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The Power of Certainty: Experimental Evidence on the Effective Design of Free Tuition Programs

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THE POWER OF CERTAINTY: EXPERIMENTAL EVIDENCE ON THE EFFECTIVE DESIGN OF FREE TUITION PROGRAMS

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This project would not have been possible without our collaborators at the University of Michigan Office of Enrollment Management, particularly Kedra Ishop, Steve Lonn, Paul Robinson, and Betsy Brown. We are grateful to the Michigan Department of Education (MDE) and Michigan's Center for Educational Performance and Information (CEPI) for providing data. Seminar participants at the University of Michigan, Columbia Teachers College, Washington University in St. Louis, and the University of Wisconsin provided helpful comments. Sarah Cohodes, Joshua Goodman, CJ Libassi, and Matt Notowidigdo generously read initial drafts. The Institute of Education Sciences of the US Department of Education (through grants R305B1170015), the Smith Richardson Foundation, and the Andrew Carnegie Fellows Program funded this research. This project was approved by the University of Michigan's Health Sciences and Behavioral Sciences Institutional Review Board (under study research ID HUM00096289); Harvard University's Institutional Review Board (IRB21-1221); and Colby College's Institutional Review Board (2021-093). This study is registered at the randomized trial registry of the American Economic Association under RCT ID AEARCTR-0001831, with 10.1257/rct.1831-3.0. A pre-analysis plan was filed in August 2019 (Dynarski et al., 2019). The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

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The Power of Certainty: Experimental Evidence on the Effective Design of Free Tuition Programs

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Abstract

Proposed "free college" policies vary widely in design. The simplest set tuition to zero for everyone. More targeted approaches limit free tuition to those who demonstrate need through an application process. We experimentally test the effects of these two models on the schooling decisions of low-income students. An unconditional free tuition offer from a large public university substantially increases application and enrollment rates. A free tuition offer contingent on proof of need has a much smaller effect on application and none on enrollment. These results are consistent with students placing a high value on financial certainty when making schooling decisions.

JEL codes: I0,I21,I22,I23,I24,I28

A long line of research examines policies to increase college enrollment, especially among low-income students (see Dynarski and Scott-Clayton (2013) and Page and Scott-Clayton (2016) for reviews). Recently, the policy debate has focused on a variety of "free college" proposals. These policies differ in their eligibility and implementation details, with the most straightforward setting tuition to zero for all students. More complicated versions limit free tuition to those who apply for student aid and demonstrate financial need through a months-long paperwork process.

Complicated application processes have been shown to discourage takeup in means-tested programs, especially among those with the greatest need (Currie 2006; Finkelstein and Notowidigdo 2019; Herd and Moynihan 2019). This includes financial aid for college (Dynarski and Scott-Clayton 2006; Bettinger et al. 2012). Research suggests that seemingly minor, bureaucratic changes in the aid process will produce outsized effects on behavior. We explore this hypothesis in a large-scale field experiment.

We randomly assign high-achieving, low-income high school seniors to receive an early commitment of four years of free tuition at the University of Michigan (UM), a highly selective public university, provided they apply and are admitted.[1] All of these students are eligible for means-tested subsidized school meals, and

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[1] For brevity, we use "tuition" to refer to tuition and all required fees. At UM, this is a minor distinction, since fees are small (roughly

therefore have family incomes near the poverty line.[2] At UM, the vast majority (90%) of such students receive grants that fully cover tuition (and typically receive thousands more to cover living expenses). A commitment of free tuition to this population of students is therefore relatively cheap for the university, while providing students certainty that their tuition is zero.

In an earlier experiment at UM (Dynarski et al. 2021) this early commitment more than doubled application and enrollment rates. For the present study we add a new treatment arm, in which we inform students of an existing "free tuition" program at UM that (like typical aid in the US) requires an annual application, does not provide a four-year guarantee, and confirms eligibility only *after* college admission. A control group receives business-as-usual recruitment materials and is eligible for the *same* financial aid as this new treatment arm.

Students in both treatment arms applied to UM at higher rates than the control group, indicating that sending out information about "free tuition" increases students' willingness to apply. But the increase in applications was three times larger among students given the up-front, four-year commitment: 63% of them applied to UM, an increase of 28 percentage points over the control group's 35%. In the informational arm 44% applied, an increase of just nine percentage points.

The up-front commitment of free tuition increased the share of students enrolling at UM to 26% (from 17% in the control group), an increase of roughly 50%. The new, informational arm had no detectable effect on enrollment. We conclude that "free college" policies that require verification of aid eligibility after application (the current status quo) have limited scope for affecting student enrollment.

I. The U.S. Financial Aid System

Higher education in the U.S. is characterized by a high degree of price discrimination, with some students paying the full "sticker price" and others a lower "net price" after grant aid is applied. As a rule, students do not know the net price they will face before they apply to colleges. Federal aid, such as the Pell Grant, is fairly predictable given a student's family income and household size (Dynarski and Scott-Clayton 2006). But the Pell Grant isn't generous enough to cover tuition and fees at four-year colleges.[3] Getting tuition to zero at four-year colleges requires a combination of state grants, private scholarships, and price discounts from the colleges themselves (this last is referred to as "institutional aid").

Individual colleges "package" these various sources of aid to construct a net price for each student, communicated in an offer letter. To get offer letters, students must apply to colleges, fill out the Free Application for Federal Student Aid (FAFSA), and be admitted. Governments and institutions use the extensive financial data on the FAFSA to calculate an "Expected Family Contribution (EFC)," a measure of a student's ability to pay. For students entering college from high school, offer letters typically arrive in March or April of the senior year. But offer letters can arrive as late as the summer after high school for those whose aid

$200, with in-state tuition $16,000). But fees can be greater than tuition. In Massachusetts, a "free tuition" program left students still paying thousands in fees (Cohodes and Goodman 2014).

[2]They are identified, for the purposes of this study, using restricted-use, administrative data on eligibility for subsidized school meals.

[3]By contrast, the Pell Grant is generous enough to cover tuition costs at most community colleges.

applications are hung up by bureaucratic delays.

Since institutional aid varies considerably across schools (and within schools over time), it is not at all straightforward for students to predict their net price ahead of time. Schools have latitude in packaging aid. Some require students to complete additional aid applications beyond the FAFSA. The most common of these is the CSS Profile, administered by the College Board and required by many selective private colleges (and a handful of public schools, including UM). The Profile requires financial information beyond that gathered by the FAFSA, including home equity and income from non-custodial parents. Participating colleges use this additional data to customize their definition of need (EFC) when distributing institutional aid. An implication is that a student will face varying net prices even among colleges that commit to meeting students' full need.

Once a student enrolls in a given college for a given net price, their future costs remain unpredictable. As a rule, students get only a one-year commitment on their net price. Students have to reapply for aid annually. During the time a student is enrolled, tuition will likely rise and aid policies may shift at the federal, state, or institutional level. The bottom line is that, in the US system, students and families face uncertainty in net prices across colleges, across time, and within colleges over time.

II. Setting and Research Design

The complexity and unpredictability of the financial aid system has informed an ongoing initiative at the University of Michigan at Ann Arbor (UM) aimed at closing income gaps in college choices. Since 2016, UM has offered thousands of low-income students an up-front guarantee of four years of free tuition (the "HAIL Scholarship"). HAIL diverges from typical financial aid in promising free tuition *before* application, waiving financial aid forms, and committing to four years of aid.

A previous experimental evaluation revealed dramatic effects of HAIL on the behavior of low-income, high-achieving students. Students randomized to receive the HAIL offer were more than twice as likely as those in a "business as usual" control group to apply to, be admitted by, and enroll at the University of Michigan (Dynarski et al. 2021).[4]

The HAIL Scholarship was designed in a close, ongoing partnership between our research team and university administrators. We worked together to define the terms of HAIL and how it would be communicated to students. Our research team used data from the Michigan Department of Education (MDE) to identify the high-achieving, low-income students who got the HAIL offer. All of these students complete a needs test to receive subsidized school meals; UM could therefore commit up-front to covering their tuition without incurring much additional expense. In fact, as we show later, over four years at UM, the first two cohorts receiving HAIL received the same grant aid as control students.

Independent of our partnership, university administrators continued long-standing efforts to attract a diverse set of students, including school visits, on-campus programming, and marketing. In 2017, UM announced a new program, the Go Blue Guarantee, as part of these recruitment efforts. The Go Blue Guarantee promises free tuition to (in-state) students with income below $65,000 and assets below $50,000.

[4]Further analysis showed no evidence that the HAIL intervention diverted students from other highly selective colleges.

Despite the "guarantee" in the title, receipt of the Go Blue Guarantee is conditional on verification of income and assets through the traditional aid system, described in the previous section. Students learn of their eligibility for the Go Blue Guarantee only after applying to UM, filling out aid forms, being admitted, and getting an offer letter that details their net price.

Some elements of HAIL, namely the promise of "free tuition," were built into the Go Blue Guarantee, while others, including the waiving of aid forms and the four-year commitment, were not. Unlike HAIL, which was limited to a set of students who had already qualified for need-based, subsidized school meals, the Go Blue Guarantee was widely advertised through billboards, TV commercials, and print media.

