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Do mentoring, information, and nudge reduce the gender gap in economics majors?

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ABSTRACT

The gender gap in economics majors (i.e., male students are much more likely to major in economics than are their female counterparts) has remained large, despite narrowing gaps observed in many other fields. This study examines whether mentoring, the provision of additional information, and nudges help reduce the gender gap in economics majors via a randomized controlled experiment conducted in introductory economics classes at a large, public, four-year institution in the United States. The results show that the treatment effects are heterogeneous and have the most significant impact on female students with grades above the median. The treatments increase these female students' probability of majoring in economics by 5.41–6.27 percentage points.

1. Introduction

During the 2014–2015 academic year, 57 percent of bachelor's degrees were conferred to women.[1] Despite the significant improvement in female educational attainment, the gender distribution across college majors remains uneven. Economics is one of the few disciplines that have shown a persistent gender gap in the past two decades. Compared to the 18 percent of bachelor's degrees in computer and information sciences awarded to women, 19 percent in engineering, 43 percent in mathematics and statistics, and 38 percent in physical sciences and chemistry, only 31 percent of bachelor's degrees in economics were awarded to women. The gender difference in college majors has a profound impact on subsequent occupational choices and the gender wage gap (Blau & Kahn, 2017; Robst, 2007).

Prior studies have found that women are likely to gravitate towards other disciplines when they receive low grades in introductory economics classes (Goldin, 2015; Rask & Tiefenthaler, 2008) and that a substantial percentage of students would switch majors if major-specific population earnings information was perfect (Arcidiacono, Joseph Hotz, & Kang, 2012). If such decision-making is based on incomplete information, improved information may mitigate the problem. An alternative intervention, such as mentoring, is considered a viable approach to mitigate the gender gap. Blau, Currie, Croson, and Ginther (2010) show that mentoring increases female assistant professors' success in economics.

This study examines whether mentoring, the provision of additional information, and nudges help reduce the gender imbalance in economics majors via a randomized controlled experiment conducted in introductory economics classes at Colorado State University, a large, public, four-year institution. Students enrolled in introductory economics classes were randomly assigned to treatment and control groups. During the semester, treatments such as the provision of information on career prospects, average earnings, and grade distributions were provided to women in the treatment group. A nudging message was also sent to female students in the treatment group with a midterm grade above the median. Additionally, half of the treated female students were invited to attend mentoring activities throughout the semester. To evaluate the mechanisms of the treatment effects, two waves of surveys were administered to elicit students' subjective assessments of the probability that they would major in economics before and after the treatments.

This study contributes to the literature in three ways. First, through the experimental design, the causal effect of interventions on female students' likelihood of majoring in economics is identified. Second, this

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[1] Author's calculation based on 2016 U.S. Department of Education Table 318.30. Economics encompasses agricultural economics, natural resource economics, business/managerial economics, economics (general), applied economics, econometrics and quantitative economics, development economics and international development, international economics, and economics (other).

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study contributes to the growing literature that uses data from subjective expectations to understand individual decision-making. Finally, the panel nature of surveys allows me to examine the potential mechanisms of treatment effects by exploiting the variation *within* individuals. My empirical results indicate that female students with a grade above the median are most susceptible to the intervention. The treatments increase these female students' probability of majoring in economics by 5.41 – 6.27 percentage points. The effects are even larger for freshmen and sophomores among these high-performing female students, who are 11.2 to 12.6 percentage points more likely to declare economics as their major within the subsequent year.

2. Background

Although the under-representation of women in science, technology, engineering, and mathematics (STEM) fields is widely reported and researched, the enduring gender inequalities in economics garner less public attention. The share of female students in colleges has increased dramatically from 39 to 57 percent over the past few decades (Goldin, Lawrence, & Kuziemko, 2006). Goldin (2015) analyzed data for U.S. college graduates in 2015, and after adjusting for the over-representation of women in higher education, found that for every female economics major, there were 2.9 male majors.[2] The attrition among women in the economics pipeline throughout their education and career path is also substantial (Boring, 2017; Kahn, 1995). Researchers largely agree that the lack of female faculty members in disciplines or the gender differences in mathematical aptitudes and training do not explain the gender imbalance in economics (see Allgood, William, & Siegfried, 2015 for a comprehensive review). Although simply having female role models does not necessarily increase the number of female majors in economics, an organized mentoring program targeting women might yield a different result. Blau et al. (2010) show that mentoring programs for female junior economists' increases the number of their top-tier publications, their total number of publications, and their total number of successful federal grants. However, little is known about the effectiveness of mentoring for women in the early stages (e.g., college) of the pipeline.

