Women in Economics

Edited by Shelly Lundberg

A VoxEU.org Book

CEPR Press

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ISBN: 978-1-912179-27-5

Cover image by NanuVision

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Foreword

The missing women in economics have become an issue, essentially because their share in academic positions is not progressing. Why is this? What are the deeper causes? How can we address them? Fortunately, we can increasingly rely on solid research to answer these questions. We no longer need to discuss conjectures or anecdotal evidence because there is a rapidly increasing body of literature on the topic, as evidenced in this book.

At CEPR we have been taking steps to redress an imbalance in the number of female researchers appointed to our network. Some progress has already been made, and female researchers in the CEPR network have increased from 19% in 2015 to 24.5% today. The good news is that at the affiliate level women now represent 41.5%. The share of women at fellows level, however, remains much lower at 18.2. Clearly, more needs to be done.

To this end, we have appointed a Vice-President, Hélène Rey, to take charge of initiatives that help redress the gender imbalance and, in recent months, we have been showcasing great women economic minds and the outstanding contributions they make to the field. There are exceptional women who do extremely interesting work in all areas of economics - from development to labour, macroeconomics, finance and so on. Thus, it is important to give them and their work more visibility if we wish to create more role models for younger generations of those women already in the field of economics, and those aspiring to become economists.

An important contribution that we all can make is to raise awareness of the issues among our junior and senior faculty and our own graduate students. At the Graduate Institute in Geneva, for example, a group of students has initiated a regular workshop to present and discuss the newest research on women in economics. For any such seminar, or serious discussion the present book should be an invaluable guide.

CEPR is grateful to Shelly Lundberg for her editorship of this book. Our thanks also go to Sophie Roughton and Alexander Southworth for their swift and excellent handling of its production.

Beatrice Weder di Mauro
President, CEPR
March 2020

Introduction

Shelly Lundberg
University of California, Santa Barbara

Women in the economics profession: Challenges and opportunities along the pipeline

This book examines the role and progress of women in professional economics, a field in which they are substantially under-represented. In recent years, there has been a flood of rigorous empirical research documenting the barriers that women face at various stages of the training and promotional pipeline and evaluating programmes designed to support and encourage female economists. The first section provides an overview of the representation of women in economics departments in the United States and research institutes in Europe, highlights the scarcity of Black women in American economics, and provides a bit of history on the 'first gender reckoning' of economics. The second section provides some insight on the forces that discourage women from majoring in economics as undergraduates and how they might be combatted, and on the paths to success for female graduate students. Chapters in the next section document differential treatment of women in the evaluation of research for publication and acceptance at conferences, as well as gender differences in collaborative networks that may affect research productivity. The 'leaky pipeline' is the topic of the fourth section, in which chapters focus on the promotion gender gap in academics and central banking, and institutional factors that contribute to that gap, including gender bias in student evaluations and the inequitable consequences of gender-neutral tenure-clock-extension policies. The concluding section returns to policies and programmes that can support women and combat bias at all stages of the professional pipeline in economics.

Where are we and how did we get here?

The representation of women in academic economics in the United States grew substantially during the 1970s and 1980s in the wake of a wave of feminist activism throughout the academy. In the next chapter, Jenna Stearns and I show how that progress

stalled in the ensuing decades, with the share of female assistant professors and PhD students remaining roughly constant since the mid-2000s. We review the literature on gendered barriers in economics (much of which is discussed in more detail in later chapters), including a gender gap in tenure probabilities that is unique to this field, differential assessments in the publishing process, and institutional structures that fail to function in a gender-neutral way. It is difficult to quantify the impact of some factors that are likely to discourage the entry and persistence of female scholars, including an adversarial and aggressive culture in economics that seems particularly off-putting to (and possibly directed at) women and outright sexual harassment, which has been shown to be more prevalent in male-dominated academic disciplines (National Academies of Sciences, Engineering, and Medicine, 2018).

Cléo Chassonnery-Zaïgouche, Beatrice Cherrier, and John Singleton provide a historical perspective on the upheaval of the early 1970s in American economics and the establishment of the Committee on the Status of Women in the Economics Profession (CSWEP) as a standing committee of the AEA in the next chapter. They argue that a panel discussion of CSWEP's first report at the 1973 AEA meetings reveals a link between contrasting views of the labour market and beliefs about the appropriate role of CSWEP in advancing the careers of female economists. Conservatives such as Milton Friedman and George Stigler advocated a non-interventionist position, whereas CSWEP chair Carolyn Shaw Bell emphasised the need for more transparency and professionalism on the economics job market to enhance competition and disrupt the 'old boys network'. 'Justice….is not a goal of a scientific society' stated Stigler. Divergent views of what makes labour markets truly 'competitive' continue to influence discussions of diversity in economics.

Emmanuelle Auriol, Guido Friebel, and Sascha Wilhelm report on a project that employed web-scrape data collection to investigate the position of women economists in Europe. They report that, as in the US, the representation of women falls from about 40% at the entry level to 22% among full professors and that a cohort effect alone cannot explain this change. Women's representation also decreases with the prestige of the institution. There are substantial differences across countries in the share of women in economics institutes, with more gender equality among economists in France, the Nordic countries, and former socialist countries than in Germany and the Netherlands.

Rhonda Vonshay Sharpe illustrates the importance of taking an intersectional approach to the lack of diversity in economics by highlighting the extraordinary scarcity of Black women in this field. Any analysis that assumes all female economists or all Black economists share the same experiences is belied by data showing that, in the past decade, Black women have experienced a decline in the absolute number of US

undergraduate degrees in economics they have received, though undergraduate degrees received by white women have grown modestly and degrees received by Black men have increased substantially. These degrees are also concentrated in historically Black colleges and universities, perhaps a consequence of the rarity of Black female faculty and an absence of role models elsewhere.

The path to a PhD

Choice of college major is the first step in the diversity pipeline problem facing economics. The representation of women in economics undergraduate programmes has remained flat for 20 years, even as women make up an increasing fraction of college students and the female fraction of majors in other STEM fields has continued to rise. In their chapter, Tatyana Avilova and Claudia Goldin tell the story of the Undergraduate Women in Economics (UWE) Challenge, which they have led since 2015. Economics departments were recruited into the programme, randomised into treatment and control groups, and treatment institutions received funding and guidance to initiate interventions to increase the number of female economics majors. These interventions fell into one or more of three groups: (1) providing students with better information about what economists do, (2) providing mentoring and role models and creating networks among students, and (3) improving the content and relevance of introductory economics courses.

Final data on results from UWE projects are not yet available, but one successful intervention that was administered as a field experiment is described in the next chapter by Catherine Porter and Danila Serra. Lack of female role models is often noted as a barrier to women choosing economics as an undergraduate major. The authors implemented a relatively inexpensive intervention in randomly-chosen Principles of Economics classes. Successful and 'charismatic' alumnae of the programme were chosen with the help of current undergraduates to visit classes briefly and discuss their educational experiences and career paths. The results were dramatic: role model visits increased the probability that treated female students would major in economics by eight percentage points (from a base of 9%) with no impact on male majors. This provides strong evidence of the salience of role models for women's choice of major.

Leah Boustan, Andrew Langan, and I. Bailey Palmer turn to the graduate student phase of the journey towards professional economics careers and show that there is substantial heterogeneity among PhD programmes in both the share of women in the programme and in the relative success of female graduates in job placement and early publishing. To learn which aspects of a programme may be important in predicting women's

success, they conducted exploratory interviews with faculty and former students in a small number of high- and low-performing programmes. A few key aspects of the programme appear to matter for relative female graduate success – hiring and retaining female faculty, student works-in-progress seminars that mandate regular feedback from faculty, a more supportive seminar culture, and a general awareness of gender bias issues. Their chapter offers valuable suggestions for department leadership wishing to improve outcomes for under-represented students (and probably for graduate students more broadly).

Many economists report that their fellow students were important influences on their training and success. Valerie Bostwick and Bruce Weinberg investigate the impact of gender mix of peers in doctoral programmes in STEM, economics, and psychology on attrition and on-time graduation rates. They find that the gender composition of entering PhD cohorts has a significant impact on the gender gap in PhD persistence and completion, with the effect driven almost entirely by differences in the probability of dropping out in the first year of the programme. The effect is most pronounced in the most male-dominant fields, and the authors speculate that the mechanism is likely to be an improvement in the climate for women when the female fraction of the cohort is high.

Research and publishing

Female economists publish less than male economists on average, and we are beginning to understand some of the forces that contribute to this gap. Erin Hengel was the first to point out that economics research papers written by women appear to be held to higher standards in the publishing process than papers written by men. As in several other professions (medicine, real estate, law), there appears to be a quality/quantity trade-off, with female economists producing less output of higher quality than equivalent men. In her chapter, Hengel summarises the results of her study, showing that female-authored papers at some elite journals are subjected to extended review times, and result in published papers with abstracts that are significantly more readable, according to standard measures. Female economists appear to internalise this discrimination throughout their careers, with experienced women (but not experienced men) writing more readable working papers than inexperienced women.

The evidence for this key insight is bolstered by the work described in the chapter by David Card, Stefano DellaVigna, Patricia Funk, and Nagore Iriberri, who use data for the entire reviewing process from four leading journals to examine the behaviour of referees and editors. They find that the recommendations of male and female

referees evaluate the papers of male and female authors (and mixed-gender papers) in a similar way, and that editors appear to be gender-neutral in the value they place on the recommendations of male and female referees as well. However, all referees appear to hold female-authored papers to a higher bar than male-authored papers, if we measure paper quality by citations. All-female-authored papers receive about 25% more citations than similar male-authored papers and their calculations suggest that R&R rates for female authors would rise by 50% if editors were to maximise citations by treating female-authored papers more leniently, given the bias in referee recommendations.

The chapter by Lorenzo Ductor, Sanjeev Goyal, and Anja Prummer reports the findings of their study of gender differences in the collaborative networks of economists. Using the EconLit database, they undertake a detailed analysis of co-authoring patterns, and find that women work with a smaller network of distinct co-authors than men and tend to collaborate repeatedly with the same co-authors and their co-authors' collaborators, constructing a tighter network. Since larger networks are associated with higher levels of research output, these patterns may disadvantage women. The gender difference in network size is pervasive and does not seem likely to erode as the share of women in economics increases, since it does not vary with field gender share and has increased over time. Also, the same gender disparities in collaboration patterns appear in sociology, a field with equal shares of men and women. The source of these gender differences in collaboration are unknown; one possibility is that women believe tighter networks may assist them in promotion and tenure decisions in female-hostile environments.

Conferences are important venues for the professional development of economists: they are events where researchers can receive feedback about their work, increase their visibility, and develop networks and contacts with possible collaborators. Entry into many academic conferences is very competitive, with only a fraction of submitted manuscripts being selected for presentation. Laura Hospido and Carlos Sanz use data from three large general-interest academic conferences to test for gender gaps in the evaluation of submissions. After controlling for a rich set of controls for author and paper quality, including author characteristics, field, paper cites at submission, eventual publication of the submitted paper, and referee fixed effects, they find that all-female-authored papers are about 7% less likely to be accepted than all-male-authored papers. In a result contrary to the Card et al. finding on journal referees, this differential treatment is limited to male referees and perhaps reflects greater in-group bias for an outcome with social content.

Career paths and promotion

An early contribution to the new empirical research on the impact of gender on the success of professional economists highlighted in this book was work by Donna Ginther and Shulamit Kahn (2004), which showed that, after controlling for research productivity, women who received economics PhDs in the 1970s and 1980s were 18 percentage points less likely to receive tenure within ten years than similar men. In her chapter, Kahn discusses previous research on the 'leaky pipeline' in economics, and the uniqueness of economics as a field with a substantial gender tenure gap not explained by research productivity. She also provides a rare positive note, summarising recent work with Ginther using more recent PhD cohorts that shows an insignificant gender gap in promotion rates in very research-intensive universities (but large gaps in less research-oriented universities).

Less is known about the status and career progression of female economists outside academia, and the chapter by Laura Hospido, Luc Laeven, and Ana Lamo makes an important contribution by examining personnel records for professional staff at the European Central Bank. They find that, prior to the introduction of a public commitment and set of policy changes designed to foster gender balance in 2010, there was a gender gap of 36% in the probability of promotions that was also reflected in a gender gap in salary levels. After 2011, the promotion gap decreased by about 80%; although women remained less likely to apply for promotion than men, they had a higher probability of being selected, conditional on applying. This study provides an unusual piece of evidence on the impact of a broad-based corporate diversity policy on personnel outcomes.

Family-friendly corporate policies have received much attention as a possible mechanism for helping women combine a professional career with the domestic responsibilities that tend to weigh more heavily on mothers. In American universities, the fixed-length tenure clock period has been a notable hurdle for assistant professor parents trying to build a tenurable research record, despite a temporary decline in productivity after childbirth. Some universities have introduced policies that stop the tenure clock for mothers, but more have adopted gender-neutral policies that give all new parents an extra year before their tenure decision. Heather Antecol, Kelly Bedard, and Jenna Stearns examine the impact of the rollout of these policies at top-50 US economics departments between 1980 and 2005, and find that men are 17 percentage points more likely to get tenure at their first job after this policy is adopted, while women are 19 percentage points less likely to do so. Men who gain more pre-tenure time as a result of this policy are more likely to publish an additional article in a top journal but women, who appear to bear more of the costs of a new child, do not. These

results indicate that policies intended to help women need to be carefully designed, as they may, as in the case of this gender-neutral policy, have unintended consequences.

Student evaluations of teaching (SETs) are used as an input for many academic personnel decisions, including tenure and promotion, particularly in the US. Anne Boring reviews a growing international literature with strong causal inference designs based on random assignment of instructors or instructor identities in online classes that consistently finds evidence of biases against female instructors, often driven by the judgements of male students. In addition to direct impacts on faculty assessments, such biases may also drive female instructors to spend more time on teaching and less on research in an attempt to combat them. Some treatments have been found to be effective in reducing gender biases in SETs: one successful intervention provided students with information about research findings that previous students in the same university had been biased in their evaluations of female instructors.

What can we do?

Lack of access to informal mentoring and networking opportunities in a male-dominated profession has long been thought to be a disadvantage facing junior women economists, and providing such mentoring has been a focus of the AEA's Committee on the Status of Women in the Economics Profession since its founding. The chapter by Donna Ginther, Janet Currie, Francine Blau, and Rachel Croson reports on a follow-up assessment of CSWEP's flagship intensive mentoring programme, CeMENT. Causal estimates of the impact of such programmes are rare, but this evaluation, based on participants and those who were randomised out of the over-subscribed programme in 2004-2014, provides an unusual opportunity to gauge their potential effectiveness on short- and long-term outcomes. The estimates show that access to CeMENT increased the probability to having a tenure stream job by 14.5% and increased the probability of having tenure in a top-50 ranked institution by 9.0 percentage points. Most of the impact on tenure can be attributed to significant increases in pre-tenure publications in top-five and other highly regarded journals, but the effect on tenure is marginally significant even after controlling for these factors, suggesting that mentoring may provide professional advantages to women beyond easily-observable productivity metrics.

In the final chapter, Kasey Buckles surveys existing evidence on the effectiveness of efforts to attract and retain women in economics with the goal of beginning a 'toolkit' of strategies for departments and institutions dedicated to diversifying economics. She focuses on three 'success stories' of interventions that have proven to be effective targeting three groups of women – undergraduates, job candidates,

and junior academics. First, a low-cost intervention provided female students with information about career prospects in economics careers, a description of the grade distribution for the course and, for those with higher grades, encouragement to major in economics. The latter treatment groups were significantly more likely to major in economics. Second, a randomised intervention found that STEM departments who received a series of workshops on gender bias were substantially more likely to hire women after the treatment. Finally, Buckles returns to mentoring programmes such as CeMENT, which provide intensive feedback on current research, access to senior role models and, for many, a continuing supportive peer network and have large positive impacts on early career success. All of these interventions, for which we have credible evidence of causal effects, can be adapted and extended to broader populations, given the will and resources to do so.

The contributions to this book demonstrate conclusively that the under-representation of women in economics cannot be attributed simply to less interest in economics among women, or the inevitable consequences of female household responsibilities. Women in economics face clear barriers to field entry and professional success that are distinct from those in other math-focused fields. A lack of role models and limited access to mentoring appear to be relevant, but women also appear to face implicit bias in the assessment of their research and other professional contributions that limit their success and persistence in the field. Other chapters show that we have made considerable progress in developing strategies that can help women surmount these barriers. The intrinsic scientific benefits to improving diversity in economics have been discussed elsewhere (Bayer and Rouse, 2016); the studies in this book demonstrate the challenges and illustrate some strategies for advancing this goal.

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About the author

Shelly Lundberg is the Distinguished Professor of Economics and the Leonard Broom Professor of Demography at the University of California, Santa Barbara. She is a Fellow and past President of the Society of Labor Economists and a Research Fellow at

IZA. Lundberg served as Chair of the AEA's Committee on the Status of Women in the Economics Profession from 2016 to 2018.

Lundberg's research is focused in labour economics and the economics of the family, including issues such as discrimination, inequality, family decision-making and the intra-household allocation of resources. Recent projects include studies of decision-making by children, the effects of child gender on parental behaviour, the location decisions of married couples, the impact of government-provided care for the elderly on the labour supply of adult children, the economic returns to psychosocial traits, and the gender gap in educational attainment. She received her PhD in Economics from Northwestern University in 1981.

Part I: Where are we and how did we get here?

