

What UWE Did for Economics

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Men outnumber women as undergraduate economics major by three to one nationwide. Even at the best research universities and liberal arts colleges men outnumber women by two to one or more. The Undergraduate Women in Economics Challenge was begun in 2015 as a randomized controlled trial with 20 treatment schools and 68 control schools to evaluate whether better course information, mentoring, encouragement, career counseling, and more relevant instructional content could move the needle. In this paper, using the available pre- and post-intervention data for treatment schools and pre-intervention data for control schools, we make preliminary observations on the trends in the number of female economics majors and women's enrollment in principles and intermediate courses. We also discuss the results from RCTs conducted by individual treatment departments, which show that low-cost, targeted interventions can be successful in recruiting more women into economics.

I. Introduction

Women do not major in economics to the same degree as do men. In fact, the fraction of majors in economics who are female is lower than in chemistry, mathematics and statistics (Bayer and Rouse, 2016). In fields that are even more male-dominated than economics, such as engineering, the fraction of majors who are female has increased in the past decade. But the fraction in economics has not. It has not budged in the last 30 years (Bayer and Rouse, 2016; Levenstein, 2019). The Undergraduate Women in Economics (UWE) project seeks to uncover why women do not major in economics to the same degree as men and what can be done to change that.

Why should Economics as a field be interested in its gender gap? One is the impact of diverse representation, including gender representation, on social welfare. Studies that randomized member assignment for group projects found that gender diversity in teams enhanced productivity and overall performance and that it also increased the production of novel ideas (Bear and Woolley, 2011; Ellison and Mullin, 2014; Hoogendoorn et al., 2013). Other studies found that group collaboration was greatly improved by the presence of women in the group (Fenwick and Neal, 2001; Woolley et al., 2010). The impact of gender representation on the types of ideas that are on the table is evident specifically among economists as well: May, McGarvey, and Whaples (2014) analyze the results of a 2007 survey of 143 American Economic Association (AEA) member PhD economists about their opinions on various economic areas. The authors find that opinions on market solutions, government interventions, and government spending, taxing, and redistribution vary

greatly by gender. The authors conclude that “gender diversity in policy-making circles may be an important aspect in broadening the menu of public policy choices.”

Because women and men specialize in different parts of economics, fewer women will mean less of a particular part of economics. It will mean fewer labor economists and more finance economists. It isn't just that opinions will differ. It is that entire research fields will. We cannot say whether the change will be for the better. But we can say that it matters.

Aside from the potentially positive impact on the field as a whole, the choice of major is also important to individual student welfare. Students choose their major to maximize their present utility (their enjoyment of the coursework) and their future utility (which depends on their career opportunities and future earnings, which are both conditional on the choice of major). In order to optimally choose their major, a student must have information about the content of the courses in a given major, the skills that they will learn, and their career prospects.

There is evidence that economics is a lucrative field. Black et al. (2003) find that economics is the highest earning major in the social sciences and that it generates higher earnings than a business degree. However, many college seniors, both male and female, realize too late in their studies that statistics, econometrics, and economic modeling are helpful tools. Students often think that economics is only for those who want to work in the financial and corporate sectors. Particularly, advice from parents, relatives, and friends often emphasizes the importance of economics to finance and banking careers, and thereby disproportionately encourages males to major in economics.¹ Women who are interested in other fields and policy work may be discouraged from majoring in economics because they do not see its relevance to their career aspirations. An emphasis on usefulness of economics to careers in development and health, for example, would do more to attract women as majors relative to men. Furthermore, better information can help all undergraduates realize the importance of economics to their futures.

Finally, we may simply be curious, as economists, about whether the “market for majors” — where the students supply the majors and the departments demand students to major in their discipline — in economics is at an optimal equilibrium, or if there are market inefficiencies that are preventing economics departments from achieving it. The 2018-19 AEA Climate Survey identified that women faced more instances of discrimination based on gender than their male colleagues over the course of their careers. It is not unfathomable

¹ Zafar (2013), for example, finds that male undergraduates are more interested, than are female undergraduates, in the pecuniary aspects of the future career their major will enable.

that discrimination and institutional barriers faced by graduate students and faculty in the field are also faced by undergraduate students.

The *Undergraduate Women in Economics (UWE) Challenge*, designed as a randomized controlled trial, is an initiative with the goal of increasing the number of undergraduate women majoring in economics. The UWE Challenge seeks to identify the potential barriers — informational and other — that could be preventing women from majoring in economics and to remove these obstacles through various interventions.

The official treatment year for the UWE Challenge was in AY 2015/16, with first year students as the most likely targets for the interventions. Assuming a four-year graduation rate, we would expect the treated first years to begin to graduate in AY 2018/19. If the students decide to major in economics, they would have to complete the standard course requirements for an economics major, including principles of economics, an introductory course, and the intermediate microeconomics and macroeconomics sequence.

Only partial data from the control schools is available, meaning that we cannot draw conclusions about the aggregate effects of the interventions on the treatment group. However, there are some preliminary takeaways from the data so far. One, both the share of female BAs who major in economics and the fraction female among economics majors has been increasing, both at the treatment and the control schools, over the past ten years. Two, there is also an increase in AY 2018/19, when the treated students would be expected to graduate, either due to the interventions or an underlying trend of growing popularity of economics. Three, enrollment data show that more women are ending up in economics via higher enrollment in principles of economics rather than greater persistence of women through the undergraduate pipeline.

Although results on the treatment group impact in the aggregate are still unavailable, three individual treatment departments have conducted their own RCTs, and conclusive results from two — Colorado State University and Southern Methodist University — are available at this time. Li (2018) at CSU implement three different interventions that focus on providing more information to students (about careers in economics and the student's performance in principles), encouragement to pursue economics, and peer mentoring. The aggregate impact of the combined interventions was substantial, on average increasing the likelihood that women declared an intent to major in economics by 5.4—6.3 percentage points. The greatest impact came from an intervention that encouraged first year and sophomore women who received a grade above the median to major in economics.

Porter and Serra (forthcoming) at SMU examine the impact of a role model intervention on the students' likelihood of taking intermediate and other economics courses, as well as their likelihood of majoring in economics. They find that the fraction of women taking the intermediate course within a year increases by 11 percentage points on a base of about 12 percent, and the percentage of women who majored in economics increased more than 6 percentage points from a baseline of less than 9 percent. Much of the effect came from women with high GPAs. The results from these two studies show that simple but well-thought-out interventions can have having a significant effect on female undergraduates and their choice of major.

In Section I, we first discuss the various facts that sparked our project, including national data on economics majors and administrative data from one undergraduate institution. In Section II, we discuss the design of our RCT, created in AY 2014/15 and sent into the field in AY 2015/16. We also describe the characteristics of the treated group of schools and the various initiatives that this group put into effect during their treatment year. Section III discusses some preliminary observations in the aggregate data, as well as the results from individual RCTs. Section IV concludes.

II. Women in Undergraduate Economics

A. *Economics Majors by Gender: 1984 to 2018*

There are almost three male majors nationwide for every female economics major today, expressed relative to their numbers as degree recipients (generally BA but also BS). We term that statistic the “conversion ratio.” The reason to deflate or scale by the number of degree recipients is that women outnumber men as undergraduates (and have done so ever since around 1980). As long as the number of male and female undergraduates is different at the school, a simple ratio of male to female majors would obscure the unequal appeal of economics among male and female students.

Figure 1 gives the conversion ratio from 1984 to 2018, presented as three-year centered moving averages, for top 100 universities, top 100 liberal arts colleges, and all institutions which graduates at least 1 economics major in that year.² There were relatively more female economics majors in the late 1980s than today across all types of institutions. But by the early 1990's, the conversion ratio increased substantially, and then increased

² Data are from the U.S. Department of Education, NCES, IPEDS. Schools are included only if they grant a bachelor's degree in economics and are coeducational. The top group of 100 is from *US News & World Report* at the time the UWE project was begun.

again to a ratio of almost 3 to 1 by the end of the 2000's. Although the conversion ratio has decreased slightly since around 2008, primarily due to more women majoring in economics at the top universities, the conversion ratio at the top liberal arts colleges has only gotten worse in the last 30 years. At all institutions, the conversion ratio has been between 2.5 and 3 men for every 1 woman since 1990.

B. Evidence and Lessons from "Adams College"

When we began designing our project, we obtained administrative data from an institution we call "Adams College." When we obtained the data in 2013, the conversion ratio for Adams was 1.8 and the fraction female among economics majors was 0.35, not much different from those at its peer institutions, such as Stanford, Princeton, and Harvard.

At Adams and many of its peer institutions, incoming freshmen are asked what they believe their primary major will be. Twice as many men than women put economics as their more probable primary major at Adams. We have discovered similar results hold for its peer institutions. The die is cast, it would appear, even before students unpack their bags: two men will major in economics for every woman. The first lesson from the Adams data is that useful treatments must occur soon after students arrive on campus. But there are other moments in the undergraduate experience when interventions could make a difference.

Adams women divide into three almost equal groups among those who either major in economics or stated they would major in the subject upon their arrival at college: (1) 0.33 stated upon arrival that economics was their primary major and did major in it; (2) 0.31 stated economics was their primary major but did not major in it; and (3) 0.36 majored in economics but did not state it was their primary major upon arrival.

