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# WHAT DID UWE DO FOR ECONOMICS?

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## ABSTRACT

Economics is among the most popular undergraduate majors. However, even at the best research universities and liberal arts colleges men outnumber women by two to one, and overall there are about 2.5 males to every female economics major. The *Undergraduate Women in Economics (UWE) Challenge* was begun in 2015 for one year as a randomized controlled trial with 20 treatment and 68 control schools to evaluate the impact of light-touch interventions to recruit and retain female economics majors. Treatment schools received funding, guidance, and access to networking with other treatment schools to implement programs such as providing better information about the application of economics, exposing students to role models, and updating course content and pedagogy. Using 2001-2021 data from the Integrated Postsecondary Education Data System (IPEDS) on graduating BAs, we find that UWE was effective in increasing the fraction of female BAs who majored in economics relative to men in liberal arts colleges. Large universities did not show an impact of the treatment, although those that implemented their own RCTs showed moderate success in encouraging more women to major in economics. We speculate on the reasons for differential treatment impact.

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A randomized controlled trials registry entry is available at
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Economics has long been among the most popular undergraduate majors. But women do not major in economics to the same degree as do men. Although there are relatively more female economics majors now than there were twenty years ago in 2002 (compared with their numbers as BA recipients), that gain has merely brought us back to levels achieved a decade before that, in 1992. The fraction of female majors in economics is lower than in many of the STEM fields (Bayer and Rouse 2016).

Several years ago, we started the *Undergraduate Women in Economics* (UWE) *Challenge*, a randomized controlled trial (RCT) with the purpose of addressing this gender gap in economics. We have written several papers about the reasons for creating UWE, its implementation, and the many offshoots of the program, which we term "RCTs within the RCT" (Avilova and Goldin 2018, 2020; Goldin 2015).[1] Now that many of the undergraduate cohorts treated by the interventions have graduated, we can provide an assessment of how well our "light-touch" program functioned to attract more women to major in economics. We will speculate about why it worked in some institutions but not in others.

The bottom line is that UWE was effective in increasing the fraction of female BAs who majored in economics relative to men in liberal arts colleges. Large universities did not show an impact of the treatment. The sheer size of these institutions likely meant that the light-touch interventions could not reach enough undergraduates. In some cases, enrollment capacity limitations and constraints on the number of faculty and teaching staff may have prevented departments from recruiting more students. However, among the large universities, those that implemented their own experiments do show moderate success in encouraging more women to major in economics, probably due to the greater involvement of the faculty and staff in the UWE RCT(even if some of the individual RCTs showed limited impact).

The experiences of the schools in the UWE *Challenge* also revealed more information about the barriers students face to majoring in economics and how we can design interventions to encourage more women to enter the field.

There is a considerable lack of knowledge about the field of economics among undergraduates, including the wide array of issues that economists study and the potential career paths. A common misperception is that economics is only about finance. That view often dissuades women from majoring in economics, at the same time that it encourages men to do so. Women's greater grade sensitivity is another factor that has led many to exit the field after taking the Principles sequence even when they have the same grades as men who remain with the major. Exposing women to more role models, providing mentoring

[1] Parts of this paper draw on those papers.

resources, creating courses that appeal to students' interests in current issues, and supporting student clubs and conferences can help increase women's interest in the field. The UWE *Challenge* has uncovered many of the reasons why women are scarce in economics and has emphasized that we could do much more to demonstrate, as an AEA video has stressed, that "Economics: it's much more than you think."

*Economics' Gender Gap*

There are several reasons to be concerned that women are underrepresented in economics. Most important is that some of the difference is due to incorrect or misperceived information about the major and career options that are available. Providing accurate information should be a low-cost intervention. Another is that there is a large earnings premium for majoring in economics. Finally, gender imbalances change the nature of economics since women and men gravitate to different fields within economics.[2]

Our measure of the gender gap in economics and its change over time must consider the fact that women have become the majority of undergraduates nationwide and receive far more bachelor's degrees than do men. We employ various forms of a statistic we term the "conversion ratio." The conversion ratio gives the extent to which male or total (female and male) undergraduates opt into economics as a major relative to female undergraduates. The ratio is scaled by the number of degree recipients, and thus shows the extent to which male or all versus female undergraduates get "converted" into the economics major.

One version of the conversion ratio is given by the ratio of male to female economics majors relative to female to male BAs across $N$ institutions, $i$ , in year $y$, as in eq. (1).[3]

$$(1)\quad \text{Conversion Ratio}_y^{MF} = \left[\frac{\sum_i Male\ Economics\ Majors_{iy} \,/\, \sum_i Male\ BAs_{iy}}{\sum_i Female\ Economics\ Majors_{iy} \,/\, \sum_i Female\ BAs_{iy}}\right]$$

where BA is a shorthand for the degree from a four-year institution (bachelor's degree), which can be a Bachelor of Arts (BA) or a Bachelor of Science (BS).

[2] On differences in economics fields by gender, see Fortin et al. (2021). On differences in opinions about economic policy by gender, see May et al. (2014). On the financial return to economics, see Black, et al. (2003), and Bleemer and Mehta (2022), who provide causal evidence that economics majors earn a premium independent of gender. On differences in aptitude, course performance, and demographic characteristics not being of importance in the fraction of women relative to men majoring in economics, see Emerson et al. (2012).

[3] All BAs will not equal all majors when each graduate is allowed to have more than one major, as is the case in the IPEDS after 2001.

We use this definition in our discussion of general trends when the unit of analysis is a group of institutions or the US as a whole in year *y*. It produces a figure for the number of male economics majors relative to that for female economics majors, given their relative proportions as BAs.

Another version of the conversion ratio computes female economics majors to total (= female + male) economics majors relative to the female to total BA ratio for school *i* in year *y*, as given by eq. (2), where *T* = total.

$$(2) \quad \text{Conversion Ratio}_{iy}^{FT} = \left[\frac{(Female\ Economics\ Majors\ /\ (Female\ BAs)}{(Total\ Economics\ Majors\ /Total\ BAs)}\right]_{iy}$$

We will use this version when individual schools are the unit of observation because the number of female economics majors in some schools is very small. The conversion ratio as expressed in eq. (1) when computed for individual schools is highly sensitive to the small number of female economics majors because it contains the ratio of male to female economics majors.

We have referred to the concept of a major. But schools have increasingly allowed students to have double (or even triple) majors when they have satisfied the institutional requirements for each. The National Center for Education Statistics (NCES) began collecting information on multiple majors in the Integrated Postsecondary Education Data System (IPEDS) in 2001, although it is not clear how the IPEDS allocates majors between first and second major when the institution treats them equally.[4]

When the IPEDS first reported multiple majors in 2001, about 10% of all economics majors in our 88-school sample took it as a second major. At that time, the figure was about the same for men and women. But by 2021 about 19% of all female economics majors (first plus second) had economics as their second major, whereas 14% of the men did. The difference is even higher in the 20 liberal arts colleges in our sample, for which 24% of all female economics majors in 2021 had economics as their second major whereas 17% of the men did.[5] More women than men have economics as a secondary or multiple major.

