695
scores to UM	(0.015)	(0.016)	
UM application rate in 2015	0.067	0.056	0.024
	(0.004)	(0.004)	
Missing 2015 app rate	0.004	0.020	0.015
	(0.003)	(0.006)	
School size			
# of 11th grade students in school	189.1	175.1	0.055
	(0.003)	(0.006)	
# of HAIL students in school	3.8	3.9	0.649
	(0.140)	(0.163)	
F-test for joint significance: p-value			0.0004
Number of schools	526	500	1026
Number of students	1978	1932	3910

Source: Michigan administrative data and University of Michigan Office of Enrollment Management data.

Notes: All analyses done at the school-year level. P-values are from a t-test of the coefficient on treatment status from a regression of the characteristic on treatment and strata dummies. F-test p-value is from a regression of treatment status on all characteristics and strata dummies; F-test tests all the school characteristics (not including strata) jointly. Robust standard errors reported. "Other race/ethnicity" includes Hispanic, American Indian or Alaska Native, and Native Hawaiian or other Pacific Islander students.

Table 3

Estimated Effect of HAIL Scholarship on Application, Admission, and Enrollment to UM (First and Second HAIL Cohorts)

Outcome	Treatment effect		Control mean
Applied	0.416	0.413	0.259
	(0.021)	(0.019)	
Admitted	0.174	0.163	0.149
	(0.019)	(0.017)	
Enrolled	0.149	0.141	0.117
	(0.018)	(0.016)	
Strata dummies	X	X	
Covariates		X	
Number of schools	1,026		
Number of students	3910		

Source: Michigan administrative data and University of Michigan Office of Enrollment Management data.

Notes: All analyses done at the school-year level. Covariates include all characteristics listed in Table 2. Robust standard errors reported. Application, admission and enrollment measured in the summer and fall following expected high school graduation. Admission and enrollment are unconditional on application.

Table 4

Estimated Effect of HAIL Scholarship on Application, Admission, and Enrollment to UM by High School Geography (First and Second HAIL Cohorts)

Panel A. Region			
	Southeast	West Central	Upper Peninsula
Applied	0.369	0.462	0.398
	(0.031)	(0.029)	(0.059)
	[0.363]	[0.2]	[0.156]
Admitted	0.156	0.185	0.187
	(0.031)	(0.026)	(0.054)
	[0.202]	[0.116]	[0.105]
Enrolled	0.142	0.151	0.176
	(0.029)	(0.024)	(0.051)
	[0.167]	[0.085]	[0.08]
Number of schools	408	474	144
Number of students	1848	1646	416
Panel B. Urbanicity			
	Suburb	City	Town/Rural
Applied	0.381	0.296	0.483
	(0.031)	(0.063)	(0.028)
	[0.335]	[0.464]	[0.159]
Admitted	0.156	0.057	0.225
	(0.029)	(0.067)	(0.026)
	[0.164]	[0.319]	[0.097]
Enrolled	0.133	0.114	0.181
	(0.027)	(0.061)	(0.024)
	[0.14]	[0.221]	[0.078]
Number of schools	359	118	549
Number of students	1784	530	1596

Source: Michigan administrative data and University of Michigan Office of Enrollment Management data.
Notes: All analyses done at the school-year level. Coefficients are from separate regressions of outcome on treatment status and strata dummies, estimated on the subgroup. Robust standard errors reported in parentheses.Control mean for subgroup in brackets. Application, admission and enrollment measured in the summer and fall following expected high school graduation. Admission and enrollment are unconditional on application.

Table 5

Estimated Effect of HAIL Scholarship on Application, Admission, and Enrollment to UM by Selected Student Characteristics (First and Second HAIL Cohorts)

Panel A. Gender

	Male	Female
Applied	0.398	0.418
	(0.028)	(0.025)
	[0.286]	[0.239]
Admitted	0.138	0.188
	(0.024)	(0.022)
	[0.139]	[0.143]
Enrolled	0.114	0.163
	(0.022)	(0.021)
	[0.105]	[0.115]
Number of schools	729	855
Number of students	1637	2273

Panel B. Race/Ethnicity

	White or Asian	Black	Other
Applied	0.434	0.250	0.242
	(0.022)	(0.060)	(0.068)
	[0.234]	[0.478]	[0.393]
Admitted	0.181	0.070	0.043
	(0.019)	(0.059)	(0.062)
	[0.129]	[0.283]	[0.258]
Enrolled	0.153	0.034	0.072
	(0.018)	(0.055)	(0.058)
	[0.103]	[0.234]	[0.199]
Number of schools	948	206	191
Number of students	3312	330	268

Source: Michigan administrative data and University of Michigan Office of Enrollment Management data.
Notes: All analyses done at the school-year level. Coefficients are from separate regressions of school-subgroup-level outcome rate on treatment status and strata dummies. Robust standard errors reported in parentheses. Control mean for subgroup in brackets. UM application, admission and enrollment measured in the summer and fall following expected high school graduation. Admission and enrollment are unconditional on application.

Table 5 (cont.)

Estimated Effect of HAIL Scholarship on Application, Admission, and Enrollment to UM by Selected Student Characteristics (First and Second HAIL Cohorts)

Panel C. Free or Reduced-Price Lunch Eligibility

	Free Lunch	Reduced-Price
Applied	0.416	0.406
	(0.023)	(0.032)
	[0.27]	[0.245]
Admitted	0.169	0.138
	(0.021)	(0.028)
	[0.151]	[0.146]
Enrolled	0.145	0.108
	(0.020)	(0.026)
	[0.116]	[0.118]
Number of schools	923	607
Number of students	2748	1162

Panel D. Pre-Treatment Interest in UM

	Sent ACT/SAT Scores to UM	Did Not Send Scores to UM
Applied	0.370	0.431
	(0.029)	(0.023)
	[0.421]	[0.161]
Admitted	0.168	0.163
	(0.030)	(0.019)
	[0.255]	[0.081]
Enrolled	0.156	0.138
	(0.028)	(0.018)
	[0.199]	[0.059]
Number of schools	663	882
Number of students	1514	2396

Source: Michigan administrative data and University of Michigan Office of Enrollment Management data.
Notes: All analyses done at the school-year level. Coefficients are from separate regressions of school-subgroup-level outcome rate on treatment status and strata dummies. Robust standard errors reported in parentheses. Control mean for subgroup in brackets. UM application, admission and enrollment measured in the summer and fall following expected high school graduation. Admission and enrollment are unconditional on application.

Table 6

Estimated Effect of HAIL Scholarship on Application, Admission, and Enrollment to UM by Historical School Connection to UM and Number of HAIL Students (First and Second HAIL Cohorts)

	Percentile of interacted variable			P-value on interaction term
	25th	Median	75th	
Panel A. Prior School-Level UM Application Rate				
Estimated treatment effect				
Applied	0.464	0.445	0.414	0.000
Admitted	0.195	0.188	0.177	0.161
Enrolled	0.164	0.16	0.153	0.365
Prior application rate at percentile	0.019	0.038	0.071	
Panel B. Prior School-Level UM Enrollment Rate				
Estimated treatment effect				
Applied	0.48	0.445	0.407	0.000
Admitted	0.198	0.187	0.176	0.14
Enrolled	0.169	0.16	0.151	0.249
Prior enrollment rate at percentile	0	0.013	0.027	
Panel C. Number of HAIL Students in School				
Estimated treatment effect				
Applied	0.445	0.429	0.396	0.001
Admitted	0.19	0.181	0.163	0.036
Enrolled	0.165	0.156	0.139	0.032
# of HAIL students at percentile	2	3	5	

Source: Michigan administrative data and University of Michigan Office of Enrollment Management data.
Notes: All analyses done at the school-year level. Results are from a regression of the outcome on treatment, the named variable, the interaction of the two, and strata dummies. Robust standard errors estimated. Estimated treatment effects at percentiles calculated by adding the estimated coefficient on treatment to the product of the estimated interaction term and the value of the interacted variable at the percentile. Prior UM application rate and enrollment rates are for the graduating class of 2015.