Principles of Economics is a very popular course at Adams, particularly among those who had an initial interest in the field. Almost 80 percent of those who gave economics as their probable future major take the course and another part of that group places out of Principles through a five on the AP exam.

The 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 intended major. Women who take Principles have a much higher probability of majoring in the subject if they obtain a high grade. That is not true for males, who major in economics almost independent of their grade in Principles.

Male students get higher grades in the Principles course than do female students, as can be seen in Figure 2.A. But conditional on the grade received, female students have a far steeper gradient regarding their likelihood of majoring in the subject, as can be seen in Figure 2.B. A woman who obtains a B+ in Principles has a 22 percent chance of majoring in economics but a man who receives a B+ has a 41 percent chance. A woman who gets an A in principles has a 42 percent likelihood of majoring in the subject and that is about the same as that for a man (41 percent). Note that there is no difference in the probability that male students major in economics if he gets a B+ or an A, but the fraction is reduced for female students by almost 20 percentage points. The line indicating the likelihood of a man majoring in economics is almost flat with respect to their principles grade whereas it is steeply sloped for women.³

What accounts for these differences? It is possible that female students work hard in subjects at which they excel (or 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 males stick with their goal even if they do poorly. It is also possible that this behavior is the result of “stereotype” threat. Once women do poorly in a subject at which they are often told they will perform poorly at, they shy away from it. One way to test this is to see if the same behavior occurs in courses in which women are thought to do well in, such as literature. Various pieces of evidence suggest that women gravitate to fields in which they do well, independent of the notion of stereotype threat.⁴

The important point here is that interventions that praise students who get a B+ or a B in Principles should have a greater impact on female than male students. The second lesson from the Adams data is that helping female students not get discouraged in the gateway course in economics could encourage them to major in the field.

As in most other institutions, the courses that follow Principles for the major at Adams are the intermediate theory courses and econometrics. There is no differential fall off by sex after students take these courses. The prime moments where female students

³ Note that the difference in the gradient regarding the grade in Principles for males versus females exists within groups. For example, it exists for certain groups like Asian-Americans and international students who have relatively high rates of majoring in economics and it also exists for those who intended to major in economics and for those who did not intend to do so. See Rask and Tiefenthaler (2008) for almost identical results from another institution.

⁴ For example, Butcher, McEwan, and Weerapana (2016) analyze an anti-grade inflation policy at Wellesley. They find that the policy led to a relative increase in economics majors because economics was among the subjects that graded the harshest. The anti-grade inflation policy led other subjects, that had previously been “comfort” or easy graders, to grade more harshly.

relative to male students decide to major in economics are at the very start of their undergraduate life and just after taking Principles.

The majors that attract the students who leave the Economics major at Adams are a mixed bag of government, psychology, and general social sciences.

Another interesting determinant of whether women major in economics is a feature that cannot be altered: ethnicity and birthplace. At Adams and its peer institutions, international students, defined as those whose home country is outside the US, disproportionately major in economics and within the group females have a greater share than they do in the total. The same is true for Asian Americans. These are interesting facts that explain some portion of why certain institutions (e.g., Berkeley, UCLA) have a higher fraction female than do comparable institutions with fewer Asian students. But there are apparently no implications for increasing the share of women among undergraduate economics majors.

What about math-ability? The raw difference between males and females in declaring economics as one of the three top choices upon acceptance at Adams is 0.187. Including the pre-admission scores on the SAT math and the Adams math placement test reduces the difference by just 1 percentage point to 0.177. Math-ability does not have much to do with the initial decision to major in economics and with the choice of an eventual major.

What about taking economics prior to admission? Males disproportionately take AP economics, but that does not explain the large differences in major choice. Among male undergraduates, 15.8 percent got a five on the macro AP and 11.4 percent of females did; 12 percent of males but 9.2 percent of females got a five on the micro AP. Differences regarding the major are much larger. Including whether a student got a five on the economics AP decreases the difference between males and females in the declaration of economics as the intended major by less than 1 percentage point. Similar results hold for the eventual major.

The data from Adams College inform the moments during a student's college career when they should especially be targeted, to encourage them to consider one major over another. These observations inform the project design for the UWE< which will be described in the following section.

III. Study Design

A. *Origins of UWE*

The observations from the IPEDS data sparked Goldin, when she was president of the AEA, to think about how to get more women to major in economics.⁵ Economics as a field had become complacent. The major was popular among male students, and men had once greatly outnumbered women as undergraduates. But that was no longer the case and economics was losing out. The discipline had become concerned that there were too few female economics students at the graduate level and finally realized that only by increasing the undergraduate pipeline could those numbers increase.

In addition to wanting more majors to increase graduate enrollment, some economists also realized that female undergraduates, as students and as members of society, were losing out by overlooking economics. The oversight, moreover, was often for the wrong reasons.

Goldin submitted a proposal to the Alfred P. Sloan Foundation to support an RCT (randomized controlled trial) now called *Undergraduate Women in Economics (UWE) Challenge*, or *The Challenge*. The project was funded by Sloan in Summer 2014 and Tatyana Avilova was hired as the project manager. An advisory group (now called the Board of Experts) met in November 2014 to discuss strategy, specifically by discussing potential barriers for women and interventions that could address them.⁶

In January 2015 e-mails were sent to the departmental chair and/or head of the undergraduate economics program at all colleges and universities (separate campuses) that granted an economics BA to, on average, at least 15 graduates per year from 2011 to 2013, as given in the IPEDS data. There were only 344 of these institutions in the US. Each e-mail recipient was asked whether the person agreed, in principle, to implement a set of treatments or interventions in their department to increase the number of female majors. They were told that their institution would receive \$12,500 for their efforts and that the funds could be used in any way that would further the stated objective. The email also included a list of potential interventions, to give the departments an example of the kind of work that was expected of the participating schools.

We received enthusiastic replies from 167 schools, almost half of the 344 institutions we initially contacted, demonstrating a strong latent demand for action.⁷ Due to the large number of positive responses, we increased the cutoff number of BAs in

⁵ See Bayer and Rouse (2016) on the beneficial impact of greater diversity on the field of economics.

⁶ Information on the Board of Experts is at: <http://scholar.harvard.edu/goldin/board-experts>

⁷ We later determined that some interested faculty never received the e-mail since it was sent to the person we believed was the chair of the department or of the undergraduate program.

economics from 15 to 30 per year. We wanted to ensure that the economics program at each institution was large enough to pick up changes in majors induced by the interventions rather than from fluctuations due to small cohort size. We also imposed other requirements to increase the power of the experiment.⁸

We narrowed the group to 88 schools, which we have termed the “treatable” sample. We then stratified the 88 treatable schools into four selectivity groups and randomly picked five schools from each group of 22.⁹ All 20 randomly picked “treatment” schools agreed to take part in the trial. The remaining 68 schools make up the “control” group. Of these 68 schools, 36 agreed to report additional data for further comparison with the treatment school sample.¹⁰ The make-up of the control group thus differs depending on the outcome being analyzed. Data reported by the schools will be discussed in more detail in the Data section below.

B. Treatment and Control Institutions

Our 20 treatment schools are 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. Some have business schools with undergraduate majors (business programs appear to syphon off females from economics more than they do males). Several allow double or even triple majors. In terms of the variables of interest, they range widely in terms of the fraction female among their recent group of BA economics majors and in terms of the fraction of their undergraduates who major in economics. Figure 3 gives a map showing the geographic range of the 20 schools.

⁸ The cutoff of 30 majors, left 118 schools in sample. Next, we eliminated all schools that were not in the “top 100 universities” or the “top 100 colleges” category according to *US News & World Report (USN&WR)*. We also eliminated some PhD granting institutions that produced fewer than three PhDs in the 2008-2012 period. This left us with a “treatable” sample of 88 schools.

⁹ We combined the *USN&WR* rankings for top universities and top colleges, and ranked all 88 institutions from highest to lowest. Schools with the same ranking (e.g., #1 university and #1 college) were ordered based on the average SAT score. The ranked list was then divided into four groups of 22, with a number 1 through 22 based on their relative *USN&WR* rank. Ten (10) random numbers were drawn from one to twenty-two using an online random number generator. Schools with the first five numbers were assigned to the treatment group and schools with the second five numbers were assigned to a waitlist. The rest of the schools were automatically assigned to the control group. We did not need to contact any schools on the wait list.

¹⁰ Because all of the control schools were originally invited to participate in the *UWE Challenge*, they are aware of the initiative. They cannot be prevented from implementing interventions of their own design, but they were not provided with the same guidance and resources as were the treatment institutions. For all institutions in the control and treatment groups, the numbers of male and female economics majors will be available through the IPEDS database.