[4] The 2022/23 IPEDS instructions do not include a clear way for schools to list double majors. The instructions are: "Double Majors: When a student receives a single degree with majors in two (or more) program specialties, report the degree in one program (1st major); you should report the second program specialty as a second major." There is no guidance regarding which program to put first and second. If these are listed alphabetically, first majors will be a biased group (Source: NCES, "2022-23 Survey Materials > Instructions"). See also the discussion in Stock (2017).

[5] Note that these calculations are averages of schools. In contrast, the data we will discuss in Figures 1a and 1b aggregate data for all institutions within groups, such as top 100 liberal arts colleges.

Therefore, the number of males per female economics majors decreases somewhat when all majors are included rather than just the first major.

We have graphed in Figure 1a and 1b the results for eq. (1) among all undergraduate institutions in the US that had an economics major. Figure 1a has only the "first" major and Figure 1b has both majors. We provide both to show that the differences are small but that women, more than men, take a secondary major in economics when given the option. We will only discuss Figure 1b results since the two graphs are sufficiently similar.

Information is provided for two types of institutions (top 100 universities and top 100 liberal arts colleges) as well as for all institutions. In the most recent years the number of male to female economics majors (adjusted for BAs) was around 2.5 across all institutions, 2.4 for the liberal arts colleges, and 2.1 for top universities. In addition, the change since around 2008 was in favor of female economics majors.

That trend is interesting because the Great Recession, like many economic downturns, led to an increase in economics majors in general. But the 2008 downturn increased the *relative* number of female economics majors.

Also of note are the previous fluctuations. There were relatively fewer male to female economics majors in the late 1980s across all the types of institutions shown. But by around 1990, the conversion ratio had increased and reached levels about equal to those before the Great Recession. With the exception of liberal arts colleges, there has been a relative increase in female economics majors in the last decade shown. But men clearly still dominate with about 2.5male majors relative to female majors accounting for the relative number of BAs.

## *The* UWE *Challenge*

### *Background*

In 2013, the conversion ratio across all institutions was 2.8, that is there were almost three male economics major for every female major relative to overall male to female BAs. Economics had always been a large, popular major. The field had become complacent. Meanwhile, female undergraduates increased as a fraction of all college students. In fact their numbers exceeded those of male undergraduates, and of male BAs, around 1980 (see Goldin, Katz, and Kuziemko 2006). It was about time for the field of

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Also note that although we know first and second economics majors, we did not collect information on whether a first economics major had another major or not.

economics to realize that it was losing out by not attracting women to the same degree as men.

At that time Goldin was the incoming president of the American Economic Association and raised the issue in various ways. She was soon encouraged by the Alfred P. Sloan Foundation to create a program to encourage more women to major in economics and apply for funding.[6]

To prepare for this undertaking, Goldin obtained administrative data for a highly-ranked undergraduate institution, dubbed "Adams College." In 2013, the conversion ratio at Adams was 1.8 and the fraction female among its economics majors was 0.35, similar to the ratio at Adams' peer institutions.

At Adams (and its peer institutions) incoming freshmen are asked what they believe their primary major will be. Twice as many men than women at Adams put economics as their most probable primary major. We discovered similar results held for its peer institutions. Therefore, even before students unpacked their bags, the die had been cast: two men planned to major in economics for every woman who did the same. The first lesson from the Adams data was that useful treatments must occur soon after students arrive on campus.

Principles of economics is a popular course at Adams, as it is elsewhere. Women who take Principles but do not eventually major in the subject are disproportionately among those who obtained a grade below an A- in the course. The relationship holds even among those who gave economics as their probable major. Women who take Principles have a much higher probability of majoring in the subject if they obtain an exceptional grade, that is A- or A. That is not true for men, who major in economics almost regardless of their grade in Principles. Therefore, conditional on the grade received, female students have a far steeper gradient (in other words, greater "grade sensitivity") regarding their likelihood of majoring in economics.[7]

It is possible that female students work harder in subjects at which they excel (or are told they excel), whereas male students take subjects they know will eventually benefit them. Female students may seek more comfort in their selection of a major, whereas male students stick with their goal even if they do poorly. Another possibility is that female students consider their grade in an introductory course to be an indicator of their future

[6] Danny Goroff of the Alfred P. Sloan Foundation encouraged Goldin to pursue the project.
[7] These findings are in Goldin (2015). Similar results are in Patnaik, et al. (2023) for the University of Wisconsin, Madison and Antman, et al. (2022) for the University of Colorado, Boulder.

success in the discipline, whereas male students do not interpret it as such.

What about mathematical ability? The Adams data were clear: mathematical ability had little to do with the initial decision to major in economics and with the choice of an eventual major.

*The Birth of UWE*

In the summer 2014, the Alfred P. Sloan Foundation generously funded a grant through the National Bureau of Economic Research (NBER) that enabled the implementation of an RCT, later termed the *Undergraduate Women in Economics* (UWE) *Challenge*. The purpose of the RCT was to uncover why women do not major in economics to the same degree as men and to assess what could be done about the disparity.[8]

In January 2015, UWE sent e-mails to the department chairs (or the undergraduate program coordinators) of all US colleges and universities with a reasonably-sized undergraduate program (graduating at least 15 economics majors on average between AY 2010-11 and AY 2012-13), to ask if their department was willing to implement a set of interventions meant to increase the number of female majors.[9]

The letter listed the fraction female among undergraduate majors at that institution since it was discovered that many department chairs and undergraduate program directors did not know about the large gender imbalance at their schools. The heads of the departments or undergraduate programs were also asked if they would be willing to cooperate in the collection of aggregated data that would not require Institutional Review Board (IRB) approval. Finally, they were told that they would be given $12,500 if they were selected to be part of the program and were informed that the funds could be used in any reasonable way that might further the stated objective. A list of possible light-touch (and inexpensive) interventions was included (see Appendix 1).

A sufficiently large number of affirmative replies came back that allowed the sample to be further limited to 88 schools with a larger aggregate number of economics majors.[10] Of those, 20 were randomly chosen as treatments, and the rest became controls. (See Appendix 2 for the schools in the treatment and control groups and for the method used to select the treatments, which involved taking five schools randomly from each of four

[8] Tatyana Avilova was hired as the project manager for two years and then matriculated as a graduate student in economics at Columbia University from which she received her PhD in 2022.
[9] We omitted Harvard University.
[10] Even though the aggregate number of majors among the sample institutions was increased, the fraction of BAs majoring in economics in many of the schools was still very small.

"clusters" of 22 schools ordered from highest to lowest using 2013 *US News & World Report* rankings. We will mention the issue of clusters again in the empirical estimation.)

The 20 treatment schools are by design a highly varied group. Some are large state universities, a few are flagship institutions, some are small liberal arts colleges, and several are Ivy League institutions. A few have business schools with business undergraduate majors and even economics majors.