1 Women in economics: Stalled progress

Shelly Lundberg, Jenna Stearns
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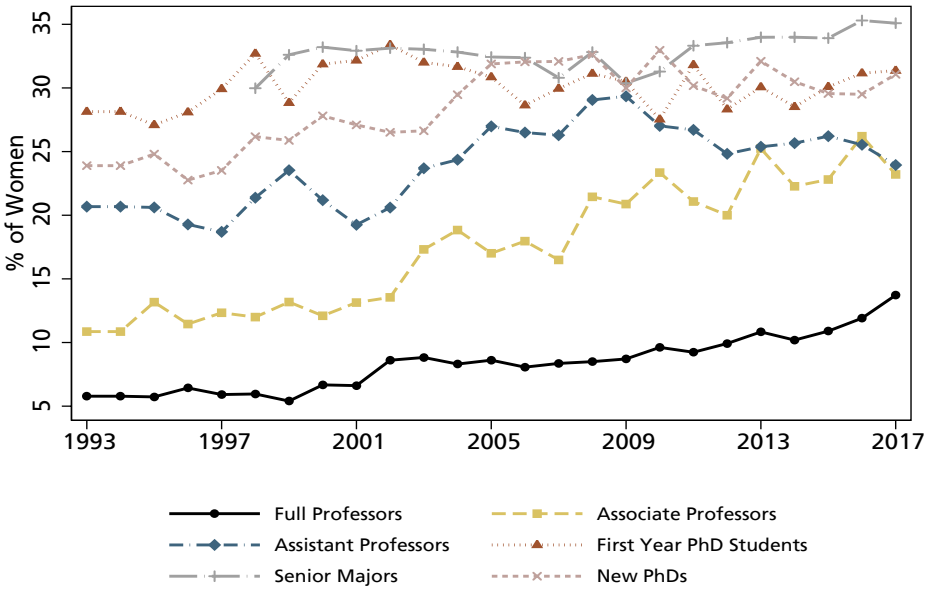
Evidence of a 'leaky pipeline' for women in academic economics is not new. Studies of economists from the 1980s and 1990s showed that women were significantly less likely to be promoted to tenured positions than men (Ginther and Kahn 2004, McDowell et al. 2001). Economics became substantially less male-dominated during this period however, with the share of women in top PhD-granting departments more than doubling at all ranks in the 20 years between 1972 and 1993. More recently, this growth in female representation in the economics discipline has stalled. The share of female assistant professors and PhD students has remained roughly constant since the mid-2000s.

Little consensus has emerged as to why improvement in women's status in economics has slowed in recent decades. In our paper (Lundberg and Stearns 2019), we first document trends in the gender composition of academic economists over the past 25 years. We then review the recent literature on other dimensions of women's relative position in the discipline and assess evidence on the barriers that female economists face in publishing, promotion, and tenure. We propose that differential assessment of men and women is one important factor in explaining women's failure to advance in economics, reflected in gendered institutional policies and apparent implicit bias in promotion and tenure processes.

Figure 1 shows the share of women in 43 top PhD-granting departments (these departments grant approximately two-thirds of US PhDs and can be consistently tracked over time) from 1993 to 2017. The share of female full and associate professors increased from 6% to 13% and 11% to 23%, respectively. The pattern is different for assistant professors, however: the share of women increased from 20% to 29% between 1993 and 2009 but has since decreased to 24%, leaving little net growth at junior ranks over the past 24 years. There has also been little improvement in female representation amongst first-year PhD students, or senior undergraduate economics majors. Progress towards gender equality at the intake levels of the profession appears to have ceased,

while women's representation at senior levels continues to rise, fuelled for now by the entry of women into academic economics in past decades.

Figure 1 Representation of women among first-year PhD students, new PhDs, and faculty by rank for 43 PhD-granting departments, 1993-2017



Source: Authors, using data from the Committee on the Status of Women in the Economics Profession (CSWEP) and the Universal Academic Questionnaire for PhD-granting departments from 1993 to 2017.

The share of female faculty decreases with rank, as in most academic disciplines, and economics remains solidly within the lowest group in terms of female faculty shares at all levels, alongside physics, math, and engineering, and far below the biological and other social sciences. Unlike other academic disciplines, however, the promotion gap in economics cannot be fully explained by differences in productivity or family characteristics. Ginther and Kahn (2014) conclude that 'economics is the one field where gender differences in tenure receipt seem to remain even after background and productivity controls are factored in and even for single childless women'. Economics has also made less progress than other maths-intensive fields over the past 25 years, in terms of improving gender equity in income, promotion, and job satisfaction (Ceci et al. 2014).

In many academic disciplines, women have fewer publications than men on average (Ceci et al. 2014, Ginther and Kahn 2004). A leading hypothesis for the lower productivity of female academics is that women have more intense domestic

responsibilities and, in most science, engineering, technology, and mathematics (STEM) fields, publications by single childless men and women are not significantly different. However, in economics and the physical sciences, there is a significant gender gap in productivity among the childless as well. With productivity differences that appear unrelated to family demands and unexplained, persistent differences in tenure rates, the gender gap in economics appears to be distinct from that in other disciplines.

If women's relative failure to advance in departments of economics cannot be explained by the gender gap in productivity, the possibility of differential treatment arises. An emerging literature in economics is reporting evidence that female economists face substantial barriers throughout their careers.

Early-career female economists may be adversely affected by limited access to the mentoring and social networks that support research activities. Men and women have different research collaboration and co-authorship networks (McDowell et al. 2006), and women's co-authorship patterns are distinct from those of men in ways that are predictive of lower output (Ductor et al. 2018). When papers are sole-authored, male and female economists receive similar credit in terms of their impact on tenure decisions (Sarsons 2017). However, women receive significantly less credit than men for co-authored work, particularly when they co-author with men. This contrasts with evidence from sociology, where Sarsons finds that men and women benefit equally from co-authored work.

Women and men in economics may also face different experiences throughout the publishing process. The empirical evidence for outright discrimination against women in manuscript review is mixed (Ferber and Teiman 1980, Blank 1991, Abrevaya and Hamermesh 2012). More recently, Card et al. (2020) study referee recommendations and editorial decisions at four leading economics journals, and find no evidence of differential gender bias. But both male and female referees appear to hold female authors to a higher standard (as measured by future citation counts), resulting in a substantial difference in the probability that female-authored papers are rejected. Hengel (2017), finds that economics papers written by female authors spend six months longer under review at one top journal, although they are objectively more readable. These differences in co-authorship networks and potential biases in the publishing process may both contribute to the substantial under-representation of female authors in top journals (Hamermesh 2013).

Even policies that have been supported on the grounds of gender equity may create biases against women's success. Antecol et al. (2018) examine the effect of gender neutral tenure-clock-stopping policies, which allow assistant professors who have children to extend their tenure clock. They find that these policies substantially increase

the probability that men get tenure in their first job, but reduce the probability that women do. Effects on publications suggest that fathers use the additional time on the tenure clock more productively than mothers.

What can explain the unique challenges that women seem to face in economics? An adversarial and aggressive culture within academic economics may play a role, though its impact is difficult to quantify. Anecdotal evidence suggests that women may choose to go into less male-dominated fields based on early experiences with toxic environments that men are more likely to tolerate. While it is difficult to obtain quantitative estimates of outright harassment, there are many reports of women in economics experiencing inappropriate behaviour in job interviews, seminars, meetings, and at conferences (Shinall 2018). Recent work also suggests that gender harassment is a serious problem in academics more broadly (National Academies of Sciences, Engineering, and Medicine 2018).

Differences in productivity between men and women likely drive some of the gender gaps in economics, though it is important to recognise that productivity gaps can arise both because of the different choices men and women make, and also because of the differential constraints they face. However, the fact that gender gaps in professional outcomes conditional on productivity are larger in economics than in other academic disciplines suggests that the disparate assessment of men and women may be another important factor in explaining female disadvantage. If this is the case, as recent evidence seems to indicate, continued progress toward equality in academic economics will require a concerted effort to remove opportunities for bias in the hiring and promotion processes. Continued action to do so can be justified both on the basis of simple fairness and also on the benefits of creating an environment where equal work yields equal rewards.

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2 Women in European economics

Emmanuelle Auriol, Guido Friebel, and **Sascha Wilhelm**
Toulouse School of Economics and CEPR; Goethe University, Frankfurt and CEPR; METRO Germany

Women are under-represented among academic economists. For instance, in 2017, only 13.9% of full professors in the US were women, despite the fact that over the last decades, between 30% and 35% of PhDs in economics have been earned by women (CSWEP 2017). The large gap between the percentage of women holding a PhD and those who eventually go on to become full professors has been interpreted as evidence of a 'leaky pipeline' in which, over the different stages of a career, the attrition of women is higher than that of men (Bayer and Rouse 2016, Lundberg and Stearns 2019). An important concern with the 'leaky pipeline' literature is that most of its evidence comes from the US.

To learn more about the situation in Europe, the Women in Economics (WinE) Executive Committee of the EEA sponsored a web-scrap data collection by the two of us who are based at Goethe University, Frankfurt (Friebel and Wilhelm 2019).[1] One problem with the European academic market is its lack of standardisation in labour management practices, titles, web design, and so on. After web-scraping the websites of research institutions, we carefully separated the data entry of non-academic from academic staff, and then translated the multitude of different titles (more than 1,000) into a simple hierarchy of positions in descending order: (full) professor, associate professor, assistant professor, lecturer, research fellow, and research associate.

In a recent paper (Auriol et al. 2019) exploiting this new dataset, we seek to (1) provide an answer to the question of whether the situation in Europe is similar to the US, or whether there are important differences, (2) investigate to what extent there are important differences *within* Europe, and (3) study when exactly the 'leaky pipeline' starts.

1 We designed an algorithm to monitor on a daily basis all known URLs of European institutions that contribute to research in economics. The algorithm identifies the individuals listed on these websites and, where available, records the position titles these individuals hold. Gender is identified through first names, and a gender identification software analysing pictures of the individuals.

Table 1 Female position share across Europe (percentage)

Hierarchical level	All	Top-300	Top-100
Research associate	39.11	38.05	35.31
Entry level	38.78	39.06	36.44
Associate professor	33.48	34.59	32.37
Reaearch Fellow	30.07	29.70	26.26
Professor	22.52	22.08	19.93
Total	31.51	31.35	28.19

Figure 1 Percentage of women in position of full professor

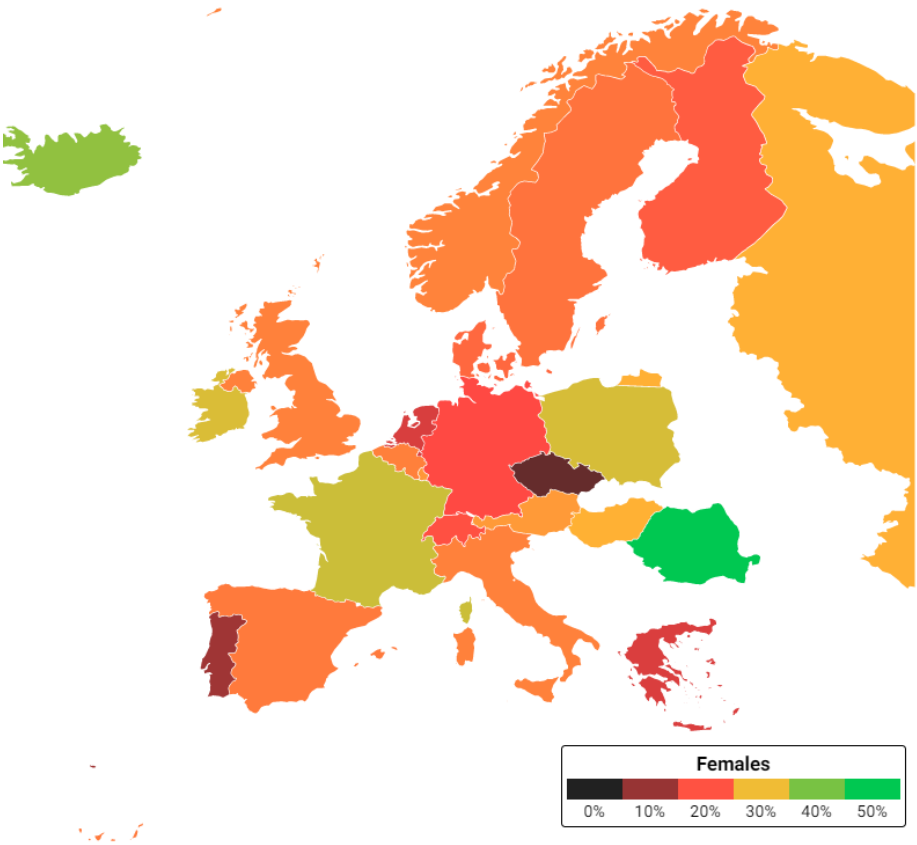


Table 1 reveals that there is also a 'leaky pipeline' in Europe: from 39% at entry level the share of women falls to 22% at the level of full professor. In comparison to the US, European countries have a higher share of women full professors in their research

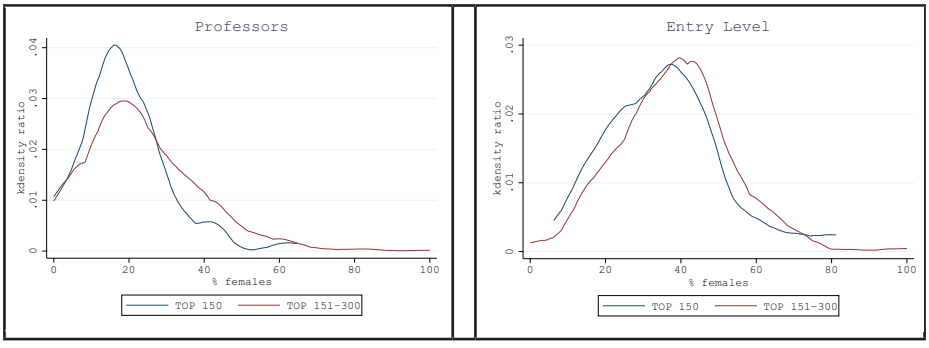
institutions, but the attrition rate between junior and senior ranks is comparable on both sides of the Atlantic.

Although in all countries, the proportion of female researchers at all levels is much higher than at the full professor level, Figure 1 shows that there are important differences throughout Europe. The Nordic countries and France score much higher on gender equality than, for instance, Germany and the Netherlands. This may be owing in part to historical and institutional reasons (the formerly socialist countries, for instance, score particularly highly, possibly because economics was considered a 'female' occupation during socialist times). However, it may also be partly driven by other factors, such as recruitment policies related to the ranking of the research institution, which is next measured through research output from RePEc (Research Papers in Economics).

Comparing the top half of the top-300 institutions in terms of research output on RePEc with the bottom half, Figure 2 shows that at the full professor level, the better institutions have fewer women researchers. This could be interpreted as evidence of the 'leaky pipeline'.

However, the figure also shows that at the junior (entry) level, the more prestigious research institutions in Europe hire significantly fewer women than the less prominent institutions. The mode for the bottom half of the top-300 research institutions is much higher (around one third) than for the top half (around 15%), for the full professorship level. Surprisingly, the gap is of similar magnitude for the entry level. This suggests that the 'leaky pipeline' is only one part of the story, or that the 'leaky pipeline' may start much earlier than is usually considered (notably, at the transition between graduation and first job). This result that has not been documented in the literature, and it remains to be seen whether the same is true in the US.

Figure 2 Kernel density estimates by level



In conclusion, the data reveal that in Europe, there is a 'leaky pipeline'. As we show in our paper, a cohort effect explanation cannot explain the current numbers alone. Furthermore, it does not explain why economics is an outlier compared to other social sciences and STEM fields with similar requirements (Ceci et al. 2014). We argue, however, that it may have to be complemented, because higher ranked universities are employing women to a lesser degree than lower ranked universities even at entry level.

How can this be explained? It is hard to believe that women are not as 'good' as men when graduating (if anything, they are more successful). Hence, the early difference is likely to be caused by, or during, the process of matching graduates to research institutions. It cannot be excluded that part of this could be driven by unconscious biases against women. Another possibility is that women may tend not to apply for the best academic positions, perhaps because they lack confidence or encouragement by placement officers and their advisors. In fact, letters of recommendation written for individuals applying for academic positions use different adjectives to describe men and women, with adjectives used to describe women viewed more negatively in hiring decisions (Madera et al. 2009, Schmader et al. 2007).

To find out whether this is the case in the economics profession in Europe, we would need data from the hiring committees of as many research institutions as possible – a hard, but not impossible task. Another possibility, which could again be tested with such data, is that women apply but do not get selected by the good research institutions.

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3 Black women economists: At the intersection of race and gender

Rhonda Vonshay Sharpe
Women's Institute for Science, Equity and Race

Much of the research about the progress of women in economics fails to disaggregate the data using an intersectional approach, i.e. reporting and collecting the data by intersecting race/ethnicity with gender, an approach which may mask the nuances in outcomes specific to each race/ethnic gender group (Sharpe 2019). Consistent with Sharpe and Swinton (2012), Table 1 shows that 63% of men and of women who completed the doctorate in economics in the US between 1965-2015 held an undergraduate degree in economics, compared to 70% of Black women who completed the doctorate in economics and held a bachelor's degree in economics. Despite this, the research on factors that influence majoring in economics does not take an intersectional or feminist approach.

Studies that do not take an intersectional approach assume that all women and all Blacks share the same experiences. The data for economics degrees conferred at the bachelor's level suggest this assumption is flawed. For the 20 years 1998-2017, Black men earned 5,520 more bachelor's degrees in economics than Black women, an increase in the Black-gender gap up from 5,022 degrees for the 1996-2015 twenty-year period. The Black-White gap for women decreased from 65,000 for the 1996-2015 period to 62,682 degrees for 1998-2017. Because the Black-gender gap increased, this suggests race operates differently for Black women than for Black men. Additionally, Black women were the only women with a negative growth percentage for the 20 years, which suggests that gender operates differently for Black women.

The importance of an intersectional approach can also be seen in the data on the top producers for bachelor's degrees conferred to Black women and all women. Spelman College, the number one producer of economics bachelor's degrees conferred to Black women, is ranked 37th on the list of top producers for women.

The University of Maryland, College Park ranked 2nd on the list of top producers of economic bachelor's degrees conferred to Black women, is ranked 13th on the list of top producers for women. Rutgers University, ranked 4th on the list of top producers of economics bachelor's degrees conferred to women, is ranked 5th on the list of top producers for Black women. Rutgers is the only institution in the top-ten for both Black women and all women.