We provide the fraction female among economics majors in Figure 4 (adjusted for the numbers of male and female BAs) for all 88 “treatable” schools and for the 20 randomly selected treatment schools.¹¹ Not surprisingly the group of 20 nests inside the larger group of 88 from which they were randomly drawn (from four selectivity segments). The range for our treatment sample is considerable. At the high end are UC Berkeley (0.39) and Brown University (0.38). At the lower end are Illinois State University (0.14) and the University of Connecticut (0.16).¹²

The treatment institutions used the provided funding and guidance from the project organizers to propose and initiate interventions that intended to disproportionately increase the number of female economics majors, possibly without decreasing the number of male economics majors. Funding was provided in increments of \$2,500, \$5,000, and \$5,000 upon meeting the following respective milestones: attending the initial meeting for treatment schools in May 2015; completing a proposal of interventions before the start of the fall semester of the treatment year; and submitting a progress report at the start of the spring of the treatment year. The treatment institutions were encouraged, although not obligated, to continue the interventions going forward, but funding was officially provided in the designated treatment year only.

C. Range of Treatments

In May 2015, we met in Cambridge, MA with the treatment schools in two groups of ten to discuss the issues faced by each and the treatments and interventions each thought would be useful to employ. We had acknowledged early on that each potential treatment would not fit all schools and that a limited set of treatments would not adequately address the problem. Instead, we assembled a list of potential treatments in three (somewhat overlapping) areas and required our treatment schools to use several of them:

1. *Better Information*: These interventions are to provide more accurate information about the application of economics and career paths open to economics majors. Interventions include informational sessions at the start of the academic year, having diverse speakers at events, and ensuring the presence of at least one female adviser.
2. *Mentoring and Role Models*: The intent is to create networks among students and to show support for their decision to major in the field. Potential interventions include mentoring freshmen and sophomores by upper-class students, providing more

¹¹ We graph this version of our “conversion” ratio because it has less extreme values.

¹² The one school in the group of 88 that is at parity is MIT, in large part because economics is even less technical than many of the other popular majors there. Other engineering schools (not in the group of 88) have similarly high values for the fraction female.

guidance to students in finding summer jobs and RA-ships in economics, organizing faculty-student lunches, and producing videos about the department and its students. If possible, recruiting female upper-class students and faculty members was encouraged. However, since it was not possible to increase their number, the added burdens on existing female instructional staff could be counterproductive.¹³

3. *Instructional Content and Presentation Style*: This category is meant to improve beginning economics courses and make them more relevant to a wider range of students. Examples include using more evidence-based material in gateway courses, and incorporating projects, such as those in the local community, into beginning and upper-level courses to allow students to apply their knowledge to current issues.

Treatment schools submitted plans of action by the start of the Fall 2015 semester and provided progress reports in January 2016. All but one school began their treatment year in AY 2015/16.¹⁴ Their proposals and progress reports discuss a wide range of implemented interventions, which we have listed in Table 1. Twelve departments focused on providing more complete information about upper-level courses through various means, such as on the department website, at academic fairs, or to first year advisers at the college. Eleven departments sent letters of encouragement to students who did well in principles, and 10 departments used video materials (either produced by the AEA or within their department) to convey information about the content of the major and the wide application of economics, and to show examples of diverse students who choose to major in economics.

Many schools also initiated “Undergraduate Women in Economics” clubs for undergraduate students, who assisted in planning events and other outreach initiatives to encourage more women to major in economics. Given the level of student participation, the UWE sponsored several conferences that brought together students and faculty from many of the treatment schools. The conferences offered the attendees an opportunity to network with other UWE participants and to exchange advice on interventions. The first such conference was held at the University of Virginia in April 2016. The second was held a year later at Colorado State University in April 2017, and the third was held University of Illinois Urbana-Champaign in 2018. In addition to the UWE conference, Williams College started a northeast undergraduate research conference, *Women in Economics Research* (WiER). The conference has been held annually since April 2017.

¹³ See Carrell, Page, and West (2010) for convincing evidence that female instructors in STEM fields increase grades of females and their likelihood of majoring in STEM more than male instructors do.

¹⁴ Because of staffing problems, University of Central Florida began their treatment year in 2016/17.

D. Data

In addition to proposing and implementing interventions to target undergraduate students, the treatment schools are instructed to report data beyond what can be obtained through the IPEDS database. The treatment schools report the following data on graduating majors (BAs) and course enrollment, from AY 2008/09 to AY 2019/20:

Graduating majors (BAs):

- The number of economics degrees conferred in an academic year, by gender¹⁵;
- The number of double majors, by gender;
- The number of transfer students, by gender;
- The number of economics minors, by gender;

Course enrollment:

- Enrollment in principles of economics (introductory economics course), by gender by section (micro and macro, if available) and by student cohort (first year and sophomore);
- Enrollment in intermediate economics courses, by sex by section (micro and macro, if available) and by student cohort (first year, sophomore, and junior).

The number of economics degrees conferred (graduating majors or BAs) and all degrees conferred by gender^{16,17} is available through the IPEDS. However, the IPEDS data is posted with a two-year lag and as of December 2019 is available up to AY 2017/18¹⁸. For AY 2018/19, IPEDS data on economics majors is supplemented by data reported by the treatment schools, and data on all majors was collected from statistics posted by the individual offices of institutional research at each school, where available¹⁹.

¹⁵ We request data on female, male, and other students.

¹⁶ IPEDS only reports data for female and male majors and does not have data on other genders. Some schools have recently begun to collect enrollment and majors data for other genders in addition to women and men. Ideally, we would be able to estimate statistics for female, male, and nonbinary and other students. However, since IPEDS data is only available for female and male students, to keep the statistics consistent, we do not include nonbinary and other students in the statistics on graduating majors.

¹⁷ The IPEDS also asks race and ethnicity of majors.

¹⁸ AY 2017/18 data is provisional.

¹⁹ For AY 2018/19, data on all economics BAs is available for 14 treatment schools, and data on all BAs is available for 13 treatment schools.

We collect more detailed information on graduating majors from the reporting schools to account for various institutional features. For example, several participants, such as the University of California schools, have many transfer students who enter after completing two years of community college. Most of the prerequisite coursework for the major, for these students, is completed prior to their transfer. By the time that they enroll in one of our schools, they would already be on track to a specific major and would not be affected by interventions aimed at students in the initial gateway stage of the major. Seeing what portion of total majors are accounted for by these transfer students may reveal the effect of interventions.

In addition to graduating majors, the schools also report contemporaneous enrollments in the principles and intermediate economics courses in various detail. As we saw in the Adams data, some of the best times to target undergraduate students with interventions are right as they start their university careers, and also after they finish the introductory course in economics and are considering whether they want to continue onto the intermediate courses. Examining the course enrollment data at these stages would allow us to see where interventions may or not be effective in encouraging women to major in economics.²⁰

Data on the graduating majors at the 68 control schools will come from IPEDS. In addition to this, more than 30 of our control schools agreed to report the more detailed data on majors and course enrollment, same as is reported by the treatment schools. At this time, data on majors at the control schools is only available up to AY 2017/18, the year before most of the treated students will begin to graduate. Enrollment data for this group is only available up to AY 2014/15, the last year of the pre-treatment period. The lack of most recent data for the control schools limits our ability to make conclusions about the impact of the interventions on female economics majors and women's enrollment in economics courses. We still present the data from the control schools for the pre-treatment period, to illustrate that the pre-intervention trends that we observe for the treatment schools can also be observed in the larger sample of control institutions. In future work, data on graduating majors and course enrollment from the controls institutions will allow us to evaluate the impact of the initiative.

²⁰ As we do not use IPEDS data when looking at enrollment, we include female, male, and other students in the aggregate statistics for total enrollment. On the other hand, since the sample of schools reporting enrollment data for nonbinary and other students is very small, we do not include other students as a separate category when breaking down statistics by gender.

IV. Results

A. *Evaluating the Initiative*

In (most of) the treatment schools, the treatment year ran in AY 2015/16. Students who were treated as first years in AY 2015/16 are likely to have the following trajectory at the school if the interventions are successful: take principles in AY 2015/16 (assuming the student did not place out with credit from AP courses they took in high school); take the intermediate sequence in AY 2016/17; declare a major in economics, and, after fulfilling all of the requirements and assuming a four-year graduation rate, graduate as an economics major in AY 2018/19.

We begin by looking at the statistics of the main outcome of interest, the number of female economics majors. We then examine the points in a student's career when the interventions are likely to have impacted their decision to major in economics, by looking at the persistence (the likelihood of continuation) of women from principles to intermediate courses, and at the share female in principles courses. We make several observations about trends in the data and the potential channels through which we would observe the trends in the outcome measures.

Note that the interventions could have increased not just the number of female economics majors but also the number of male and other economics majors. The goal of the UWE was to increase the number of women, and especially not to decrease the number of men in economics. Some of the interventions may disproportionately affect women, leading to an increase in the relative number of women in economics.

Figures 5 through 10 present preliminary data from the treatment and control schools. In the Figures, the year stands for the spring of the academic year and includes data from the entire academic year (e.g. data for 2016 = data for AY 2015/16). The solid line marks the main official treatment year (although not all treatment schools may have implemented an intervention in that year). The dotted line on the graphs of majors denotes the year when treated first years would begin to graduate. On the graphs of persistence, the dotted line marks the year that treated first years would take intermediate courses to stay on schedule to major in economics. In all graphs, the statistics for the group are calculated by school, for example:

$$\text{Mean share female in Principles}_{gt} = \frac{1}{S_g} \sum_s \text{Share female in Principles}_{st}$$

Where t is the year, s is a school, and S_g is the total number of schools in group g {control, treatment}.