Table 7

Estimated Effect of HAIL Scholarship on College Choice (First and Second HAIL Cohorts)

College attended	Treatment effect	Control mean
Highly competitive or above	0.146	0.135
	(0.018)	
UM	0.146	0.107
	(0.017)	
Highly competitive or above other than UM	0.000	0.028
	(0.007)	
Four-year	0.074	0.675
	(0.020)	
Two-year	-0.035	0.116
	(0.013)	
Any	0.039	0.791
	(0.018)	
In Michigan	0.045	0.727
	(0.020)	
Public in Michigan	0.062	0.645
	(0.021)	
Outside Michigan	-0.006	0.064
	(0.010)	
Number of schools	1,026	
Number of students	3,910	

Source: Michigan administrative data and National Student Clearinghouse data.
Notes: All analyses done at the school-year level. Coefficients are from regressions of outcome on treatment status and strata dummies. Robust standard errors reported. Enrollment is measured at the first college attended in the fall following expected high school graduation and is unconditional on any college enrollment.

Table 8

Estimated Effect of HAIL Scholarship on College Choice by Selected School and Student Characteristics (First and Second HAIL Cohorts)

Panel A. Region			
	Southeast	West Central	Upper Peninsula
Highly competitive or above	0.129	0.163	0.160
	(0.030)	(0.024)	(0.052)
	[0.199]	[0.092]	[0.091]
UM	0.133	0.155	0.167
	(0.029)	(0.022)	(0.052)
	[0.162]	[0.068]	[0.078]
Four-year	0.041	0.114	0.037
	(0.029)	(0.031)	(0.060)
	[0.774]	[0.579]	[0.697]
Any	0.024	0.045	0.061
	(0.026)	(0.027)	(0.055)
	[0.84]	[0.758]	[0.757]
Number of schools	408	474	144
Number of students	1848	1646	416
Panel B. Urbanicity			
	Suburb	City	Town/Rural
Highly competitive or above	0.136	0.079	0.181
	(0.029)	(0.063)	(0.024)
	[0.163]	[0.249]	[0.088]
UM	0.126	0.078	0.187
	(0.027)	(0.058)	(0.023)
	[0.139]	[0.203]	[0.063]
Four-year	0.039	0.007	0.103
	(0.030)	(0.064)	(0.030)
	[0.746]	[0.704]	[0.622]
Any	0.014	0.018	0.053
	(0.027)	(0.056)	(0.026)
	[0.838]	[0.783]	[0.762]
Number of schools	359	118	549
Number of students	1784	530	1596

Source: Michigan administrative data and National Student Clearinghouse data.

Notes: All analyses done at the school-year level. For Panels A and B, coefficients are from separate regressions of outcome on treatment status and strata dummies, estimated on the subgroup. For Panels C and D, coefficients are from separate regressions of school-subgroup-level outcome rate on treatment status and strata dummies. Robust standard errors reported in parentheses. Control mean for subgroup in brackets. Enrollment is measured at the first college attended in the fall following expected high school graduation and is unconditional on any college enrollment.

Table 8 (cont.)

Estimated Effect of HAIL Scholarship on College Choice by Selected School and Student Characteristics (First and Second HAIL Cohorts)

Panel C. Gender

	Male	Female
Highly competitive or above	0.110	0.167
	(0.023)	(0.021)
	[0.135]	[0.125]
UM	0.112	0.161
	(0.022)	(0.020)
	[0.1]	[0.104]
Four-year	0.073	0.086
	(0.027)	(0.025)
	[0.672]	[0.671]
Any	0.029	0.055
	(0.023)	(0.021)
	[0.798]	[0.793]
Number of schools	729	855
Number of students	1637	2273

Panel D. Race/Ethnicity

	White or Asian	Black	Other
Highly competitive or above	0.151	0.061	0.082
	(0.018)	(0.057)	(0.057)
	[0.119]	[0.272]	[0.179]
UM	0.150	0.018	0.079
	(0.017)	(0.052)	(0.056)
	[0.096]	[0.214]	[0.167]
Four-year	0.072	-0.041	0.167
	(0.022)	(0.055)	(0.064)
	[0.675]	[0.792]	[0.593]
Any	0.031	-0.062	0.121
	(0.018)	(0.049)	(0.055)
	[0.801]	[0.848]	[0.716]
Number of schools	948	206	191
Number of students	3312	330	268

Source: Michigan administrative data and National Student Clearinghouse data.

Notes: All analyses done at the school-year level. For Panels A and B, coefficients are from separate regressions of outcome on treatment status and strata dummies, estimated on the subgroup. For Panels C and D, coefficients are from separate regressions of school-subgroup-level outcome rate on treatment status and strata dummies. Robust standard errors reported in parentheses. Control mean for subgroup in brackets. Enrollment is measured at the first college attended in the fall following expected high school graduation and is unconditional on any college enrollment.

Table 9

Estimated Effect of HAIL Scholarship on College Persistence (First HAIL Cohort)

	Attended fall following high school graduation		Attended two consecutive falls following high school	
College attended	Treatment effect	Control mean	Treatment effect	Control mean
Highly competitive or above	0.153	0.129	0.135	0.126
	(0.024)		(0.023)	
UM	0.147	0.104	0.128	0.102
	(0.022)		(0.022)	
Four-year	0.091	0.651	0.109	0.557
	(0.028)		(0.029)	
Any	0.057	0.779	0.079	0.683
	(0.025)		(0.027)	
Number of schools	529			
Number of students	2108			

Source: Michigan administrative data and National Student Clearinghouse data.

Notes: All analyses done at the school-year level. Coefficients are from regressions of outcome on treatment status and strata dummies. Robust standard errors reported. Enrollment is measured at the first college attended in the two falls following expected high school graduation and is unconditional on any college enrollment.

Table 10

Estimated Effect of HAIL Scholarship on College Persistence by Selected School and Student Characteristics (First HAIL Cohort)

Panel A. Region			
	Southeast	West Central	Upper Peninsula
Highly competitive or above	0.127	0.148	0.132
	(0.039)	(0.029)	(0.067)
	[0.183]	[0.089]	[0.091]
UM	0.113	0.144	0.125
	(0.037)	(0.028)	(0.066)
	[0.145]	[0.07]	[0.091]
Four-year	0.091	0.146	0.046
	(0.042)	(0.043)	(0.083)
	[0.667]	[0.462]	[0.563]
Any	0.084	0.085	0.053
	(0.038)	(0.041)	(0.080)
	[0.746]	[0.632]	[0.676]
Number of schools	204	247	78
Number of students	951	927	230
Panel B. Urbanicity			
	Suburb	City	Town/Rural
Highly competitive or above	0.160	0.016	0.150
	(0.035)	(0.085)	(0.031)
	[0.115]	[0.267]	[0.1]
UM	0.129	-0.006	0.161
	(0.033)	(0.079)	(0.030)
	[0.096]	[0.234]	[0.076]
Four-year	0.112	0.057	0.118
	(0.044)	(0.085)	(0.042)
	[0.623]	[0.646]	[0.498]
Any	0.109	0.050	0.067
	(0.041)	(0.072)	(0.040)
	[0.722]	[0.739]	[0.648]
Number of schools	179	60	290
Number of students	930	284	894

Source: Michigan administrative data and National Student Clearinghouse data.