If the success of HAIL was largely due to eliminating informational barriers—informing low-income, high-achieving students that UM was affordable and a good academic fit—then the Go Blue Guarantee could potentially achieve the same goals through marketing, without an up-front commitment. We as researchers were not sanguine since previous work had shown that informational interventions about college costs did nothing to change student behavior (e.g., Bettinger et al. 2012 and Bergman, Denning and Manoli 2019).

After the Go Blue Guarantee had been in place for a few years, we worked with the university to gauge its effectiveness with a three-armed randomized trial.[5] One treatment arm replicates the original HAIL offer: a mailing with an unconditional, up-front offer of four years of free tuition and encouragement to apply. A second treatment, which we refer to as the Go Blue Encouragement (GBE), contains information about the Go Blue Guarantee and encourages students to apply. A control arm receives business-as-usual materials that describe UM and encourage students to apply.

Communications for the two treatment arms (HAIL and Go Blue Encouragement) were made as similar as possible. Both highlighted "free tuition" and praised students' academic achievements. The packets were the same size and were similarly designed with UM branding and bright coloring (Appendix A). Each packet included a letter signed by the president of the university. These letters were identical but for a single paragraph. In the HAIL arm this paragraph read:

> We believe you to be an academically excellent student who has worked hard for your achievements. If you apply to U-M and are admitted for the fall 2020 term, we will reward your hard work with the **HAIL Scholarship**, which covers the full cost of your in-state tuition for four years of study at our Ann Arbor campus. That's an approximate $66,000 value to you and your family. Additionally, after a review of your financial aid applications, you will likely be eligible for additional aid to cover costs of housing, meals, textbooks, and other expenses.

For students in the Go Blue Encouragement arm, this paragraph instead read:

> We believe you to be an academically excellent student who has worked hard for your achievements. That's why we hope you are planning to apply to the University of Michigan. Furthermore, our **Go Blue Guarantee** can help you with your college costs, as it covers the full cost of in-state tuition for in-state students who are admitted to the Ann Arbor campus and whose families earn incomes of $65,000 or less, with $50,000 or less in assets. If your family earns more, you can still Go Blue; we provide tuition support for families with incomes up to $180,000.

[5] It would have been informative to include enough arms to separately identify the effects of each component of the treatments (information about aid, a guarantee of free tuition, praise of students' academic achievement). In practice, we were constrained by the capacity of the university to manage multiple treatment arms as well as by statistical power: about 2000 low-income seniors each year meet the academic criteria for inclusion in the study. Expanding this low-income sample would require adding students with a low probability of admission to UM, which our partners did not want to do.

Letters to parents, mailed two weeks after the student packets, described the program (HAIL or Go Blue Guarantee) and encouraged them to help their children apply. Emails to school principals, sent around the same time as the student packets, explained the program, listed eligible students, and asked the principal to transmit the information to school staff who supported students in their college applications.

Comparing the three experimental conditions sheds light on existing barriers within the aid system. In expectation, control and Go Blue Encouragement students face identical aid eligibility. Any differences in outcomes between the control and Go Blue Encouragement arms reflect informational barriers, since all of these students are eligible for the same aid.

The HAIL and Go Blue Encouragement arms both get information about aid and an encouragement to apply. The HAIL arm, unlike the Go Blue Encouragement arm, is guaranteed free tuition early (before application), without verification, and for four years. Comparing outcomes for HAIL and the Go Blue Encouragement arms therefore captures the effect of the only difference between their treatments: an up-front, unconditional, four-year tuition guarantee.

III. Data, Sample, and Randomization

We identify students for the intervention using longitudinal, student-level administrative data from MDE that contain the universe of students attending public high schools in Michigan (Michigan Department of Education 2022*a*; Michigan Department of Education 2022*b*).

We identify high-achieving students using high school GPA and SAT scores, which come from mandatory, in-school 11th grade testing. GPA is self-reported on the SAT student questionnaire.[6] For this intervention, qualifying SAT scores start at 1100 and qualifying GPAs at a B. Students with higher test scores faced a lower GPA threshold and vice versa. The Office of Enrollment Management (OEM) at UM set the GPA and score cutoffs; they are similar to the criteria the school uses when gleaning prospective recruits from national data on SAT takers.[7]

We identify low-income students using data on qualification for federally subsidized school meals. Students with family income below 130% of the federal poverty line qualify for free meals and those with incomes up to 185% of the poverty line qualify for reduced-price meals. In 2020, the thresholds for a free or reduced-price meal were $34,060 and $48,470, respectively, for a family of four.

Of the approximately 100,000 juniors in Michigan's 1,000 public high schools in the 2018-19 school year, 1,796 students from 477 schools met both the income and academic criteria for the sample. Four-fifths of our sample[8] qualifies for a free lunch and the remainder for a reduced-price lunch. The mean SAT in our sample is 1260 and 85% of the sample has a GPA of A or A+.

[6]For high-achieving sample students in earlier cohorts, self-reported GPA on the SAT questionnaire was closely aligned to the official GPA on transcripts.The state of Michigan stopped collecting transcripts from school districts several years ago.

[7]Grades and scores alone do not determine admission. Like most highly selective colleges, UM uses a holistic admissions process that also considers factors such as family background and extracurricular activities.

[8]Unless otherwise noted, we report school-level means, which weight each school equally, to be consistent with our empirical specifications. Student-level means are very similar.

A. Randomization

We randomly assign high schools to the treatment arms. That is, all seniors in a school who meet the income and academic criteria are assigned the same treatment status. We do this because we hypothesize treatment spillovers within schools, which would attenuate estimated effects toward zero if we randomized within schools. The probability of assignment to each arm is one-third.

We stratify the sample by region (Southeast vs. rest of Michigan) and urbanicity (city vs. suburb, town, or rural) and randomize within each of the resulting four strata. We chose these strata because in our earlier experiment students in rural areas responded more strongly to the treatment (Dynarski et al. 2021). We rerandomized to achieve balance within region on school characteristics (see Appendix Table 1).

The randomization resulted in a HAIL arm of 595 students in 159 schools, a Go Blue Encouragement arm of 591 students in 159 schools, and a control arm of 610 students in 159 schools. Sample characteristics are shown in Table 1. A third of the schools are in the Southeast region of the state, which includes the metropolitan areas of Ann Arbor, Detroit, and Lansing. Another one-sixth of schools are in the largely rural Upper Peninsula. The remaining schools are scattered across the Lower Peninsula, with many in the Grand Rapids area. Over half the schools are rural, about a third are suburban, and the remainder urban.

Based on race categories that are not mutually exclusive, our sample is 82% White, 9% Black, 7% Hispanic, 8% Asian, 2% American Indian, and less than one percent Native Hawaiian or Pacific Islander. Seven percent of the sample belongs to more than one of these categories.

We create a summary measure of the likelihood of attending a highly selective college like UM. We use pretreatment characteristics to create a predicted probability for each student.[9] For our sample, the mean predicted probability of attending a school at least as competitive as UM is 13%.

Balance checks are shown in Appendix Table 1. None of the pairwise comparisons between the treatment and control groups is statistically significant at conventional levels. This is substantiated by joint F-tests for each pair of treatment arms, which reveal that, together, these observed characteristics do not predict treatment status.

IV. Empirical Strategy

We estimate the effect of the HAIL and Go Blue Encouragement treatments on application, admission, and enrollment at the University of Michigan, as described in our pre-analysis plan (Dynarski et al. 2019). We use internal data on these outcomes from the university (University of Michigan Office of Financial Aid 2022; University of Michigan Office of Enrollment Management 2022), as well as data from the National Student Clearinghouse (Michigan Department of Education 2022*a*; Michigan Department of Education 2022*b*) that tracks college enrollment nationwide.

[9] To construct this index, we use historical cohorts of students to estimate a regression of highly selective college attendance on academic and demographic characteristics (test score, GPA, race, gender, an indicator for persistent economic disadvantage, urbanicity, region, and number of high-achieving, low-income students in the school). We then apply the estimated coefficients to our sample to assign them predicted probabilities.

We estimate the following by ordinary least squares (OLS):

$$Y_j = \beta_0 + \beta_1 HAIL_j + \beta_2 GBEncouragement_j + S_j + u_j \quad (1)$$

where Y_j is an outcome of interest at school j. We collapse the individual student data to the school level and conduct analysis on these means. $HAIL_j$ and $GBEncouragement_j$ indicate assignment to the HAIL or Go Blue Encouragement treatment group, respectively. S_j is a vector of strata dummies.

β_1 and β_2 are the parameters of interest and measure the causal effect of being randomized into the HAIL or Go Blue Encouragement treatment arm, respectively, relative to the control arm. This is the estimated effect of the intent to treat (ITT). These parameters represent the ITT with schools weighted equally.

V. Results

The estimated effects of the HAIL and Go Blue Encouragement treatments are in Panel A of Table 2. Appendix Figure 1 depicts the effects visually. Relative to the control condition, the HAIL offer increased the UM application rate by 28 percentage points, while the Go Blue Encouragement treatment increased it by 8 percentage points. HAIL increased admission to UM (unconditional on application) by 9.6 percentage points, while GBE increased admission by a statistically insignificant 2.5 percentage points. Enrollment effects for the two treatments are also very different. The HAIL offer increased enrollment by nearly 9 percentage points, while the Go Blue Encouragement had no detectable effect.