In spring 2015, UWE leadership met with primary investigators (faculty and teaching staff) of the 20 treatment schools to discuss what might work at their institutions. During the next year, treatment institutions used the funding and guidance from the project organizers to propose and initiate interventions that would disproportionately increase the number of female economics majors, possibly without decreasing the number of male economics majors. The treatment institutions were encouraged, although not obligated, to continue the interventions going forward, but funding was provided only in the treatment year.[11]

*Light-Touch and Heterogeneous Treatments*

Most RCTs have specific treatments. But one size would not fit all the treatment institutions, which varied by characteristics such as size, resources, commitment of faculty, and the use of instructors and adjuncts. Instead, a list of potential light-touch treatments in three (somewhat overlapping) areas were assembled and treatment schools were requested to use several of them. The treatment schools submitted progress reports and these have informed our knowledge of the treatments used.

(1) *Better Information*: These interventions were meant to provide more accurate information about economics and the career paths open to economics majors. Many potential majors did not know that economics concerns subjects such as economic development, health, education, inequality, and population change and thought that economics was only the study of financial markets. Treatment schools had academic fairs and pre-major department information sessions. Some created eye-catching flyers to give to freshmen and upper-class students. Some schools ensured that female professors, instructors, and/or upper-year students were at informational fairs.

(2) *Mentoring and Role Models*: The intent was to create networks among students and to show support for their decision to major in the field. Many of the treatment schools

[11] In fall 2018/winter 2019, remaining funds from the Sloan Grant were made available to the schools as mini grants for additional interventions. Six schools received grants ranging from $1,500 to $3,000.

initiated "Undergraduate Women in Economics" clubs and the UWE *Challenge* sponsored several regional conferences. Departments organized clubs that either focused on recruiting women to economics or opened membership to all students but made promoting diversity in economics one of its central missions. The clubs were resource-intensive but appeared to be useful at both the larger departments and the liberal arts colleges. Schools that regularly had seminars, invited more female speakers. See the Appendix 3 listing of the student conferences that were sparked by the UWE *Challenge*.

(3) *Instructional Content and Presentation Style*: These interventions were intended to improve economics courses (primarily, but not only, introductory ones) and make them more relevant to a wider range of students. Four treatment schools (University of California Berkeley, Connecticut College, University of Richmond, and University of Connecticut) created courses that expanded the topics discussed to demonstrate the wide-range of economics and its concern with individual well-being.

*The Impact of UWE on Economics*

*The UWE RCT*

The UWE RCT began in Fall 2015. The target treatment group consisted of first-year undergraduates and sophomores who had not yet selected their majors.[12] Even juniors and seniors could have been "treated" if the treatments incentivized them to change their major to economics or to declare a second major in economics. Much would have depended on the type of treatment, whether it was part of a class (such as having a female guest lecturer in Principles) or a broader department event.

As noted above, schools elected to have a variety of treatments, some of which would have had an impact on all undergraduates and some of which would have affected only students in certain courses, such as Principles. It is possible that majors graduating as early as AY 2015-16 could have been "treated." But most of the impact would have been experienced among those who entered as first-years during the treatment year and graduating in AY 2018-19, and for the existing sophomores, graduating in AY 2017-18.[13]

We use the IPEDS to explore whether the 20 treated schools had outcomes at graduation different from those of the 68 control schools during and after the treatment

[12] We use "first-years" as the gender inclusive term for "freshmen." This term does not apply to "transfer students" who are in their first year at the school but have previously completed coursework at another postsecondary institution.
[13] Assuming graduation in four years. Since many graduate in more than four years, the impact of the treatment could last for a few more.

year. The dependent variable is the conversion ratio ($\mathrm{CR}_{iy}^{FT}$) for female ($F$) majors relative to Total = male and female ($T$) majors in year $y$ for institution $i$, and is defined in eq. (2). We estimate versions of eqs. (3) and (4):

$$(3) \quad \mathrm{CR}_{iy}^{FT} = \alpha_0 + \alpha_1\tau_i + \alpha_2\mathrm{Year} + \alpha_3(\tau_i \times \mathrm{Year}) + \gamma\mathbf{I}_iC + \delta(\mathrm{Year} \times \mathbf{I}_iC) + \epsilon_{iy}$$

$$(4) \quad \mathrm{CR}_{iy}^{FT} = \beta_0 + \beta_1\tau_i + \beta_2\mathrm{Post} + \beta_3(\tau_i \times \mathrm{Post}) + \varphi\mathbf{I}_iC + \omega(\mathrm{Post} \times \mathbf{I}_iC) + \varepsilon_{iy}$$

where $\tau_i$ = treatment school $i$ and $C$ = one of four clusters as an indicator variable (see Appendix 2 discussion of the selection mechanism). In eq. (4) the years during which the treatment should have been evident is given by Post. We have coded these years as AY 2017-18 to AY 2020-21, which would presume that the treatment schools maintained some elements of the treatment after the treatment year. We have also added the covariates Public for a state institution, Liberal Arts for a liberal arts college, and log(total BAs) for the size of the undergraduate institution.

To provide some broader empirical content to the analysis, Figure 2 (part A) graphs the fraction female among economics majors in the 88 institutions in the analysis sample from 2001 to 2021 and separately for the 23 liberal arts colleges and the 65 universities (not liberal arts colleges). The fraction female among all economics majors varies from around 0.29 to 0.32. It first declines to 2008 and then rises somewhat. But the fraction of all undergraduates who are female also increased in this period and varies across institutions. Thus the conversion ratio given by eq. (2) is also graphed (part B). The level is about twice as high, varying from around 0.52 to 0.62, and the time trend, not surprisingly, is similar to that for the fraction female.[14] Both ratio ratios are higher for the liberal arts colleges.

Table 1 gives the estimates of the treatment effects. All schools are in col. (1), liberal arts colleges (5 treatments and 18 controls) are in col. (2), and all institutions other than the liberal arts colleges (15 treatments and 50 controls) are in cols (3) and (4). Almost three-quarters (11 of 15) of those that are not liberal arts institutions in the treatment group are large state universities. Because of the small number of observations in the post-treatment years (AY 2017-18 to AY 2020-21) we use the eq. (4) version that aggregates treatment years into the variable "Post."

The main finding in Table 1 is that a treatment effect of the UWE intervention is discernable and substantial for the liberal arts colleges, but not for the entire group of treatment schools. The impact of (treatment × post) for the liberal arts college in col. (2) is

[14] The conversion ratio is divided by the fraction of all BAs in the academic year who are female, which is generally more than one-half.

17% of the mean for the dependent variable. There are several potential reasons for the different impact by type of institution.

During the treatment year, each of the liberal arts colleges was actively involved in multiple interventions. Several of the larger institutions (whether public or private) also attempted multiple interventions. However, some struggled to get faculty buy-in despite the enthusiasm of the faculty and staff who were directly involved in the UWE *Challenge*. Most faculty supported increased diversity in economics and participated in one-time interventions, but were less enthusiastic about those that demanded continued commitment. Department chairs were likewise concerned about increased burdens on their female and underrepresented minority (URM) faculty. The higher faculty-student ratio at the liberal arts colleges may have been a factor that enhanced the treatments at those schools.