Figure 5 shows the number of economics BAs as a share of all BAs averaged by school, for male, female, and all students, by treatment status. Figure 6 focuses specifically on the number of female economics BAs as a share of all female BAs. This measures our main outcome of interest, the popularity of economics (relative to all other fields) among all BAs.

On average, treatment and control schools have roughly the same share of BAs pursue economics. In recent years, economics has become slightly more popular at control schools. Within both the treatment and the control group, men in economics consistently make up a greater share of all male BAs than women in economics relative to all female BAs. At the same time, the share of women majoring in economics has been on an upward trend since around 2009 both at the treatment and the control schools, indicating that economics has been becoming more popular among women compared to other fields even before the start of the treatment period. Looking at the treatment school data for 2019, when students targeted by the interventions would begin to graduate, on average there was a decline in the share of men in economics and a very small increase for women. Whether these most recent changes can be attributed to the interventions will be clearer once data from control schools is available.

Since we may be interested in whether the interventions are disproportionately impacting women compared to men, we also look at the share female among all economics majors. Figure 7 shows the number of female economics BAs as a share of all economics BAs, averaged by school, by treatment status. On average since 2009, treatment schools have had a greater share of women among economics majors than control schools, and this share of women has been steadily increasing since 2012. For the control schools, on average the female share of economics majors has been relatively flat until 2015. The control schools closed the gap with the treatment schools in 2017, but given the following year, this may have been temporary. In 2019, we see that the mean share of female economics majors at the treatment institutions has increased.

Ideally, we would see parallel trends for the treatment and control schools prior to the implementation of the interventions, but this is not what we observe in Figure 7. However, the increasing share of women among economics BAs at the treatment schools may be due to an increase in the number of women in the overall graduating cohort. To take this into account, we look at the fraction female of all economics majors, adjusted by the total number of BAs. This is the same statistic as in Figure 4, given by:

$$\text{Fraction Female (adjusted)} = \frac{\text{Female Econ BAs/Female BAs}}{\text{Female Econ BAs/Female BAs} + \text{Male Econ BAs/Male BAs}}$$

An increase in the adjusted fraction female means that more women relative to men are majoring in economics, adjusting for the total number of women and men graduating from the institution. An increase in the *adjusted* fraction female means that more women are being drawn to economics than would be explained by a simple increase in the number of women at the school.

Figure 8 shows the adjusted fraction female averaged by school, for treatment vs. control schools. Unlike Figure 7, which only shows increasing fraction female for the treatment sample, Figure 8 shows that the fraction female has been increasing at both the treatment and the control schools since prior to the start of the treatment period. At the same time, for the treatment schools the increase in the adjusted fraction female from 2018 to 2019 is the largest over this time period. Data from the control schools will help to evaluate whether this increase is due to previous trend or if it can be attributed to the interventions²¹.

Next, to determine where the women majoring in economics are entering the field, we now turn to the enrollment data. Figure 9 shows, for treatment schools only, the persistence of students from principles to intermediate courses, by gender j and year of enrollment in the intermediate sequence t . The formula for persistence is as follows:

$$\text{Persistence}_{jt} = \frac{\text{Number of students in Intermediate Courses}_{jt}}{\text{Number of students in Principles}_{j,t-1}}$$

Course enrollment data is self-reported by the schools. As is consistent with the data from Adams College, men are more likely to take the intermediate sequence after taking principles. This share has been roughly flat for the past several years at the treatment schools. For women, on average their persistence from principles to intermediate courses has also been flat during the treatment period. Although the fraction of female economics majors is increasing, this is not because women are (on average in the treatment sample) becoming more likely to stick with economics after they finish the gateway course.

²¹ It should be noted that the high average adjusted fraction female for the control schools in 2017 (as well as the average adjusted fraction female for control schools in 2009, 2010, and 2013) is in part due to the high adjusted fraction female (greater than 0.61) at MIT. At schools like Stanford and MIT that focus heavily on STEM fields, economics tends to be a relatively small major. It is also viewed as being more similar to the humanities rather than the STEM fields, attracting more women to the major.

If the persistence rate is not changing, the number of female economics majors could be increasing if the baseline number of women taking principles is increasing. Figure 10 shows the number of female students as a share of all students enrolled in principles²². Some schools teach principles as a single course while other schools offer it in two sections, principles of microeconomics and principles of macroeconomics. For schools that teach principles as a single course, we use enrollment data from the single course. For schools that teach principles as a sequence, we use enrollment data from the micro section only, since we cannot track individual students in the data, and students who take the first half of the sequence are likely to continue to the second half.

The female share of principles enrollment at the treatment schools, averaged by school, has been on an upward trend on average since 2011. For the control schools, the share of women enrolled in principles has been virtually flat during the sample period. After the treatment year, the female share of principles enrollment at the treatment schools was higher than in all previous years. Schools are becoming better at attracting a higher share of female students every year.

To make firm conclusions, the control school data is needed. As the data collection continues, it is important to note a few reasons why the UWE intervention might have had an impact even if we cannot measure it. Some reasons have been mentioned above. Additionally, there is considerable variation in majors from year to year. Our power calculation indicates that we should be able to detect a change in the fraction of female BAs who are economics majors of 0.0072 between our control and treatment groups. But because the mean (unweighted by treatment school) is about 0.04, that is a fairly large change.

There is also leakage in various ways. Not all of our treatment schools were able to implement interventions in the first year. Some the “treated” students were sophomores and upperclassmen at the time of treatment and will graduate before the treatment class does. In addition, our current estimates of the BAs do not take into account the transfer students, none of whom would have been treated. Finally, after learning about the *UWE Challenge*, some of the control schools instituted interventions of their own to increase the number of female majors. The data from the control schools will show whether there is a “rising tide” that has been encouraging more women to major in economics at all schools, or if the effect can be attributed to the UWE interventions.

²² This number is not adjusted by the total number of students who could be enrolled in principles, as that would require us to know how many undergraduates at the school have not yet taken principles.

B. RCTs within the RCT

We are fortunate that several of our treatment schools executed their own RCTs for which they obtained IRB approval at their institution. These provide results in advance of our own and are cleaner due to an absence of the complications mentioned. The two schools for which we have results — Colorado State University and Southern Methodist University — were among those with the lowest fraction female majoring in economics among recent graduating classes.²³

Colorado State University, under the direction of Prof. Hsueh-Hsiang (Cher) Li, ran an RCT in Spring 2016. Three treatments were included in the principles course that mirrored those the UWE suggested more generally: (1) Students in the treatment arm were shown a video during section about careers in economics and given information on the earnings of economists; (2) Female students in the treatment arm received information on the grade distribution at mid-term and those at and above the median were sent letters praising their work and encouraging them to major in the field; and (3) Female students in the treatment arm, regardless of their grades, were encouraged to partake in peer mentoring activities.

Students were asked at the start and end of the semester whether they planned to major in economics. The aggregate impact of all three treatments was substantial (increasing the likelihood that women declared the intent to major in economics by 5.4–6.3 percentage points, conditional on taking the Principles course), particularly given the small cost. Although each intervention had some impact, treatment (2), which encouraged female students to major in the field who had a grade above the median, had by far the greatest effect, increasing their likelihood of declaring the intent to major in economics by about 12 percentage points.

At Southern Methodist University, Profs. Catherine Porter and Danila Serra (forthcoming) ran a field experiment in which they randomized which Principles sections would engage with a role model intervention. They estimated the impact of the intervention on women and men's likelihood of enrolling in intermediate courses and other economics courses, and if they subsequently majored in economics. The same Principles

²³ UC Santa Barbara also did an RCT, but their results are not available yet. Their field experiment was to send congratulatory and encouraging messages to students in the Principles course (Ec1) who did reasonably well.

course, with the same instructors, was offered the year preceding the experiment, giving the authors the ability to do an instructor fixed-effects model as well.

The intervention was a 15-minute statement by one of two female graduates of SMU economics on the importance of economics to their careers. The interventions increased the fraction of women taking the intermediate course within a year by 11 percentage points on a base of about 12 percent. The authors find similarly large effects (a 70% increase) on the likelihood of female students taking any economics course. Finally, the authors find that the percentage of women who declared the economics major increased from below 9% to above 15 percent. There was no impact on the men in the class. As in other studies (e.g., Carrell, Page and West, 2010), much of the effect came from female students with high GPAs. Furthermore, the women who shifted fields disproportionately came from low-earning fields (e.g. the humanities) rather than from high-earning fields (e.g. other STEM fields and business). The authors find, consistent with the results from Adams College, that grades in the Principles course have no influence on the decision to continue with the subject for males but are strongly related to continuation for females.

Both the CSU and the SMU studies show that simple, low-cost interventions can have significant effects on the undergraduate women and their choice of major.

V. What UWE Has Done for Economics

We do not yet know whether the interventions adopted by the UWE treatment schools will have an aggregate impact on the number of female undergraduates who major in economics in the entire treatment sample. However, the within-school RCTs did have effects and these effects were very large. In one case the outcome was whether the students said they would major in economics, in another whether the students did actually major in economics, and the interventions moved the needle on both.