The acceptance rates for induced applicants (obtained by dividing treatment effects on admission by treatment effects on application; Panel C of Table 2) from the two treatment arms are both about 30%. This suggests that applications induced by the two treatments were viewed as similarly qualified by admissions officers (we do not have admissions scores or notes). These acceptance rates for induced applicants may seem low given these students' qualifications. The university's overall acceptance rate for this cohort was 26%, implying that marginal applicants in our sample were equally (or somewhat more) qualified than the typical applicant to UM.

Yield rates for students induced into admission by the two treatments are starkly different. The implied yield rate for marginal HAIL students (90% yield for induced admits) is also almost triple that for Go Blue Encouragement (33%).

We examine characteristics of applicants from the three arms to get a sense of the marginal applicant under each condition. Differences in the characteristics of applicants from the Go Blue Encouragement and control arms are small. That is, the Go Blue Encouragement induces application by students who are much like inframarginal applicants (Appendix Table 2).

By contrast, there are large differences between HAIL applicants and those from the other arms. They come from high schools where past cohorts of students were less likely to apply to UM (8% vs. 11%). They are twice as likely to live in the remote Upper Peninsula (14% vs 7%) and less likely to be from an urban area. Applicants from the HAIL arm have a substantially lower predicted probability of attending a selective

college (16% vs. 23% among control applicants).

Data from the National Student Clearinghouse reveal similar effects of HAIL on nationwide college enrollment as found in Dynarski et al. (2021), though they are less precise due to the smaller sample (Panel B of Table 2). Although we cannot reject null effects, the point estimates suggest that in the absence of the intervention, students induced into UM by HAIL would not have attended college at all, or attended less selective colleges.[10] HAIL did not "poach" students from other schools as selective as UM, nor did it increase enrollments at such schools.

None of the point estimates for Go Blue Encouragement is substantively or statistically significant. The Go Blue Encouragement had no impact on enrollment at UM or anywhere else.

VI. MECHANISMS

In this section, we discuss potential explanations for the pattern of effects just discussed.

A. Does Information and Marketing Change Behavior?

The mailings for the two treatment arms were visually similar and had a similar tone. Differences in marketing and information cannot, therefore, explain the larger impact of HAIL relative to the Go Blue Encouragement on application (20 percentage points larger) and enrollment (9 percentage points larger).

We can, however, interpret the nine percentage point difference in application rates between the Go Blue Encouragement and the control group as an effect of colorful mailings, encouragement to apply, and detailed aid information. But this effect on applications did not translate into increased enrollments, which is consistent with a previous literature showing null effects of information interventions on enrollment (Hurwitz and Smith 2018; Hyman 2020; Gurantz et al. 2021).

B. Do Burdensome Aid Forms Deter Students from Applying?

HAIL waives aid forms. Perhaps students respond so strongly to HAIL, in part, because they really, really despise aid forms. If HAIL increased applications because it waived paperwork requirements that marginal enrollees found burdensome, we would expect students in the HAIL arm would be less likely to fill out the FAFSA than those in the other arms.[11]

We find that 98 to 99% of enrolled students complete the FAFSA, with no significant differences across the three arms. Nor is the timing of aid applications consistent with students in the HAIL arm avoiding the aid form. If anything, HAIL students are quicker to submit their FAFSA applications than control and Go Blue Encouragement students (see Appendix Figures 2 and 3). We also find no statistically significant differences in submission of the CSS Profile (Appendix Figure 4).

[10] The control mean for UM enrollment is higher than it was in the first cohorts, while in the HAIL arm it is about the same. This mechanically produces a smaller treatment effect of HAIL (9 vs 15 percentage points) than in the first two cohorts. This could be explained by many factors, including changes in the definition of the experimental sample, secular time effects, the introduction of the Go Blue Guarantee, or growing knowledge of the HAIL Scholarship.

[11] We only observe FAFSA filing for enrolled students.

C. Does Higher Aid Lead to a Higher Response?

HAIL students are guaranteed free tuition. Students in the other arms are likely, but not guaranteed, to get free tuition. A large literature shows that students respond to price in their enrollment decisions (Page and Scott-Clayton 2016). Could differences in the amount of aid going to students in each arm explain the difference in behavior that we observe? We investigate this question by examining the financial aid packages of students in our sample who enrolled at UM, by treatment status (see Table 3 and Figure 1).[12] Panel A contains results comparing the experimental cohort discussed here; panels B and C contain results for the first two cohorts of the HAIL intervention, for whom we have four years of financial aid data.

Across treatment arms, students who enroll at UM have similar family finances, with nearly indistinguishable (and very low) EFCs. Sample students who enroll at UM overwhelmingly wind up with generous aid. Annual grants average $26,676 for the HAIL students, vs. $25,309 for students from the other arms (see the first panel of Table 3). (Because students in the Go Blue Encouragement arm enrolled at the same rate as students in the control arm, and were eligible for the same aid, we pool these two arms for simplicity.[13])

Grants for HAIL recipients are about $1,400 higher than for the other arms. HAIL's effect on enrollment, as discussed above, is 8.6 percentage points, a 49% increase over the control group. This implies an elasticity of enrollment with respect to grant aid of about nine.

This elasticity is far larger than those typical in the literature. The closest evidence to our own is Angrist, Autor and Pallais (2022)'s experimental evaluation of a Nebraska scholarship program for disadvantaged students targeting four-year colleges.[14] This program worked through the traditional aid system, with students learning about their eligibility after applying. The intervention doubled grant aid and increased four-year enrollment by 12 percent, an implied elasticity of 0.12.[15] Castleman and Long (2016)'s regression discontinuity analysis of a need-based grant in Florida implies an elasticity of at most 0.4.[16] Our enrollment effects are also larger than those found across a wide range of settings, as summarized by Page and Scott-Clayton (2016).

Although it is impossible to rule out the higher dollar value as the channel through which HAIL affects student behavior, we do not believe it is the primary mechanism.

The strongest evidence on this front, in our opinion: for the initial cohorts of HAIL there was *no* difference in grants between treatment and control students in either their first year of enrollment, or across their four years combined (again, this is only for those who enroll at UM; see the second and third panels of Table 3). If anything, students in the HAIL arm had slightly *lower* grants than those in the control arm for those cohorts ($24,207 vs. $24,729 in the first year; $105,735 vs. $106,643 across all four years).[17] Yet, students offered HAIL enrolled at a rate 15 percentage points higher than those in the control group (of which

[12] We only have aid packages for those who *enroll* at UM.

[13] Separating these two arms produces similar but noisier patterns in the figure and table. We find no statistically significant differences between the aid packages of control and Go Blue Encouragement students (see Appendix Table 3).

[14] Very few studies have data on the aid *received* by each student, which we need to calculate the elasticity. The two discussed in this paragraph do.

[15] This calculation is based on estimates reported in Figure 1(A) and Table 2 of Angrist, Autor and Pallais (2022).

[16] This calculation is based on the increase in aid for students eligible for the Bright Futures Florida Academic Scholar award and the effect on four-year public enrollment.

[17] The "business as usual" aid received by the control group has grown slightly less generous over time. In the initial two cohorts, 93% of the control group got free tuition, while for the focal cohort of this study it was 88%.

12% enrolled), an even larger absolute and relative effect than we see in the present study (see Figure 4 in Dynarski et al. 2021). Higher grant aid cannot explain this earlier, striking result. We suspect it does not explain the effects for this present analysis, either.[18]

D. The Value of Certainty and the Power of Zero

Insights from decades of behavioral economics research lend further support to our assertion that rational responses to price changes cannot fully explain our findings. Tversky and Kahneman (1986) documented the nonlinear psychological value of certainty, relative to even a very high probability, when it comes to financial reward. Prospect theory suggests that even if 90% of the control group got free tuition, pushing that likelihood to 100% could have a large effect on behavior.

The distribution of aid in Figure 1 is consistent with a certainty effect. HAIL had very little effect on the *average* grants that students receive, but did reduce their *variance*. The distribution of grant aid for HAIL has a tighter spread, and zero mass below tuition costs. We can also see this in Table 3, where the standard error for grant aid is *lower* for the HAIL students than for the other arms ($423 vs $585, see the first panel of Table 3). This is true even though the N for the HAIL students is substantially smaller than for the other pooled arms (117 vs 169) and the average grant slightly higher ($26,676 vs. $25,309). The HAIL intervention reduced the variance in grant aid, increasing the certainty students faced in tuition prices.[19]

HAIL's effect could also be driven by the special value of guaranteeing a tuition price of *zero*. Research has established the nonlinear power of a "free" price tag, with consumers perceiving free items as more valuable over and above their reduced cost (Shampanier, Mazar and Ariely 2007).

Beyond resolving uncertainty in tuition costs for the first year of college, HAIL guarantees that tuition is zero for four years. Business-as-usual financial aid requires students to reapply annually, learning their net price one year at a time. This difference could further intensify any "power of zero," as well as intensify the effect of shifting from a high probability to a certainty of having tuition covered for four years of college.