Notes: All analyses done at the school-year level. For Panels A and B, coefficients are from separate regressions of outcome on treatment status and strata dummies, estimated on the subgroup. For Panels C and D, coefficients are from separate regressions of school-subgroup-level outcome rate on treatment status and strata dummies. Robust standard errors reported in parentheses. Control mean for subgroup in brackets. Enrollment is measured at the first college attended in the two falls following expected high school graduation and is unconditional on any college enrollment.

Table 10 (cont.)

Estimated Effect of HAIL Scholarship on College Persistence by Selected School and Student Characteristics (First HAIL Cohort)

Panel C. Gender

	Male	Female
Highly competitive or above	0.120	0.150
	(0.030)	(0.028)
	[0.118]	[0.115]
UM	0.119	0.136
	(0.029)	(0.026)
	[0.091]	[0.098]
Four-year	0.116	0.112
	(0.039)	(0.036)
	[0.561]	[0.56]
Any	0.030	0.105
	(0.036)	(0.032)
	[0.71]	[0.682]
Number of schools	384	441
Number of students	883	1225

Panel D. Race/Ethnicity

	White or Asian	Black	Other
Highly competitive or above	0.145	0.100	0.051
	(0.024)	(0.076)	(0.072)
	[0.11]	[0.221]	[0.183]
UM	0.100	0.051	0.142
	(0.076)	(0.072)	(0.023)
	[0.221]	[0.183]	[0.09]
Four-year	0.105	-0.018	0.089
	(0.031)	(0.089)	(0.090)
	[0.552]	[0.695]	[0.497]
Any	0.072	-0.014	0.047
	(0.029)	(0.080)	(0.086)
	[0.687]	[0.757]	[0.615]
Number of schools	496	100	114
Number of students	1786	165	157

Source: Michigan administrative data and National Student Clearinghouse data.

Notes: All analyses done at the school-year level. For Panels A and B, coefficients are from separate regressions of outcome on treatment status and strata dummies, estimated on the subgroup. For Panels C and D, coefficients are from separate regressions of school-subgroup-level outcome rate on treatment status and strata dummies. Robust standard errors reported in parentheses. Control mean for subgroup in brackets. Enrollment is measured at the first college attended in the two falls following expected high school graduation and is unconditional on any college enrollment.

Table 11

Estimated Spillover Effect of HAIL Scholarship on Application, Admission, and Enrollment to UM for non-HAIL Students, Controlling for Historical Rates (First and Second HAIL cohorts)

	(1)	(2)	(3)
Panel A. Application			
Treatment Effect on non-HAIL students	-0.011	-0.000	0.001
	(0.005)	(0.002)	(0.002)
R-squared	0.030	0.852	0.870
Strata dummies	X	X	X
2015 application rate		X	X
2009-2014 application rates			X
Panel B. Admission			
Treatment Effect on non-HAIL students	-0.005	-0.000	0.000
	(0.003)	(0.001)	(0.001)
R-squared	0.024	0.782	0.828
Strata dummies	X	X	X
2015 admission rate		X	X
2009-2014 admission rates			X
Panel C. Enrollment			
Treatment Effect on non-HAIL students	-0.004	-0.000	0.000
	(0.002)	(0.001)	(0.001)
R-squared	0.022	0.725	0.770
Strata dummies	X	X	X
2015 enrollment rate		X	X
2009-2014 enrollment rates			X
Number of schools		1,025	

Source: Michigan administrative data and University of Michigan Office of Enrollment Management data.

Notes: All analyses done at the school-year level. Coefficients are from regression of outcome rate for non-HAIL eligible students on treatment status and strata dummies, plus controls as indicated. Schools missing historical rates are assigned values of zero, and regressions include missingness indicators. Robust standard errors reported in parentheses.

Table 12

Randomization-Based Inference on College Choice Outcomes (First and Second HAIL Cohorts)

College Attended	Estimated treatment effect	Simulated treatment effects (10,000 iterations)				# greater than estim. effect	Randomiz.-based p-value	Sampling-based p-value
		Mean	Std. Dev.	Min	Max			
Highly competitive or above	0.146	0.000	0.020	-0.077	0.075	0	0.000	0.000
UM	0.146	0.000	0.019	-0.064	0.083	0	0.000	0.000
Highly competitive or above other than U	0.000	0.000	0.007	-0.023	0.024	9,809	0.981	0.981
Four-year	0.074	0.000	0.022	-0.082	0.081	11	0.001	0.000
Two-year	-0.035	0.000	0.014	-0.051	0.053	112	0.011	0.007
Any	0.039	0.000	0.019	-0.079	0.064	385	0.039	0.031
In Michigan	0.045	0.000	0.020	-0.084	0.084	265	0.027	0.021
Public in Michigan	0.062	0.000	0.021	-0.085	0.086	30	0.003	0.003
Outside Michigan	-0.006	0.000	0.010	-0.036	0.036	5,432	0.543	0.531

Source: Michigan administrative data and National Student Clearinghouse data.

Notes: Each simulated treatment effect comes from first randomly assigning schools to treatment using the same randomization algorithm used for true assignment, then running a regression of the outcome on "treatment" status, including controls for strata. Exact p-value is calculated as the number of simulated effects greater in absolute value than the estimated effect.

Appendix Table 1

Number of Students in Schools in Treatment and Control group, by Cohort

	Number of schools	Number of students
First cohort		
Treatment	262	1057
Control	267	1051
Total Y1	529	2108
Second cohort		
Treatment (from Y1)	211	832
Treatment (newly randomized)	27	43
Treated in Y1, no HAIL students in Y2	51	-
Total Treatment	238	875
Control (from Y1)	227	867
Control (newly randomized)	32	60
Control in Y1, no HAIL students in Y2	40	-
Total Control	259	927
Total Y2	497	1802

Source: Michigan administrative data.

Appendix Table 2

Balance Table: School Characteristics by Subgroup (First and Second HAIL Cohorts)