The interventions that most of our treatment schools have used were relatively inexpensive and straightforward in their design, which is important if more schools are to adopt similar interventions. But they do require the time and initiative of hard-working undergraduate instructional staff and faculty. Unless the chair of the department or, better yet, the dean of the school or the provost at the university provides incentives, there is little motivation to add to the duties of teaching personnel. The Undergraduate Women in Economics program, together with the Alfred P. Sloan Foundation, provided incentives by giving recognition to the initiatives as well as funding, collective support, and encouragement. In some instances, the initiatives were recognized by the “higher ups” in the university.

Some of our control schools, we have been told, were motivated by the UWE *Challenge* to try their own interventions to increase the number of female majors. If enough of the schools did that, we could see a trend break in the IPEDS data. We will know more about the impact of the UWE treatments in the near future.

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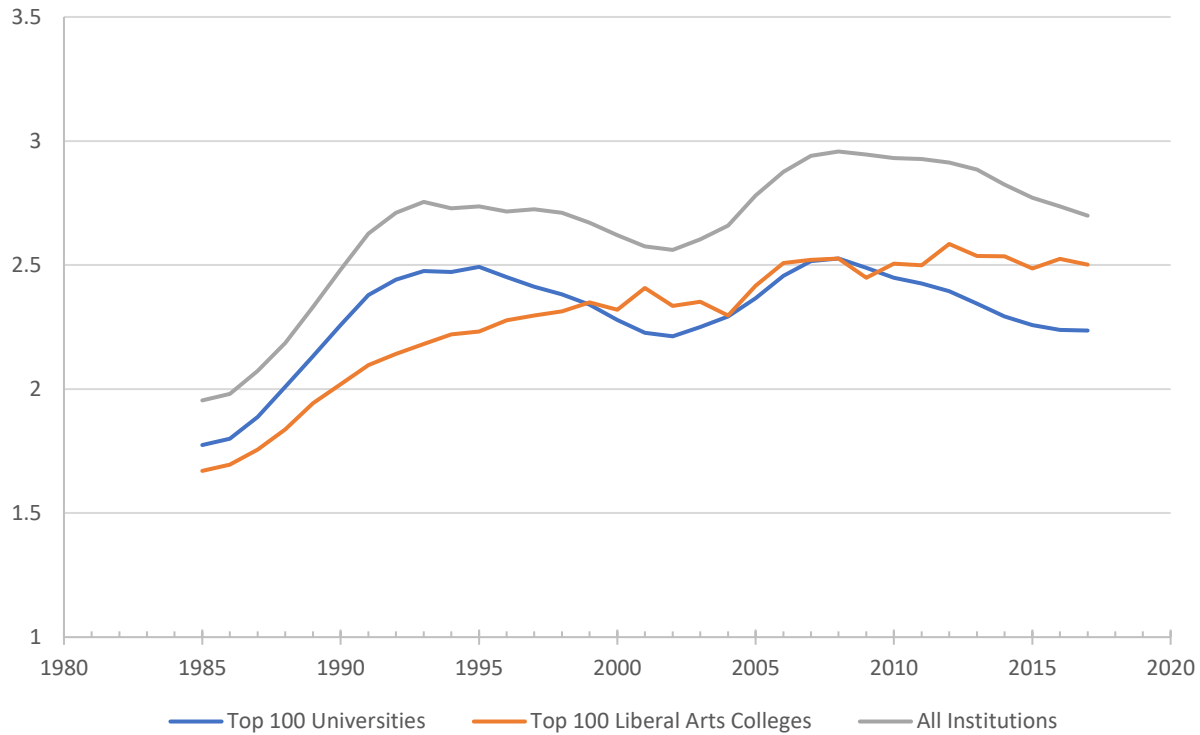
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Figure 1: Economics Conversion Ratios (Male Economics Majors/Male BAs)/(Female Economics Majors/Female BAs): 1984 to 2018



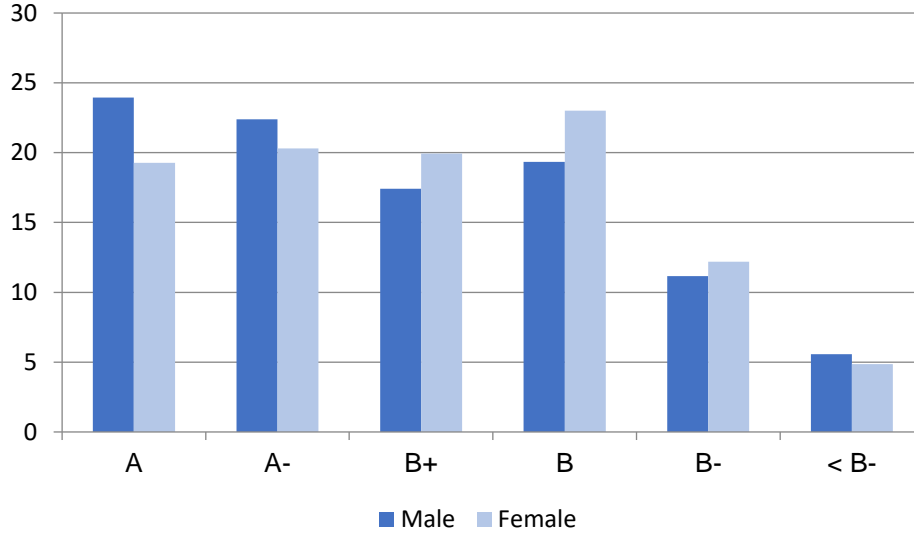
Source: NCES-IPEDS on-line.

Notes: Three-year centered moving averages shown. The list of “Top 100” institutions is from US News and World Report. Only the “first” major is shown. Adding the “second” major generally decreases the “conversion” ratio. Thus, relatively more women have economics as their “second” major. The last year of data is for 2018.

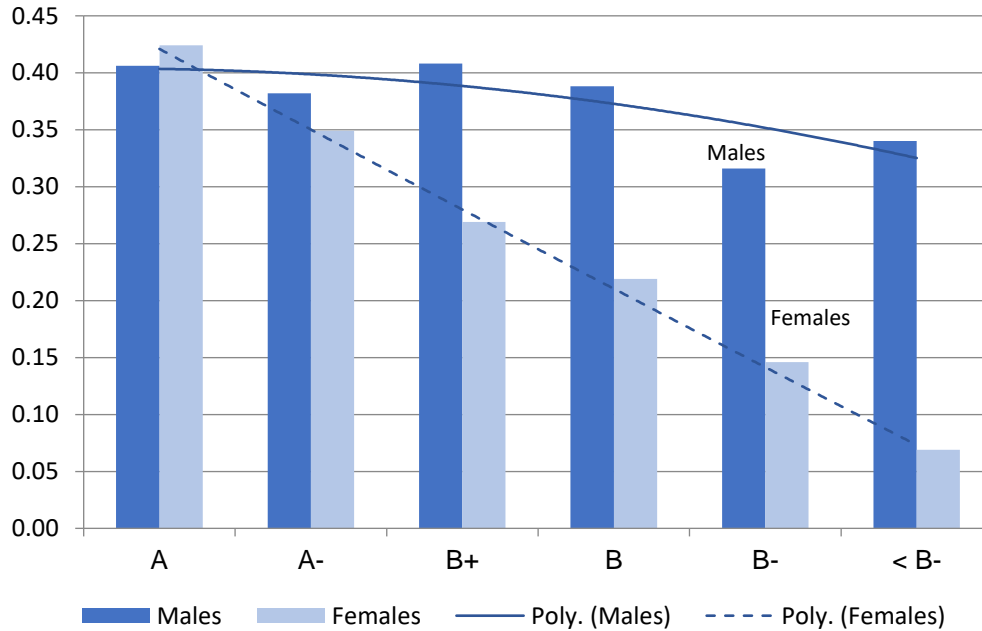
Schools are included only if they granted an undergraduate degree in economics. The economics “conversion ratio” = $[(\text{Male Economics BAs}/\text{All Male BAs})/(\text{Female Economics BAs}/\text{All Female BAs})]$, where BA is meant to include all undergraduate bachelor’s degrees.