Evidence using data from liberal arts or selective research colleges shows that women are more sensitive to poor grades received in introductory economics classes than are men (Goldin, 2015; Horvath, Barbara, & Wright, 1992; Owen, 2010; Rask & Tiefenthaler, 2008). However, Main and Ost (2014) find that sensitivity to letter grades in introductory economics courses does not explain the gender differences in declaring economics as a major when "plus" and "minus" are used in the letter grades. The empirical results are inconclusive regarding whether gender differences in sensitivity to grades contribute to the under-representation of women in economics majors. More importantly, no prior studies have directly examined whether providing different grade information (such as percentile distributions) affects how female students interpret signals from their grades.

Students choose their college major facing uncertainty about their abilities and the outcomes. Students receive new information from courses they take and may choose to persist in the major they originally choose, switch to another major, or drop out of college to maximize their expected utility among all the alternatives (Manski, 1993; Altonji, 1993; Arcidiacono, 2004; Stinebricker & Stinebrickner, 2012; Stinebricker & Stinebrickner, 2014; Zafar, 2011; Zafar, 2013).

Arcidiacono et al. (2012) find that both perceived ability and expected earnings are important determinants of college major choices for students at Duke University. They estimate that 7.8 percent of students would switch majors if they had the same expectations about the average returns for different majors but different expectations about their perceived comparative advantages across majors. Their findings suggest that imperfect information about major-specific career outcomes may lead to sub-optimal major choices. Wiswall and Zafar (2015) provided New York University students with information regarding population major-specific earnings and find that students' expectations regarding their own earnings were altered as a response to the new information, although the correction was relatively inelastic. They find that expected earnings and perceived ability are significant factors for college major choices, but heterogeneity in preferences and tastes is the dominant determinant. Zafar (2013) collected data on subjective expected major-specific outcomes of sophomores at Northwestern University. He finds that enjoying coursework is the most important determinant and largely explains the gender gap in college majors, while gender differences in self-assessed ability and future earnings explain a small portion of this gap.

This study explicitly investigates the hypotheses regarding the causes of gender imbalance in undergraduate economics, namely, whether mentoring, information intervention, and nudges affect female students' probability of majoring in economics. Specifically, I use a randomized controlled experiment to examine whether these interventions help reducing the gender gap in economics majors. By exploiting the information from students' subject beliefs, I can investigate the potential mechanisms of the treatment effects.

3. Experiment design and empirical specifications

3.1. Experiment design

Students with heterogeneous tastes and preferences self-select into different courses and majors. Without exogenous variations, it is difficult to identify the causal effect of taking a specific course on students' decisions regarding their major. To overcome the issue of unobserved preferences that are generally correlated with students' choices and outcomes, a randomized controlled experiment was conducted in this study to identify the causal effects of interventions (including mentoring, information provisions, and "nudges") on the likelihood that female students major in economics. Because the treatments are randomly assigned, they are uncorrelated with unobserved personal characteristics or preferences and hence identify the causal effects.

In the spring semester of 2016, five sections of microeconomics and three sections of macroeconomics classes were offered by six instructors.[3] Each section was supported by two teaching assistants (TAs) who each taught three recitation sections, which were scheduled to fill a common range of recitation schedules.[4] Therefore, within the same introductory course, multiple recitation sections were offered by different TAs at the same time. If students were making their selections based on unobserved preferences for specific schedules, they still had a similar probability of being assigned into the control, partial, or full treatment groups. To ensure that students received the information treatment (i.e., a video clip viewing and information dissemination through a pamphlet), the treatment was conducted in class. To balance the influence of instructors and TAs across treatments, the treatments were randomly assigned at the recitation level. Each of the three recitation sections taught by the same TA were randomly assigned into either the full treatment, partial treatment, or control group. During the

[2] Goldin (2015) terms this the "conversion rate" after adjusting the ratio by considering that women greatly outnumber men in many universities. The formula for the conversion rate is $\frac{\text{Male Econ / Male BA}}{\text{Female Econ / Female BA}}$.

[3] The Department of Economics offered an additional small honors section of the introductory macroeconomics class in the Spring 2016 semester to serve 24 selective honor students. Because this group of students differs from regular students in many observable ways and because there are no equivalent classes to serve as a comparison group for the experiments, this study excludes the honors section from the analysis.

[4] If the introductory courses were scheduled on Mondays and Wednesdays, the recitations sections were scheduled on Thursdays (4:00- 4:50PM, or 5:00-5:50PM) or Fridays (1:00-1:50PM). If the introductory courses were scheduled on Tuesdays and Thursdays, the recitations sections were scheduled on Fridays (1:00-1:50PM) or Mondays (4:00-4:50PM or 5:00-5:50PM).