VII. Effects of the Statewide Go Blue Guarantee Program

We want to stress that our experiment does not constitute a test of the effect of the statewide Go Blue Guarantee. The Go Blue Guarantee was implemented in 2018 and extended to all students in the state. In our 2019 experiment, therefore, everyone in the sample was potentially eligible for the new program. In the ITT estimates, any statewide effect of the Go Blue Guarantee is reflected in the behavior of the control group.

Time patterns in application, admission, and enrollment at the University of Michigan for high-achieving students from the state of Michigan shed some light on whether the statewide rollout of the Go Blue Guarantee had any effect on student decisions. In Figure 2 we plot these rates separately for low-income and non-low-income

[18] Further, differences in realized aid could have affected *applications* only if students could predict aid months before they got their offer letters. Research shows that low-income families are inaccurate in predicting net costs (Avery and Kane 2004). Yet we see very large effects of HAIL on application rates, not just enrollment. We also see differences in application between the control and GBE students, which, because these groups are eligible for identical aid, is not consistent with students responding to true differences in aid.

[19] By contrast, the standard error of the expected family contribution is actually *higher* for the HAIL students than it is for the other arms ($524 vs $415). Under business-as-usual in the aid system, this would lead to a higher variance in grant aid. Instead, the variance is smaller.

students who have SAT scores of at least 1100.

For low-income students, we clearly see the effects of the initial rollout of the HAIL Scholarship for the 2016 cohort. We see sharp increases when the experiment started, of 8 percentage points in application, 2.8 percentage points in admission, and 2.7 percentage points in enrollment. HAIL students comprise approximately a quarter of the low-income population depicted in Figure 2.[20] The experimental results for these cohorts (see Dynarski et al. 2021) are roughly four times the magnitude of the time series jumps, which is consistent with the HAIL treatment-group students producing all of the increase.

The raw time-series is also consistent with the pattern of results in the present paper. When the Go Blue Guarantee is implemented for the class of 2018, there is a small increase in application rates but none in admission or enrollment. These descriptive statistics line up with our experimental results: Go Blue Encouragement had a moderate effect on application but none on enrollment, while HAIL had large effects on both application and enrollment.

VIII. Discussion

A growing number of states and institutions offer free tuition to students from low- and moderate-income families. In 2020, Democrats campaigned on a promise of free college. At first glance, these policies appear straightforward. Our study suggests that the design of these proposals will have a large effect on student decisions.

We predict that a straightforward, zero-tuition program like HAIL would substantially expand enrollments among low-income students. We expect little effect of policies that rely on the traditional aid process, which does not resolve uncertainty about aid until after application. Programs like these essentially re-brand and promote existing aid and attempt to change student behavior by addressing information barriers. Multiple studies, including our own, now show that just informing students about aid has little to no effect on their decisions (Bettinger et al. 2012; Hurwitz and Smith 2018; Bergman, Denning and Manoli 2019; Hyman 2020; Gurantz et al. 2021).

A downside of universal free tuition is that it is expensive, since the subsidy goes to all students regardless of income. At community colleges (which largely enroll students of modest means) a zero-tuition approach would convert what is essentially a policy of free *net* tuition into a policy of free *sticker-price* tuition, providing students greater certainty while requiring little change in per-student spending.

A universal free-tuition policy at four-year colleges would require substantial funding, since they rely on the tuition revenue of full-paying students. These colleges could create *targeted* programs like the HAIL Scholarship. A cheap form of targeting: piggyback on qualification for existing need-based programs such as subsidized school meals or other social welfare programs. Our findings suggest these policies would substantially expand the attendance of low-income students at four-year colleges, where they are currently under-represented.

[20] Our experimental sample is a subset of the low-income sample because Figure 2 is limited to students with a minimum ACT or SAT score, while eligibility for HAIL also depends on GPA.

Our findings are more broadly relevant to the design of social policy. A compelling body of research now shows that requiring recipients to demonstrate eligibility through an application process reduces participation of the most disadvantaged (Currie 2006; Finkelstein and Notowidigdo 2019; Herd and Moynihan 2019). Policymakers should weigh whether efforts to target assistance may have the unintended effect of excluding the targeted beneficiaries. Automatically opting recipients into programs, either through universal eligibility or administrative screening that does not require applicant opt-in, consistently maximizes participation of those with the greatest need.

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Table 1
School-Level Summary Statistics by Treatment Arm

Characteristic	Control	HAIL	Go Blue Encouragement
Pred. prob. of highly selective college attendance	0.13	0.13	0.13
	(0.13)	(0.12)	(0.12)
Southeast school	0.35	0.35	0.35
	(0.48)	(0.48)	(0.48)
School in UP	0.15	0.18	0.15
	(0.36)	(0.38)	(0.36)
City school	0.13	0.13	0.13
	(0.33)	(0.33)	(0.33)
Town/rural school	0.53	0.53	0.52
	(0.50)	(0.50)	(0.50)
Suburban school	0.35	0.35	0.36
	(0.48)	(0.48)	(0.48)
Distance of school from UM (miles)	98.9	104.1	97.5
	(86.74)	(86.65)	(75.65)
UM application rate of school, class of 2015	0.07	0.07	0.06
	(0.08)	(0.10)	(0.09)
Average ACT score of school, class of 2015	19.96	19.92	19.89
	(1.85)	(2.06)	(2.07)
Proportion of sample students with A or A+ GPA	0.86	0.87	0.84
	(0.24)	(0.22)	(0.26)
Proportion of sample students with A-, B+, or B GPA	0.14	0.13	0.16
	(0.24)	(0.22)	(0.26)
Average SAT of sample students	1260	1264	1262
	(71.14)	(72.77)	(61.83)
Proportion female	0.56	0.55	0.57
	(0.35)	(0.36)	(0.34)
Proportion under-represented minority	0.17	0.15	0.18
	(0.28)	(0.27)	(0.29)
Proportion eligible for free lunch	0.80	0.81	0.79
	(0.28)	(0.25)	(0.28)
Average number of sample students	3.8	3.7	3.7
	(3.50)	(3.19)	(3.51)
Number of schools	159	159	159
Number of students	610	595	591

Notes: All analyses conducted at the school level. Standard deviations in parentheses. Summary index calculated from parameters of an OLS regression estimating the relationship between observable characteristics and a binary indicator for attending a college as competitive as the University of Michigan. "Under-represented minority" includes all students who are Black, Hispanic, American Indian, or Native Hawaiian or Pacific Islander.
Source: Michigan Department of Education (2022*b*), University of Michigan Office of Enrollment Management (2022).

Table 2
HAIL Scholarship and Go Blue Encouragement Treatments and College Choice Outcomes

Outcome	HAIL	Go Blue Encouragement (GBE)	HAIL vs. GBE
Panel A. Estimated Treatment Effects on University of Michigan Outcomes (UM administrative data)			
Applied to University of Michigan	0.280	0.082	0.198
	(0.038)	(0.039)	(0.038)
		[0.354]	
Admitted to University of Michigan	0.096	0.025	0.071
	(0.036)	(0.035)	(0.037)
		[0.230]	
Enrolled at University of Michigan (UM data)	0.086	0.008	0.077
	(0.033)	(0.032)	(0.034)
		[0.174]	
Panel B. Estimated Treatment Effects on Enrollment Outcomes (National Student Clearinghouse data)			
University of Michigan (NSC data)	0.089	0.010	0.080
	(0.033)	(0.032)	(0.034)
		[0.169]	
Highly competitive or above (other than UM)	0.010	-0.002	0.012
	(0.016)	(0.015)	(0.017)
		[0.039]	
Four-year	0.039	-0.009	0.048
	(0.035)	(0.036)	(0.036)
		[0.724]	
Two-year	0.002	0.012	-0.010
	(0.021)	(0.021)	(0.022)
		[0.071]	
Any	0.041	0.002	0.038
	(0.031)	(0.033)	(0.032)
		[0.796]	
Panel C. Induced University of Michigan Acceptance and Yield Rates (non-experimental)			
Induced acceptance rate (admission effect / application effect)	0.343	0.305	0.038
Induced yield rate (enrollment effect / admission effect)	0.896	0.320	0.576
Number of schools		477	
Number of students		1,796	

Notes: All analyses done at the school level. Robust standard errors reported in parentheses. Treatment effect coefficients are from estimating Equation (1). The "HAIL" and "Go Blue Encouragement" columns report estimates of β_1 and β_2, respectively. Control means are in square brackets. The difference, and standard error of the difference, between the HAIL and Go Blue Encouragement effect coefficients reported in the right-most column are the difference between β_1 and β_2. UM application, admission and enrollment are measured in the summer and fall following expected high school graduation. Admission and enrollment are unconditional on application.
Source: Michigan Department of Education (2022*b*), University of Michigan Office of Enrollment Management (2022).