Table 1 Undergraduate feeder disciplines for economics by race/ethnicity (%)

Discipline		Maths & Statistics	Economics	Non-S&E Fields	S&E Other and related fields	N/A	Total
Asian	Women	6	64	12	16	2	100
	Men	4	66	16	13	1	100
Black	Women	5	70	15	11	0	100
	Men	4	61	18	16	2	100
Hispanic	Women	3	68	12	16	0	100
	Men	5	67	19	8	1	100
White	Women	8	63	16	12	1	100
	Men	10	62	13	13	2	100
Other	Women	10	46	30	14	0	100
	Men	13	47	21	12	7	100
Total	Women	7	63	14	14	1	100
	Men	8	63	15	13	2	100

Source: Public Use 2017 Survey of Doctorate Recipients

Schools ranked on the top producer lists for women and Black women, also underscore the need for disaggregating the data using an intersectional approach and generate suspicion about the rhetoric that increasing role models for women in STEM disciplines will increase the representation of women (Drury et al. 2011, Herrmann and Adelman 2016, Milgram 2011). Spelman College ranked 1st, and North Carolina Agricultural and Mechanical University (NC A&T), ranked 9th on the list of top producers of economic bachelor's degrees conferred to Black women, are the only institutions on the list that historically have had Black women as tenured economics faculty. Howard University, the only historically Black college university (HBCU) with a doctorate programme in economics, and the number one feeder of Blacks who go on to pursue the doctorate in economics (Sharpe and Swinton 2012), has never had a Black woman as a tenured economics faculty member but has historically had White women as tenured faculty

members and has an Asian women as a tenured faculty member.[1] For economics, the research suggests that increasing women on the faculty may not increase the likelihood that women will major in economics (Emerson et al. 2018). However, for Black women, it is unclear if women, Blacks, or Black women role models have a greater influence on majoring in economics.

Table 2 Economics undergraduate degree production: 1998-2017

Race, Ethnicity & Gender		1998-2007	2008-2017	Total	Year-Difference	Growth
Black	Female	5,028	4,858	9,886	-170	-3%
	Male	6,372	9,034	15,406	2,662	42%
	Subtotal	11,400	13,892	25,292	2,492	22%
	Gender-Difference	-1,344	-4,176	-5,520	-2,832	211%
Women	Hispanic	3,956	6,786	10,742	2,830	72%
	Native American	260	268	528	8	3%
	Asian	14,173	16,890	31,063	2,717	19%
	White	34,975	37,593	72,568	2,618	7%
	Other	3,289	6,224	9,513	2,935	89%
	Temporary Resident	7,863	18,439	26,302	10,576	135%
Total	Women	69,544	91,058	155,975	21,514	31%
	Men	143,377	203,874	340,190	60,497	42%
	Total	208,201	287,964	496,165	79,763	38%
	Gender-Difference	-73,833	-112,816	-184,215	-38,983	53%

Source: Integrated Postsecondary Education Data Survey

Doctorate programmes in economics have been at the centre of the conversation about diversity, but historically, have had a low representation of non-White economists (Collins 2000). Most have never hired a Black economist (Price 2008, Price and Sharpe 2017, Price and Sharpe 2018). Price (2009) finds an inverse relationship between the supply of newly minted Black economists and the hiring of Black economists on the faculty of doctorate economics departments. Hence, the lack of Black faculty is not a function of the supply of Black economists, but a function of the demand for Black economists, i.e. 'color line' problem, in that race appears to be the employment barrier (Price 2009).

The consequences of the interaction of the 'color line' with gender were revealed when the 2019 AEA Climate Survey found that 53% of Black women reported experiencing discrimination based on their race, 69% reported experiencing discrimination based on their gender, and 62% reported experiencing discrimination at the intersection of race and gender. Do these findings explain why Black women are substituting away from economics? Or has the void of Black women in the economics profession intensified the hostile environment for Black women economists at all stages of the profession? If the latter is true, then increasing the representation of Black women in the profession may stymie the discrimination experienced by Black women.

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Rhonda's research focuses on three areas: gender and racial inequality, the diversity of STEM, and the demography of higher education. Her research has been featured on the PBS News Hour, in the *New York Times*, and on the Kerri Miller Show. She is a recurring guest on the BBC's Business Matters. Rhonda serves on the boards of the International Association of Feminist Economists and Diversifying and Decolonizing Economics.

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4 'Out in the open' controversy: Economists' perspectives on the first gender reckoning in economics

Cléo Chassonnery-Zaïgouche, Beatrice Cherrier, and **John D. Singleton**
University of Cambridge; CNRS; University of Rochester

'Resolved that the American Economic Association (AEA) declares that economics is not a man's field', read the set of resolutions adopted by the scientific society in December 1971. The product of a small group of women in the economics profession organising themselves, the resolutions called for the elimination of disparities in recruitment, salary, and promotion by university departments, among other demands. In response, the AEA established the Committee on the Status of Women in the Economics Profession (CSWEP) to 'adopt a positive program to eliminate sex discrimination among economists'. Chaired by Wellesley economist Carolyn Shaw Bell, the Committee's first tasks would be to gather data and produce a report on the status of women in economics.

CSWEP's first report, titled *'Combatting Role Prejudice and Sex Discrimination'*, was to be presented at the December 1973 AEA meetings and, under Bell's leadership, the Committee sought to organise a panel discussion of the report and resolutions. The idea was to elicit discussion and debate regarding the under-representation of women in the profession, chiefly by inviting comments from notable economists with sharply differing perspectives. CSWEP members expected 'out in the open' controversy from the panel. The organisation of, and comments offered by the panellists, which this article survey and contextualise, thus provide a valuable window into the views of economists at the time concerning the profession's first gender reckoning. The 1973 panel discussion represents one episode of the larger history, whose fuller context and evolution we trace in related work (Chassonnery-Zaïgouche et al. 2019).

In August of 1973, Bell wrote to University of Chicago economist Milton Friedman to inquire about his interest in participating on the panel. A former President of the AEA,

Friedman was also well known for his outspoken social and political views. While Friedman declined, as he was not planning to attend the meetings, he did so with regret, he explained, because he in fact held strong views on the resolutions adopted by the AEA. Friedman especially disagreed with the report's statement that 'every economics department shall actively encourage qualified women graduate students without regard to age, marital or family status'. Though he 'sympathize[d] very much with the objective of eliminating extraneous considerations from any judgment of ability or performance potential' and agreed there had been discrimination against women in the profession, Friedman argued that preferential treatment for women via affirmative action or quotas – 'reverse discrimination' – would be inefficient and potentially lead to unwanted consequences.

Discussing how economics programmes should invest in graduate students, Friedman argued in his letter to Bell that, given limited funds for training people, 'it is appropriate to use those funds in such way to maximise the yield for the purpose for which the funds were made available'. In particular, 'those funds were made available to promote a discipline rather than to promote the objectives of particular groups'. From this perspective, it followed that efficiency requires 'to take into account the age of men or women, the marital or family status of men or women, and the sex of potential applicants insofar as that affects the likely yield from the investment in their training'. Friedman's position was informed by Beckerian notions of discrimination as taste-based (and, hence, inefficient) as much as human capital theory.

For the December panel, Friedman was replaced by his colleague at Chicago, George Stigler. The other panellists to offer comments on the CSWEP report were Elizabeth Clayton, a specialist in comparative economics and on the Soviet economy, and David Gordon, a radical labour economist then at the New School for Social Research. In their remarks, each participant drew upon analytical frameworks to assess the analysis and proposals made by CSWEP. While all three acknowledged the existence of discrimination against women economists, their views on the causes and consequences of such discrimination – and, accordingly, what the AEA's response should be – diverged significantly.

For instance, Clayton argued that CSWEP had not gone far enough. She recommended 'preferential hiring' for 'equally qualified' women as a remedy for the under-representation of women in the profession. 'Employers complain that women are less able academically, less recommended, less motivated. Women counter that they are discriminated against academically, less well recommended for reasons of sex bias, and less motivated because of paucity of opportunities… these are empirical questions', Clayton explained, adding that the 'motivation' argument had a 'cultural ring'.

For Gordon, on the other hand, addressing the under-representation of women in economics required confronting the inadequacies of 'orthodox economics'. He advocated for an alternative theoretical framework that considered the 'structure of jobs', created by a mix of technological change, power, and labour unions. He applied his dual labour market theory to the market for economists: there existed an internal tenure-track segment alongside a more precarious, secondary labour market. Drawing on the results of a survey of economics departments conducted by CSWEP, Gordon noted that women comprised just 2% of full professors, but 68% of special lecturers.

For his part, Stigler, like Friedman, opposed any 'active' policy by the AEA to promote women. 'Justice, if I may be so bold, is not a goal of a scientific society', Stigler contended. The AEA's goal was instead scientific advancement, and that could only be gained through 'open competition', not through 'dictating' best employment practices to universities. Stigler's remarks were thus a clear-throated expression of views Friedman had elaborated to Bell in their exchange of letters. As Friedman had argued, '…there is no alternative to letting the market decide – with market defined in the very broadest sense to include the market in ideas, in tastes, in values, in beliefs as well as the market in strict physical goods – other than to let the preferences or values or tastes or beliefs of some people dominate the preferences or values or tastes or beliefs of other people…'

While these extreme views successfully aroused controversy, the middle-ground, empirically informed perspective CSWEP advocated for and practised, was not well represented by the panel. Bell's vision of labour markets, as revealed in her replies to Friedman and her career trajectory, are informative in this regard. While endorsing the free market as a kind of ideal, the remedies that Bell pushed to fight the under-representation of women in economics betray a concern with the consequences of imperfect information for access to employment opportunities, expectations, employers' and employees' behaviour, and the efficiency of market outcomes. In this respect, her replies to Friedman echo elements of Arrow's theory of statistical discrimination, which he had elaborated in a paper given in Princeton in 1971. Arrow's idea was that employers use gender as a proxy for unobservable characteristics: beliefs on average characteristics of groups translate into discrimination against individual members of these groups. Nonetheless, Bell's contribution was embedded in a more radical theoretical criticism of economic theory, one she would later outline in a 1974 paper on *Economics, Sex and Gender*. That she aimed to challenge the notion that the typical family must be built around a breadwinning father and a stay-at-home mother was already seen in her insistence, in her response to Friedman, that economists and citizens alike are 'brainwashed' by social norms and beliefs.

While agreeing on the benefit of competition for the economics profession, Bell objected that there was nothing 'in [Friedman's] statement, in the discipline *per se* or in the existence of scarce resources, to identify those recipients who will, in fact, contribute most to the field'. Instead, Bell argued to Friedman that the recipients of investment were selected by those 'controlling the awards who learned certain cultural patterns, including beliefs about sex roles'. Thus, Bell admonished economists to re-examine their own biases. She added in her reply to Friedman that 'until we have a society where little girls are not only able to become dentists and surveyors and readily as little boys but are expected to become dentists and surveyors as readily as little boys we cannot in all conscience rely on the dictates of economic efficiency to allocate human beings'.

As this survey highlights, Bell, Friedman, and the AEA session participants' divergent takes on which actions the newly-established CSWEP should pursue were inextricably intertwined with their theoretically and empirically-informed views of the labour market at large. These views were also tied to their respective methodological beliefs, as well as personal experiences: Friedman thus argued for a non-interventionist position based on the benefit of competition in the abstract, while Bell pointed to specific measures to ensure competition in practice, including creating openness and transparency on the economics job market to disrupt the 'old boy' network (e.g. the JOE listing). The most successful CSWEP initiatives were based on this kind of 'mainstreaming' strategy: advocating for higher professional standards while employing mainstream theoretical and empirical economic arguments on how the labour market worked (or did not).

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Part II: The Path to a PhD

5 'What can UWE do for economics?'

Tatyana Avilova and **Claudia Goldin**
Columbia University; Harvard University and NBER

What can UWE do for economics? The answer is: 'A lot'.

Economics' gender gap

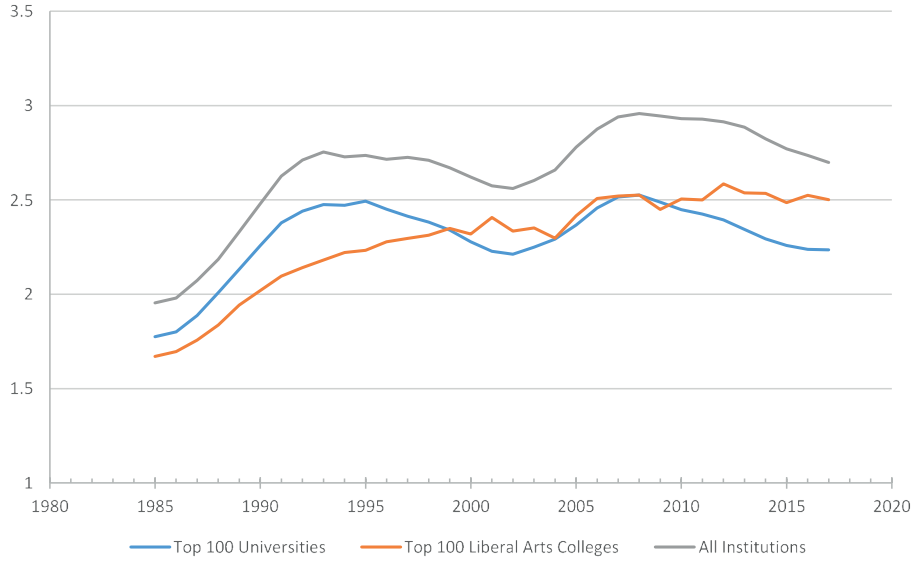
Women do not major in economics to the same degree as do men. In fact, the fraction of female majors in economics is lower than in fields like chemistry, mathematics and statistics. In engineering, a field that is even more male-dominated than economics, the fraction of majors who are female has increased in recent years. However, the fraction in economics has not budged much in the last 30 years.

During the past decade, there have been three male economics majors nationwide for every female economics major, expressed relative to their numbers as degree recipients (Bachelor of Arts (BA) and Bachelor of Science (BS)). We term that statistic the 'conversion rate'. It is deflated, or scaled, by the number of degree recipients, because women outnumber men in bachelor's degrees.

The conversion rate for the most recent years, given in Figure 1, is 2.7 among all institutions, 2.2 among the top-100 ranked universities (public and private non-profit), and 2.5 for the top-100 ranked liberal arts colleges. With the exception of the liberal arts colleges, there has been a relative increase in economics for women. But men clearly dominate.

As can be seen in Figure 1, there were relatively more female economics majors in the late 1980s than today, across all types of institutions. By around 1990, the conversion rate had reached levels about equal to its more recent levels by type of institution.

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 centred moving averages shown. 'Top-100' institutions from *US News* and *World Report*. Only the 'first' major is shown. Adding the 'second' major generally decreases the 'conversion' rate. Thus, relatively more women have economics as their 'second' major. The last year of data is for 2018.

The Undergraduate Women in Economics project, known as the UWE Challenge, was launched in 2015 to uncover why women have not majored in economics to the same degree as men, and to find out what can be done to address this disparity.

Should economics be interested in its gender gap? Firstly, a diverse representation may enhance productivity. In addition, men and women differ in their opinions regarding market solutions, government intervention, and redistribution, and they are differentially represented across its fields. Women specialise in labour and public economics more, and men favour macro and econometrics more.

However, economics isn't just for experts. It is a fundamentally useful (and lucrative) degree programme, and women should not be left out of its insights and rewards. If they take the subject and detest it, then they have made their own decision. But that doesn't appear to be the problem. Long before they get to college, women decide that they don't want to major in economics and men decide that they do. What is going on? The answer is a lot of misinformation about economics.

To understand why women are not majoring in economics, we obtained administrative data from an anonymous institution we have labelled 'Adams College'. When we obtained the data in 2013, the conversion rate for Adams was 1.8 and the fraction of females among economics majors was 0.35, not much different from those at its peer institutions, such as Stanford, Princeton, and Harvard.

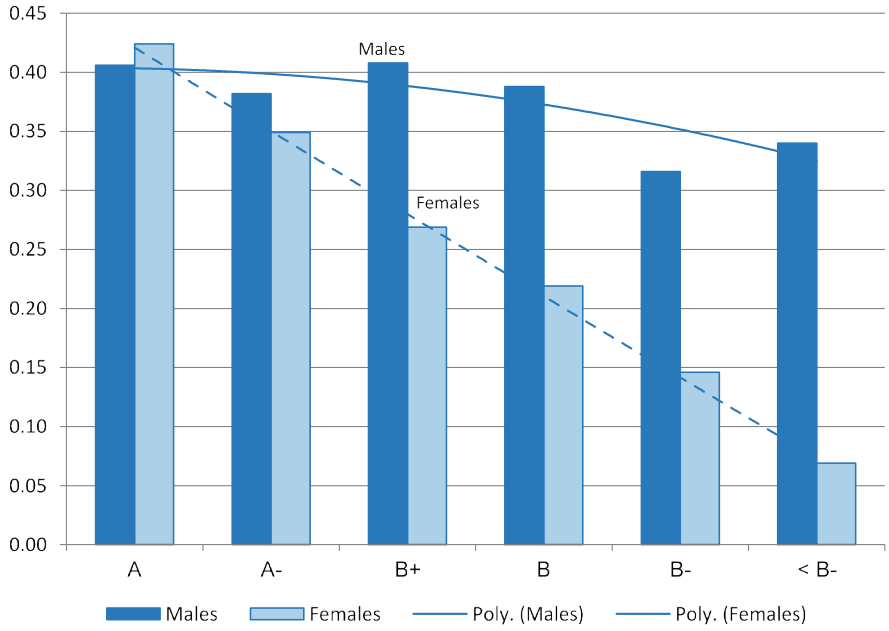
At Adams and many of its peer institutions, incoming freshmen are asked what they believe their primary major will be. Twice as many men as women put economics as their probable primary major at Adams. The die is cast, it would appear, even before students unpack their bags: two men will major in economics for every woman. The first lesson from Adams is that useful treatments to increase women's representation in economics must occur soon after students arrive on campus (if not before).

The second lesson from the Adams data is that supporting female students in the economics gateway course could encourage them to major in the field. Principles of Economics is a very popular course at Adams and elsewhere. Women who take Principles, but do not eventually major in the subject, are disproportionately represented 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 a high grade. That is not true for men, who major in economics almost regardless of their grade in Principles.

Male students get higher grades in the Principles course than female students. However, conditional on the grade received, female students have a far steeper gradient regarding their likelihood of majoring in economics, as can be seen in Figure 2. A woman who gets an A grade in Principles has a 42% likelihood of majoring in the subject and this is similar for men (41%). However, a woman who obtains a B+ in Principles has a 22% chance of majoring in economics, while a man who gets a B+ has a 41% chance. There is no difference in the probability that a male student majors in economics if he gets a B+ or an A, but the fraction is reduced for a female student by almost 20 percentage points.

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 behaviour 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.

Figure 2 Fraction majoring in economics by grade in Principles: 'Adams College'



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

Source: 'Adams College' administrative data.