	Upper Peninsula			West Central			Southeast		
	Control	Treatment	P-value	Control	Treatment	P-value	Control	Treatment	P-value
Upper Peninsula	-	-	-	-	-	-	-	-	-
West Central	-	-	-	-	-	-	-	-	-
Southeast	-	-	-	-	-	-	-	-	-
Suburban	0.000	0.000	-	0.157	0.176	0.429	0.673	0.701	0.944
				(0.024)	(0.025)		(0.032)	(0.033)	
City	0.000	0.000	-	0.153	0.118	0.294	0.2	0.1	0.338
				(0.023)	(0.021)		(0.025)	(0.022)	
Rural	1.000	1.000	-	0.7	0.7	0.878	0.175	0.188	0.439
				(0.030)	(0.030)		(0.026)	(0.028)	
Distance from UM	243.3	268.1	0.139	97.5	98.8	0.544	32.2	36.7	0.004
	(9.872)	(10.240)		(2.138)	(2.155)		(1.044)	(1.110)	
Proportion female	0.569	0.615	0.369	0.563	0.593	0.365	0.580	0.617	0.215
	(0.041)	(0.048)		(0.023)	(0.024)		(0.024)	(0.022)	
Proportion white or Asian	0.894	0.904	0.818	0.868	0.861	0.774	0.772	0.803	0.472
	(0.028)	(0.027)		(0.016)	(0.017)		(0.025)	(0.022)	
Proportion black	0.034	0.019	0.434	0.052	0.055	0.802	0.165	0.148	0.734
	(0.016)	(0.016)		(0.010)	(0.011)		(0.022)	(0.020)	
Proportion other race/ethnicity	0.072	0.077	0.809	0.080	0.083	0.867	0.063	0.049	0.444
	(0.024)	(0.023)		(0.013)	(0.013)		(0.014)	(0.011)	
Proportion free lunch eligible	0.702	0.575	0.065	0.690	0.671	0.500	0.732	0.756	0.320
	(0.039)	(0.049)		(0.022)	(0.022)		(0.021)	(0.019)	
Proportion reduced-price lunch eligible	0.298	0.425	0.065	0	0	0.500	0.268	0.244	0.320
	(0.039)	(0.049)		(0.022)	(0.022)		(0.021)	(0.019)	
Average SAT (or equivalent)	1253	1252	0.846	1252	1257	0.318	1257	1265	0.252
	(7.340)	(8.268)		(4.033)	(4.094)		(4.145)	(4.696)	
Average GPA	3.846	3.850	0.813	3.831	3.837	0.659	3.806	3.822	0.170
	(0.018)	(0.017)		(0.008)	(0.008)		(0.009)	(0.009)	
Proportion limited English proficient	0.000	0.000	-	0.003	0.003	0.898	0.003	0.006	0.351
				(0.002)	(0.001)		(0.002)	(0.003)	
Proportion special ed	0.000	0.005	0.286	0.011	0.021	0.339	0.009	0.006	0.523
	(0.000)	(0.005)		(0.005)	(0.007)		(0.004)	(0.003)	
Proportion who sent ACT/SAT scores to UM	0.305	0.286	0.605	0.372	0.360	0.679	0.380	0.426	0.273
	(0.037)	(0.042)		(0.023)	(0.023)		(0.025)	(0.025)	
UM application rate in 2015	0.045	0.025	0.009	0.055	0.042	0.011	0.090	0.084	0.497
	(0.006)	(0.004)		(0.004)	(0.003)		(0.007)	(0.009)	
Missing 2015 app rate	0.013	0.000	0.335	0.000	0.013	0.080	0.005	0.036	0.023
	(0.013)	(0.000)		(0.000)	(0.007)		(0.005)	(0.013)	
# of 11th grade students in school	94.4	77.8	0.199	162.9	145.5	0.151	253.8	242.8	0.081
	(10.008)	(7.832)		(6.832)	(6.848)		(11.257)	(11.075)	
# of HAIL students in school	2.9	2.8	0.789	3.6	3.4	0.849	4.3	4.8	0.921
	(0.235)	(0.312)		(0.159)	(0.187)		(0.282)	(0.320)	
F-test for joint significance: p-value		0.000			0.000			0.000	
Number of schools	79	65	144	236	238	474	211	197	408
Number of students	231	185	416	842	804	1646	905	943	1848

Source: Michigan administrative data.

Notes: All analyses done at the school-year level. For region and urbancity subgroups, p-values are from a t-test of the coefficient on treatment status from a regression of the characteristic on treatment and strata dummies, estimated on the subgroup. For gender and race, p-values are from separate regressions of school-subgroup-level characteristic on treatment status and strata dummies. F-test p-values are from regressions of treatment status on all characteristics and strata dummies; F-test tests all the school characteristics (not including strata) jointly. Robust standard errors reported.

Appendix Table 2 (cont.)

Balance Table: School Characteristics by Subgroup (First and Second HAIL Cohorts)

	Suburb			City			Rural		
	Control	Treatment	P-value	Control	Treatment	P-value	Control	Treatment	P-value
Upper Peninsula	0.000	0.000	-	0.000	0.000	-	0.283	0.241	0.235
							(0.027)	(0.026)	
West Central	0.207	0.233	0.602	0.529	0.560	0.784	0.584	0.622	0.320
	(0.030)	(0.032)		(0.061)	(0.071)		(0.030)	(0.030)	
Southeast	0.793	0.767	0.602	0.471	0.440	0.784	0.133	0.137	0.917
	(0.030)	(0.032)		(0.061)	(0.071)		(0.020)	(0.021)	
Suburban	-	-	-	-	-	-	-	-	-
City	-	-	-	-	-	-	-	-	-
Rural	-	-	-	-	-	-	-	-	-
Distance from UM	46.8	52.3	0.150	65.1	64.5	0.829	129.9	131.6	0.856
	(2.484)	(2.570)		(5.258)	(4.996)		(5.485)	(5.695)	
Proportion female	0.557	0.620	0.054	0.574	0.575	0.975	0.579	0.601	0.424
	(0.025)	(0.021)		(0.042)	(0.052)		(0.022)	(0.023)	
Proportion white or Asian	0.845	0.810	0.132	0.574	0.574	0.835	0.890	0.916	0.156
	(0.021)	(0.021)		(0.049)	(0.059)		(0.015)	(0.012)	
Proportion black	0.104	0.151	0.037	0.308	0.212	0.115	0.036	0.022	0.186
	(0.018)	(0.020)		(0.049)	(0.048)		(0.009)	(0.007)	
Proportion other race/ethnicity	0.051	0.039	0.406	0.118	0.214	0.082	0.074	0.062	0.428
	(0.013)	(0.008)		(0.030)	(0.046)		(0.012)	(0.010)	
Proportion free lunch eligible	0.712	0.740	0.224	0.838	0.768	0.192	0.675	0.646	0.402
	(0.022)	(0.019)		(0.030)	(0.050)		(0.021)	(0.021)	
Proportion reduced-price lunch eligible	0.288	0.260	0.224	0.162	0.232	0.192	0.325	0.354	0.402
	(0.022)	(0.019)		(0.030)	(0.050)		(0.021)	(0.021)	
Average SAT (or equivalent)	1263	1268	0.833	1252	1250	0.875	1249	1256	0.174
	(4.380)	(4.683)		(7.296)	(9.939)		(3.804)	(3.935)	
Average GPA	3.788	3.820	0.013	3.828	3.841	0.671	3.845	3.839	0.594
	(0.010)	(0.009)		(0.016)	(0.024)		(0.008)	(0.008)	
Proportion limited English proficient	0.002	0.003	0.772	0.012	0.019	0.306	0.000	0.001	0.157
	(0.002)	(0.001)		(0.006)	(0.012)		(0.000)	(0.001)	
Proportion special ed	0.013	0.011	0.599	0.000	0.011	0.278	0.008	0.015	0.252
	(0.007)	(0.006)		(0.000)	(0.010)		(0.003)	(0.006)	
Proportion who sent ACT/SAT scores to UM	0.391	0.397	0.730	0.386	0.489	0.160	0.343	0.342	0.885
	(0.025)	(0.024)		(0.044)	(0.056)		(0.021)	(0.022)	
UM application rate in 2015	0.089	0.078	0.329	0.110	0.098	0.928	0.043	0.034	0.009
	(0.007)	(0.009)		(0.015)	(0.014)		(0.003)	(0.002)	
Missing 2015 app rate	0.006	0.028	0.062	0.000	0.040	0.151	0.004	0.011	0.300
	(0.006)	(0.012)		(0.000)	(0.028)		(0.004)	(0.006)	
# of 11th grade students in school	288	262.3	0.018	207.1	199.4	0.814	121.2	112.4	0.253
	(12.401)	(11.421)		(13.533)	(20.064)		(4.790)	(4.859)	
# of HAIL students in school	4.8	5.2	0.986	4.4	4.7	0.160	3	2.9	0.724
	(0.283)	(0.302)		(0.549)	(0.888)		(0.119)	(0.124)	
F-test for joint significance: p-value		0.000			0.002			0.000	
Number of schools	179	180	359	68	50	118	279	270	549
Number of students	852	932	1784	297	233	530	829	767	1596

Source: Michigan administrative data.