Table 3
Student Financial Aid by Treatment Arm and Compared with the Original HAIL Cohorts

	Focal Cohort		
	Panel A. First Year		
	Mean		
	Control & Go Blue Encouragement	HAIL	P-value
Grants	$25,309	$26,676	0.047
	(585)	(423)	
Loans	$1,312	$956	0.213
	(273)	(184)	
Proportion with Grants $\geq$ Tuition	0.880	1.000	0.000
	(0.024)	(0.000)	
Expected Family Contribution	$2,397	$2,481	0.867
	(415)	(524)	
Cost of Tuition	$15,960		
	(132)		
Number of students	169	117	
Number of students in the study	1,201	595	

	Original Two Cohorts					
	Panel B. First Year			*Panel C. Sum of Years 1 - 4*		
	Mean			Mean		
	Control	HAIL	P-value	Control	HAIL	P-value
Grants	$24,729	$24,207	0.360	$106,643	$105,735	0.720
	(497)	(235)		(2230)	(1011)	
Loans	$1,339	$1,766	0.125	$5,293	$7,282	0.042
	(202)	(164)		(772)	(592)	
Proportion with Grants $\geq$ Tuition	0.932	1.000	0.000	0.896	0.997	0.000
	(0.017)	(0.000)		(0.025)	(0.003)	
Expected Family Contribution	$1,902	$2,078	0.531	$8,264	$8,812	0.601
	(269)	(206)		(1220)	(827)	
Cost of Tuition	$14,672			$66,199		
	(403)			(398)		
Number of students	237	465		193	347	
Number of students in the study	1,978	1,932		1,978	1,932	

Notes: Analysis done at the student level. Includes only students enrolled at the University of Michigan full time for full first year (panels A and B) or full time for all four years (panel C) and who have financial aid data reported. Standard errors are clustered at the school level. Includes zeros for students who receive no aid. "Total grant aid" includes all institutional and departmental scholarships and grants, federal grants, state grants and scholarships, private scholarships, and other departmental aid. Expected family contribution is capped at the cost of attendance, as determined by the University of Michigan (includes tuition, fees, books and supplies, room and board, transportation, and personal expenses). Original two cohorts refers to the students studied in Dynarski et al. (2021), who first enrolled in the fall of 2015 and 2016.
Source: Michigan Department of Education (2022*b*), University of Michigan Office of Enrollment Management (2022), University of Michigan Office of Financial Aid (2022).

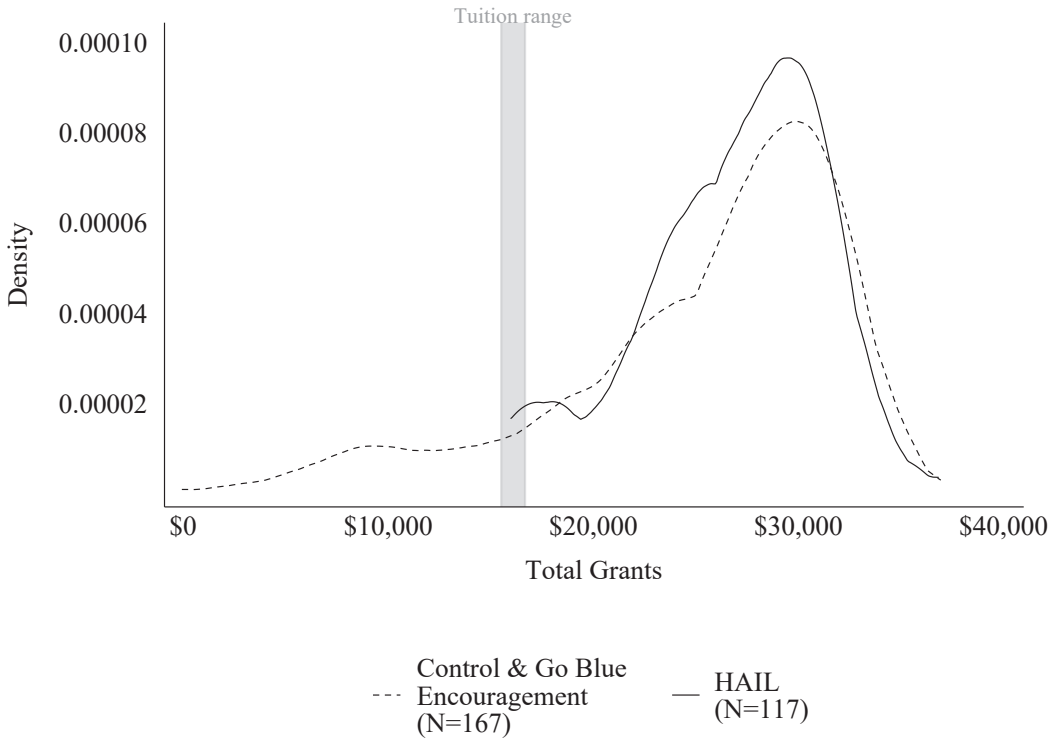


Figure 1
Distribution of Total Grants Awarded to Students, by Treatment Arm

Notes: Figure plots the distribution of total grant aid by treatment group, among students who were enrolled full time for the full first year, and who have aid data reported. Control and GBE are combined. Grant aid includes all institutional and departmental scholarships and grants, federal grants, state grants and scholarships, private scholarships, and other departmental aid. The gray bar represents the in-state tuition range for lower-division (first and second year) programs of study (ranging from $15,520 to $16,071 depending on the school or college each student is enrolled in). For simplicity, we refer only to tuition. Unlike many other institutions, the fees at the University of Michigan are very small ($214.19 for this cohort's first year). The distributions are not statistically significantly different, with an exact p-value from a two-sample Kolmogorov-Smirnov test of 0.244.
Source: Michigan Department of Education (2022*b*), University of Michigan Office of Enrollment Management (2022), University of Michigan Office of Financial Aid (2022).

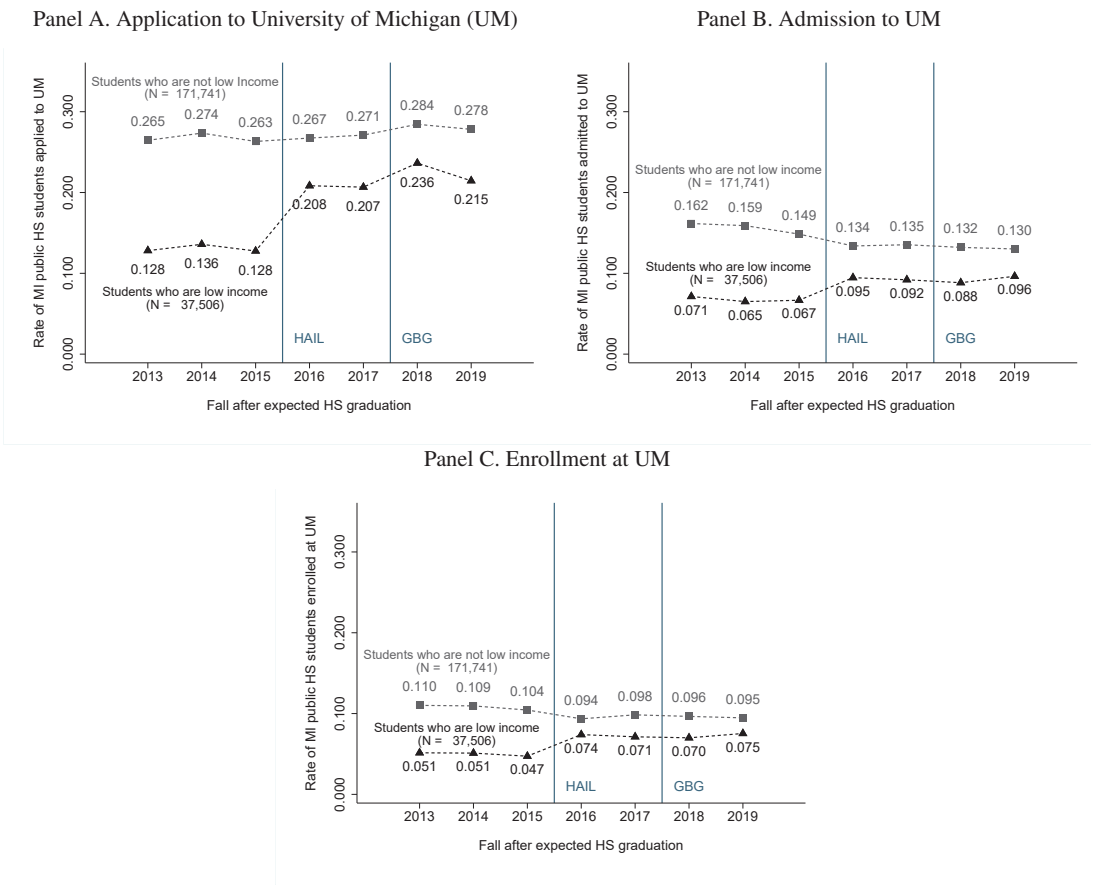


Figure 2
University of Michigan Application, Admission, and Enrollment Rates
for High-achieving Michigan Public High School Students

Notes: Figure plots the rate of UM application, admission, and enrollment, or the number of students who applied (or were admitted/enrolled) divided by the number of students in each 11th grade cohort in Michigan public schools. High-achieving students are students who scored at least a 23 on the ACT before 2016, or a 1100 or the SAT in 2016 or later, to correspond with the HAIL academic criteria. UM announced the Go Blue Guarantee in 2017 and implemented it in January of 2018.
Source: Michigan Department of Education (2022*b*), University of Michigan Office of Enrollment Management (2022).