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

The birth of UWE

The data from Adams College sparked Claudia Goldin, when she was president of the AEA, to think about how to get more women to major in economics. 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.

The Alfred P. Sloan Foundation funded a randomised controlled trial (RCT) now called the Undergraduate Women in Economics (UWE) Challenge in the Summer of 2014 and Tatyana Avilova was hired as the project manager. In January 2015, we invited institutions with reasonably-sized undergraduate programmes to implement a set of

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. Of the schools that agreed to be in the RCT, we randomly chose 20 as treatments and the rest became controls.

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 programmes appear to syphon off women from economics more than they do men).

Treatment institutions used the funding and guidance from the project organisers 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.

Most RCTs have specific treatments. However, one size would not fit our varied treatment institutions. 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. We found that many potential majors did not know that economics concerned economic development, health, education, inequality, and so forth.
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. Many schools initiated 'Undergraduate Women in Economics' clubs and the UWE Challenge sponsored several regional conferences.
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.

RCTs within the RCT

Several of our treatment schools executed their own RCTs for which they obtained Institutional Review Board (IRB) approval. Two of them – Colorado State University (CSU) and Southern Methodist University (SMU) – were among those with the lowest fraction of females majoring in economics.

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: (1) students were told about careers and earnings in economics; (2) female and male students received information on the grade distribution at mid-term, and female students at and above the median were sent letters praising their work and encouraging them to major in the field; and (3) female students, regardless of their grades, were encouraged to partake in peer mentoring activities.

The aggregate impact of all three treatments was substantial, particularly on female students with a grade above the median. After the treatment, the probability of majoring in economics increased by about six percentage points for all female students and by about 12 percentage points for freshmen and sophomores specifically, compared to a baseline probability of 13% for women taking the Principles course.

At SMU, Profs. Catherine Porter and Danila Serra ran a field experiment in which they randomised which Principles sections engaged in a role model intervention (Porter and Serra, forthcoming). 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 in 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 six percentage points on a base of less than 9%. These are extremely large effects. There was no impact on the male students in the class. The authors found, consistent with the results from Adams College, that grades in the Principles course had no influence on the decision to continue with the subject for men but were strongly related to continuation for women.

Stay tuned

We do not yet know whether the many interventions adopted by the UWE treatment schools had an impact on the number of female undergraduates who majored in economics. The 'RCTs within the RCT' show that small and inexpensive interventions have had large effects. NCES-IPEDS data for all schools will tell us more by the end of next spring when the May/June 2019 graduation data are available.

The interventions that most of our treatment schools have used were low-cost. But they required the time and initiative of undergraduate instructional staff and faculty.

The UWE programme, together with the Alfred P. Sloan Foundation, provided advice, funding, and gave recognition to these hard-working staff.

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

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About the authors

Claudia Goldin is the Henry Lee Professor of Economics at Harvard University and was the director of the NBER's Development of the American Economy programme from 1989 to 2017. Most of her research interprets the present through the lens of the past and explores the origins of current issues of concern. Her research is currently focused on college women's aspirations for and achievement of career and family.

She is the author and editor of several books, among them *Understanding the Gender Gap: An Economic History of American Women* (Oxford 1990), *The Regulated Economy: A Historical Approach to Political Economy* (with G. Libecap; University of Chicago Press 1994), *The Defining Moment: The Great Depression and the American Economy in the Twentieth Century* (with M. Bordo and E. White; University of Chicago Press 1998), and *Corruption and Reform: Lesson's from America's Economic History* (with E. Glaeser; Chicago 2006). *The Race between Education and Technology* (with L. Katz; Belknap Press, 2008), was the winner of the 2008 R.R. Hawkins Award for the most outstanding scholarly work in all disciplines of the arts and sciences. Her most recent volume is *Women Working Longer: Increased Employment at Older Ages* (edited with L. Katz; University of Chicago Press 2018).

Goldin was the President of the American Economic Association in 2013 and of the Economic History Association in 2000. She is a member of the National Academy of Sciences and the American Philosophical Society and a fellow of the American

Academy of Political and Social Science, the American Academy of Arts and Sciences, the Society of Labor Economists (SOLE), the Econometric Society, and the Cliometric Society. She received the BBVA Prize in Economics, Finance, and Management in 2019, the IZA Prize in Labor Economics in 2016, and the Mincer Prize in 2009 for lifetime contributions to the field of labour economics. From 1984 to 1988 she was editor of the *Journal of Economic History*. Goldin received her BA from Cornell University and her PhD from the University of Chicago.

Tatyana Avilova is a PhD candidate at the Department of Economics at Columbia University. Her research interests include health care policy; health care provision for the elderly, residents in rural areas, and other vulnerable populations; and representation in the economics profession. Her most recent project investigates the effect of prescription drug monitoring programmes on health-related outcomes.

Tatyana is the Project Manager for the Undergraduate Women in Economics (UWE) Challenge. She is also the co-organiser for the Diverse Economics Conference, a partnering initiative between the UWE, the Federal Reserve Bank of Richmond, and the Robins School of Business at the University of Richmond. Currently, she is working with the CORE USA team of the CORE Project to produce new pedagogical resources for teaching introductory economics and to evaluate the impact of the CORE curriculum on students. Before her work with the UWE, Tatyana was a 2013-14 Fulbright Fellow in Japan, where she conducted research on the work-life balance of nurses in Ibaraki Prefecture. She received her BA in Economics from Harvard College.

Acknowledgments: The authors thank the Alfred P. Sloan Foundation for funding the Undergraduate Women in Economics (UWE) Challenge through grant no. G-2014-14504 and to Danny Goroff of the Sloan Foundation for encouraging Goldin to undertake the project. Thanks also go to the members of the UWE advisory board who helped the authors set up the UWE Challenge. For more information see http://scholar.harvard.edu/goldin/UWE.

6 Female role models inspire women to major in male-dominated fields

Catherine Porter and **Danila Serra**
Lancaster University; Texas A&M University

A potential barrier to women's participation in economics and other male-dominated fields is the lack of female role models. Changing this may be a pathway to increasing the number of female economists. In our research, we introduced a relatively inexpensive intervention, where women with successful careers who had majored in economics gave talks to undergraduate students enrolled in Principles of Economics classes at their *alma mater*. This inspired young women to take further economics classes and ultimately doubled their likelihood of majoring in economics. We propose including our low-cost intervention in the toolkit of institutions and organisations trying to improve the gender balance in economics and other male-dominated fields.

This volume documents the challenges of trying to achieve gender equality in economics. Here we focus on a specific potential cause – and therefore remedy – to increasing women's participation: a dearth of female role models. Due to historic gender imbalances, traditionally male-dominated fields suffer from a scarcity of female role models. In turn, such scarcity contributes to the difficulty of attracting women into fields where the gender imbalance is more severe and persistent. In economics, the percentage of degrees going to women has been stagnant at between 30 and 35% for the last 20 years (Lundberg and Stearns 2019). As a result, it is difficult for young female students to meet successful career women who could inspire them to major in economics by sharing their own education experiences and career paths.

Female teachers and university professors could act as role models. There is indeed evidence of a positive impact of female instructors on female students' decision to major in a STEM discipline. In particular, Lim and Meer (2019) find that Korean female middle school students who are randomly assigned to female mathematics teachers in 7th grade are more likely to take advanced mathematics courses in high school, to attend a STEM-focused high school, and to plan to major in STEM. In the

context of higher education, Carrell et al. (2010) find that the greater the proportion of introductory mathematics courses taught by randomly assigned female professors at the United States Air Force Academy, the higher the likelihood that top female students major in STEM.

In economics, there is no strong evidence that the gender of professors in introductory classes affects female students' propensity to stay with the major. Even if there were an impact, it would be difficult to isolate the pure role-model effect, as female professors could behave differently toward female students, or use pedagogical methods that could be more effective on female students, or simply be perceived as more accessible by female students, hence leading to different behaviours on the part of students (e.g. greater likelihood of attending office hours).

In a recent paper (Porter and Serra, forthcoming), we isolate role model effects on the decision of female students to major in economics, by conducting a field experiment where we exposed students enrolled in randomly chosen Principles of Economics classes, to carefully selected female role models. The study was conducted at Southern Methodist University, in Dallas, Texas between 2015 and 2019. The role models were two successful and charismatic career women who had majored in economics at the same university. We selected them from a long list of alumni with the help of two female students who were majoring in economics at the time. The students shortlisted the alumni based on their interest in their fields of work, and conducted scripted interviews via Skype with the finalists, with the objective of identifying the most charismatic and inspiring alumni. The selected role models separately visited randomly selected Principles of Economics classes in spring 2016. Each visit lasted approximately 15 minutes and consisted of the role models describing their educational experiences and career paths, with an emphasis on why economics is a great major and how it had contributed to their professional successes. No gender-specific issues were discussed.

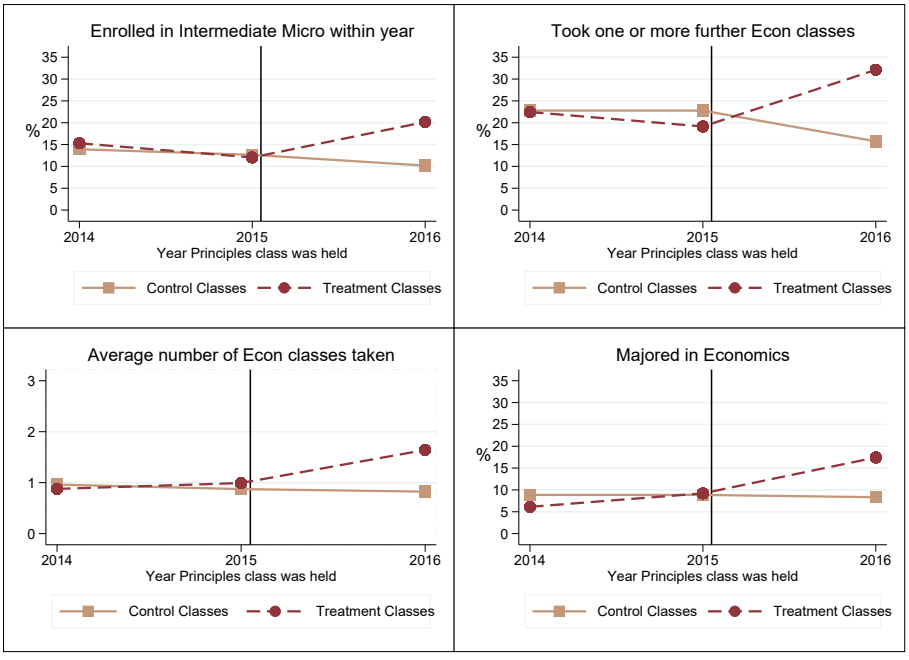
Our intermediate outcome variables are enrollment in intermediate microeconomics within a year from the principles class (as this is a strong predictor of the decision to major in economics), and enrollment in any other economics class after the principles class. Our final outcomes are the total number of economics classes taken and ultimately – the decision to major in economics. We employ a difference in differences estimation strategy, by looking at the same principles of economics classes, i.e. same instructors and same day and time of instruction, the year before our intervention took place (Spring 2015), and comparing the 2016 and 2015 differences in the outcomes of female students enrolled in treatment versus control classes, whereas the treatment classes were treated only in 2016.

Figure 1 shows:

1. The percentages of female students taking intermediate microeconomics the year after the principles class (top left)
2. The percentages taking at least another economics class after principles (top right)
3. The average number of economics classes taken after the principles class (bottom left)
4. The percentages of female students majoring in economics (bottom right).

We also report data for the 2014 Spring Principles female cohort, which allows us to provide a better visualisation of the pre-intervention trends and the sharp increase in our outcome variables as a result of the intervention.

Figure 1 Effect of role model visits on female student education choices



Our difference-in-differences estimates show that the role model visits increased the likelihood that female students enrolled in Principles of Economics classes would major in economics by eight percentage points. The effect is large, considering that the baseline percentage of majoring women in our target sample was 9%.

Who switched? By looking at which university-wide majors saw a decline as a result of the intervention, we are able to assess which fields of study the female students

whom we attracted towards economics would have majored in, absent the intervention. Overall, we do not see any significant declines in the proportion of women choosing other majors that lead to high earnings, i.e. STEM, finance and business majors. The only field that saw a reduction in female majors as a result of our intervention is that of humanities and languages, which suggests that the students who were nudged to study economics will likely experience a significant increase in their expected life earnings as a result.

One remaining question is: why did the intervention work so well? After all, the classroom visits were short and the students did not receive any personalised one-to-one mentoring from the role models. Two possible channels may have been at play: information and inspiration. The role models worked in sectors not stereotypically associated with the economics major. One had started her career in management consulting but soon abandoned that job to become the sales manager at a non-profit company located in a developing country. The other had had a stellar career in marketing. Did the intervention work by altering the information set available to the students? Or simply by inspiring them to become successful career women by choosing a major that they had previously overlooked? In order to address these questions, we analysed survey data collected from women enrolled in treatment and control classes in both control and treatment years. We find that the role model visits affected the information available to students, as significantly more of them mentioned marketing and management as possible jobs associated with the economics major. However, we do not see any evidence that the intervention increased the proportion of women desiring to work in marketing or management (survey-based), nor do we see a change in the proportion of women majoring in these fields. This provides suggestive evidence that the intervention worked primarily through an *inspiration* channel, and highlights the importance of being exposed to role models who look like you, come from a similar background as you, and show you that you can succeed in this field. Perhaps the secret ingredient in our intervention was that the role models were chosen with the help of female undergraduates, who clearly knew best what would inspire their peers.

The effects are large for a short intervention, which was cheaper and easier to implement in the short term than hiring female instructors, although certainly replication is needed to see whether it would work in other settings. It is possible that female students need to be exposed to female role models other than instructors, as they might identify more with career women than professors, despite our attempts to be inspiring ourselves – not everyone wishes to become an academic. Other ways of exposing female students to role models include increasing female representation in academic textbooks (Stevenson and Zlotnik 2018), and important initiatives promoted by the Committee on the Status of Women in the Economics Profession of the American Economic Association, the

Diversifying and Decolonising Economics Network, and the UK Royal Economic Society's #DiscoverEconomics to show young women and other under-represented minorities that economics can be a source of success for a much more diverse type of person, in a variety of sectors and settings. The success of such programmes will eventually be self-perpetuating, but we need to keep working actively towards this goal.

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About the author

Catherine Porter is a Senior Lecturer in Economics at Lancaster University in England. She holds a BA from the University of Wales in Bangor, an MSc from Bristol University and a DPhil from the University of Oxford. She is a Research Associate of the Young Lives project on International Childhood Poverty at the University of Oxford, and at GRADE, Group of Analysis for Development in Lima, Peru. Her research focuses on gender and the effects of role models on educational decisions; the determinants and consequences of childhood poverty; the effectiveness of social protection and education policies; and the short-and long-term effects of shocks on wellbeing. She has lived or worked in Ethiopia, The Gambia, India, Peru, Uganda and Vietnam.

Danila Serra is an Associate Professor of Economics at Texas A&M University. She holds a PhD in Economics from Oxford University. In her work, she applies lab and field experimental methods to the study of corruption, governance and the provision of public services, with special focus on non-monetary incentives and bottom-up accountability systems. She has published numerous highly cited articles in peer-

reviewed journals and co-edited a book on the topic of corruption. Some of her more recent work focuses on issues related to gender differences in education and labour market participation, gender norms and women's empowerment. In November 2017, Danila was chosen as the inaugural recipient of the Vernon Smith Ascending Scholar Prize. The prize, named after the 2002 Economics Nobel Prize winner Vernon Smith, is a 'budding genius' award granted by the International Foundation for Research in Experimental Economics (IFREE) to an exceptional scholar in the field of experimental economics.

7 Variation in women's success across PhD programmes in economics

Leah Boustan, Andrew Langan, and **I. Bailey Palmer**
Princeton University; Mathematica Inc.[1]; Princeton University

The share of women in economics is below many other technical fields, and has not increased since the 1990s. Although women's under-representation in economics is well documented, its causes remain a mystery. In a recent paper (Boustan and Langan 2019), we present new data – both quantitative and qualitative – on graduate programmes in economics to understand the wide and persistent variation in women's success across departments. We find that departments with better outcomes for women also hire more women faculty, facilitate advisor-student contact, provide collegial research seminars, and are notable for senior faculty with awareness of gender issues.

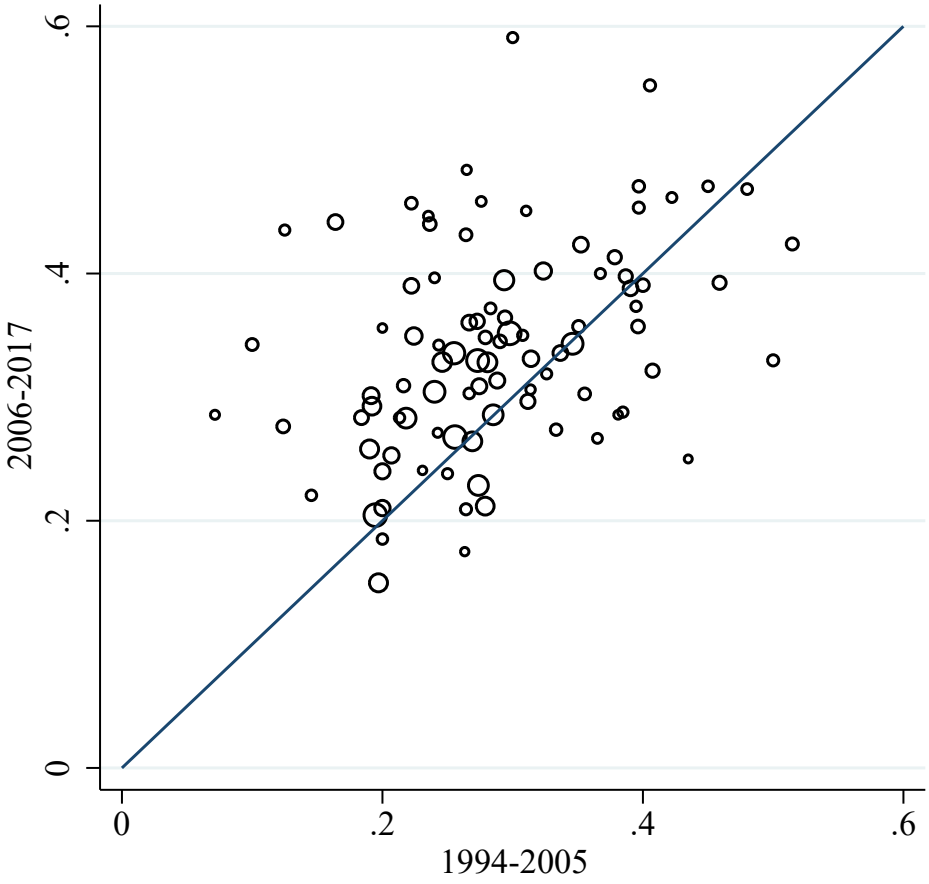
New facts

We start by documenting wide variation in the average share of women in the graduating classes of economics PhD programmes during the past 30 years, ranging from 10% to more than 50% of the student body. This variation is primarily explained by differences in initial enrollment, rather than differential attrition from the programme. Most programmes increased the share of women in the student body from the 1990s to the 2000s, particularly the largest ones. Yet, the share of women in a PhD programme tends to be a persistent attribute of a department, with a strong correlation in the gender composition of graduating classes over time.