Notes: All analyses done at the school-year level. For region and urbancity subgroups, p-values are from a t-test of the coefficient on treatment status from a regression of the characteristic on treatment and strata dummies, estimated on the subgroup. For gender and race, p-values are from separate regressions of school-subgroup-level characteristic on treatment status and strata dummies. F-test p-values are from regressions of treatment status on all characteristics and strata dummies; F-test tests all the school characteristics (not including strata) jointly. Robust standard errors reported.

Appendix Table 2 (cont.)

Balance Table: School Characteristics by Subgroup (First and Second HAIL Cohorts)

	Male			Female		
	Control	Treatment	P-value	Control	Treatment	P-value
Upper Peninsula	0.150	0.121	0.294	0.144	0.118	0.267
	(0.018)	(0.017)		(0.017)	(0.016)	
West Central	0.446	0.451	0.837	0.449	0.456	0.813
	(0.026)	(0.027)		(0.024)	(0.024)	
Southeast	0.404	0.428	0.600	0.407	0.426	0.606
	(0.025)	(0.027)		(0.024)	(0.024)	
Suburban	0.360	0.405	0.293	0.343	0.400	0.083
	(0.025)	(0.026)		(0.023)	(0.024)	
City	0.129	0.098	0.174	0.134	0.095	0.065
	(0.017)	(0.016)		(0.016)	(0.014)	
Rural	0.512	0.497	0.893	0.523	0.506	0.637
	(0.026)	(0.027)		(0.024)	(0.024)	
Distance from UM	93.6	91.7	0.869	91.4	92.7	0.794
	(4.241)	(4.132)		(3.791)	(3.877)	
Proportion female	-	-	-	-	-	
Proportion white or Asian	0.864	0.853	0.547	0.832	0.837	0.736
	(0.015)	(0.017)		(0.015)	(0.015)	
Proportion black	0.066	0.061	0.794	0.096	0.101	0.839
	(0.011)	(0.011)		(0.012)	(0.012)	
Proportion other race/ethnicity	0.070	0.086	0.296	0.072	0.062	0.450
	(0.011)	(0.013)		(0.010)	(0.009)	
Proportion free lunch eligible	0.710	0.681	0.345	0.693	0.698	0.765
	(0.019)	(0.020)		(0.018)	(0.017)	
Proportion reduced-price lunch eligible	0.290	0.319	0.345	0.307	0.302	0.765
	(0.019)	(0.020)		(0.018)	(0.017)	
Average SAT (or equivalent)	1275	1278	0.697	1245	1249	0.393
	(3.565)	(4.102)		(3.184)	(3.324)	
Average GPA	3.778	3.786	0.466	3.851	3.855	0.566
	(0.008)	(0.009)		(0.006)	(0.006)	
Proportion limited English proficient	0.003	0.011	0.203	0.002	0.003	0.452
	(0.002)	(0.005)		(0.001)	(0.002)	
Proportion special ed	0.019	0.017	0.897	0.004	0.009	0.235
	(0.006)	(0.006)		(0.002)	(0.004)	
Proportion who sent ACT/SAT scores to UM	0.400	0.422	0.607	0.337	0.350	0.711
	(0.021)	(0.022)		(0.018)	(0.018)	
UM application rate in 2015	0.072	0.061	0.062	0.071	0.059	0.048
	(0.004)	(0.005)		(0.004)	(0.004)	
Missing 2015 app rate	0.003	0.009	0.262	0.002	0.021	0.009
	(0.003)	(0.005)		(0.002)	(0.007)	
# of 11th grade students in school	205	199.5	0.282	201.7	188.9	0.146
	(7.420)	(7.793)		(7.041)	(6.790)	
# of HAIL students in school	4.5	4.7	0.726	4.2	4.3	0.673
	(0.177)	(0.214)		(0.161)	(0.185)	
F-test for joint significance: p-value		0.132			0.000	
Number of schools	381	348	729	432	423	855
Number of students	853	784	1637	1125	1148	2273

Source: Michigan administrative data.

Notes: All analyses done at the school-year level. For region and urbancity subgroups, p-values are from a t-test of the coefficient on treatment status from a regression of the characteristic on treatment and strata dummies, estimated on the subgroup. For gender and race, p-values are from separate regressions of school-subgroup-level characteristic on treatment status and strata dummies. F-test p-values are from regressions of treatment status on all characteristics and strata dummies; F-test tests all the school characteristics (not including strata) jointly. Robust standard errors reported.

Appendix Table 2 (cont.)

Balance Table: School Characteristics by Subgroup (First and Second HAIL Cohorts)

	White or Asian			Black			Other race/ethnicity		
	Control	Treatment	P-value	Control	Treatment	P-value	Control	Treatment	P-value
Upper Peninsula	0.156	0.135	0.320	0.059	0.019	0.147	0.137	0.135	0.960
	(0.017)	(0.016)		(0.024)	(0.013)		(0.035)	(0.035)	
West Central	0.469	0.485	0.587	0.327	0.314	0.876	0.558	0.562	0.826
	(0.023)	(0.023)		(0.047)	(0.046)		(0.051)	(0.051)	
Southeast	0.375	0.380	0.874	0.614	0.667	0.486	0.305	0.302	0.842
	(0.022)	(0.022)		(0.049)	(0.046)		(0.047)	(0.047)	
Suburban	0.346	0.359	0.654	0.446	0.705	0.001	0.284	0.312	0.903
	(0.022)	(0.022)		(0.050)	(0.045)		(0.047)	(0.048)	
City	0.104	0.079	0.177	0.337	0.162	0.011	0.211	0.229	0.975
	(0.014)	(0.012)		(0.047)	(0.036)		(0.042)	(0.043)	
Rural	0.550	0.562	0.705	0.218	0.133	0.172	0.505	0.458	0.889
	(0.023)	(0.023)		(0.041)	(0.033)		(0.052)	(0.051)	
Distance from UM	95.6	97.7	0.721	66.2	58.1	0.383	96.7	102.5	0.534
	(3.728)	(3.827)		(6.827)	(4.231)		(7.448)	(8.397)	
Proportion female	0.562	0.604	0.061	0.636	0.718	0.153	0.575	0.512	0.452
	(0.016)	(0.016)		(0.044)	(0.040)		(0.049)	(0.047)	
Proportion white or Asian	-	-		-	-	-	-	-	-
Proportion black	-	-		-	-	-	-	-	-
Proportion other race/ethnicity	-	-		-	-	-	-	-	-
Proportion free lunch eligible	0.690	0.666	0.334	0.812	0.812	0.608	0.775	0.750	0.635
	(0.015)	(0.016)		(0.036)	(0.035)		(0.041)	(0.043)	
Proportion reduced-price lunch eligible	0.310	0.334	0.334	0.188	0.188	0.608	0.225	0.250	0.635
	(0.015)	(0.016)		(0.036)	(0.035)		(0.041)	(0.043)	
Average SAT (or equivalent)	1260	1264	0.358	1239	1250	0.270	1251	1237	0.169
	(2.978)	(3.004)		(7.360)	(6.799)		(8.325)	(8.473)	
Average GPA	3.822	3.831	0.270	3.812	3.791	0.540	3.802	3.841	0.126
	(0.006)	(0.006)		(0.016)	(0.018)		(0.019)	(0.017)	
Proportion limited English proficient	0.002	0.003	0.437	0.010	0.005	0.657	0.007	0.005	0.786
	(0.001)	(0.001)		(0.010)	(0.005)		(0.007)	(0.005)	
Proportion special ed	0.009	0.013	0.438	0.005	0.014	0.550	0.011	0.016	0.595
	(0.003)	(0.004)		(0.005)	(0.011)		(0.011)	(0.012)	
Proportion who sent ACT/SAT scores to UM	0.369	0.374	0.919	0.457	0.384	0.118	0.410	0.419	0.902
	(0.016)	(0.017)		(0.046)	(0.043)		(0.049)	(0.048)	
UM application rate in 2015	0.068	0.055	0.013	0.090	0.086	0.713	0.073	0.059	0.100
	(0.004)	(0.004)		(0.010)	(0.014)		(0.009)	(0.007)	
Missing 2015 app rate	0.004	0.015	0.089	0.000	0.029	0.068	0.000	0.010	0.342
	(0.003)	(0.006)		(0.000)	(0.016)		(0.000)	(0.010)	
# of 11th grade students in school	193	179	0.095	234.1	264	0.364	205.2	227.1	0.467
	(6.640)	(6.365)		(12.684)	(16.545)		(12.777)	(0.000)	
# of HAIL students in school	4	4	0.634	4.8	5.8	0.264	4.8	6.1	0.068
	(0.149)	(0.171)		(0.341)	(0.503)		(0.307)	(0.584)	
F-test for joint significance: p-value		0.007			0.006			0.233	
Number of schools	480	468	948	101	105	206	95	96	191
Number of students	1688	1624	3312	162	168	330	128	140	268