The Power of Certainty: Experimental Evidence on the Effective Design of Free Tuition Programs

ONLINE APPENDIX

Elizabeth Burland, Susan Dynarski, Katherine Michelmore,
Stephanie Owen, and Shwetha Raghuraman

Appendix A. Intervention Materials

Exhibit 1
HAIL Student Letter

September 11, 2019

<<First_Name>> <<Last_Name>>
<<Person_Address1>>
<<Person_Address2>>
<<Person_City>>, <<Person_State>> <<Person_Postal>>

Dear <<First_Name>>,

As you are thinking about life after your senior year, we hope you are considering and will apply to the University of Michigan. You can put your incredible talents to work here in Ann Arbor – relatively close to home – where you will be surrounded by professors and resources to help you during your journey.

We believe you to be an academically excellent student who has worked hard for your achievements. If you apply to U-M and are admitted for the fall 2020 term, we will reward your hard work with the **HAIL Scholarship**, which covers the full cost of your in-state tuition for four years of study at our Ann Arbor campus. That's an approximate $66,000 value to you and your family.

Additionally, after a review of your financial aid applications, you will likely be eligible for additional aid to cover costs of housing, meals, textbooks, and other expenses.

The University of Michigan is an outstanding advantage for families in our state. Among all Michigan colleges, U-M students are the most likely to earn their degree, with 92% graduating in six years. When they do, they join a global base of more than 580,000 alumni who are eager to help them make connections and advance in their careers. Importantly, students who hold a U-M bachelor's degree earn 22% more annually than the national median, or $61,099, within five years after graduation. And 10 years after graduation that number rises to more than $85,000.

<<First_Name>>, please take a look at the enclosed materials and discuss this outstanding offer with your family. We look forward to receiving your application, with the fee waived, preferably by our Early Action deadline of November 1.

Similarly, please begin submitting your financial aid documents as of Oct. 1, when the FAFSA and CSS Profile become available. You do not need to wait until your application is complete to submit these documents. More information about applications to the university and for financial aid can be found at admissions.umich.edu.

Additionally, you may reach out with admissions questions to Dustin Castro in the Office of Undergraduate Admissions at 734-615-4008 or dcastro@umich.edu; or with financial aid questions to Raquel Arevalo in our Office of Financial Aid at 734-763-6600 or arevalor@umich.edu.

Go Blue!

Dr. Mark Schlissel
President

Exhibit 2
Go Blue Encouragement Student Letter

September 11, 2019

<<First_Name>> <<Last_Name>>
<<Person_Address1>>
<<Person_Address2>>
<<Person_City>>, <<Person_State>> <<Person_Postal>>

Dear <<First_Name>>,

As you are thinking about life after your senior year, we hope you are considering and will apply to the University of Michigan. You can put your incredible talents to work here in Ann Arbor – relatively close to home – where you will be surrounded by professors and resources to help you during your journey.

We believe you to be an academically excellent student who has worked hard for your achievements. That's why we hope you are planning to apply to the University of Michigan. Furthermore, our **Go Blue Guarantee** can help you with your college costs, as it covers the full cost of in-state tuition for in-state students who are admitted to the Ann Arbor campus and whose families earn incomes of $65,000 or less, with $50,000 or less in assets. If your family earns more, you can still Go Blue; we provide tuition support for families with incomes up to $180,000.

The University of Michigan is an outstanding advantage for families in our state. Among all Michigan colleges, U-M students are the most likely to earn their degree, with 92% graduating in six years. When they do, they join a global base of more than 580,000 alumni who are eager to help them make connections and advance in their careers. Importantly, students who hold a U-M bachelor's degree earn 22% more annually than the national median, or $61,099, within five years after graduation. And 10 years after graduation that number rises to more than $85,000.

<<First_Name>>, please take a look at the enclosed materials and discuss this outstanding offer with your family. We look forward to receiving your application, with the fee waived, preferably by our Early Action deadline of November 1.

Similarly, please begin submitting your financial aid documents as of Oct. 1, when the FAFSA and CSS Profile become available. You do not need to wait until your application is complete to submit these documents, and may receive additional aid to cover costs of housing, meals, textbooks, and other expenses. More information about applications to the university and for financial aid can be found at admissions.umich.edu.

Additionally, you may reach out with admissions questions to Dustin Castro in the Office of Undergraduate Admissions at 734-615-4008 or dcastro@umich.edu; or with financial aid questions to Jim Eddy in our Office of Financial Aid at 734-763-8424 or ofa-go.blue.guarantee@umich.edu.

Go Blue!

Dr. Mark Schlissel
President

Exhibit 3
HAIL Foldout (first page)


HAIL SCHOLARSHIP
UNIVERSITY OF MICHIGAN
#VICTORS2024
The HAIL Scholarship is brought to you by:
OFFICE OF UNDERGRADUATE ADMISSIONS UNIVERSITY OF MICHIGAN
OFFICE OF FINANCIAL AID UNIVERSITY OF MICHIGAN
THE VALUE OF A MICHIGAN DEGREE
The University of Michigan is consistently ranked as one of the top 25 universities worldwide, and as the No. 1 public research university in the U.S.
We appreciate our rankings, but we value student success even more. At Michigan, you'll stay, graduate, and become a member of the world's largest living alumni group.
Our freshman retention rate is 97%, compared to the national rate of 79%. (Our students like it here!)
Our graduation rate is 92%, compared to the national average of 59%. (Our students learn—and go on to great things!)
After graduation, you'll become part of an incredibly large, supportive network of alumni from all over the world. Anywhere you go, you're likely to meet a proud Wolverine. GO BLUE!
U-M offers all this and better lifetime earnings, too.
By 2020, 65% of job openings will require workers with at least some college education.
Georgetown University Center on Education and the Workforce Recovery 2020 Report
$61,099
$85,000
Department of Education (2019)
Average earnings of U-M Bachelor's Degree grads after 5 years
Average earnings of U-M Bachelor's Degree grads after 10 years
Learn more and register for a free U-M e-book:
<<purl>>
HAIL: High-Achieving Involved Leader
A scholarship at the University of Michigan for students like you who are intent on reaching their full potential at a school with the resources and support to help them succeed.
CSS PROFILE
The CSS Profile is a financial aid application that allows us to determine eligibility for U-M gift aid and scholarships.
This money can be used to pay for expenses other than tuition and does not have to be paid back.
Apply with CSS Profile
FAFSA (FREE APPLICATION FOR FEDERAL STUDENT AID)
This is the application used to determine eligibility for federal, state, and college-sponsored financial aid, including grants, educational loans, and Work-Study programs.
This money can be used to pay for expenses other than tuition.
FAFSA®: Apply for Aid
COLLEGE APPLICATION
The Common Application and Coalition Application are online college applications used by U-M. Students enter basic information and statistics into either application, and meet the school's particular requirements—like the additional essays.
Your future starts here
MAKING ACCESS A REALITY

Exhibit 4
Go Blue Encouragement Foldout (first page)


GO BLUE GUARANTEE
FREE TUITION
FOR FAMILIES WITH INCOMES $65,000 & UNDER
ASSETS BELOW $50,000
TUITION SUPPORT
FOR FAMILIES WITH INCOMES UP TO $180,000
FOUR YEARS FOR QUALIFYING IN-STATE STUDENTS | ANN ARBOR CAMPUS
The Go Blue Guarantee is brought to you by:
OFFICE OF UNDERGRADUATE ADMISSIONS UNIVERSITY OF MICHIGAN
OFFICE OF FINANCIAL AID UNIVERSITY OF MICHIGAN
THE VALUE OF A MICHIGAN DEGREE
The University of Michigan is consistently ranked as one of the top 25 universities worldwide, and as the No. 1 public research university in the U.S.
We appreciate our rankings, but we value student success even more. At Michigan, you'll stay, graduate, and become a member of the world's largest living alumni group.
Our freshman retention rate is 97%, compared to the national rate of 79%. (Our students like it here!)
Our graduation rate is 92%, compared to the national average of 59%. (Our students learn—and go on to great things!)
After graduation, you'll become part of an incredibly large, supportive network of alumni from all over the world. Anywhere you go, you're likely to meet a proud Wolverine. GO BLUE!
U-M offers all this and better lifetime earnings, too.
By 2020, 65% of job openings will require workers with at least some college education.
Georgetown University Center on Education and the Workforce Recovery 2020 Report
$61,099
$85,000
Department of Education (2019)
Average earnings of U-M Bachelor's Degree grads after 5 years
Average earnings of U-M Bachelor's Degree grads after 10 years
Learn more and register for a free U-M e-book:
<<purl>>
GO BLUE GUARANTEE
The Go Blue Guarantee is our commitment to keeping a world-class education affordable and accessible for all Michigan residents pursuing undergraduate study on our Ann Arbor campus.
CSS PROFILE
The CSS Profile is a financial aid application that allows us to determine eligibility for U-M gift aid and scholarships.
This money can be used to pay for expenses other than tuition and does not have to be paid back.
Apply with CSS Profile
FAFSA
(FREE APPLICATION FOR FEDERAL STUDENT AID)
This is the application used to determine eligibility for federal, state, and college-sponsored financial aid, including grants, educational loans, and Work-Study programs.
This money can be used to pay for expenses other than tuition.
FederalStudentAid
FAFSA®: Apply for Aid
COLLEGE APPLICATION
The Common Application and Coalition Application are online college applications used by U-M. Students enter basic information and statistics into either application, and meet the school's particular requirements—like the additional essays.
Your future starts here
REALITY