These new facts are based on two data sources: newly available annual surveys of graduate departments conducted by the Committee on the Status of Women in the Economics Profession (CSWEP), and our own hand-collected faculty rosters from PhD-granting economics departments in the United States from 1994 to 2017 (Langan 2018).

1 The views expressed herein are those of the author and not necessarily those of Mathematica, Inc.

Figure 1 Share of women PhD recipients by department: 1994-2005 vs 2006-2017



Source: CSWEP department survey

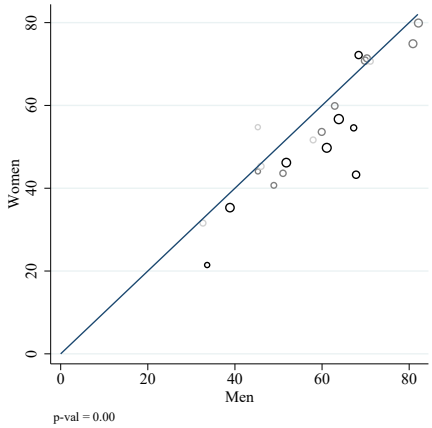
Note: Correlation0.38; Weighted Correlation: 0.45

Few measurable characteristics of a department are quantitatively associated with the share of women in the student body. One important attribute of a department that appears to be associated with gender composition of the student body is share of women of the faculty. Departments with a greater share of women on their faculty also have more women in their student body: a 10 percentage point increase in faculty share is associated with a 2.5 percentage point increase in student share. This relationship could be causal if, for example, women on the faculty serve as role models for women students, or it could reflect other departmental attributes that are attractive to both women faculty members and graduate students.

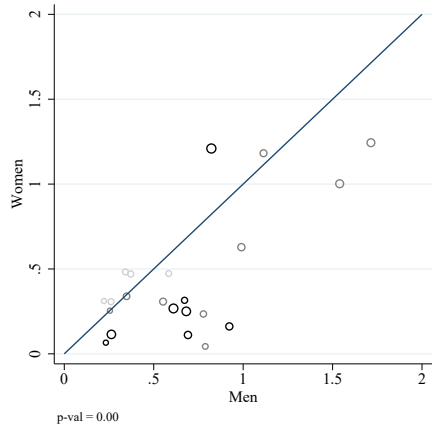
On average, men and women who graduated from the same programme between 1994 and 2017 are no different in their propensity to be offered and accept a faculty position at a US PhD-granting department. We also find no gender differences in the likelihood of promotion to associate professor within ten years of graduation. However, conditional on taking a job in a US PhD-granting economics department, men land placements at higher-ranked departments, and publish more in the top journals in the first seven years after obtaining their degree, than women from the same programmes.

Figure 2 Post-graduation outcomes for men and women, PhD economists by graduate department

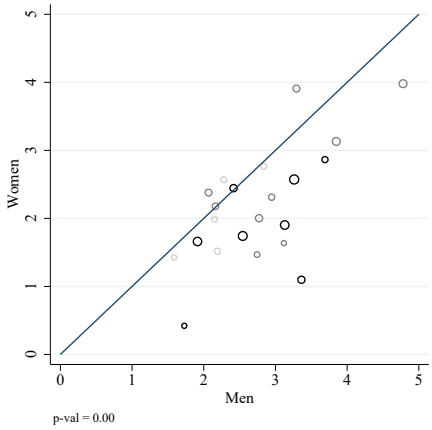
A) Average Rank of 1st Placement (rank = 100 - [2017 US News ranking]; better departments have higher scores).



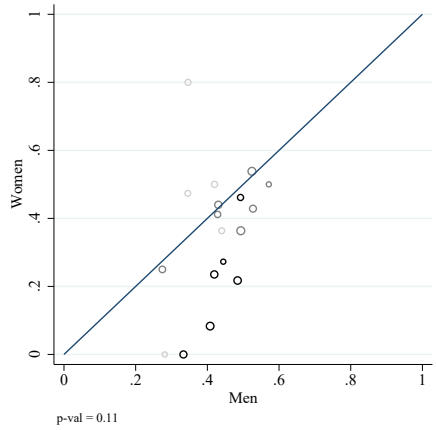
B) Top 5 publications (in first 7 years after PhD).



C) Top 55 Publications (in first 7 years after PhD).



D) Ever Promoted (in first 10 years after PhD)



Source: Faculty rosters, Langan (2018).

Table 1 Comparative success of women by programme

Group	ID	Share women	Change in share women	Retention	Rates of placement at PhD	Placement rank	Top 55	Top 5	Promotion
Best relative outcomes for women	A	✓		×	✓✓		✓	✓✓	
	B		✓	✓	×			✓	✓✓
	C		✓✓			✓✓		✓	×
Better relative outcomes	D				✓			✓	✓
	E		✓	✓✓		✓			✓
Neutral	F		×				✓		
	G			✓✓					
	H	✓					×		
	I					✓			
	J			××	✓		✓✓		
	K	×	×		×	✓	✓✓		
	L			✓	✓	×	×	××	
	M	×							✓
	N		✓		✓✓			×	
Worse relative outcomes	O	××						✓✓	×
	P						×		
	Q	✓✓	✓✓	✓	××	××	××	×	
	R	✓		×		×			×
	S	✓✓	×	×	×				×
Worst relative outcomes	T	××	××			××	✓	××	
	U	×			××	×			
	V		××	××		✓✓	××	×	
Better & Best	A-E	0.30	1.28	1.02	1.09	1.01	0.92	1.21	1.14
Neutral	F-N	0.28	1.13	1.01	1.08	0.94	0.84	0.66	0.91
Worse & Worst	O-V	0.28	1.14	0.99	0.92	0.83	0.66	0.47	0.46

Note: Icons represent a department's position in the distribution of each statistic: ✓✓ = top 10%; ✓ = top 25%; × = bottom 25%; ×× = bottom 10%.

We then turn to documenting the variation across departments in relative outcomes for women students, including their graduation rates, placement into an academic job, and later research performance. In the table above, we rank 22 anonymised graduate programmes from A, the department with the best outcomes for women graduate

students across the board, relative to men in their programmes, to V, the department with the worst relative outcomes. Check marks indicate the departments that were in the top 10%, or top 25%, of any given outcome (out of 22 departments), and Xs indicate the departments that were in the bottom 10 or 25%.

Departments that have better relative outcomes for women on average are not *necessarily* better on every outcome. Even the best departments by our rankings have some poor relative outcomes for women, and even the lowest ranked schools are strong in some areas. Overall, our ranking illustrates that there is substantial and consistent variation in outcomes for women students across top departments, and thus some scope for improvement for departments that are lower down in the rankings.

What works? Evidence from interviews

Why are relative outcomes for women graduate students better within some departments than others? To get a sense of which explanatory variables may matter, we conducted a series of exploratory interviews with faculty and former students from five departments, using a snowball-style interview sample. Two departments had better than average outcomes (departments B and C), two departments had worse than average outcomes for women (departments O and T), and one department came from the middle of the group (department K).

Women on the faculty

One obvious difference that became apparent in the interviews between departments with higher and lower relative outcomes for women, is their commitment to, and success in, hiring women on the faculty. Students trained at departments B and C talked about what they saw as the benefits of having been taught by women faculty, and to have had informal interaction with women faculty outside of the classroom. A former student from Department C said: 'Every semester we always had one female teaching us in the core first year classes. Starting with that introduction to the graduate department made me feel like "I can do this and be a woman"'. In contrast, interviewees from departments with lower outcomes for women graduate students noted – and often lamented – their historical lack of representation of women on the faculty.

Advisor contact

In contrast to many other disciplines, selection of a dissertation advisor in economics is typically a decentralised process undertaken in the second or third year. This *laissez-faire* approach may be particularly hard for students who are in the minority in economics departments (including women). Students from under-represented groups may fear the actual or perceived scepticism of faculty. One student at department C reported: 'I think there was some implicit bias. I remember in the first year of the PhD programme, I got [a high score on a core exam]… and my husband did not do particularly well in the course. But I remember the professor who was teaching the course reached out to my husband and tried to encourage him to go into [the field] and didn't say anything to me'.

One feature that distinguished departments with higher relative outcomes for women was the mandatory and regular nature of student works-in-progress seminars. Offering regular public venues for student feedback may be especially important for women, who mentioned off-campus advising settings in which they felt uncomfortable or to which they were not invited. This concern arose at departments of all levels on our ranking. One student from department B described how 'one senior male faculty was known for having these weekly "salons". He would take a bunch of students out to a bar. A bunch of students would go, it routinely felt like an old boys' club…. I know one woman who went, but I wouldn't have felt comfortable'.

Seminar culture

Departments with higher relative outcomes for women are also reported to have a more constructive and collegial climate in their research seminars. By comparison, two of the three departments with lower outcomes for women were noted for having aggressive seminar styles. A faculty member from department K said that 'the word that comes to mind is combative, perhaps aggressive. People start to talk about their work and much of their audience seems to think it's their job to find the faults and tear it all down'. Unlike new hiring or a reorganisation of the graduate programme, working towards a more supportive seminar culture is an action that individual faculty members can take on their own.

Awareness of gender bias

A final difference that we noticed between departments with higher and lower relative outcomes for women was an awareness of gender bias, particularly in its more subtle and implicit forms, among the senior male faculty. Faculty at departments with higher

relative outcomes for women tended to consider gender bias in what struck us as more observant and thoughtful ways. A senior faculty member at Department K was typical of this view in saying: 'I'm confident that there is no explicit discrimination but perhaps what is happening is more subtle or subconscious … the same behaviors in a man say he's forceful and defends his ideas; he's aggressive in a good way. Those same behaviors when taken by women tend to get a different reaction in a subtle kind of way'. In contrast, faculty members at Departments O and T focused exclusively on the lack of overt discrimination against women students and did not seem aware of (or to put much credence in) the subtle differences in the way men and women experience the culture of the field.

Differences in awareness of gender issues can have important consequences in how department leadership respond to instances of harassment in a learning environment, which were mentioned at three of the five departments that we profiled. In each case, administrators condemned the harassment and sought to punish the individuals responsible, but the responses differed in whether further action was taken to change the underlying culture or institutions that contributed to the problem. At Department C, the faculty considered the event to be outside of the norm, and immediately searched for an underlying cause. After realising a new emphasis in admissions had resulted in classes with smaller numbers of women, they immediately acted to change course, and admitted a class with a 50:50 gender ratio the next year.

These new facts – both quantitative and qualitative – shed new light on a segment of the economics pipeline (graduate instruction), which is perhaps the most responsive to policy changes among academic economists. The findings above suggest that both individuals and department leadership have considerable leverage to improve gender equity at their institutions. Department chairs interested in improving women's outcomes should prioritise hiring and retaining women faculty, responding proactively to discriminatory incidents, and instituting more formal venues for graduate students to present and receive feedback on their work. Individuals can make an impact by providing feedback constructively and perhaps privately, and cultivating a more nuanced understanding of gender biases in the profession.

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8 Peer effects in graduate programmes

Valerie K. Bostwick and **Bruce A. Weinberg**
Kansas State University; Ohio State University

Doctoral education is among the highest educational achievements, and a crucial step in the career ladder of any research scientist (economists included). Doctoral students have proven commitment and made substantial investments into their field of study even before beginning the first year of a PhD programme. Yet, in the US, over 30% of these students drop out of doctoral programmes in STEM fields, economics, and psychology, within 6 years of initial enrollment.[1] For women in particular, survey evidence indicates that the climate in STEM fields may have a negative impact on persistence. In a report on the lack of women in engineering, Corbett and Hill 2015 summarise: 'Stereotypes and biases lie at the core of the challenges facing women in engineering and computing. Educational and workplace environments are dissuading women who might otherwise succeed in these fields'.

Peer characteristics and especially the gender mix of one's peers provide a likely factor affecting both the climate in doctoral programmes, as well as the differential attrition from these programmes between men and women. A large literature has shown that the peer gender composition, both in high school (Anelli and Peri 2016, Brenøe and Zölitz 2018, Mouganie and Wang 2019) and in college (Kugler et al. 2017, Astorne-Figari and Speer 2017, Zölitz and Feld 2017, Hill 2017), can have an impact on students' choice of undergraduate major. However, measuring peer groups among undergraduates is notoriously tricky, and researchers are often forced to rely on randomised roommate assignments or classmates in large introductory courses to define a student's 'peer group'.

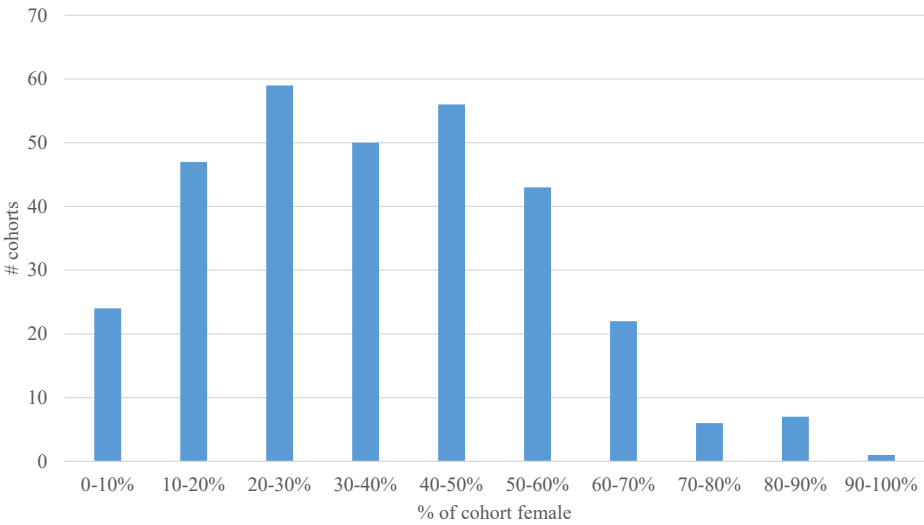
Graduate students, in contrast, experience a particularly salient peer group in their incoming cohort of classmates. Peers who enter into a particular PhD programme in the same year or cohort are thrown into an intense, time-consuming, and highly-focused environment together. This peer group typically takes several (if not all) classes together

1 Authors' calculation based on data from the Ohio Longitudinal Data Archive

in the first year of a PhD programme. Furthermore, study groups and friend groups in that first year are often derived exclusively from the set of students in this incoming cohort. In this setting, it would not be surprising to find large peer effects on individual students' academic outcomes, as well as their perceptions of the academic career choice and the environment within their field of study.

This becomes particularly relevant to the issue of differential attrition between men and women in doctoral programmes when the gender mix of the incoming peer group is highly skewed. Doctoral programmes in quantitative fields, like economics, tend to have very low female enrollment. Figure 1 shows that over two-thirds of incoming PhD cohorts in these fields are less than 50% female. Survey research indicates that environments that are predominantly male have a significantly negative impact on female retention. Even after controlling for both individual and occupation characteristics, women are more likely to report being unsatisfied with their jobs (Lordan and Pischke 2016), and are more likely to leave a field entirely (Hunt 2016) when the share of men in an occupation or field is higher. Advocates for increasing the participation of women in STEM have long emphasised the importance of gender-inclusive environments in repairing the 'leaky pipeline' to a doctoral degree.

Figure 1 Gender mix in quantitative doctoral programmes



Source: Bostwick and Weinberg 2018

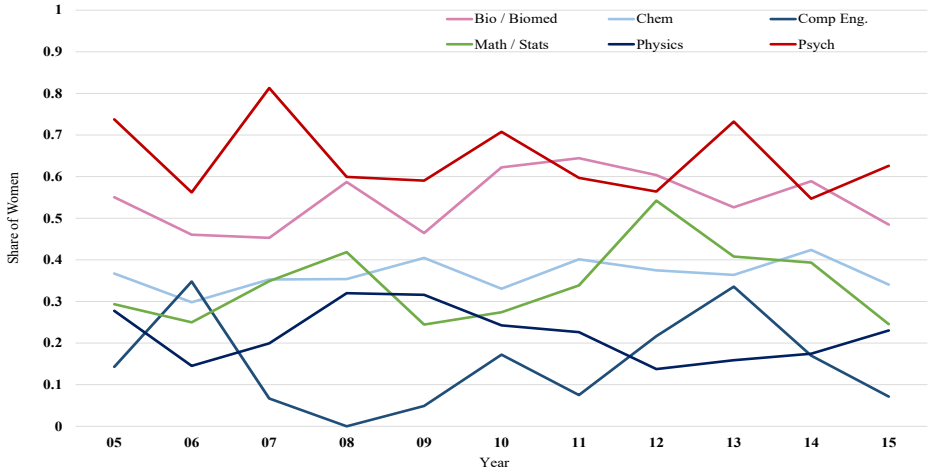
In a recent study, we further quantify these findings by studying the effects of the gender composition of an entering cohort of peers within a quantitative PhD programme on the

gender gap in doctoral attrition and on-time graduation rates (Bostwick and Weinberg 2018). For this study, we introduce a new dataset to the economics literature that links administrative transcript records from all public universities in the state of Ohio[2] to data from the UMETRICS project, which provides information on the research environment (e.g. source, timing, and duration of funding) of doctoral students. We analyse a sample of graduate students entering into doctoral programmes in STEM, economics, and psychology fields between 2005 and 2009. We exclude extremely small programmes, which results in an estimation sample of 2,513 students enrolled in 31 programmes across six universities.