Source: Michigan administrative data.

Notes: All analyses done at the school-year level. For region and urbancity subgroups, p-values are from a t-test of the coefficient on treatment status from a regression of the characteristic on treatment and strata dummies, estimated on the subgroup. For gender and race, p-values are from separate regressions of school-subgroup-level characteristic on treatment status and strata dummies. F-test p-values are from regressions of treatment status on all characteristics and strata dummies; F-test tests all the school characteristics (not including strata) jointly. Robust standard errors reported.

Appendix Table 3

Estimated Effect of HAIL Scholarship on Application, Admission, and Enrollment to UM by High School Geography, With Covariates (First and Second HAIL

Panel A. Region

	Southeast		West Central		Upper Peninsula	
Applied	0.369	0.360	0.462	0.462	0.398	0.415
	(0.031)	(0.031)	(0.029)	(0.027)	(0.059)	(0.056)
	[0.363]		[0.2]		[0.156]	
Admitted	0.156	0.128	0.185	0.176	0.187	0.215
	(0.031)	(0.027)	(0.026)	(0.024)	(0.054)	(0.050)
	[0.202]		[0.116]		[0.335]	
Enrolled	0.142	0.119	0.151	0.144	0.176	0.198
	(0.029)	(0.026)	(0.024)	(0.023)	(0.051)	(0.049)
	[0.167]		[0.085]		[0.08]	
Covariates		X		X		X
Number of schools		408		474		144
Number of students		1848		1646		416

Panel B. Urbanicity

	Suburb		City		Town/Rural	
Applied	0.381	0.366	0.296	0.276	0.483	0.483
	(0.031)	(0.030)	(0.063)	(0.061)	(0.028)	(0.027)
	[0.335]		[0.464]		[0.159]	
Admitted	0.156	0.119	0.057	0.000	0.225	0.221
	(0.029)	(0.025)	(0.067)	(0.057)	(0.026)	(0.024)
	[0.164]		[0.319]		[0.097]	
Enrolled	0.133	0.101	0.114	0.078	0.181	0.180
	(0.027)	(0.024)	(0.061)	(0.051)	(0.024)	(0.023)
	[0.14]		[0.221]		[0.078]	
Covariates		X		X		X
Number of schools		359		118		549
Number of students		1784		530		1596

Source: Michigan administrative data and University of Michigan Office of Enrollment Management data.

Notes: All analyses done at the school-year level. Coefficients are from separate regressions of outcome on treatment status and strata dummies, estimated on the subgroup. Covariates include all characteristics listed in Table 2. Robust standard errors reported in parentheses. Control mean for subgroup in brackets. Application, admission and enrollment measured in the summer and fall following expected high school graduation. Admission and enrollment are unconditional on application.

Appendix Table 4

Estimated Effect of HAIL Scholarship on Application, Admission, and Enrollment to UM by Selected Student Characteristics, with Covariates (First and Second HAIL Cohorts)

Panel A. Gender

	Male		Female	
Applied	0.398	0.395	0.418	0.415
	(0.028)	(0.027)	(0.025)	(0.023)
	[0.286]		[0.239]	
Admitted	0.138	0.131	0.188	0.184
	(0.024)	(0.022)	(0.022)	(0.020)
	[0.139]		[0.143]	
Enrolled	0.114	0.110	0.163	0.164
	(0.022)	(0.021)	(0.021)	(0.020)
	[0.105]		[0.115]	
Covariates		X		X
Number of schools		729		855
Number of students		1637		2273

Panel B. Race/Ethnicity

	White or Asian		Black		Other	
Applied	0.434	0.433	0.250	0.285	0.242	0.259
	(0.022)	(0.021)	(0.060)	(0.063)	(0.068)	(0.064)
	[0.234]		[0.478]		[0.393]	
Admitted	0.181	0.172	0.070	0.097	0.043	0.053
	(0.019)	(0.017)	(0.059)	(0.056)	(0.062)	(0.063)
	[0.129]		[0.283]		[0.258]	
Enrolled	0.153	0.147	0.034	0.043	0.072	0.083
	(0.018)	(0.016)	(0.055)	(0.052)	(0.058)	(0.060)
	[0.103]		[0.234]		[0.199]	
Covariates		X		X		X
Number of schools		948		206		191
Number of students		3312		330		268

Source: Michigan administrative data and University of Michigan Office of Enrollment Management data.
Notes: All analyses done at the school-year level. Coefficients are from separate regressions of school-subgroup-level outcome rate on treatment status and strata dummies. Covariates include all characteristics listed in Table 2 and are at the school-subgroup level. Robust standard errors reported in parentheses. Control mean for subgroup in brackets. UM application, admission and enrollment measured in the summer and fall following expected high school graduation. Admission and enrollment are unconditional on application.

Appendix Table 4 (cont.)

Estimated Effect of HAIL Scholarship on Application, Admission, and Enrollment to UM by Selected Student Characteristics, with Covariates (First and Second HAIL Cohorts)

Panel C. Free or Reduced-Price Lunch Eligibility

	Free Lunch		Reduced-Price	
Applied	0.416	0.414	0.406	0.405
	(0.023)	(0.022)	(0.032)	(0.030)
	[0.27]		[0.245]	
Admitted	0.169	0.159	0.138	0.132
	(0.021)	(0.019)	(0.028)	(0.026)
	[0.151]		[0.146]	
Enrolled	0.145	0.138	0.108	0.105
	(0.020)	(0.018)	(0.026)	(0.024)
	[0.116]		[0.118]	
Covariates		X		X
Number of schools	923		607	
Number of students	2748		1162	

Panel D. Pre-Treatment Interest in UM

	Sent ACT/SAT		Did Not Send Scores	
Applied	0.370	0.366	0.431	0.430
	(0.029)	(0.028)	(0.023)	(0.022)
	[0.421]		[0.161]	
Admitted	0.168	0.156	0.163	0.157
	(0.030)	(0.027)	(0.019)	(0.018)
	[0.255]		[0.081]	
Enrolled	0.156	0.148	0.138	0.132
	(0.028)	(0.026)	(0.018)	(0.017)
	[0.199]		[0.059]	
Covariates		X		X
Number of schools	663		882	
Number of students	1514		2396	

Source: Michigan administrative data and University of Michigan Office of Enrollment Management data.
Notes: All analyses done at the school-year level. Coefficients are from separate regressions of school-subgroup-level outcome rate on treatment status and strata dummies. Covariates include all characteristics listed in Table 2 and are at the school-subgroup level. Robust standard errors reported in parentheses. Control mean for subgroup in brackets. UM application, admission and enrollment measured in the summer and fall following expected high school graduation. Admission and enrollment are unconditional on application.