Figure 2: Grade Distribution by Sex in Principles and the Fraction Majoring in Economics by Grade for 2005 to 2013 Graduating Classes at “Adams” College

A. Distribution of Grades in Principles-Spring (or Fall if placed out)



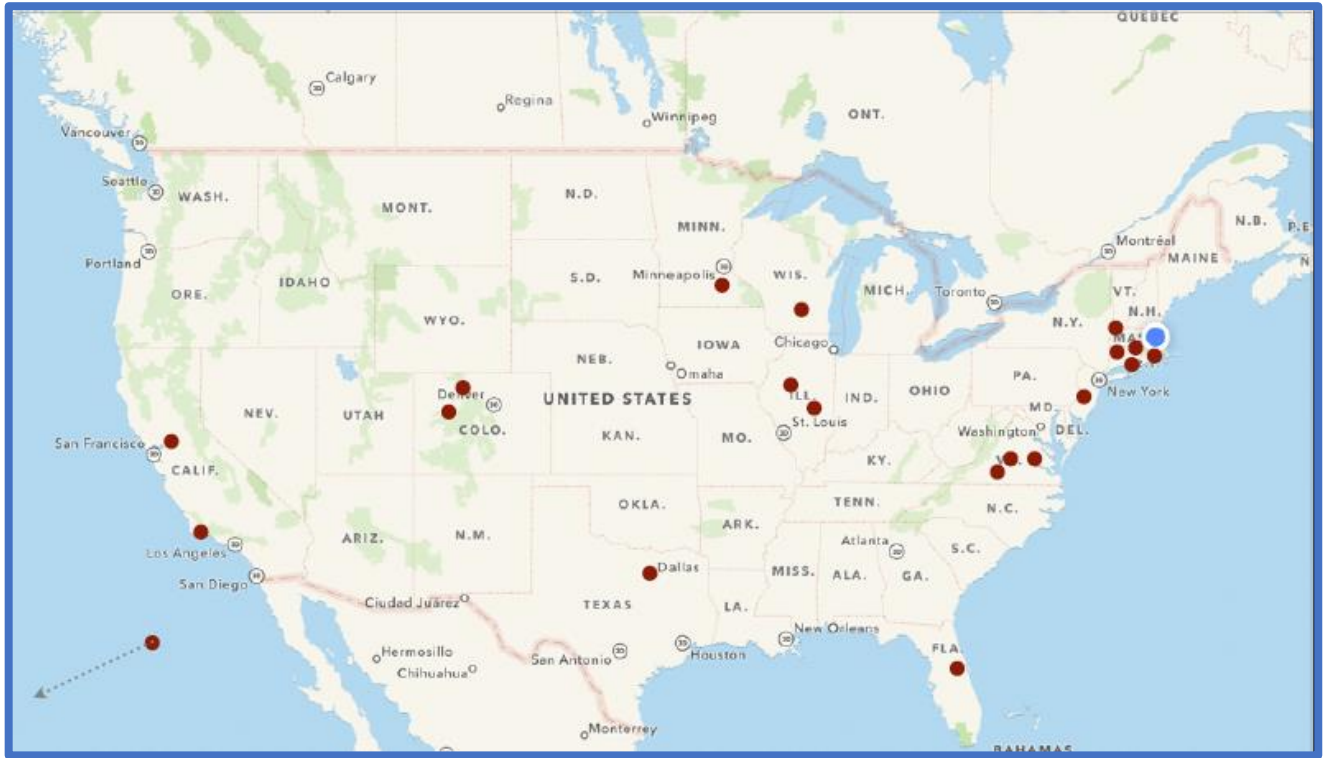
B. Fraction Majoring in Economics by Grade in Principles-Spring (or Fall if placed out)



Source: Adams College administrative data.

Notes: Grade is for Principles-Spring or -Fall if student placed out of Principles-Spring. Results do not change if Principles-Fall is used. Trend-lines are second degree polynomials.

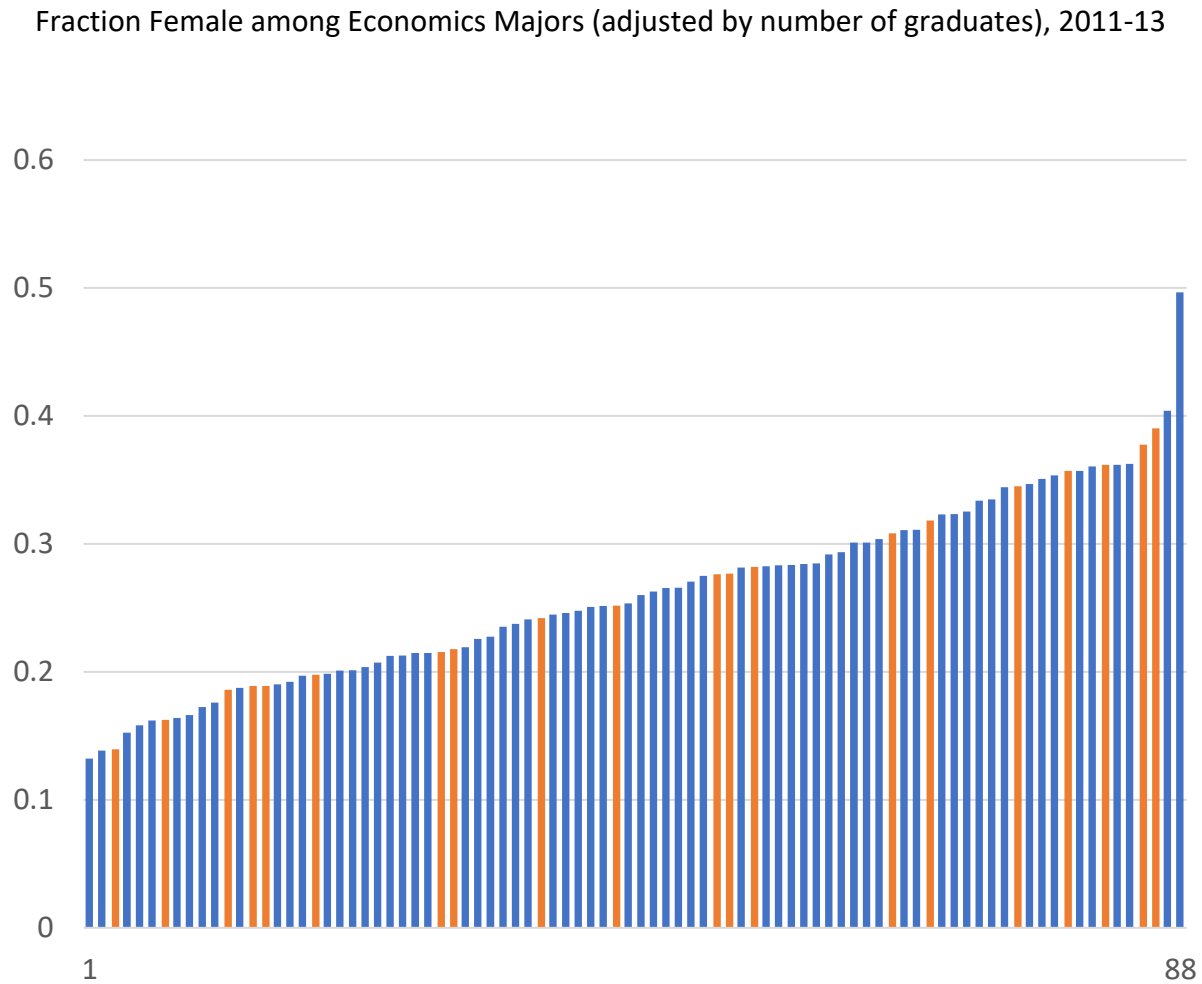
Figure 3: The Twenty UWE Treatment Schools



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; UC Santa Barbara; UC Berkeley; University of Central Florida; UC 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.

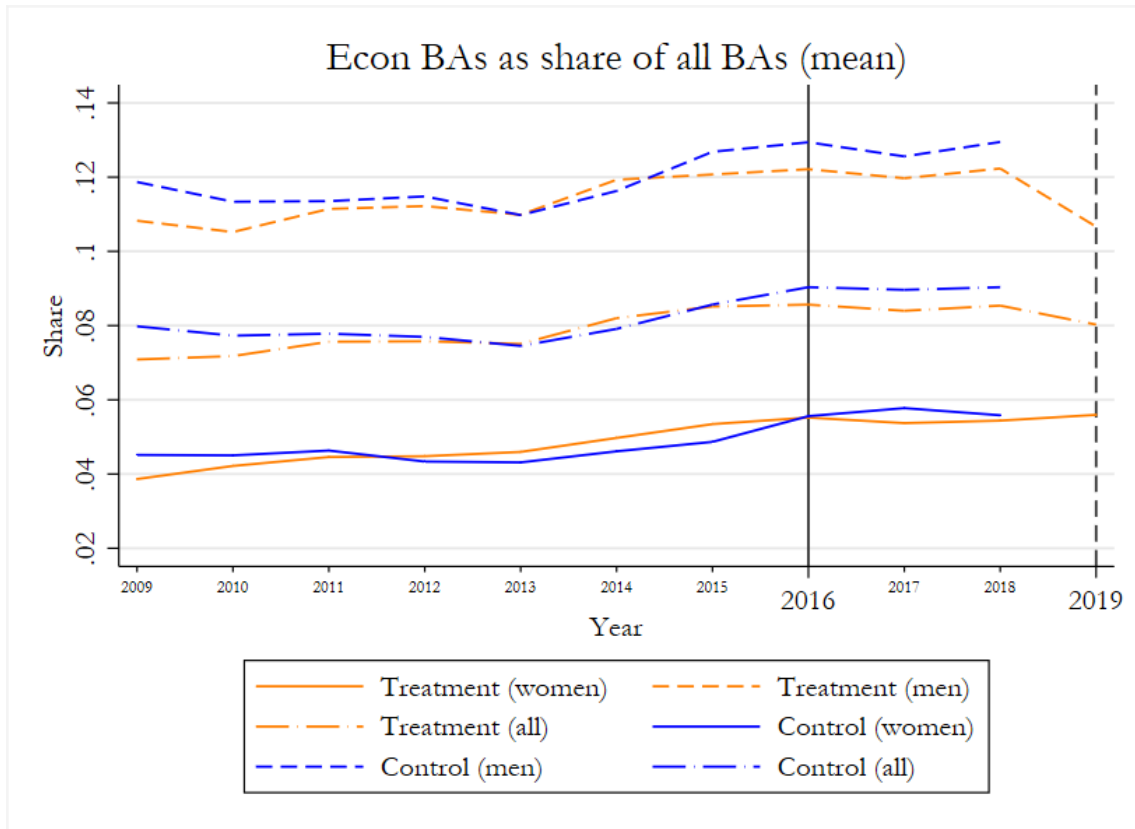
Figure 4: Fraction Female (Adjusted) among the 88 “Treatable” and the 20 Treatment (Orange) Institutions (2011-2013)