Figure 2 shows the share of women in the entering cohorts of those 31 doctoral programmes at Ohio public universities. Visual inspection as well as formal statistical analysis indicates that while some programmes tend to have relatively high shares of women and others tend to have relatively low shares of women, the fluctuations around those levels are large and effectively random. We utilise the year-to-year variation within a particular PhD programme and compare students who enter that programme in a particularly male-heavy cohort to students who enter in a year with relatively more women. This strategy draws on the natural experiment caused by uncertainty on both sides of the PhD admissions process. While a doctoral programme's admissions committee might be targeting a specific gender mix, and an incoming student might know the average gender composition of past cohorts in a programme, neither party can fully anticipate the realised gender composition of an incoming cohort of students. This uncertainty ensures that any deviations in the gender mix of an incoming cohort of peers from the average gender mix for that programme is essentially as good as random.

By comparing those students who chance into a cohort with an above-average fraction of female students to those who happen to enroll in a cohort with a particularly low fraction of women, we find that peer gender composition has a significant impact on the gender gap in PhD persistence and completion. Specifically, women students who enroll in a cohort with no other female peers are 12 percentage points less likely than their male peers to graduate within six years of initial enrollment. However, in cohorts with a more equal gender mix this gap closes. Increasing the share of women students in a cohort by one standard deviation increases the probability of on-time graduation for women relative to men by four percentage points.

Figure 2 Trends in gender composition by field



Source: Botswick and Weinberg 2018.

This gender gap in on-time graduation is almost entirely driven by differences in the probability of dropping out during the first year of a PhD programme. Women who enter an otherwise all-male peer group, are seven percentage points more likely to drop out in their first year than their male counterparts. Additionally, as with the effect on on-time graduation, this gender gap shrinks as the fraction of women in a cohort increases. This result is not surprising considering that dropping out is most common in the first year of doctoral programmes and that the first year is when these students are primarily involved in coursework with their peers (rather than research which dominates the later years of doctoral education).

A second important finding from the study, is that these effects of peer gender composition on attrition and completion, are most pronounced in those fields that typically have the highest rates of female under-representation. In our data, these 'typically-male' fields include: computer engineering (where the average cohort is only 15% women), physics (average cohort is 24% female), and economics (where the average cohort is 32% female). In a 'typically-male' programme, a woman who happens to enroll into a cohort with no other female peers is 13 percentage points more likely to drop out in the first year than her male peers. In fields that are less male-dominated, this gender gap is much smaller (six percentage points), and not statistically significant.

Finally, we attempt to investigate the mechanisms underlying these gender peer effects by analysing some of the more likely channels. Given the experimental evidence showing that women are less competitive when vying against male counterparts (Gneezy et al. 2003), we might expect peer gender composition to impact women's

chances of obtaining financial support on faculty research grants. However, we find no evidence of such an effect. Alternatively, an increase in the share of peers who are female might benefit women students through better performance in first year classes (if, for example, women are better able to learn when surrounded by other women). We look at the impact of the gender mix of a cohort on first year performance through grades and find a small effect. That is, women have slightly worse grades than men in highly-male cohorts. However, this gap in grades is not large and we estimate that this difference in classroom performance can, at most, account for only one-quarter of the total effect of peer gender composition on degree completion.

The remaining three-quarters of the peer effect we are then left to attribute to unmeasurable mechanisms within the doctoral education environment. We speculate that these unobserved mechanisms are largely comprised of changes in the climate experienced by each incoming cohort. For example, when the fraction of women in a cohort is particularly high, the intangible climate towards women (in that specific cohort) improves, thereby improving female students' experience and perceptions of the field. The more female-friendly environment thus increases female students' persistence in the PhD programme and probability of on-time graduation. These observed improvements in persistence occur despite the fact that these women experience no change in the prospect of financial support and only marginal improvements in first year grades. While observers have pointed to a number of reasons for increasing diversity on the basis of gender (as well as other dimensions), our research points to a novel reason for increasing diversity – that it may improve the retention of other women, especially in fields where women are heavily under-represented.

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Part III: Research and Publishing

9 Gender and collaboration

Lorenzo Ductor, Sanjeev Goyal, and **Anja Prummer**
Universidad de Granada, Spain; University of Cambridge; Queen Mary University of London

Research is very much a collaborative activity and economists increasingly co-author with others. These collaborations impact their research output, a point formalised in Lindenlaub and Prummer (2019). They study the interplay between different network features and performance, and show that the number of connections (degree) facilitates access to new ideas, while a higher overlap among connections (greater clustering) and repeated interaction (stronger ties), sustains greater peer pressure and trust. Different network structures yield distinct advantages, and in uncertain environments, such as research, more connections and a larger network is particularly beneficial. This claim has been empirically confirmed by Ductor, Fafchamps, Goyal, van der Leij (2014).

These findings are the point of departure for the network and output analysis in Ductor, Goyal and Prummer (2018). We provide a systematic analysis of long-term trends in gender differences in economics research, both in collaboration and output patterns. We use the EconLit database, a bibliography of over 1,627 journals in economics, compiled by the editors of the *Journal of Economic Literature*, over the period 1970 to 2017.

During this time, economics has undergone a profound transformation in terms of gender composition: the fraction of female authors publishing in a journal listed in EconLit grew from 8% to 29% over this period (see Figure 1). Despite the increase in the share of women in economics, men have produced 25% more articles compared to women throughout the period under study.

Output differences remain large even after controlling for experience and choice of field (and other observable factors), which motivates our study on the impact of patterns of collaboration.

We identify large and persistent gender differences in networks: women have lower degree, but higher clustering and strength than men. Remarkably, despite the substantial increase of women in economics, the differences in co-authorship patterns have either increased as in the case of degree (see Figure 2) or have remained stable, as in case of clustering (see Figure 3).

Figure 1 Fraction of female authors publishing in a journal over time

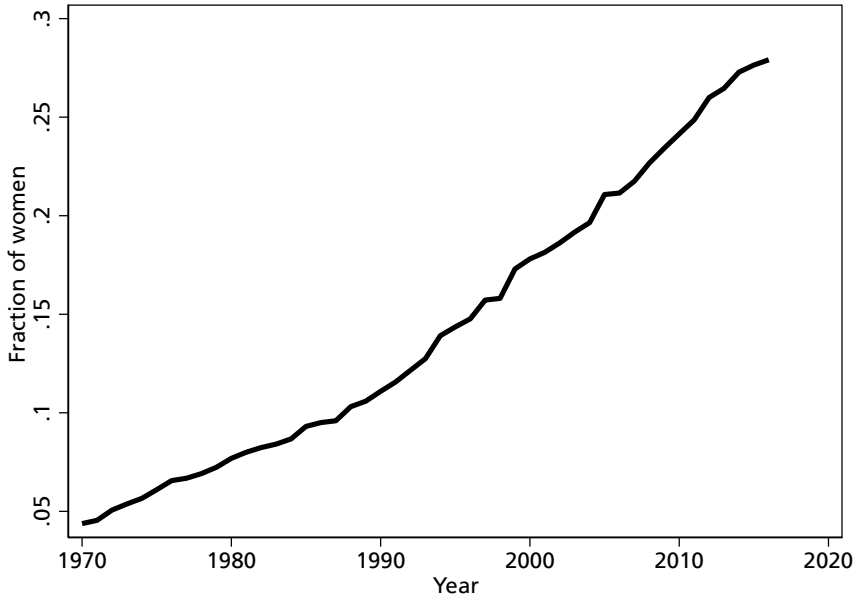


Figure 2 Gender differences in average degree over time

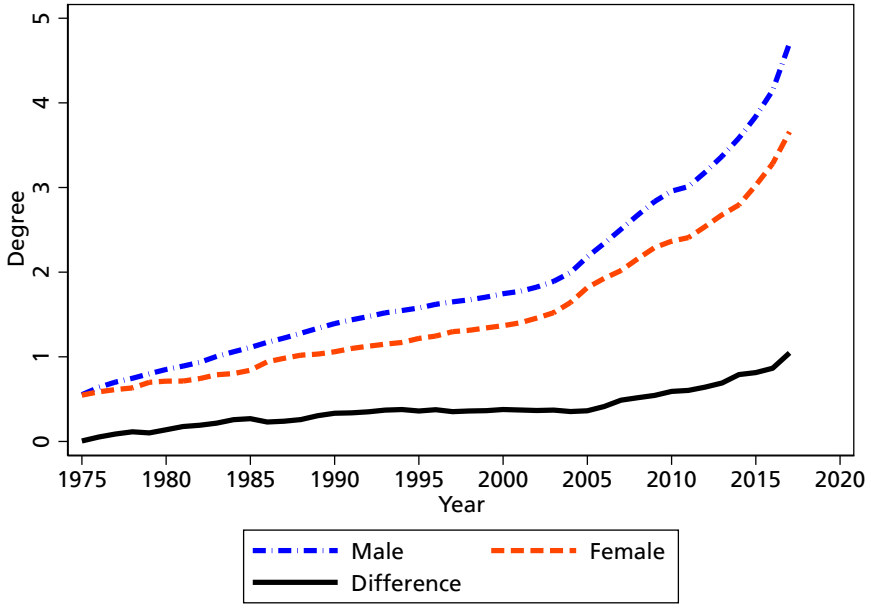
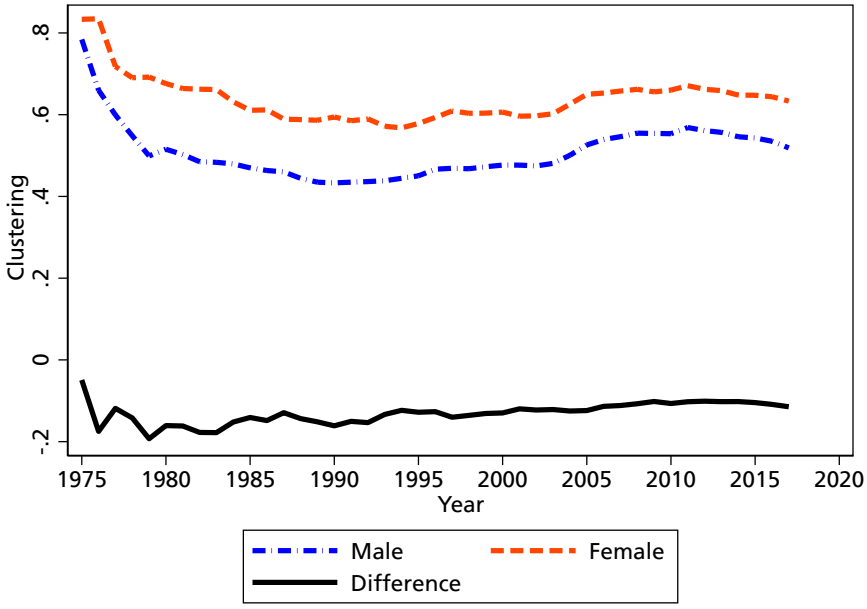


Figure 3 Gender differences in clustering over time



Men connect to a larger number of distinct co-authors, resulting in a larger network, while women tend to collaborate repeatedly with the same co-authors, and their co-authors' collaborators, leading to a tighter network. These network disparities could explain some of the output gap. We therefore link the gender differences to research output and show that network characteristics reduce the gender output gap by 21%. Therefore, network characteristics should be considered when discussing gender disparities in output.

Given the importance of network characteristics, we investigate the persistence in network differences across gender further, documenting a number of empirical facts.

First, the influx of women in the profession could have ameliorated the gender gap in co-authorship networks. One reason for this may be homophily, the desire of women to collaborate with other women, and for men to work with other men. We document that men and women display some gender homophily, the extent of which remains perfectly stable across time (taking into account the different shares of women in our period of study).

It may be the case that the difference in degree is mainly driven by homophily and the under-representation of women in the profession. This idea has been made precise by Currarini et al. (2009). Their model generates a positive correlation between the relative

size of a group in the population and its (average) degree. We test their prediction in two ways.

First, we exploit variation in gender shares across time. Figure 2 illustrates that despite the increase of women in the profession, the gender differences in the number of co-authors has actually increased. This holds true if we include various controls, and is also robust if we consider cohorts instead of years.

Second, we use variation in gender shares across fields. Some fields in economics, such as labour and development, have a larger share of women, whereas other fields, such as microeconomic theory, have a smaller share of women. We show that the share of women in a given field does not have a significant impact on their number of co-authors.

Even though there has been an increase in the share of women, this does not seem to have helped in reducing the differences in collaboration patterns.

This persistent difference in the number of co-authors could potentially be due to women working more on their own compared to men. To investigate this, we look at the share of single-authored papers compared to all papers written for all authors. We find that women in fact write fewer papers on their own, compared to male economists. So, while women have a smaller number of distinct co-authors, they still co-author more than men.

So far, our argument focuses on averages across gender, which may neglect that different collaboration patterns emerge due to observables. One such observable is differences in research output, which begs the question of whether gender differences emerge for all economists, independently of how much they produce. To address this, we rank economists according to their research output in the past five years, and analyse the differences in network characteristics. It turns out that the gender gap for the most productive economists is even more pronounced, indicating that the gender differences are pervasive.

Another important heterogeneity that should be taken into account is career time. Given the recent influx of women to the profession, the average woman is more junior than the average man. We therefore investigate whether women's networks differ at each stage of their career from men's collaboration patterns. Remarkably, it turns out that women have different collaboration patterns, independent of whether they are junior or senior.

Going one step beyond network patterns of collaboration, we turn to characteristics of co-authors and analyse how they differ across gender. We show that women co-author more with more experienced and senior economists at each stage of their career. There

are further differences across gender in co-authors research output: women's collaborators have on average a higher past research output compared to men's co-authors.

While economics has undergone significant changes in the number of journals, as well as the fraction of women in the profession, significant differences in men's and women's collaboration patterns remain; differences which contribute to the gender output gap in economics.

The persistence of the documented collaboration patterns, raises the question of whether they are specific to economics, or can be found more broadly. Some evidence points to the latter: Lindenlaub and Prummer (2019) show that the same network patterns emerge for students, in email data from Enron and Computer Science collaboration networks. In Ductor et al. (2018), we further investigate collaboration patterns in sociology. Sociology is of particular interest, as the field of sociology reached gender balance towards the end of our sample. Despite the equal share of men and women, sociology exhibits the same qualitative, but quantitatively smaller gender disparities in output, collaboration patterns, and co-author characteristics as in economics. A key difference is that sociologists do not display gender homophily, further suggesting that gender homophily is not a key driver in the gender disparities we observe.

Taking the findings on collaboration networks in economics and sociology together, it seems that simply increasing the share of women in economics will not be sufficient to erase the gender differences in collaboration networks, but it may well reduce them.

A simple policy response to our findings may be to encourage women to choose different collaboration patterns. However, this may not necessarily be optimal, as illustrated in a famous case study within a firm by Burt (1998). He documents that women with tighter networks are promoted more quickly as they borrow social capital from those they are tightly connected with; men, on the other hand are promoted more quickly if they have looser networks. A similar pattern may be at play when it comes to tenure decisions. If this were the case, women's different networks may simply be a response to facing a distinct, possibly more hostile environment, which necessitates borrowing social capital.

Creating a more female-friendly environment has been explicitly stated as a goal by professional bodies, such as the American Economic Association, and we provide one reason for why this can increase the profession's output.

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She focuses on how social interactions can improve or hinder an individual's economic success. Through the combination of theoretical and empirical work, she has been able to identify suboptimal network patterns and highlight why these patterns persist. Relatedly, she is interested in how political, cultural and religious leaders can influence individuals, taking into account their social network.

Before joining Queen Mary University of London, she was a postdoctoral fellow at the Cambridge-INET Institute. She obtained her PhD at the European University Institute, Florence. She visited the University of Wisconsin-Madison, University of California, Berkeley, New York University as well as Duke for extended periods.

10 Publishing while female

Erin Hengel
University of Liverpool

Are women held to higher standards? Evidence from peer review.

Most raw numerical counts suggest women produce less than men. For example, female real estate agents list fewer homes (Seagraves and Gallimore 2013); female lawyers bill fewer hours (Azmat and Ferrer 2017); female physicians see fewer patients (Bloor et al. 2008); female academics write fewer papers (Ceci et al. 2014).

Yet there is another side to female productivity that is often ignored: when evaluated by narrowly defined quality measures, women often outperform. For example, houses listed by female real estate agents sell for higher prices (Salter et al. 2012, Seagraves and Gallimore 2013); female lawyers make fewer ethical violations (Hatamyar and Simmons 2004); patients treated by female physicians are less likely to die or be readmitted to hospital (Tsugawa et al. 2017).

In Hengel (2019), I show that female economists surpass men on another dimension: writing clarity. Using five readability measures, I find that female-authored articles published in top economics journals are better written than equivalent papers by men. Why? Likely because they have to be. Using a model of an author's decision making process, I show that tougher editorial standards and/or biased referee assignment are most obviously consistent with women's observed pattern of choices.

I then document evidence that higher standards increase the cost to women of producing a paper and likely lower their observed productivity. The data also suggest that women respond to higher standards by conforming to those standards in ways that may make it difficult to distinguish biased treatment from voluntary choice.

Higher standards impose a quantity/quality trade-off that likely contributes to academia's 'Publishing Paradox' and 'Leaky Pipeline'.[1] Spending more time revising old research means there's less time for new research. Fewer papers results in fewer promotions, possibly driving women into fairer fields. Given that evidence of this trade-off may be present in a variety of occupations, higher standards may also distort women's productivity, more generally.