The liberal arts colleges had other advantages. Their smaller size made it easier to reach potential majors. The relative size of the major may have also made a difference. In 2020, for example, just 1 out of 200 BAs at the University of Central Florida, the largest of the treatment institutions, majored in economics, and 1 out of 100 did at Illinois State University. At UC Berkeley 1 out of 12 majored in economics and at Princeton 1 out of 10 did. But at Williams and Connecticut College 1 in 5 graduates majored in economics.[15] Adding to the problems of attracting more majors at large universities is the fact that in some public universities (such as UC Berkeley), enrollment in economics is limited. Also, some of the larger state universities have sizeable and prestigious (compared to other programs at the school) undergraduate business majors that compete directly with economics as a major.

There are ample reasons why the light-touch interventions would have reached too few undergraduates at some of the larger institutions. But six of the treatment universities did their own RCTs and evaluated them using administrative records from the schools (for which they each had their own IRB). We will discuss these RCTs and their findings in more detail below. Despite the large size of these institutions, the deliberate implementation of experimental treatments and the presence of invested faculty may have enhanced the effect of the UWE treatment.

To explore this possibility, we have added a dummy variable ("Own RCT") for these six institutions in col. (4) and interacted it with Post. It does appear that if any of the larger institutions achieved success in increasing the relative number of female majors, these

[15] The computation uses all majors, both first and second. The numbers change slightly when using just the first major: University of Central Florida 1 in 210, Illinois State University 1 in 123, UC Berkeley 1 in 14, and Williams and CT College 1 in 6.

schools did. The impact is about 15% of the mean of the dependent variable.

One problem that we must mention with the conclusion about the liberal arts colleges is that an estimation of eq. (3) indicates that the increase in the conversion ratio ($CR_{iy}^{FT}$) preceded the treatment period. Appendix 4 provides the year dummies interacted with treatment. There appear to be parallel trends through most of the pre-treatment period. But the five liberal arts colleges in the treatment group show a higher conversion ratio before the treatments even began.

We have many reasons to offer why the post-period would have provided a break with the past that lasted for four years. But we have no reasons to offer why the coefficients on the years from 2001 to 2011 are insignificantly different from zero, yet those from 2012 to 2014 are not. If our sample were considerably larger we would put less emphasis on the eq. (4) results and try to understand these anomalous findings. But given the size of our sample, we will not.

*The RCTs within the larger RCT*

As we noted above, several treatment schools executed their own RCTs (with IRB approval). In some, the results of these light-touch interventions and nudges had positive effects on the target groups. But in some they did not. The schools are Colorado State University (CSU), Southern Methodist University (SMU), University of California at Santa Barbara (UCSB), University of Illinois at Urbana Champaign (UIUC), University of Colorado at Boulder (UC Boulder), and University of Wisconsin-Madison (UW-Madison).

Prof. Hsueh-Hsiang Li, of CSU, ran an RCT in Spring 2016 (Li 2018). Three treatments were included in the Principles course that mirrored UWE recommendations about providing encouraging signs to students at the midterm and advising female students to take part in peer mentoring activities. The aggregate impact of the treatments was substantial, but the largest effects were on female students with grades above the median.

At SMU, Profs. Catherine Porter and Danila Serra ran a field experiment in which they randomized which Principles sections engaged in a role model intervention (Porter and Serra 2020). Administrative data provided information on whether students later registered for the intermediate course and whether they selected economics as their major. The same course, with the same instructors, was offered the year preceding the experiment, giving the authors the ability to do an instructor fixed-effects model. The interventions increased the fraction of women taking the intermediate course within a year by 11 percentage points on a base of about 12% and increased the fraction of women majoring in economics by more than 6 percentage points on a base of less than 9%.

The other studies found weak, negative, or heterogeneous results for the impact of light-touch interventions. Bedard et al. (2021) at UCSB sent personalized letters to Principles students after the final exam, letting them know about an upcoming informational session about the major, and students who earned a B or better were randomized to receive a message encouraging them to major in economics. Nudges were effective for Hispanic students, especially women. At UIUC the effect of informational nudges was greatest among female students who scored above the median (Halim et al. 2022). The experiment at UC Boulder found mixed results that were, on net, negative for attracting more women to economics (Antman et al. 2022). Finally, a recent experiment at UW-Madison found that intermediate course taking increased for women who had seen a presentation by female alumni speakers and similar results occurred for men who saw a presentation by male alumni speakers, but not vice versa (Patnaik et al. 2023).

More important, perhaps, than the results of these RCTs is the fact that the faculty at these institutions were encouraged to do more. That may be the reason why our investigation of the impact of the UWE treatment indicates that these six schools appear to have had a boost in the female economics majors to total economics majors conversion ratio during the post-treatment period.

*Enrollment Data*

As part of the RCT, the treatment schools reported course enrollment data for the period from AY 2008-09 to AY 2018-19. We were unable to collect enough course enrollment data from the control schools for a comparison. We can, however, compare changes in course enrollment between the liberal arts colleges and the larger institutions in our treatment group.

We looked at the share female of total course enrollment in the Principles sequence, Principles micro, Principles macro, the Intermediate sequence, Intermediate micro, and Intermediate macro. We also compared persistence from Principles to Intermediate courses for female and male students separately.[16]

We have not found any noticeable differences in the enrollment outcome measures between liberal arts colleges and larger institutions in the treatment group. Since the interventions did appear to have an effect on the number of female majors at liberal arts colleges, the smaller schools were probably more successful at retaining students after the

[16] The formula for persistence is: $\left[\frac{Number\ of\ students\ enrolled\ in\ Intermediate\ sequence\ in\ Year\ t}{Number\ of\ students\ enrolled\ in\ Principles\ sequence\ in\ Year\ t-1}\right]$.

intermediate sequence until graduation.

*Progress Reports and "Best Practices"*

In January 2016, all treatment schools submitted reports to us describing their progress regarding the interventions, obstacles they encountered, and their impressions of their accomplishments. In 2018, seven schools also submitted summary reports on what they considered, based on their experiences, "best practices" for encouraging women to major in economics.

The interventions considered successful by the involved faculty and students included student conferences, invited speaker sessions, implicit bias training, and novel courses on contemporary issues in economics, among others. Ambiguously successful interventions included online economics forums, study groups, and email "nudges."[17] A serious obstacle to growing the major through greater diversity is capacity constraints. Economics is one of the largest majors on many campuses, and departments are often wary of increasing demands on faculty and crowding the gateway courses. A detailed qualitative assessment of the interventions is provided in an online appendix.[18]

*Conclusion*

The *Undergraduate Women in Economics Challenge* tested whether deliberate efforts could move the needle on female representation among undergraduate economics majors. We find that interventions at treatment schools may have been successful at liberal arts colleges and possibly at the larger universities that, in addition, had their own RCT.

The interventions that our treatment schools used were relatively low-cost and light-touch. But they required the time and initiative of undergraduate instructional staff and faculty. The UWE program, together with the Alfred P. Sloan Foundation, provided advice, funding, and gave recognition to these hard-working faculty and teaching staff.

We should note that the UWE *Challenge* sparked many non-treatment economics departments to be less complacent in their general success in appealing mainly to male majors. If our efforts have led to a recognition that curriculum and advising should be altered to attract the majority BA group—women—we will have succeeded admirably.

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[17] "Ambiguously successful" interventions are those that received a mix of positive and negative or mostly negative feedback from the schools. Also in this category are interventions for which we have insufficient feedback because they were implemented by fewer than three schools.