Appendix B. Appendix Tables and Figures

Appendix Table 1
School-Level Balance

Characteristic	(1) Control	(2) HAIL	(3) GB Encour.	(1) vs. (2) P-value	(1) vs. (3) P-value	(2) vs. (3) P-value	Joint F-test P-value
Pred. prob. of highly selective college attendance	0.13	0.13	0.13	0.81	0.58	0.43	0.71
	(0.13)	(0.12)	(0.12)				
School in UP	0.15	0.18	0.15	0.52	1.00	0.52	0.76
	(0.36)	(0.38)	(0.36)				
Town/rural school	0.53	0.53	0.52	1.00	0.78	0.77	0.95
	(0.50)	(0.50)	(0.50)				
Suburban school	0.35	0.35	0.36	1.00	0.78	0.77	0.95
	(0.48)	(0.48)	(0.48)				
Distance of school from UM (miles)	98.9	104.1	97.5	0.55	0.85	0.39	0.68
	(86.74)	(86.65)	(75.65)				
UM application rate of school, class of 2015	0.07	0.07	0.06	0.89	0.60	0.56	0.81
	(0.08)	(0.10)	(0.09)				
Average ACT score of school, class of 2015	19.96	19.92	19.89	0.85	0.74	0.92	0.94
	(1.85)	(2.06)	(2.07)				
Proportion of sample students with A or A+ GPA	0.86	0.87	0.84	0.74	0.47	0.30	0.56
	(0.24)	(0.22)	(0.26)				
Proportion of sample students with A-, B+, or B GPA	0.14	0.13	0.16	0.68	0.52	0.29	0.57
	(0.24)	(0.22)	(0.26)				
Average SAT of sample students	1260	1264	1262	0.55	0.86	0.65	0.83
	(71.14)	(72.77)	(61.83)				
Proportion female	0.56	0.55	0.57	0.71	0.87	0.59	0.86
	(0.35)	(0.36)	(0.34)				
Proportion under-represented minority	0.17	0.15	0.18	0.59	0.63	0.31	0.59
	(0.28)	(0.27)	(0.29)				
Proportion eligible for free lunch	0.80	0.81	0.79	0.70	0.71	0.43	0.74
	(0.28)	(0.25)	(0.28)				
Average number of sample students	3.8	3.7	3.7	0.79	0.76	0.96	0.95
	(3.50)	(3.19)	(3.51)				
Overall F-test p-value				1.00	1.00	0.93	
Number of schools	159	159	159	318	318	318	477
Number of students	610	595	591	1,205	1,201	1,186	1,796

Notes: All analyses conducted at the school level. P-values for each pair of treatment arms are from a t-test of the coefficient on treatment status from a regression of the characteristic on treatment and strata dummies. The joint F-test p-value for each characteristic is from a joint significance test of the coefficients on treatment dummies from a regression of the characteristic on treatment and strata dummies, run on all treatment arms. For each pair of treatment arms, the overall F-test p-value is from a joint significance test predicting treatment based on the characteristics listed here, excluding the summary index, as well as strata dummies. Standard deviations in parentheses. All regressions use robust standard errors. We rerandomized to achieve balance within region on all listed school characteristics, except the summary index and the proportion eligible for free lunch. Summary index calculated from parameters of an OLS regression estimating the relationship between observable characteristics and a binary indicator for attending a college as competitive as the University of Michigan. "Under-represented minority" includes all students who are Black, Hispanic, American Indian, or Native Hawaiian or Pacific Islander.
Source: Michigan Department of Education (2022), University of Michigan Office of Enrollment Management (2022).

Appendix Table 2
Applicant Characteristics by Treatment Arm

Characteristic	Control	HAIL	GB Encour.	Control vs. HAIL P-value	Control vs. GBE P-value	HAIL vs. GBE P-value
Pred. prob. of highly selective college attendance	0.23	0.16	0.19	0.00	0.05	0.29
School in UP	0.07	0.14	0.07	0.07	0.77	0.10
Town/rural school	0.31	0.37	0.38	0.55	0.16	0.38
Suburban school	0.44	0.43	0.34	0.31	0.02	0.33
Distance of school from UM (miles)	78.0	89.8	73.3	0.24	0.67	0.08
UM application rate of school, class of 2015	0.11	0.08	0.11	0.34	0.76	0.53
Average ACT score of school, class of 2015	20.64	20.49	20.41	0.72	0.47	0.93
A or A+ GPA	0.90	0.87	0.89	0.22	0.70	0.52
A-, B+, or B GPA	0.10	0.13	0.10	0.25	0.78	0.48
SAT	1309	1285	1289	0.01	0.02	0.63
Female	0.54	0.55	0.55	0.94	0.79	0.93
Under-represented minority	0.18	0.15	0.18	0.53	0.97	0.66
Eligible for free lunch	0.83	0.76	0.81	0.05	0.64	0.24
Average number of sample students at school	7.6	6.6	7.5	0.51	0.86	0.65
Overall F-test p-value				0.00	0.02	0.00
Application rate	0.38	0.63	0.46			
Number of students	229	373	269			

Notes: All analyses conducted at the student level. Treatment arm comparison p-values and overall F-test p-value computed as in Appendix Table as in Appendix Table 1. All variables defined as in Appendix Table 1.
Source: Michigan Department of Education (2022), University of Michigan Office of Enrollment Management (2022).

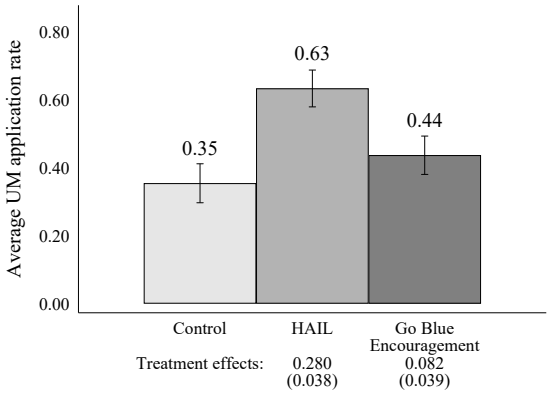
Appendix Table 3
Student Financial Aid Amounts by Treatment Arm

	Focal Cohort					
	First Year					
	Mean					
	Control	HAIL	GBE	H-C	GBE-C	H-GBE
Grants	$25,432	$26,676	$25,172	$1,244	-$260	$1,504
	(918)	(423)	(690)	(1014)	(1152)	(812)
Loans	$1,217	$956	$1,419	-$261	$202	-$463
	(412)	(184)	(346)	(453)	(540)	(393)
Proportion with Grants $\geq$ Tuition	0.886	1.000	0.873	0.114	-0.013	0.127
	(0.034)	(0.000)	(0.035)	(0.034)	(0.049)	(0.035)
Expected Family Contribution	$2,336	$2,481	$2,464	$145	$129	$17
	(605)	(524)	(564)	(803)	(830)	(773)
Cost of Tuition		$15,960				
		(132)				
Number of students	88	117	81			
Number of students in the study	610	595	591			

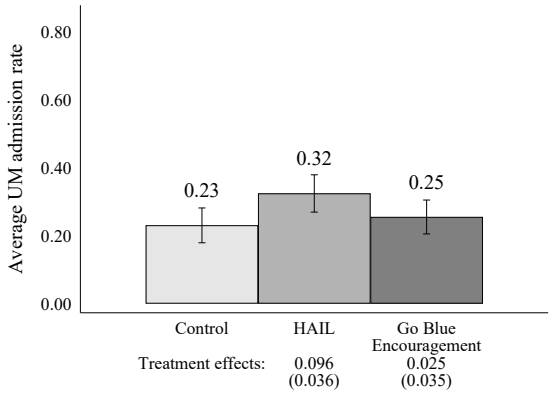
Notes: Analysis done at the student level. Includes only students enrolled at the University of Michigan full time for full first year and who have financial aid data reported. Standard errors are clustered at the school level. Includes zeros for students who receive no aid. "Total grant aid" includes all institutional and departmental scholarships and grants, federal grants, state grants and scholarships, and private scholarships, and other departmental aid. Expected family contribution is capped at the cost of attendance, as determined by the University of Michigan (includes tuition, fees, books and supplies, room and board, transportation, and personal expenses).
Source: Michigan Department of Education (2022), University of Michigan Office of Enrollment Management (2022), University of Michigan Office of Financial Aid (2022).