The gender readability gap

To determine readability, I rely on a well-known relationship: simple vocabulary and short sentences are easier to understand and straightforward to quantify. Using the five most widely used, studied and reliable formulas to exploit this, I analyse 9,122 article abstracts published in the *American Economic Review*, *Econometrica*, *Journal of Political Economy* and *Quarterly Journal of Economics*.[2]

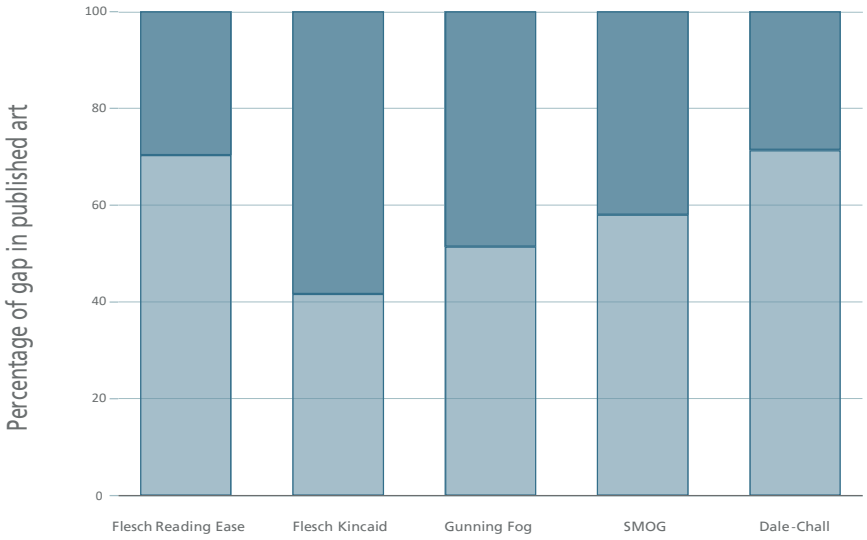
First, female-authored abstracts are 1–6% better written than similar papers by men. The difference cannot be explained by year, journal, editor, topic, institution, English language ability or with various proxies for article quality – including citations – and author productivity. This means the readability gap probably wasn't (i) a response to specific policies in earlier eras; (ii) caused by women writing on topics that are easier to explain; (iii) generated by factors correlated with gender but really related to knowledge, intelligence and creativity; nor (iv) due to a lopsided concentration of female native English speakers.[3]

Second, the gap widens precisely while papers are being reviewed. To show this, I analyse readability (conditional on citations) before and after review by comparing published articles to earlier drafts released by the National Bureau of Economic Research (NBER) Technical and Working Paper Series.[4]

Figure 1 compares the gap formed before peer review (light blue) to the gap formed in peer review (dark blue) as a percentage of the gender gap in the published article. It suggests peer review is directly responsible for almost half of the gender readability gap.

1 'Publishing Paradox' and 'Leaky Pipeline' refer to phenomena in academia whereby women publish fewer papers and disproportionately leave the profession, respectively.
2 Readability scores are highly correlated across an article's abstract, introduction and discussion sections (see Hartley et al. 2003, Hengel 2019, for a discussion).
3 It is not clear how—or even if—native English speakers write more clearly than non-native speakers. In fact, Hayden (2008) found that peer reviewed articles by the latter are more readable, on average.
4 NBER persistently releases its working papers two to three years before publication (mean 2.1 years) – precisely the length of time papers spend in peer review (Ellison 2002, Goldberg 2015).

Figure 1 Figure compares the gap formed before peer review (light blue) to the gap formed in peer review (dark blue) as a percentage of the gender gap in the published article.



Is it really discrimination?

Why does peer review cause women to write more clearly? There are two possible explanations. Either women voluntarily write better papers – e.g. because they're more sensitive to referee criticism or overestimate the importance of writing well – or better written papers are women's response to higher standards imposed by referees and/or editors.

Both explanations imply women spend too much time rewriting old papers and not enough time writing new papers. However, my evidence suggests the latter is primarily to blame. To show this, I model an author's decision-making process over time. The model establishes three sufficient conditions to test for higher standards in peer review.

1. Experienced women write better than equivalent men.
2. Women improve their writing over time.
3. Female-authored papers are accepted no more often than equivalent male-authored papers.

The intuition behind these conditions is simple. Assuming intrinsic preferences do not change over time, authors improve readability today relative to yesterday only if

they believe better writing leads to higher acceptance rates. Of course, oversensitivity and/or poor information may distort their beliefs – and affect readability – but the impact declines with experience. Holding acceptance rates constant, this implies that a widening readability gap between equivalent authors is caused by discrimination – i.e. asymmetric editorial standards and/or biased referee assignment beyond women's control.

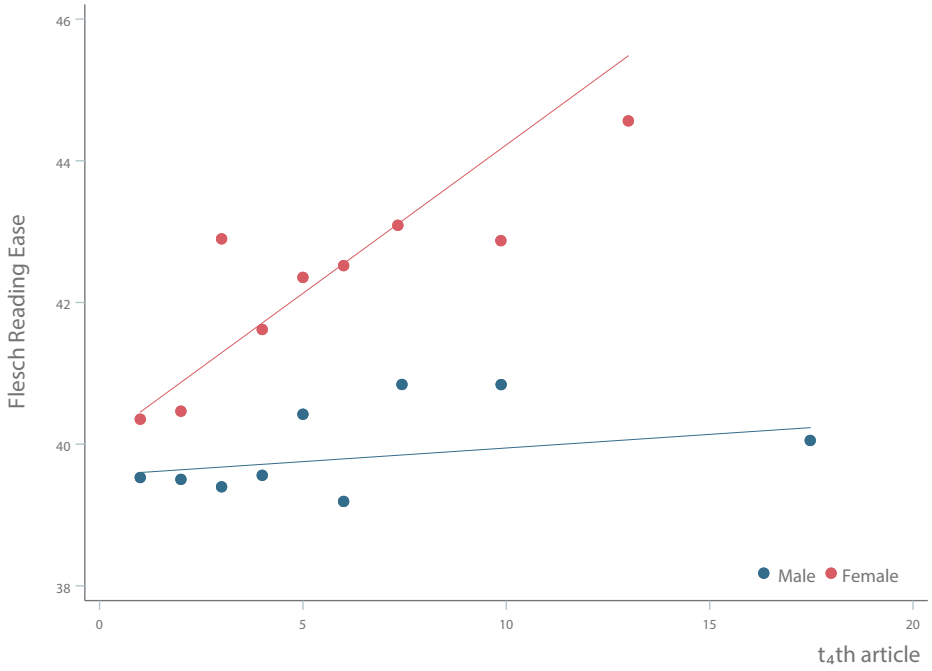
On average, conditions 1 and 2 hold. Experienced female economists write better than equivalent male economists and women improve their writing over time (but men don't) (Figure 2). Between authors' first and third published articles, the readability gap increases by up to 12%. Although my data do not identify probability of acceptance, conclusions from extensive study elsewhere suggest no gender difference (see, e.g. Ceci et al. 2014, Card et al. 2019).

Technically, however, each condition must hold for the same author in two different situations – before and after gaining experience and when compared to an equivalent, experienced author of the opposite gender. To account for this, I match prolific female authors to similarly productive male authors on characteristics that predict the topic, novelty and quality of research. I found evidence of discrimination in 60–70% of matched pairs. I then subtracted experienced male scores from experienced female scores within these matched pairs in order to obtain a pair-specific estimate of the impact of discrimination on readability.

Figure 3 displays their distribution for the Flesch Reading Ease score. In the absence of systemic discrimination against women (or men), differences in Figure 3 should symmetrically distribute around zero. They obviously don't. Not only is discrimination usually against women, but instances of obvious discrimination predominately are too: across all five scores, differences are, on average, five times more likely to be one standard deviation above zero (indicating discrimination against women) than below it (indicating discrimination against men).

Within-pair differences can also be used to generate unconditional (conservative) estimates of the effect of higher standards on authors' readability (for details, see Hengel 2019). On average, they suggest that discrimination causes senior female economists to write (at least) 7% more clearly than they otherwise would.[5]

Figure 2 Mean Flesch Reading Ease marginal mean scores for authors' first, second, ..., t_4th publication in the data.



Prolonged peer review

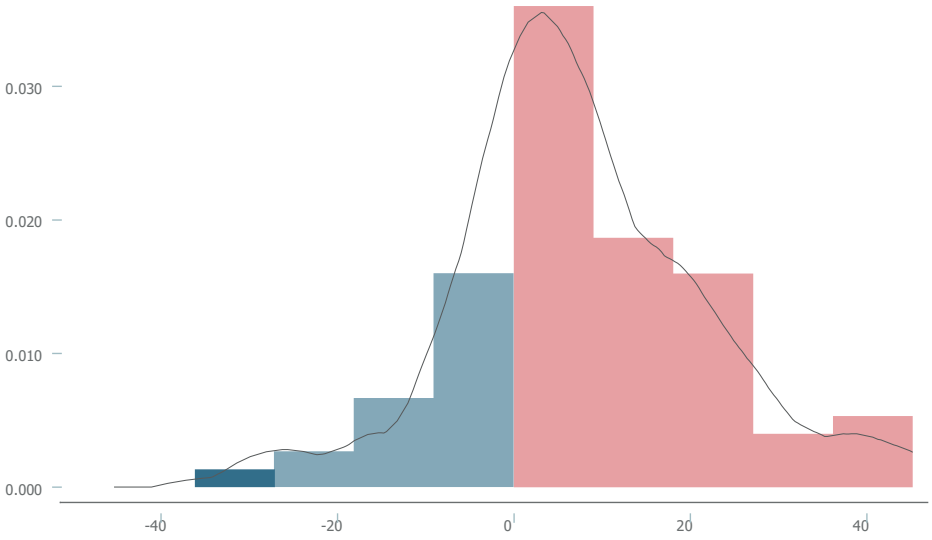
Writing well takes time, so higher standards probably delay peer review. To evaluate this hypothesis, I investigate submit-accept times at *Econometrica* and the *Review of Economic Studies*.

Figure 4 displays review time distribution of review time by author sex. Women's times (pink) are disproportionately clustered in the right tail of the distribution: articles by female authors are five times more likely to experience delays above the 75th percentile than they are to enjoy speedy revisions below the 25th.

Using a more precise estimation strategy, I find that female-authored papers spend three to six months longer in peer review compared to observably equivalent male-authored papers (for details, see Hengel 2019). The effect persists across a range of

specifications and accounts for, among other things, citations, readability, author seniority, motherhood, childbirth and field.[6]

Figure 3 Distribution of within pair differences in readability for pairs in which one member satisfies conditions 1 and 2 according to the Flesch Reading Ease score.



Note: Blue bars represent matched pairs in which the man satisfies 1 and 2 (indicative of discrimination); pink bars are pairs in which the woman does. Because male scores are subtracted from female scores, differences are positive in pairs suggesting discrimination against women and negative in pairs suggesting discrimination against men. Estimated density function drawn in grey.

How do women react to higher standards?

As a final exercise, I investigate how women react to higher standards as they update beliefs about referees' expectations. Figure 5 compares papers pre- and post-review at increasing publication counts. Hollow circles denote NBER draft readability; solid diamonds reflect readability in the final, published versions of those same papers; dashed lines trace changes made as papers undergo peer review.

All things being equal, economists who anticipate referees' demands are rejected less often; economists who don't enjoy more free time. Figure 5 implies little, if any, gender difference in this trade-off: senior economists of both sexes sacrifice time upfront to increase acceptance rates.

Moreover, only *inexperienced* women make changes during peer review. Assuming choices by senior economists express optimal tradeoffs with full information, this implies that women initially underestimate referees' expectations. Men, however, do not. Draft and final readability choices remain relatively stable over the course of their careers.

Are men just better informed about referees' expectations? Yes and no. Male and female draft readability scores for first-time publications are exactly the same. This suggests that men and women start out with identical beliefs. But those beliefs reflect standards that apply only to men; women's 'mistake' is in initially thinking the same standards apply to them, too.

Figure 4 Distribution of review times by author sex at *Econometrica* and the *Review of Economic Studies*.

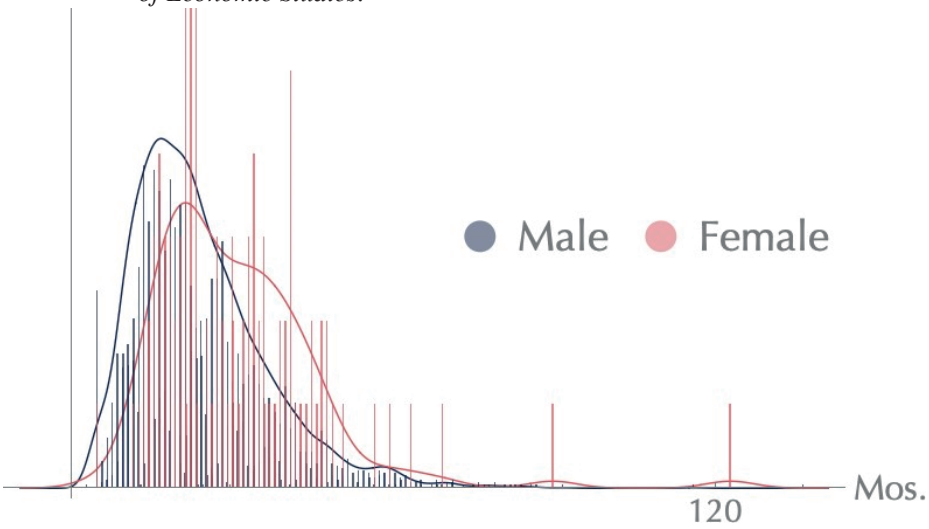
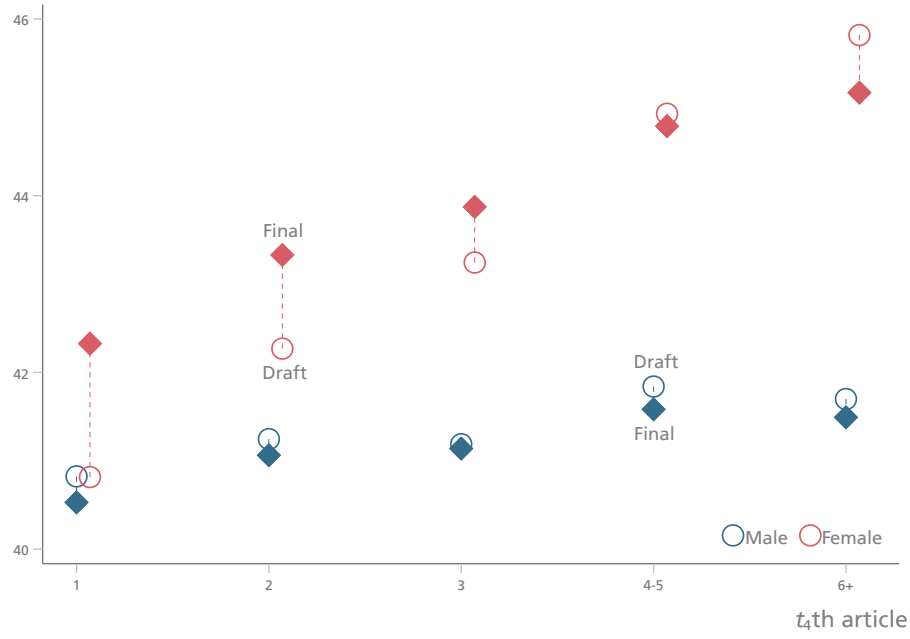


Figure 5 emphasises that women may respond to biased treatment in ways that obscure the line between personal preferences and external constraints. This suggests one needs to be careful about interpreting gender differences – especially when using data that captures only narrow viewpoints. For example, if we only concentrate attention on a cross section of papers written by senior economists, we might conclude that women simply prefer writing more clearly. Alternatively, if we limit our focus to the gap formed inside peer review, we might decide it declines with experience. But neither conclusion is supported when the data are analysed from a broader perspective.

Figure 5 also highlights that discrimination impacts more than just obvious outcomes. It corrupts productivity, too. Work that is evaluated more critically at any point in the

production process will be systematically better (holding prices fixed) or systematically cheaper (holding quality fixed). This reduces women's wages – for example, if judges require better writing in female-authored briefs, female attorneys must charge lower fees and/or under-report hours to compete with men – and distorts measurement of female productivity – billable hours and client revenue decline; female lawyers appear less productive than they truly are.

Figure 5 Flesch Reading Ease marginal mean scores for authors' first, second, third, fourth, and sixth and up, publications in the data.



Note: Hollow circles denote estimated readability of NBER working papers; solid diamonds show the estimated readability in the published versions of the same papers. Pink represents women co-authoring only with other women; blue are men co-authoring only with other men.

Policy implications

Higher standards have been recently corroborated using citations as a proxy for manuscript quality (Grossbard et al. 2018, Card et al. 2019, Hengel and Moon 2019). They also align with research on employee performance reviews, teaching evaluations and online comments: women receive more abusive feedback, less credit for intelligence and creativity, and are expected to be more organised, prepared and clear (see, e.g. Correll and Simard 2016, Gardiner et al. 2016, Boring 2017, Mengel et al. 2017, Wu 2019).

Unfortunately, there is no easy way to eliminate implicit bias. But least intrusive – and arguably most effective – is simple awareness and constant supervision. Monitoring referee reports is difficult, but it isn't impossible, especially if peer review were open. Several science and medical journals not only reveal referees' identities, they also post reports online. Quality does not decline (it may actually increase); referees still referee (even those who initially refuse) (van Rooyen et al. 1999, Walsh et al. 2000). And given what's at stake, is spending an extra 25–50 minutes reviewing a paper really all that bad (van Rooyen et al. 2010)?

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11 Are referees and editors in economics gender-neutral?

David Card*, Stefano DellaVigna*, Patricia Funk, and **Nagore Iriberri**
UC Berkeley*; Università della Svizzera italiana; University of the Basque Country

Women are under-represented in economics, and more so the higher the rank. While numerous explanations have been offered for this gap, including differences in competitiveness and in the allocation of time between work and family, an abiding concern is that stereotype biases or other forms of discrimination lead decision makers to undervalue the contributions of women. In fact, using teaching evaluations, it has been shown that female professors get lower grades, despite the fact that students appear to learn as much from women as from men (Boring 2017, Mengel et al. 2019). When it comes to being accepted at important economic conferences, the evidence is mixed (Chari and Goldsmith-Pinkham 2019, Hospido and Sanz 2019). What about the evaluation of scientific contributions by male and female authors? Blank (1991) randomly assigned submissions at the *American Economic Review* to referees, with or without masking the author's name and affiliation. She found a large but imprecisely estimated positive effect of blinding on the acceptance rate of female-authored papers. Later studies show that women seem to be held to higher standards in academic promotions (Sarsons 2017) and the publishing process (Hengel 2019). Equally worrying, a recent study documents a hostile environment for female economists (Wu 2019).