Appendix Table 5

Estimated Effect of HAIL Scholarship on College Choice, with Covariates (First and Second HAIL Cohorts)

College attended	Treatment effect		Control mean
Highly competitive or above	0.146	0.141	0.135
	(0.018)	(0.017)	
UM	0.146	0.139	0.107
	(0.016)	(0.016)	
Highly competitive or above other than UM	0.000	0.002	0.028
	(0.007)	(0.007)	
Four-year	0.074	0.080	0.675
	(0.020)	(0.020)	
Two-year	-0.035	-0.036	0.116
	(0.013)	(0.013)	
Any	0.039	0.045	0.791
	(0.018)	(0.018)	
In Michigan	0.045	0.047	0.727
	(0.020)	(0.020)	
Public in Michigan	0.062	0.064	0.645
	(0.021)	(0.021)	
Outside Michigan	-0.006	-0.003	0.064
	(0.010)	(0.010)	
Covariates		X	
Number of schools		1,026	
Number of students		3,910	

Source: Michigan administrative data and National Student Clearinghouse data.

Notes: All analyses done at the school-year level. Coefficients are from regressions of outcome on treatment status and strata dummies. Covariates include all characteristics listed in Table 2. Robust standard errors reported. Enrollment is measured at the first college attended in the fall following expected high school graduation and is unconditional on any college enrollment.

Appendix Table 6

Estimated Effect of HAIL Scholarship on College Choice by Selected School and Student Characteristics, with Covariates (First and Second HAIL Cohorts)

Panel A. Region

	Southeast		West Central		Upper Peninsula	
Highly competitive or above	0.129	0.108	0.163	0.156	0.160	0.180
	(0.030)	(0.028)	(0.024)	(0.022)	(0.052)	(0.052)
	[0.199]		[0.092]		[0.091]	
UM	0.133	0.108	0.155	0.148	0.167	0.191
	(0.029)	(0.027)	(0.022)	(0.022)	(0.052)	(0.050)
	[0.162]		[0.068]		[0.078]	
Four-year	0.041	0.045	0.114	0.120	0.037	0.049
	(0.029)	(0.030)	(0.031)	(0.031)	(0.060)	(0.062)
	[0.774]		[0.579]		[0.697]	
Any	0.024	0.022	0.045	0.056	0.061	0.069
	(0.026)	(0.027)	(0.027)	(0.028)	(0.055)	(0.057)
	[0.84]		[0.758]		[0.757]	
Number of schools	408		474		144	
Number of students	1848		1646		416	

Panel B. Urbanicity

	Suburb		City		Town/Rural	
Highly competitive or above	0.136	0.100	0.079	0.072	0.181	0.184
	(0.029)	(0.025)	(0.063)	(0.059)	(0.024)	(0.022)
	[0.163]		[0.249]		[0.088]	
UM	0.126	0.095	0.078	0.052	0.187	0.188
	(0.027)	(0.025)	(0.058)	(0.052)	(0.023)	(0.022)
	[0.139]		[0.203]		[0.063]	
Four-year	0.039	0.034	0.007	0.029	0.103	0.115
	(0.030)	(0.029)	(0.064)	(0.069)	(0.030)	(0.030)
	[0.746]		[0.704]		[0.622]	
Any	0.014	0.013	0.018	0.049	0.053	0.064
	(0.027)	(0.027)	(0.056)	(0.064)	(0.026)	(0.026)
	[0.838]		[0.783]		[0.762]	
Covariates	X		X		X	
Number of schools	359		118		549	
Number of students	1784		530		1596	

Source: Michigan administrative data and National Student Clearinghouse data.

Notes: All analyses done at the school-year level. For Panels A and B, coefficients are from separate regressions of outcome on treatment status and strata dummies, estimated on the subgroup. For Panels C and D, coefficients are from separate regressions of school-subgroup-level outcome rate on treatment status and strata dummies. Covariates include all characteristics listed in Table 2 and are at the school-subgroup level. Robust standard errors reported in parentheses. Control mean for subgroup in brackets. Enrollment is measured at the first college attended in the fall following expected high school graduation and is unconditional on any college enrollment.

Appendix Table 6 (cont.)

Estimated Effect of HAIL Scholarship on College Choice by Selected School and Student Characteristics, with Covariates (First and Second HAIL Cohorts)

Panel C. Gender

	Male		Female	
Highly competitive or above	0.110	0.107	0.167	0.167
	(0.023)	(0.022)	(0.021)	(0.020)
	[0.135]		[0.125]	
UM	0.112	0.108	0.161	0.161
	(0.022)	(0.020)	(0.020)	(0.019)
	[0.1]		[0.104]	
Four-year	0.073	0.072	0.086	0.087
	(0.027)	(0.027)	(0.025)	(0.024)
	[0.672]		[0.671]	
Any	0.029	0.029	0.055	0.059
	(0.023)	(0.023)	(0.021)	(0.021)
	[0.798]		[0.793]	
Number of schools	729		855	
Number of students	1637		2273	

Panel D. Race/Ethnicity

	White or Asian		Black		Other	
Highly competitive or above	0.151	0.147	0.061	0.060	0.082	0.099
	(0.018)	(0.017)	(0.057)	(0.052)	(0.057)	(0.059)
	[0.119]		[0.272]		[0.179]	
UM	0.150	0.145	0.018	0.020	0.079	0.097
	(0.017)	(0.016)	(0.052)	(0.049)	(0.056)	(0.058)
	[0.096]		[0.214]		[0.167]	
Four-year	0.072	0.078	-0.041	-0.050	0.167	0.187
	(0.022)	(0.021)	(0.055)	(0.055)	(0.064)	(0.063)
	[0.675]		[0.792]		[0.593]	
Any	0.031	0.036	-0.062	-0.077	0.121	0.146
	(0.018)	(0.018)	(0.049)	(0.049)	(0.055)	(0.054)
	[0.801]		[0.848]		[0.716]	
Covariates	X		X		X	
Number of schools	948		206		191	
Number of students	3312		330		268	

Source: Michigan administrative data and National Student Clearinghouse data.

Notes: All analyses done at the school-year level. For Panels A and B, coefficients are from separate regressions of outcome on treatment status and strata dummies, estimated on the subgroup. For Panels C and D, coefficients are from separate regressions of school-subgroup-level outcome rate on treatment status and strata dummies. Covariates include all characteristics listed in Table 2 and are at the school-subgroup level. Robust standard errors reported in parentheses. Control mean for subgroup in brackets. Enrollment is measured at the first college attended in the fall following expected high school graduation and is unconditional on any college enrollment.

Appendix Table 7

Estimated Effect of HAIL Scholarship on College Persistence, with Covariates (First HAIL Cohort)

College attended	Attended fall following high			Attended two consecutive falls		
	Treatment effect		Control mean	Treatment effect		Control mean
Highly competitive or above	0.153	0.152	0.129	0.135	0.134	0.126
	(0.024)	(0.020)		(0.023)	(0.020)	
UM	0.147	0.144	0.104	0.128	0.126	0.102
	(0.022)	(0.020)		(0.022)	(0.019)	
Four-year	0.091	0.097	0.651	0.109	0.115	0.557
	(0.028)	(0.028)		(0.029)	(0.029)	
Any	0.057	0.063	0.779	0.079	0.085	0.683
	(0.025)	(0.025)		(0.027)	(0.027)	
Covariates		X			X	
Number of schools	529					
Number of students	2108					

Source: Michigan administrative data and National Student Clearinghouse data.