[18] See the summary of UWE treatment institution progress reports and "best practice" reports on the UWE webpage under "Interventions."

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Table 1: Evaluating the UWE Treatment on the Female to Total Conversion Ratio [(female economics majors/total economics majors)/(female BAs/total BAs)]

| | (1) All Institutions | (2) Liberal Arts Colleges | (3) All Except LA Colleges | (4) All Except LA Colleges |
|---|---|---|---|---|
| Mean of the dependent variable | 0.567 | 0.580 | 0.562 | 0.562 |
| Mean of (female econ/total econ) [a] | 0.300 | 0.308 | 0.297 | 0.297 |
| Treatment school | 0.0020 | 0.0332 | -0.0109 | 0.00811 |
| | (0.0089) | (0.0160) | (0.0103) | (0.0128) |
| Post period | 0.044 | 0.021 | 0.063 | 0.0715 |
| | (0.0175) | (0.0229) | (0.0235) | (0.0238) |
| Treatment × Post | 0.0164 | 0.101 | -0.0169 | -0.0511 |
| | (0.0203) | (0.0353) | (0.0234) | (0.0291) |
| Own RCT | | | | -0.0471 |
| | | | | (0.0185) |
| Own RCT × Post | | | | 0.0846 |
| | | | | (0.0426) |
| Public | -0.0233 | | 0.0577 | 0.0560 |
| | (0.0139) | | (0.0159) | (0.0159) |
| log(Total BAs) | 000681 | -0.0473 | -0.0646 | -0.0635 |
| | (0.00562) | (0.0228) | (0.00962) | (0.00962) |
| Constant | 0.590 | 0.858 | 1.167 | 1.154 |
| | (0.0391) | (0.140) | (0.0716) | (0.0718) |
| $R^2$ (adjusted) | 0.248 | 0.132 | 0.338 | 0.341 |
| Number of observations | 1,848 | 483 | 1,365 | 1,365 |

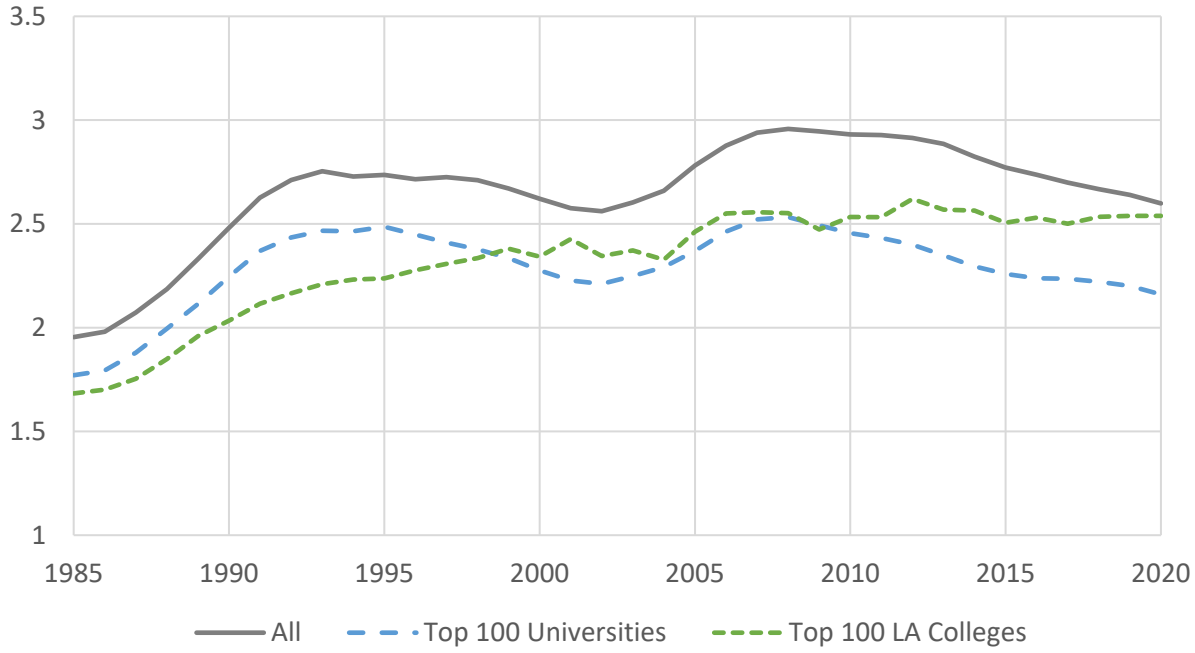
*Sources:* NCES, IPEDS data on bachelors' degrees and first and second majors combined.

*Notes:* Standard errors are in parentheses. Dependent variable is the female to total (= female + male) conversion ratio defined in eq. (2). Treatment = 1 for the 20 treatment schools (see Appendix 2). The sample is from AY 2000-01 to AY 2020-21. Post = 1 for the four years: AY 2017-18 to AY 2020-21. "Own RCT" = 1 for the six treatment schools that did their own RCTs (see text): Colorado State University; Southern Methodist University; University of California, Santa Barbara; University of Colorado, Boulder; University of Illinois, Urbana Champaign; and University of Wisconsin, Madison. Treatment was delayed for one year at the University of Central Florida, and we have changed the Post indicator accordingly. "Cluster" dummies (see Appendix 2) and their interaction with the Post period are included in all columns.

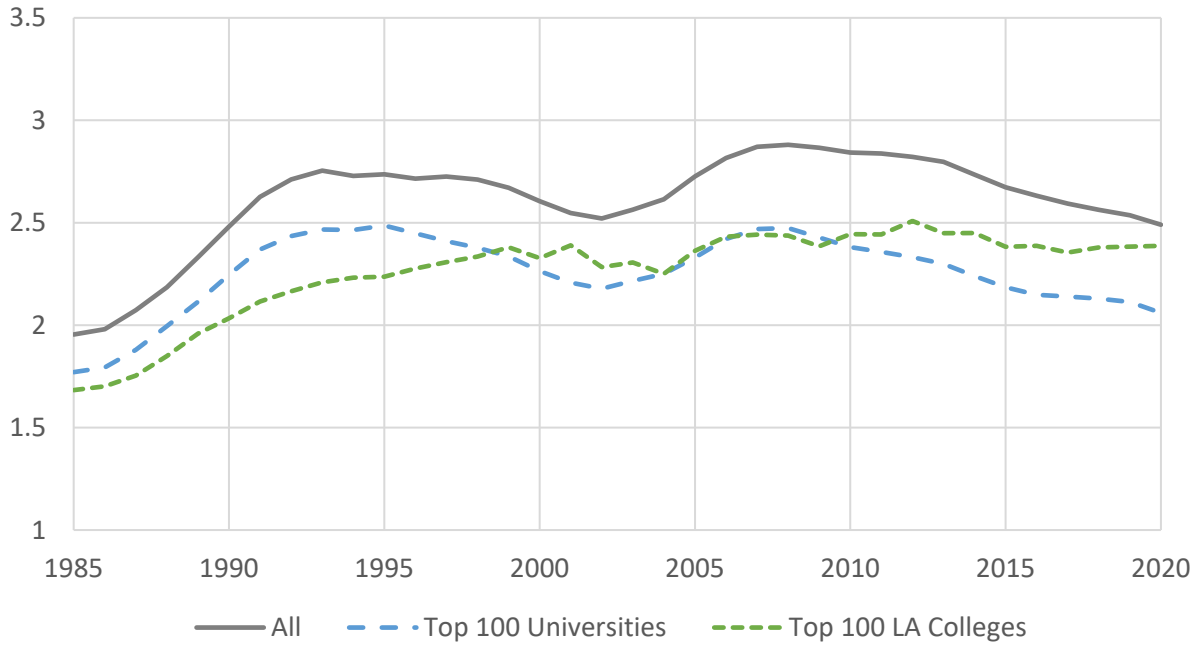
[a] The fraction of all economics majors who are female, not scaled by the fraction of BAs who are . See also Figure 2, part A.