Source: IPEDS. Data averaged across 2011 to 2013 are given. The UWE RCT was set up using these data.

$$\text{Fraction female (adjusted)} = \frac{\text{Female Econ Majors/Female BAs}}{\text{Female Econ Majors/Female BAs} + \text{Male Econ Majors/Male BAs}}$$

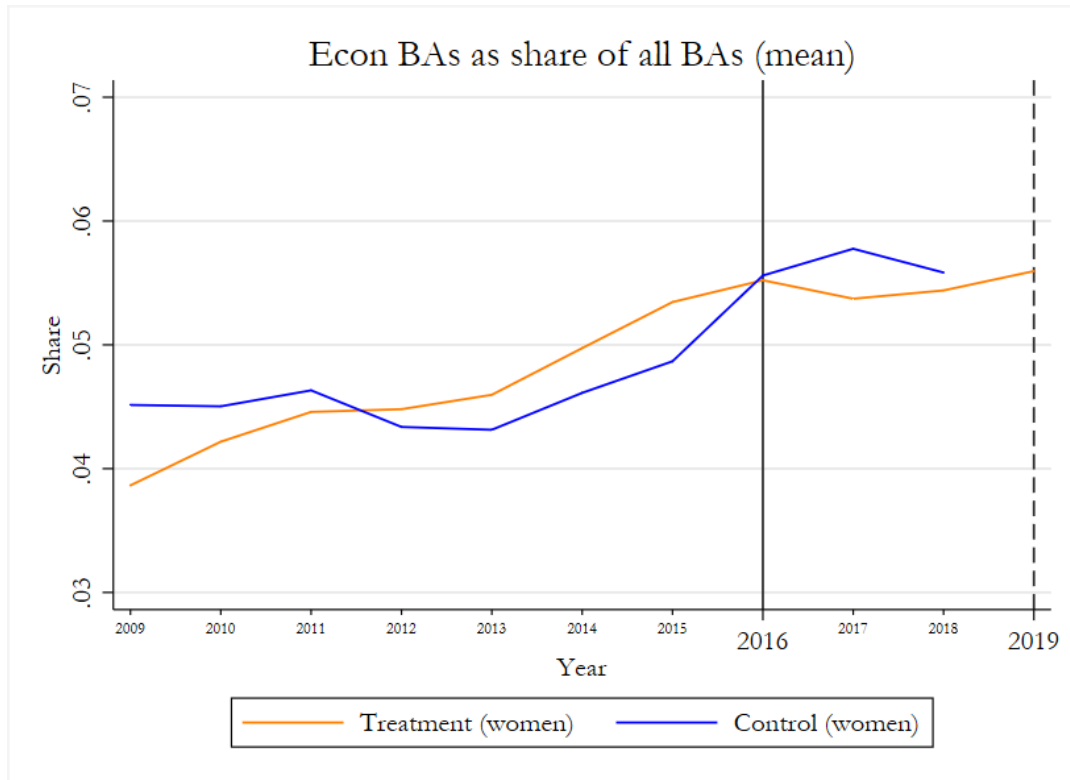
Figure 5: Economics Graduating Majors as a Share of All Graduating Majors, by sex by treatment



Note: Data averaged by school.

Source: 2009 through 2018 data for the 68 control and 20 treatment schools from the IPEDS. 2019 data on all econ majors and all econ majors by gender is reported by 14 out of 20 treatment schools. Data on all BAs in 2019 is from the offices of institutional research for 13 schools.

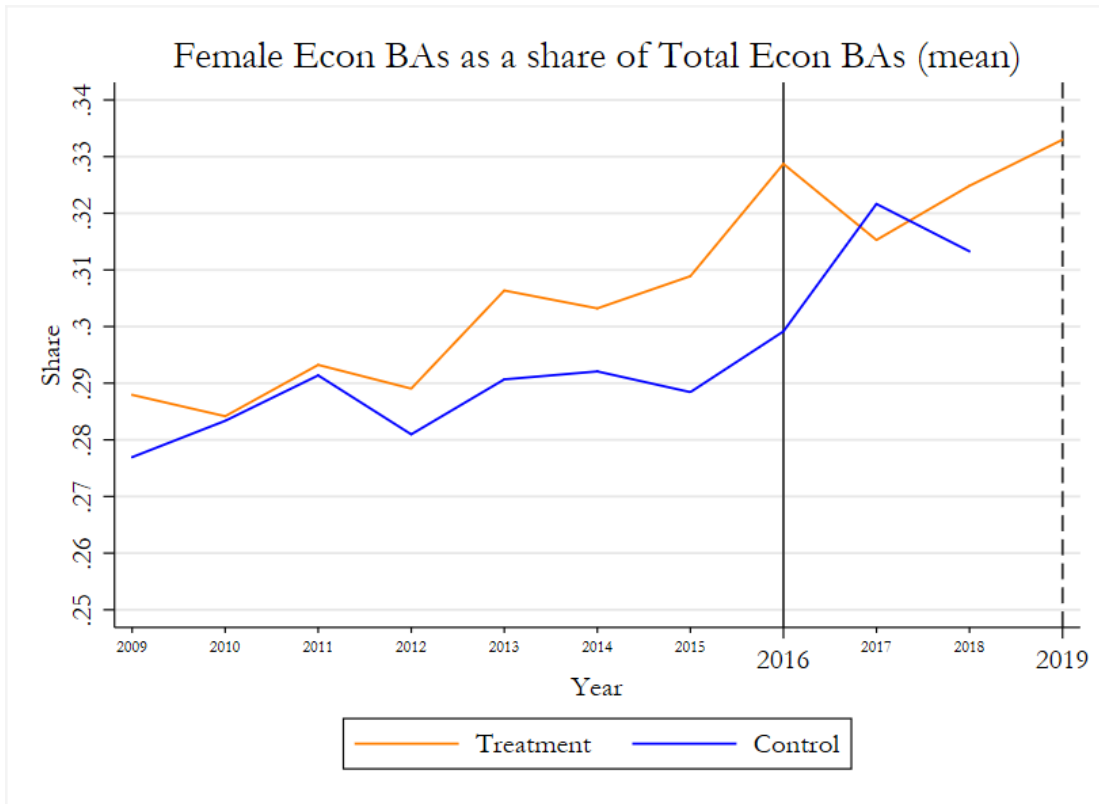
Figures 6: Female Economics Graduating Majors as a Share of All Female Graduating Majors, by treatment



Note: Data averaged by school.

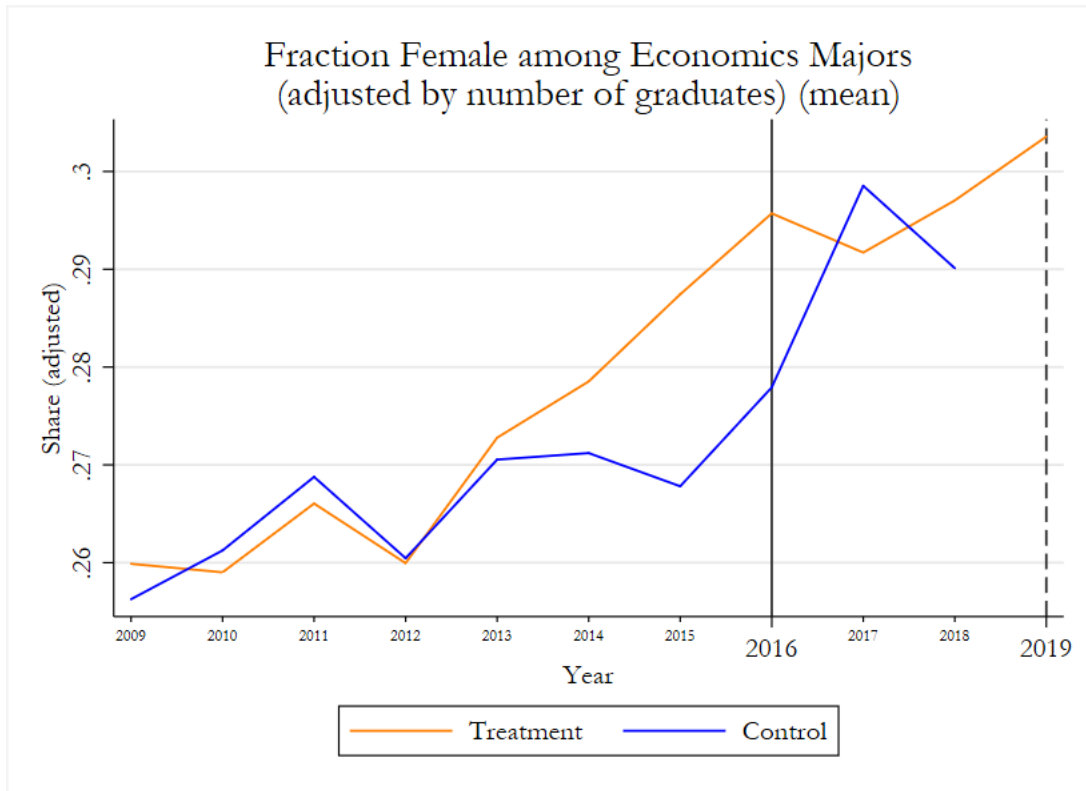
Source: 2009 through 2018 data for the 68 control and 20 treatment schools from the IPEDS. 2019 data on econ majors provided by 14 out of 20 treatment schools. Data on all BAs in 2019 is from the offices of institutional research for 13 schools.