Notes: All analyses done at the school-year level. Coefficients are from regressions of outcome on treatment status and strata dummies. Covariates include all characteristics listed in Table 2. Robust standard errors reported. Enrollment is measured at the first college attended in the two falls following expected high school graduation and is unconditional on any college enrollment.

Appendix Table 8

Estimated Effect of HAIL Scholarship on College Persistence by Selected School and Student Characteristics, with Covariates (First HAIL Cohort)

Panel A. Region

	Southeast		West Central		Upper Peninsula	
Highly competitive or above	0.127	0.117	0.148	0.145	0.132	0.167
	(0.039)	(0.033)	(0.029)	(0.028)	(0.067)	(0.055)
	[0.183]		[0.089]		[0.091]	
UM	0.113	0.097	0.144	0.144	0.125	0.156
	(0.037)	(0.031)	(0.028)	(0.027)	(0.066)	(0.054)
	[0.145]		[0.07]		[0.091]	
Four-year	0.091	0.108	0.146	0.150	0.046	0.045
	(0.042)	(0.041)	(0.043)	(0.044)	(0.083)	(0.089)
	[0.667]		[0.462]		[0.563]	
Any	0.084	0.091	0.085	0.092	0.053	0.055
	(0.038)	(0.039)	(0.041)	(0.043)	(0.080)	(0.083)
	[0.746]		[0.632]		[0.676]	
Covariates		X		X		X
Number of schools		204		247		78
Number of students		951		927		230

Panel B. Urbanicity

	Suburb		City		Town/Rural	
Highly competitive or above	0.160	0.125	0.016	0.051	0.150	0.152
	(0.035)	(0.031)	(0.085)	(0.083)	(0.031)	(0.027)
	[0.115]		[0.267]		[0.1]	
UM	0.129	0.103	-0.006	-0.025	0.161	0.162
	(0.033)	(0.029)	(0.079)	(0.085)	(0.030)	(0.027)
	[0.096]		[0.234]		[0.076]	
Four-year	0.112	0.110	0.057	0.057	0.118	0.131
	(0.044)	(0.041)	(0.085)	(0.094)	(0.042)	(0.042)
	[0.623]		[0.646]		[0.498]	
Any	0.109	0.109	0.050	0.053	0.067	0.074
	(0.041)	(0.039)	(0.072)	(0.093)	(0.040)	(0.040)
	[0.722]		[0.739]		[0.648]	
Covariates		X		X		X
Number of schools		179		60		290
Number of students		930		284		894

Source: Michigan administrative data and National Student Clearinghouse data.

Notes: All analyses done at the school-year level. For Panels A and B, coefficients are from separate regressions of outcome on treatment status and strata dummies, estimated on the subgroup. For Panels C and D, coefficients are from separate regressions of school-subgroup-level outcome rate on treatment status and strata dummies. Covariates include all characteristics listed in Table 2 and are at the school-subgroup level. Robust standard errors reported in parentheses. Control mean for subgroup in brackets. Enrollment is measured at the first college attended in the two falls following expected high school graduation and is unconditional on any college enrollment.

Appendix Table 8 (cont.)

Estimated Effect of HAIL Scholarship on College Persistence by Selected School and Student Characteristics, with Covariates (First HAIL Cohort)

Panel C. Gender

	Male		Female	
Highly competitive or above	0.120	0.110	0.150	0.156
	(0.030)	(0.028)	(0.028)	(0.025)
	[0.118]		[0.115]	
UM	0.119	0.110	0.136	0.142
	(0.029)	(0.026)	(0.026)	(0.024)
	[0.091]		[0.098]	
Four-year	0.116	0.114	0.112	0.113
	(0.039)	(0.038)	(0.036)	(0.034)
	[0.561]		[0.56]	
Any	0.030	0.030	0.105	0.106
	(0.036)	(0.036)	(0.032)	(0.032)
	[0.71]		[0.682]	
Covariates		X		X
Number of schools		384		441
Number of students		883		1225

Panel D. Race/Ethnicity

	White or Asian		Black		Other	
Highly competitive or above	0.145	0.148	0.100	0.085	0.051	0.060
	(0.024)	(0.021)	(0.076)	(0.064)	(0.072)	(0.076)
	[0.11]		[0.221]		[0.183]	
UM	0.142	0.144	0.016	0.023	0.051	0.058
	(0.023)	(0.020)	(0.067)	(0.062)	(0.071)	(0.074)
	[0.09]		[0.177]		[0.175]	
Four-year	0.105	0.110	-0.018	0.015	0.089	0.082
	(0.031)	(0.030)	(0.089)	(0.105)	(0.090)	(0.088)
	[0.552]		[0.695]		[0.497]	
Any	0.072	0.078	-0.014	0.007	0.047	0.060
	(0.029)	(0.029)	(0.080)	(0.092)	(0.086)	(0.086)
	[0.687]		[0.757]		[0.615]	
Covariates		X		X		X
Number of schools		496		100		114
Number of students		1786		165		157

Source: Michigan administrative data and National Student Clearinghouse data.

Notes: All analyses done at the school-year level. For Panels A and B, coefficients are from separate regressions of outcome on treatment status and strata dummies, estimated on the subgroup. For Panels C and D, coefficients are from separate regressions of school-subgroup-level outcome rate on treatment status and strata dummies. Covariates include all characteristics listed in Table 2 and are at the school-subgroup level. Robust standard errors reported in parentheses. Control mean for subgroup in brackets. Enrollment is measured at the first college attended in the two falls following expected high school graduation and is unconditional on any college enrollment.

Appendix Table 9

Estimated Effect of HAIL Scholarship on Application, Admission, and Enrollment to UM by Historical School Connection to UM and Number of HAIL Students (First and Second HAIL Cohorts): Regression Results

	Applied	Admitted	Enrolled
Panel A. Prior School-Level UM Application Rate			
Treatment	0.483	0.201	0.168
	(0.025)	(0.024)	(0.023)
Prior UM application rate	1.221	0.742	0.644
	(0.178)	(0.179)	(0.174)
Interaction	-0.976	-0.334	-0.217
	(0.219)	(0.238)	(0.240)
Panel B. Prior School-Level UM Enrollment Rate			
Treatment	0.480	0.198	0.169
	(0.024)	(0.023)	(0.021)
Prior UM enrollment rate	2.833	1.727	1.533
	(0.357)	(0.411)	(0.406)
Interaction	-2.655	-0.848	-0.668
	(0.548)	(0.575)	(0.579)
Panel C. Number of HAIL Students in School			
Treatment	0.477	0.209	0.182
	(0.033)	(0.032)	(0.030)
Number of HAIL students	0.019	0.012	0.010
	(0.004)	(0.003)	(0.003)
Interaction	-0.016	-0.009	-0.009
	(0.005)	(0.004)	(0.004)
Number of schools		1,026	

Source: Michigan administrative data and University of Michigan Office of Enrollment Management data.
Notes: All analyses done at the school-year level. Results are from a regression of the outcome on treatment, the named variable and a missing dummy, the interaction of the two, and strata dummies. Robust standard errors estimated. Prior UM application and enrollment rates are for the high school graduating class of 2015.