Figure 1: Economics Conversion Ratios (Male Economics Majors/Female Economics Majors)/(Male BAs/Female BAs): 1984 to 2021

Part A: First Majors




Part B: First and Second Majors (IPEDS reporting of second majors began in 2001)

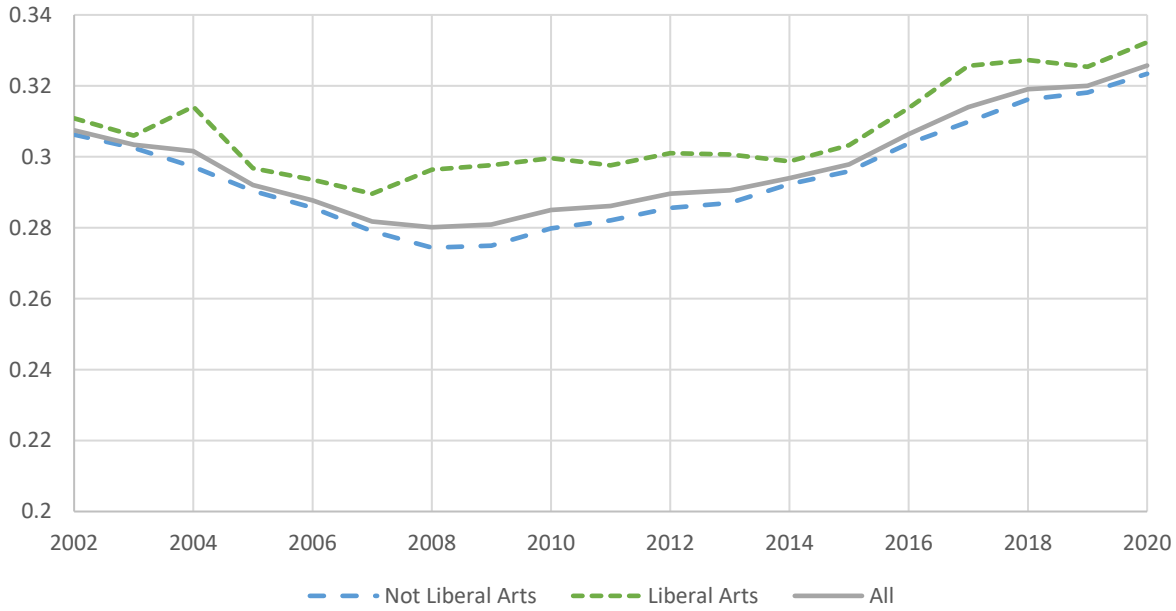


*Source*: NCES, IPEDS online.

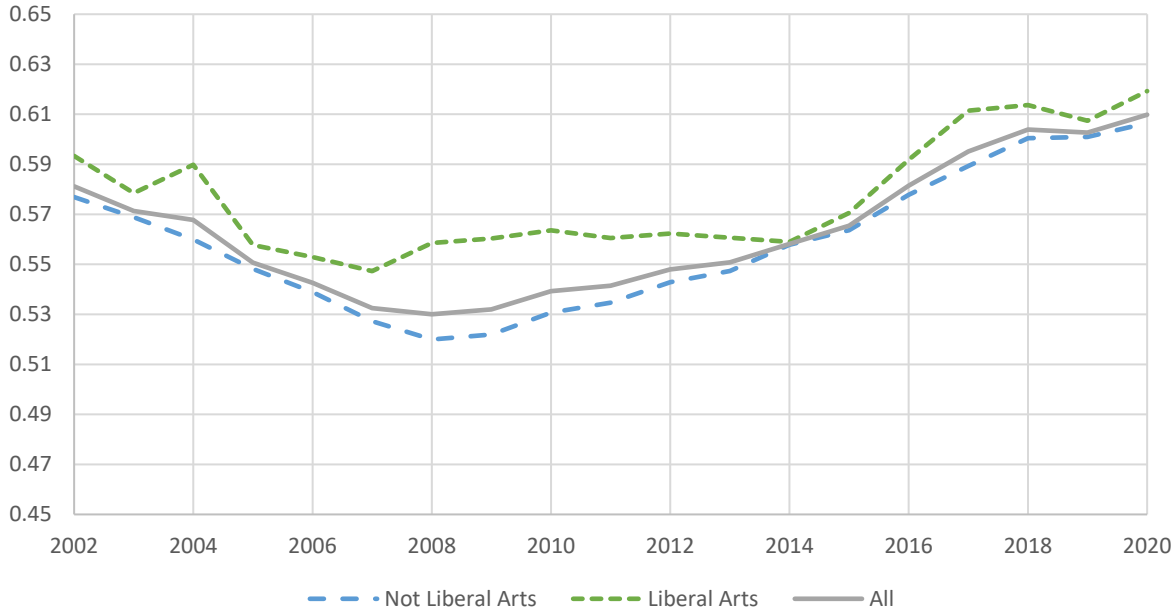
*Notes*: The conversion ratio is that in eq. (1), the ratio of male to female economics majors divided by the ratio of male to female BAs across all institutions in each of the three groups. Therefore it is a national average for these institutions. Part A gives the number for the "first major" and part B gives the number for two majors, starting in 2001. Three-year centered moving averages shown. The lists of "top 100" institutions are from the 2013 *US News and World Report*. "All" is for the entire US. Note that adding the "second" major generally decreases the "conversion" ratio since relatively more women have economics as a "second" major. Schools are included only if they granted an undergraduate degree in economics. Economics includes all fields under NCES CIP code 45.06.

Figure 2: Fraction Female and the Conversion Ratio: 88 Treatment and Control Schools, 2001-2021

Part A: Fraction Female among Economics Majors in the 88 Treatment and Control Schools




Part B: Conversion Ratio among the 88 Treatment and Control Schools




*Sources:* See Table 1.

*Notes*: All series are three-year centered moving averages. School data are not weighted. Part B: Conversion ratio is given by eq. (2) and is the dependent variable in Table 1.

Appendix 1: Invitation Letter for the *Undergraduate Women in Economics Challenge* (sent to Economics Departments at the 344 institutions that graduated at least 15 Econ BAs on average between AY 2010-11 and AY 2012-13).