Figures 7: Female Economics Graduating Majors as a Share of Total Economics Graduating Majors, by Treatment



Source: 2009 through 2018 data for the 68 control and 20 treatment schools from the IPEDS. 2019 data on female econ and all econ majors provided by 14 out of 20 treatment schools.

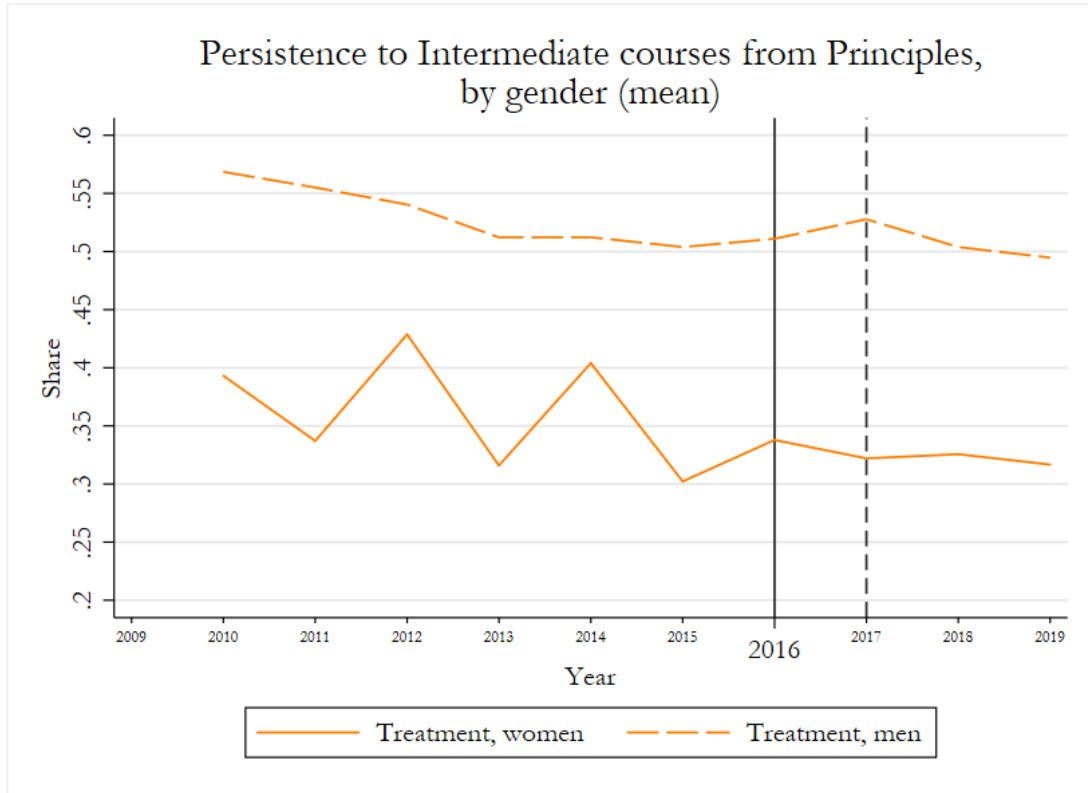
Figures 8: Fraction Female among Economics Graduating Majors, Adjusted by the Number of all Graduating Majors, by treatment



Notes: Data averaged by school. Data for the control schools is only available through 2017. For the treatment schools, the sample includes all 20 treatment schools through 2017, 12 schools in 2018, and 10 schools in 2019.

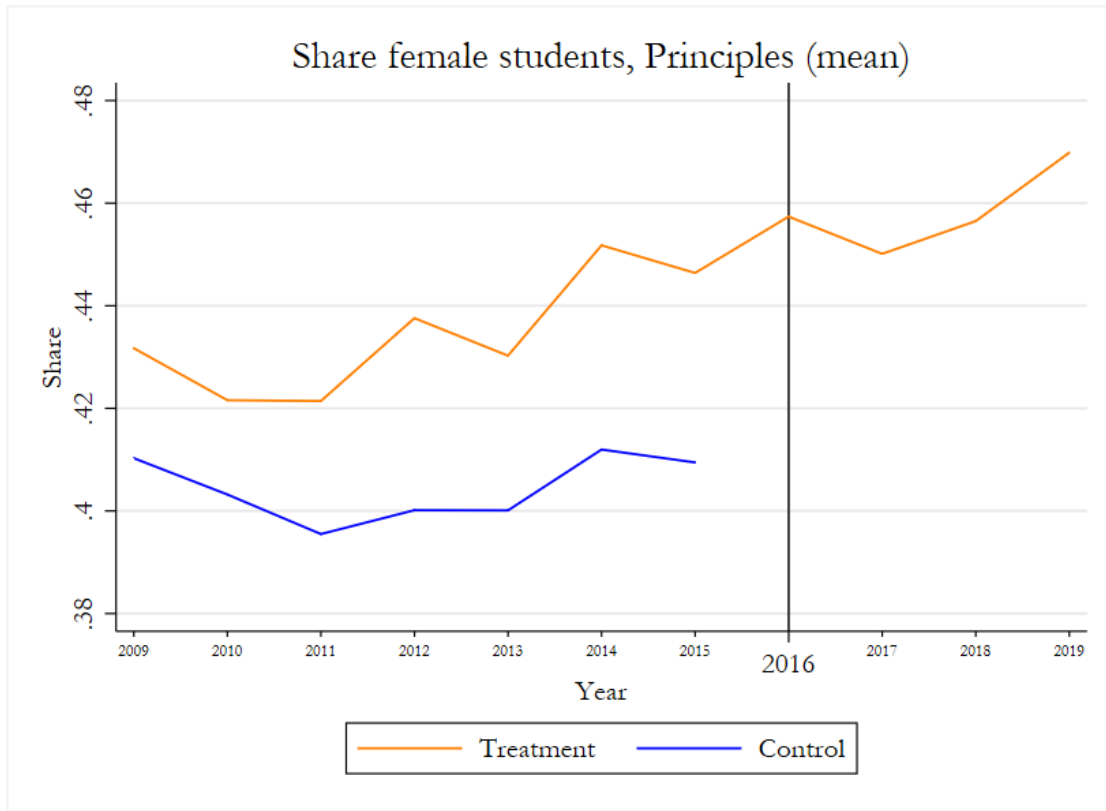
Source: 2009 through 2018 data for the 68 control and 20 treatment schools from the IPEDS. 2019 data on female econ and all econ majors provided by 14 out of 20 treatment schools.

Figure 9: Students Enrolled in Intermediate Economics Courses as a Share of Students Enrolled in Principles in the Previous Year, by sex



Source: Data is self-reported by the schools. Data is available for 18 schools from 2009 to 2011, 19 from 2012 through 2015, 18 in 2016 and 2017, and 12 in 2018 and 2019. Mean is calculated by school.

Figures 10: Women as a Share of Students enrolled in Principles, by treatment



Source: Data is self-reported by the schools. For control schools, data is available for 21 schools in 2009, 26 in 2010, and 27 from 2011 to 2015. For treatment schools, data is available for 18 schools from 2009 to 2011, 19 from 2012 through 2015, 18 in 2016 and 2017, and 12 in 2018 and 2019. Mean is calculated by school.

Table 1: Major Interventions Implemented by Treatment Institutions

Intervention Description	Number of Institutions
Providing more complete information about upper-level courses	12
Sending letters of encouragement to students in Principles	11
Use of the AEA video and/or producing own video about economics	10
Panels with faculty, alumni, and others about economics careers	7
Informational fliers about economics for freshman at start of year	7
Focus groups with students to learn what could be improved	7
UWE (Undergraduate Women in Economics) student clubs	6
Use of upper-class majors and graduate students as mentors	6
Faculty workshops with undergraduates	6
Informal lunches for faculty and students	6
Other: Social media outreach (4); extra sections in Principles (3); changes to Principles content (2); changing major requirements (2); better matched advising with incoming freshmen (2); more RA opportunities (2).	