Appendix Figure 1
Estimated Effect of HAIL Scholarship and Go Blue Encouragement Treatments
on University of Michigan Application, Admission, and Enrollment

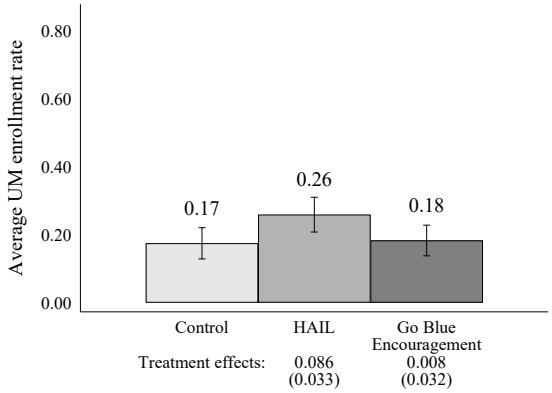
(a) Application to University of Michigan (UM)



(b) Admission to UM

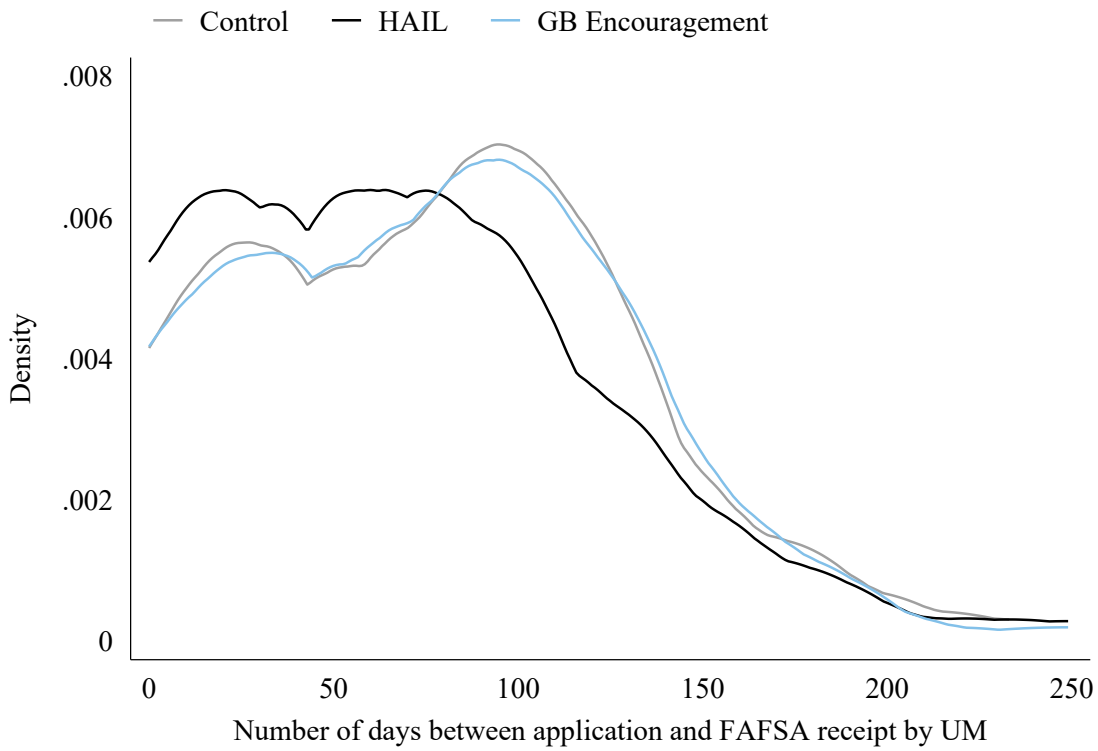


(c) Enrollment at UM



Notes: All analyses done at the school level. Treatment effect coefficients are from estimating Equation 1, a regression of the outcome on indicators for each treatment status (HAIL, Go Blue Encouragement), and strata indicators. The "HAIL" and "Go Blue Encouragement" treatment effects are estimates of β_1 and β_2, respectively. Robust standard errors reported in parentheses. Ninety-five percent confidence intervals shown based on robust standard errors. Application, admission, and enrollment measured in the summer and fall following expected high school graduation. Admission and enrollment are unconditional on application.
Source: Michigan Department of Education (2022), University of Michigan Office of Enrollment Management (2022).

Appendix Figure 2
Days between Application to UM and UM Receipt of FAFSA Application

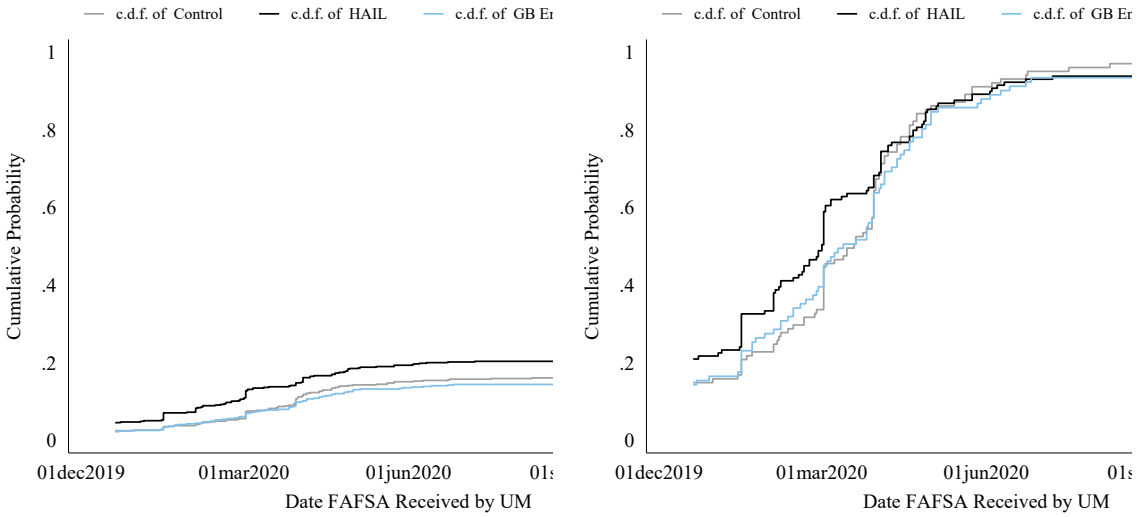


Notes: Figure plots the kernel density of days between application and when the FAFSA was received by the University of Michigan. The first recorded date of receipt by UM is December 20th, the day after early action admissions decisions were released. To calculate the number of days, we set the earliest application date at December 20th then calculated the FAFSA submission date from there, or the actual recorded date for those who apply later. Students who do not enroll at UM or file a FAFSA are excluded from this figure.
Source: University of Michigan Office of Enrollment Management (2022), University of Michigan Office of Financial Aid (2022).

Appendix Figure 3
Cumulative Distribution of the Dates FAFSA was received by UM

(a) Not Conditional on Enrollment at UM or filing FAFSA (N=1,976)

(b) Conditional on enrollment at UM, not conditional on filing FAFSA (N=321)

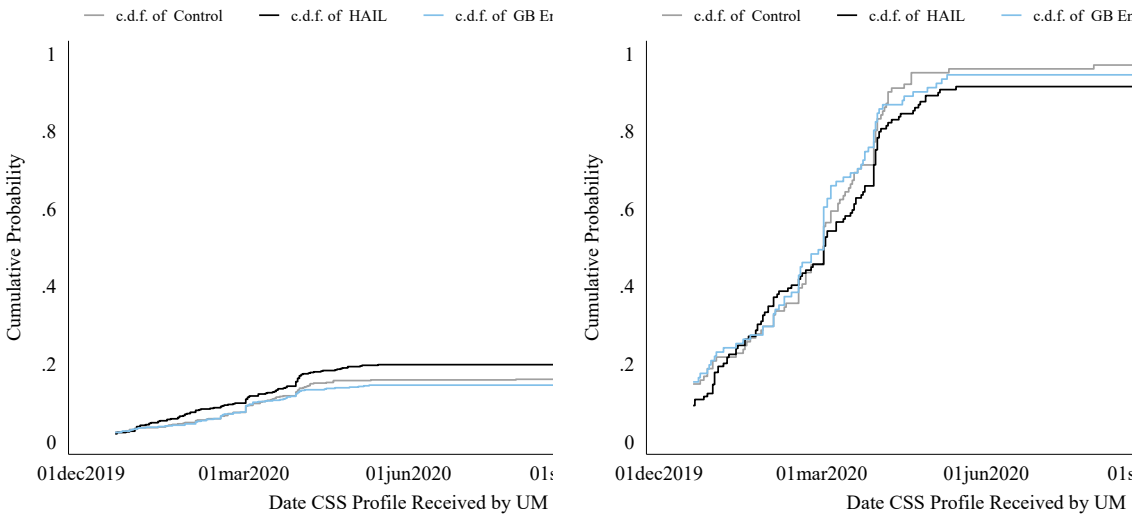


Notes: Figure plots the cumulative distribution of the date the FAFSA was received by the University of Michigan. The first recorded date of receipt by UM is December 20th, the day after early action admissions decisions were released. Panel 3a includes the full HAIL sample, and therefore students who never have a FAFSA received by UM. Panel 3b excludes students who do not enroll at UM.
Source: University of Michigan Office of Enrollment Management (2022), University of Michigan Office of Financial Aid (2022).

Appendix Figure 4
Cumulative Distribution of the Dates CSS Profile was received by UM

(a) Not Conditional on Enrollment at UM or filing CSS Profile (N=1,976)

(b) Conditional on enrollment at UM, not conditional on filing CSS Profile (N=321)



Notes: Figure plots the cumulative distribution of the date the CSS Profile was received by the University of Michigan. The first recorded date of receipt by UM is December 20th, the day after early action admissions decisions were released. Panel 4a includes the full HAIL sample, and therefore students who never have a CSS Profile received by UM. Panel 4b excludes students who do not enroll at UM.
Source: University of Michigan Office of Enrollment Management (2022), University of Michigan Office of Financial Aid (2022).

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