**Undergraduate Women in Economics**



January 23, 2015

Dear Professor Claudia Goldin,

We are inviting your economics department at Adams College to participate in an exciting initiative we are calling the *Undergraduate Women in Economics Challenge*.

The aim of the Challenge is to encourage undergraduate women to major in economics. **The Challenge will provide $12,500 per school** to implement interventions designed to fulfill this aim. Schools will be given guidance, but the precise interventions will be left up to the department's discretion. This initiative is funded by the Alfred P. Sloan Foundation through the National Bureau of Economic Research and endorsed by the American Economic Association.

We believe that the relative lack of women in economics needs to be addressed. Nationwide there are about three males for every female student majoring in economics and this ratio has not changed for more than 20 years. **At your institution, there were 1.89 male economics graduates for every female economics graduate.**[1] Although we cannot identify just one explanation for why gender differences persist, our Board of Experts from across the country met recently to figure out the common causes of this problem across institutions. You now have the opportunity to make your department part of the solution.

All we ask, at this point, is for you (or another person in your department or undergraduate office) to express an interest in joining the Challenge. We will choose, at random, at least 20 schools for the treatment group from among those that express an interest, with the remaining schools serving as the control group. The awarded funds can be used in a variety of ways to implement interventions targeting areas such as information, role models, and content and style of teaching. Examples of interventions are included on the following page. Participating institutions will submit a brief progress report every three months and provide information on the number and gender of students declaring majors (and eventually graduating from the institution) after the intervention. Upon the completion of the Challenge, data on the numbers of economics majors in the treatment and control groups will be collected and analyzed to assess the program.

If you are interested in participating in the Challenge, **please reply to this e-mail by February 13, 2015**. We will respond to all applications by February 27, 2015.

Regards,

Claudia Goldin
*Henry Lee Professor of Economics, Harvard University*
*AEA President, 2013*

Tatyana Avilova
*Project Director, Undergraduate Women in Economics, NBER*

[1] $\frac{\text{(Male Econ BAs)/(Total Male BAs)}}{\text{(Female Econ BAs)/(Total Female BAs)}}$ using US Dep. of Educ. data, averaged over 2011 to 2013.

Appendix 1 (cont.): Potential Interventions Devised by UWE Team and Board of Experts

## Potential Interventions

| Better Information | Mentoring and Role Models | Content and Presentation Style |
|---|---|---|
| Without accurate information about the broader application of economics (e.g., beyond finance and consulting), women are more likely to major in less rigorous fields, often within the social sciences or humanities. | Women are more sensitive to their grades in introductory courses when choosing their major than are men. The creation of networks among students within the department and showing support for their decision to major in the field has been effective in recruiting underrepresented minorities. | On average, female undergraduates are less confident about their quantitative skills than are men even if they are equally able and prepared. Their lack of confidence may diminish their belief that economics fits their personal strengths and abilities. |
| Use the *UWE-AEA Video* (to be produced by the AEA before Fall 2015) during freshman orientation week to highlight key points about the major, including:<br>• The many applications of economics;<br>• The diversity of its practitioners; and<br>• The range of potential careers.<br>• Also use the video at the start of the introductory course, post it on the course website, and include it on the department's website.<br><br>Augment the material provided on your department's website or in printed pamphlets to highlight information such as:<br>• Subfields and upper-level courses;<br>• Various career options and course requirements for the different career tracks; and<br>• How economics relates to other fields and majors, and the high return to an economics degree.<br><br>Guest speakers in lecture and other times:<br>• Invite alumni working in diverse fields to talk about their jobs and interests.<br>• Have talks during campus open days, e.g., freshman parents' weekend.<br>• Guest speakers in lecture classes should include diverse faculty in terms of gender, race and field.<br>• Recruit faculty, from non-business/non-finance fields, who are inspirational and approachable. | Mentoring:<br>• Increase the number of female TAs/grad students/older undergrad mentors for students in intro and intermediate courses.<br>• Make a video of your alumni talking about their work involving economics, even though "economist" may not be in their job title.<br>• Facilitate opportunities for research and collaboration with the faculty.<br>• Help students find summer jobs that value economics, are dynamic, and include human contact.<br><br>Creating student learning communities:<br>• Encourage coffee/study breaks in the economics department lounge.<br>• Organize student groups to work with the department to create talks and conferences on diverse topics.<br>• Connect with students through social media.<br><br>Faculty lunches:<br>• Have informal lunches with professors and TAs.<br>• Pick faculty who specialize in diverse areas of economic research (e.g., health, labor, education, environmental, econ history, behavioral, corporate finance).<br><br>Student counseling:<br>• Offer faculty counseling at midterms and other grade times (research papers, presentations, etc.). Convey that making mistakes is often part of learning economics. | Add modules and case studies to introductory and intermediate courses. Use more evidence-based material in teaching.<br>• Present information through real-world examples that cover diverse subfields in economics and related disciplines.<br>• Include study results and also information on the researchers who did the work and how they became interested in the subject. Invite the researchers to give a lecture.<br>• Help faculty communicate more clearly and encourage more evidence-based theory courses.<br><br>Support independent/group projects in various sub-fields (e.g., health, education, poverty, crime, inequality, sports).<br>• Have students interview community residents about issues in recent economics news (e.g., pay-day loans; Affordable Care Act; student debt) and how they have been affected.<br>• Coordinate community service opportunities that apply economic concepts and tie into course material.<br><br>Make sections more conducive to learning for students with different skill levels, styles of learning, and interests.<br>• Separate sections based on students' quantitative experience, not by ability.<br>• If sections are heavily skewed by gender, deliberately change the gender mix and collect data on grades and drop-off rates. |

Appendix 2: Treatment and Control Schools

20 Treatment schools in alphabetical order:

Brown University
Colorado State University, Fort Collins
*Connecticut College
Illinois State University
Princeton University
Southern Methodist University
*St. Olaf College
University of California Santa Barbara
University of California Berkeley
University of Central Florida
University of Colorado Boulder
University of Connecticut
University of Hawaii, Manoa
University of Illinois, Urbana-Champaign
*University of Richmond
University of Virginia
University of Wisconsin, Madison
*Washington and Lee University
*Williams College
Yale University

68 Control schools in alphabetical order

American University
*Amherst College
Boston College
Boston University
Brandeis University
Brigham Young University
*Bucknell University
*Carleton College
Case Western Reserve University
*Centre College
*Claremont McKenna College
Clemson University
*Colby College
*College of the Holy Cross
*Colorado College
Cornell University
Dartmouth College
*Davidson College
*Dickinson College
Duke University
George Mason University
George Washington University
Georgetown University
*Gettysburg College
Indiana University, Bloomington
*Lafayette College
Massachusetts Institute of Technology
Michigan State University
*Middlebury College
Northeastern University
Northwestern University
Ohio State University
Oregon State University
Rutgers University, New Brunswick
SUNY at Binghamton
*St. Lawrence University
Stanford University
Stony Brook University
*Swarthmore College
Temple University
Texas A&M University
Texas Christian University
Texas Tech University
Tulane University
*Union College
University of Arizona
University of California, Davis
University of California, San Diego
University of Chicago
University of Delaware
University of Houston
University of Kansas
University of Kentucky
University of Maryland at College Park
University of Michigan
University of Missouri, Columbia
University of North Carolina at Chapel Hill
University of Notre Dame
University of Oklahoma
University of Pittsburgh
University of Tennessee
University of Texas at Austin
University of Utah
University of Vermont
Vanderbilt University
Wake Forest University
*Wesleyan University
*Wheaton College

* = Liberal arts college

Appendix 2 (cont.):

Method for selecting the treatment group from the sample of 88 schools

Rankings of universities and liberal arts colleges from the 2013 *US News & World Report* were used. The rankings for these two groups are separate, meaning that there is a #1 … #100 for each group. We concatenated these lists, so that the top university and the top liberal arts college would both be #1 and so on down the list. This meant, given our criteria concerning the size of the major, that we had far fewer liberal arts colleges than universities but that the liberal arts colleges would be relatively high in our rankings.

We then divided the group of 88, that had responded favorably to our initial note and that had a sufficiently large group of economic majors (graduating 30 BAs or more on average between 2011 and 2013), into four groups of 22, from the highest to the lowest with regard to our rankings. We randomly selected five schools from each group of 22. Each of the groups of 22 is called a "cluster" and we have added a dummy variable for the cluster in the regressions and interacted it with the "post" period or the year.

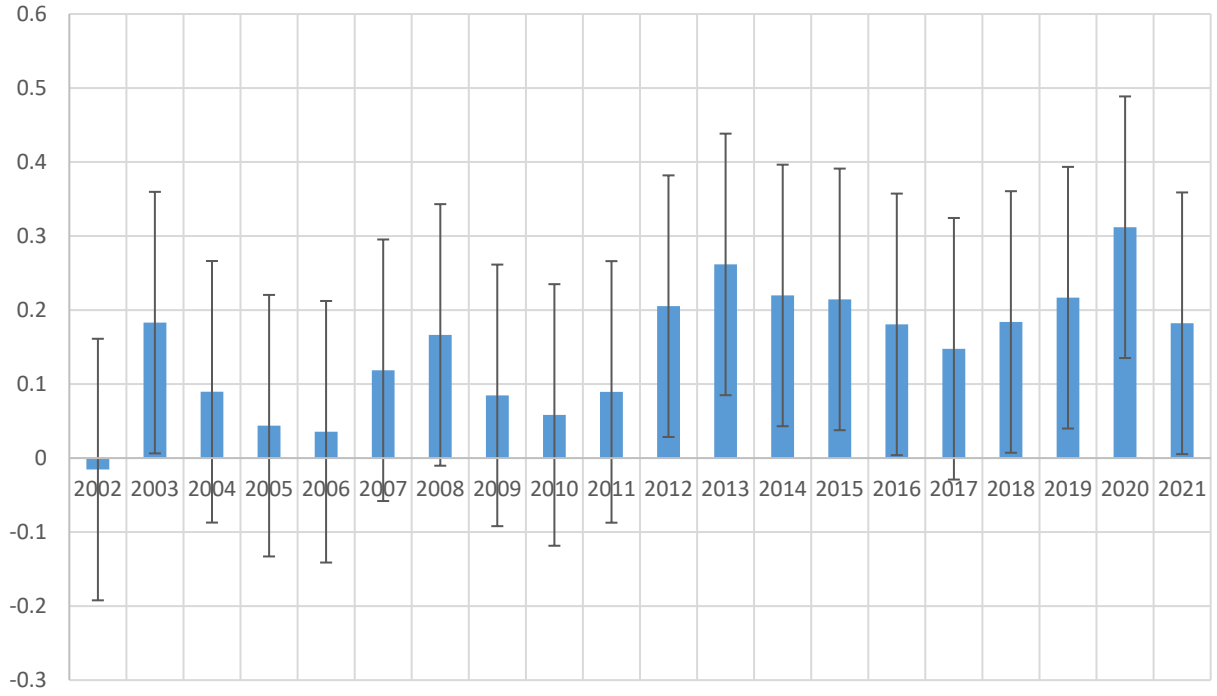
We chose the method of selecting within these "clusters" to make certain, given our small treatment sample of 20, that we had schools across the distribution of rankings. This method, in addition, guaranteed that we had a substantial number of liberal arts colleges (23 in the sample group of 88 and 5 in the treatment group), many of the largest universities in the US, as well as several state flagship institutions.

Appendix 3: Student conferences organized by, or inspired by, UWE activities.

Conferences provide an opportunity for attendees to learn new information about careers in economics, to share their research, and to network with other students and professional economists. The UWE *Challenge* has led to the implementation of several student-centered conferences including:

1. The *Undergraduate Women in Economics Conference* was run for three years (in-person in 2016, 2017, and 2019) to provide an opportunity for faculty and students from the UWE treatment institutions to discuss strategies for improving diversity in economics and to network. Students were also able to attend career and other information panels. (2016 conference attendees: Brown, CSU, CT College, UC Berkeley, UConn, UIUC, U of Richmond, UW-Madison, **UVA**, Wash & Lee, Williams, and Yale. 2017 conference attendees: Brown, **CSU**, CT College, CU Boulder, IL State U, St. Olaf, UConn, UC Berkeley, U of Hawaii, UIUC, U of Richmond, and UVA. 2018 conference attendees: Brown, CSU, IL State U, SMU, UC Berkeley, UConn, **UIUC**. Host schools are in bold. Of the 20 treatment schools only Princeton, UC Santa Barbara, and U of Central FL did not take part in any of these three conferences.)
2. *Promoting Inclusion in Economic Research* (PIER), formerly *Women in Economic Research* (WiER), was created as part of the UWE *Challenge* in April 2017. It is organized by Williams College (a treatment school) in the style of a research workshop. It provides a forum for 24 advanced undergraduate students to present their research to a group of peers and faculty and to receive feedback on their work. The conference ran in-person in 2017-2019, online in 2021, and in hybrid format in 2022 and 2023.
3. *Diverse Economics Conference* (*DivEc*), co-hosted by the Federal Reserve Bank of Richmond, the Robins School of Business at the University of Richmond (a treatment school), and the UWE started as a successor to the *UWE Conferences*, focusing on the student-oriented events. The conference ran in-person in 2019, online in 2020-2021, and in hybrid format in 2022, either as a one-day event or a series of talks over several evenings. Events include a keynote speech by a prominent academic economist, separate career panels with senior professionals and young career economists, and an information session on research assistant and other careers opportunities at the Federal Reserve System.
4. *National Conference on Women in Economics* was hosted by University of Wisconsin-Madison (a treatment school) online in 2021. The event was similar in style to the *UWE* and *DivEc* conferences and included sessions such as the "Graduate School: How to Apply, Decide, and Thrive" panel, a panel conversation with young professional economists, and a data workshop.

Appendix 4: Year × Treatment Estimates from Eq. (3) for Liberal Arts College




*Sources:* NCES, IPEDS data on bachelors' degrees and first and second majors combined.

*Notes*: The bars are the coefficients on Year × Treatment in an estimation of eq. (3) for liberal arts colleges only, including the cluster dummies, cluster × Year, and log(total BAs).