Producing high quality research and publishing in high impact journals is the most important task for an academic to be promoted, summarised as the 'publish or perish' paradigm. We ask ourselves: are referees and editors in economics gender-neutral? In this chapter, we present a comprehensive study of the role of gender in the editorial process (Card et al. 2019), based on submissions to four leading journals in economics between 2003 and 2013: the *Quarterly Journal of Economics*, the *Review of Economic Studies*, the *Journal of the European Economic Association,* and the *Review of Economics and Statistics*.

Construction of the data set

We obtain our data from information stored in the Editorial Express (EE) system, which is used by the four journals. For confidentiality reasons, we wrote a computer program that could be run by journal staff to create an anonymised database, combining information in the EE system with gender information from pre-coded lists of author and referee names. Prior to running our extraction program, we obtained a list of the names of all authors and referees from each journal for the relevant years. We developed a protocol for assigning gender to the names on these lists. Overall, we were able to assign gender to about 97% of names in our data set.

We end up with almost 30,000 submissions. For each submission, we observe paper characteristics (e.g. submission date, field of the paper), author gender and author prominence, referee gender and referee prominence, as well as the recommendations by the referees and the final R&R decision of the editor. Author- and referee-prominence is measured by the number of publications in 35 high-impact journals in the five years prior to submission. Of all submissions, roughly half are desk rejected, and the other half are sent to referees. Two-thirds of the non-desk rejected papers are all-male, 7% are all-female-authored papers and the rest are mixed gender. Among the mixed gender, we distinguish between those papers in which the female co-author is the most prominent (4%), and those in which the most published co-author is male (17%). As a measure of paper quality, we count the accumulated Google Scholar citations, collected in mid-2015. In order to give some time for papers to accumulate citations, we restrict the sample to those papers submitted before 2013.

Before having received all the data, and to address concerns over data mining, we wrote a pre-analysis plan, laying out the research design regarding the role of gender in editorial process. The pre-analysis plan is registered under AEARCTR-0003048.[1]

Do female and male referees evaluate the same paper in the same way?

One key question in the editorial process concerns referee behaviour. Does the gender of the referee matter for how a given paper is evaluated? We first look at how female and male-authored papers are matched to referees. Controlling for all observable characteristics, including field controls, we find evidence for assortative matching: compared to all-male-authored papers, all-female-authored papers are seven percentage

1 https://www.socialscienceregistry.org/trials/3048.

points (pp) more likely to be assigned to a female referee. The estimated coefficient for mixed-gender paper is 5pp (most senior author female) and 3pp (most senior author male). Does this referee-assignment process affect how a paper is evaluated? The data suggest that referee gender does not matter at all. Following a simple audit-style analysis with paper fixed effects, referee gender does not affect the evaluation of either, all-male- or all-female-authored papers (nor mixed-gender papers). This is consistent with an earlier study relying on a leading field-journal (Abrevaya and Hamermesh 2012). In sum, authors should not care whether their papers are sent to male or female referees!

Are female and male authors held to the same bar?

Although female and male referees evaluate (the same) paper in a similar way, this does not necessarily imply that referees set the same bar for male- and female-authored papers. It is possible that referees of both genders are biased for or against female-authored papers. To find out, we need to make comparisons across papers by different gender groups, taking into account differences in quality, which we measure by accumulated Google Scholar Citations from submission to mid-2015. We then investigate whether, conditional on referee recommendations, author- and paper-characteristics (e.g. year of submission fixed effects), gender has any predictive power. Intuitively, if referees correctly evaluate papers according to their quality, author characteristics such as gender should not predict citations, once referee recommendations are controlled for. On the other hand, if female authored papers – conditional on referee recommendations – accumulate more/fewer cites than all-male papers, then we could argue that female-authored papers face a higher/lower bar in the publishing process.

What do the data tell? For the sake of brevity, we compare all-female papers with all-male papers but note that the results for mixed-gender papers (especially those whose most senior author is female) tend to lie between all-female and all-male papers. We find that all-female-authored papers receive about 25% more citations than observably similar all-male-authored papers. This is consistent with female researchers facing a higher bar in the publishing process. Based on a theoretical model, we can translate this effect into R&R probabilities. Our calculations suggest that the R&R rate for all-female-authored papers would rise from 12.3% to 18.6% – a 50% increase, if editors were to maximise citations. We also find that while editors do not maximise citations when it comes to evaluating male and female-authored papers, they largely follow the referees' recommendations (which underpredict the citation potential of all-female authored papers).

One potential caveat could be that cites depend on gender. To explain our results, it needed to be the case that all-female authored papers *ceteris paribus* receive more citations. However, in a survey of economists and editors that we administered prior to receiving the data, the opposite is believed to be true. Survey respondents clearly expect that all-female authors receive *fewer* citations than all-male authors (when writing a paper of comparable quality). Hence, our estimate for the higher bar for women turns out to be a lower bound.

So far, we have interpreted the results as being consistent with a higher bar for females. An alternative explanation could be however, that all-female-authored papers have characteristics that lead to higher citations but are not as highly rewarded in the review process. As we do not have access to the actual papers in our submissions data (and cannot infer more detailed paper characteristics), we have to rely on another dataset. Though much smaller in sample, we can analyse the set of published papers (that largely correspond to our submitted papers, assuming a two-year delay between submission and publication). Among this set of papers (which is about one-tenth of the size of our submissions data) we collect very fine JEL classification codes for field, as well as objective (word counts) and more subjective (RA evaluations) measures of theoretical (as opposed to the empirical) content of a paper. Overall, the results on empirical versus theoretical content provide suggestive evidence that different characteristics of papers play some role in the observed citation premium, yet do not explain all of the citation premium in our main sample. This conclusion is tentative, given the difficulty of making inferences from published papers only.

Do editors value female and male referee recommendations equally?

As an important part of the editorial process, we also consider how editors use the information provided by male versus female referees. We first analyse the informativeness of referees, that is, the relationship between referee recommendations and the paper's future citations, by referee gender. Male and female referees do not seem to differ in their informativeness and, rightfully editors do not put different value on them either. In sum, we conclude that editors are gender-neutral in valuing advice from male and female referees.

Conclusions

Are the referees and editors in economics gender-neutral? The answer is both 'yes' and 'no'. If we focus on referee recommendations, we replicate the findings of Abrevaya and Hamermesh (2012), who observed no difference in the way referees of different genders assess papers by female and male authors. We also find no differences in how informative male and female referees are about future citations, and editors rightfully put the same weight on them. However, papers submitted by all-female authors receive 25% higher citations, conditional on referee recommendations and paper and author characteristics. While all-female-authored papers differ from all-male-authored papers in empirical content (which positively affects citations), it is unlikely to explain the whole citation gap and suggests that all-female-authored papers face a higher hurdle in the publishing process.

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12 Does gender matter to be accepted into economics conferences?

Laura Hospido and **Carlos Sanz**
Banco de España and IZA; Banco de España

The economics profession includes disproportionately few women, relative both to the overall population, and to other disciplines (Bayer and Rouse 2016).[1] Although economics became less male-dominated over time, the share of women in the profession is currently lower than in STEM fields, and it has remained flat since the mid-2000s (Lundberg and Stearns 2019). Motivated by this fact, in a recent working paper (Hospido and Sanz 2020), we study gender differences in the evaluation of submissions to economics conferences. Using unique data from the submissions to three general-interest academic conferences (the Annual Congress of the European Economic Association in 2015-2017, the Annual Meeting of the Spanish Economic Association in 2012-2017, and the Spring Meeting of Young Economists in 2017), we find that all-female-authored papers are 3.2 pp (6.8%) less likely to be accepted than all-male-authored papers. This gap is present after controlling for several factors that correlate with gender and acceptance rates: number of authors, referee fixed effects, field, cites of the paper at submission year, previous publication record of the authors, the quality of the affiliations of the authors, experience of the authors, and connections between authors and referees. We also find that the gap is entirely driven by male referees – female referees evaluate male and female-authored papers similarly, but male referees are more favourable towards papers written by men.

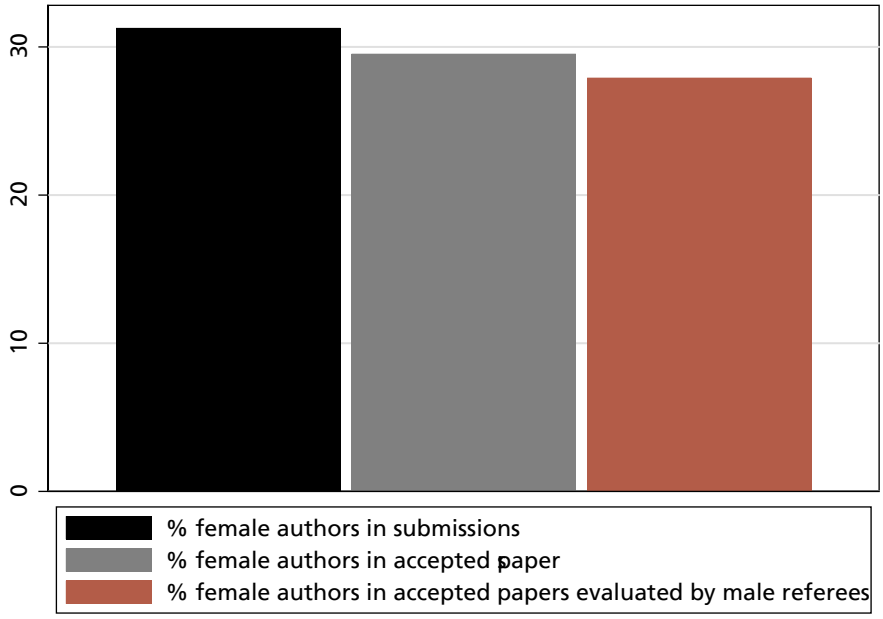
Conferences are an essential part of academic life. They are useful to receive feedback, improve presentation and communication skills, get to know fellow economists in the field, hear about the latest research, gain visibility, and develop networking and future collaborations. Recent research has shown that conferences increase individuals' likelihood of co-authoring an article with another attendant (Campos et al. 2018)

1 For instance, in the US, women account for 33% of new PhDs, 29% of assistant professors at PhD granting departments, and only 14% of full professors (Committee on the Status of Women in the Economics Profession, 2017).

and the likelihood of articles of becoming cited (de Leon and McQuillin 2018). Hence, the presence of gender gaps in the evaluation process may have substantial impact on the professional careers of economists.

Our data includes 9,342 submissions to three large general-interest academic conferences in different years, and contains information on the gender of the authors and the referees that evaluate each paper, and on the acceptance decision. As shown in Figure 1, the share of women authors in submitted papers in the data is 31.3%, while it is 29.5% in accepted papers (and even lower – 27.2% – among those evaluated by male referees). Given that papers written by men and women can be different because of factors that may also relate to acceptance rates, we have complemented the data with a rich set of controls – the field, cites, and eventual publication of the paper, the rank of the affiliations, prior publication, experience of the authors, and the connections between the authors and the referee that evaluates any given paper.

Figure 1 Share of women in economics conferences (%): raw data



We begin by showing that a one percentage point (pp) rise in the share of male authors is associated with a 0.05pp rise in the probability that the paper is accepted, i.e. switching from an all-female-authored to an all-male-authored paper increases the probability of acceptance by 5.4pp Given the baseline rate of acceptance for papers with all male authors (47.1%), this amounts to an 11.5% effect.

We then study whether this gap can be explained by factors that correlate with gender and acceptance rates: (i) given that women are more likely to single-author, we include number of authors indicators, (ii) to account for the possible non-random assignment of papers to referees, we add referee fixed effects, (iii) as women are relatively more represented in some fields than others, we include several field dummies, (iv) to account for possible gender differences in the quality of papers, we control for the cites of the paper, (v) to account for the prominence of the authors, we control for their previous publication record (defined as the number of publications in a set of top journals in the years before the submission), (vi) to account for the institutions of the authors, we control for the ranking of the affiliations of the authors, (vii) to account for possible gender differences in experience, we control for the year in which authors obtained their PhD, and (viii) to account for differences in connections between male and female authors, we control for two measures of networks: whether the referee and the authors are at the same institution (or city), and the 'shortest path' in co-authorship between the referee and the authors (i.e. 1) if they are co-authors, 2) if they are co-authors of co-authors, etc.). After taking these factors into account, the gender gap is reduced but still sizable (3.2pp, or 6.8%) and statistically significant.

Finally, we discuss the possible mechanisms and present some additional findings that are consistent with the results being driven by stereotypes against female economists. First, there is considerable evidence of in-group biases in the literature. Hence, under a stereotyping mechanism, we might expect that the gender gap is larger for male referees. We find the gap to be entirely driven by male referees – female referees evaluate male- and female-authored papers similarly, but male referees are more favourable towards papers written by men. Second, stereotyping might be stronger when referees are less informed about the authors' quality (Bagues et al. 2017). Consistent with this, we find that the gap is null when evaluating authors at top institutions, or with a good record of publications. And third, as argued also by Bagues et al. (2017), stereotyping might be stronger in fields that are less feminised and, therefore, offer fewer chances to interact with female researchers. We present some evidence that the gap is somewhat larger in more masculine fields – in particular, finance.

These findings have direct policy implications for the design of systems to evaluate research and, more specifically, to select papers for conferences. In particular, they imply that a more gender-balanced pool of referees would lead to more gender-neutral acceptance decisions.

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Part IV: Promotion

13 Gender and promotion in economics academia

Shulamit Kahn
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Economics remains a field where cutting-edge research is primarily carried out by tenured or tenure-track academics. Academics in the US must be promoted to tenure by their departments within six to eight years of being hired for them to remain in their jobs. Evidence points to women economists having a harder task passing this hurdle than men.

Prima facie evidence for this gender difference has been gathered by the Committee on the Status of Women in the Economics Profession (CSWEP) since the early 1970s showing evidence of low numbers of tenured women faculty. Later, CSWEP began creating synthetic cohorts, following the pipeline from assistant professorship to tenured associate professor, in order to establish the link between the paucity of tenured women and the tenure process itself (rather than the limited hiring of women). For decades, the CSWEP evidence showed that the proportion of women among tenured mid-level (associate) professors did not grow as quickly as the pool of assistant professors six to eight years earlier.

No doubt, for many economists, this was not compelling evidence of bias. (See Chassonnery-Zaïgouche et al. 2019, on the history of CSWEP and its efforts.) After all, perhaps tenure-track women had chosen to leave academia, or had inadequate levels of research productivity to receive tenure. Moreover, economics is a highly quantitative field, and women were under-represented in all quantitative fields at the time. It was in this context that I (then a member of CSWEP) first began using the National Science Foundation's Survey of Doctorate Recipients (SDR), a survey initially made available in Washington only, which followed individual PhD recipients over time – to study careers of individual economists. In my early work (Kahn 1993), I found that academic men from similar educational backgrounds were much more likely than women to be granted tenure: by ten years post-PhD, women were about 20 percentage points (pp) less likely to receive tenure. The women who were not granted tenure had not left the labour market, eliminating this as an explanation. However, no publication data were

available during those years, so it was impossible to know if the gender tenure gap was due to lower research productivity of the women.

Donna Ginther and I revisited this question in later waves of the SDR, which allowed us to include later cohorts while also increasing sample sizes. In Ginther and Kahn (2004), we were able to add in those who received degrees up to 1991 and also control for (self-reported) research productivity. Women economists with similar educational backgrounds who received PhD degrees during the two decades between 1972 and 1991 remained 18 pp less likely to have received tenure within ten years of their PhD than men. Publications explained little of this gap, as further controlling for publications narrowed the gender tenure gap only slightly, to 16 pp.

In this, and in later work on more recent cohorts (Ginther and Kahn 2006), we included comparisons to other science and social science fields. In this later article based on cohorts with 1981-2003 PhDs, time had brought a slight narrowing of the gender tenure gap – down to 12 pp – for women and men economists with comparable backgrounds and publications. However, similar calculations using the SDR for other science and social science fields revealed much smaller, if any, gender differences in tenure rates, ranging from a five pp disadvantage for women to a small yet statistically insignificant advantage for women! This comparison eliminated any possibility that the slower tenure progress of women was due to economics being a quantitative field.

Promotion to full professorship is a final academic hurdle in academia. It is not as crucial as receiving tenure, since academics can remain at their institution as associate professors for their entire careers. In the same SDR analyses, there was evidence that gender disparities at these higher promotion levels are even larger than the differences for tenure, with women 23 to 30 pp less likely than men to receive full professorship within seven years of tenure receipt – even with research productivity controls. Again, these rates are substantially worse than those seen among other social scientists in the SDR data, and far worse than those seen among physical scientists.

More recently, several women economists have collected direct evidence on promotion statistics for economists from the records of the top economics departments themselves. Heather Sarsons (2017) collected data on economists who applied for tenure between 1985 and 2014 at the 30 top economics departments granting PhDs. Women were on average two-thirds as likely as men to receive tenure within eight years, with 75% of men but only 52% of women having received it. This was despite similar publication records. Antecol et al. (2018) measured the gender gap in receiving tenure at the individual's first academic job in a top-50 economics department (for hires between 1980 and 2005). The gap was approximately 7 pp at its narrowest (in 1995) but near 14 pp more recently.

Why should there be a difference between economics and other fields? Sarsons (2017) believes that it is due to the alphabetical ordering of authors' names and shows that men's and women's tenure probabilities rise similarly with sole-authored papers, but that women are rewarded less than men for articles with male co-authors. Antecol et al. (2018) place some of the blame on gender-neutral tenure-clock-stopping policies, which lowered women's publication rates while increasing men's at top-50 economics departments.

None of these published studies analyses more current cohorts. Recent CSWEP data, however, show that the proportion of women among tenured associate professors has risen recently despite 15 years of an unchanging proportion of female assistant hires (Lundberg 2017).

Signs of progress are also evident in SDR data through the 2017 survey wave. For this article, I was able to examine how gender affects tenure rates of those who received PhDs after 2000 and who started in (US) tenure track jobs. With background controls (publication controls are unavailable), the gender difference in tenure rates by year 11 post-PhD fell to 4.5 pp; in hazard analysis, the ratio of women's to men's tenure rates was 93%, up from earlier values of around 68% for those with PhDs before that time.

Donna Ginther and I have also recently analysed 2009-2018 data from Academic Analytics, which include almost all US universities. These data include far more economists than do the SDR, and while Academic Analytics data do not have the background, family and career information of the SDR, they do have extensive information about research productivity of these academics, including articles published, grants received and citations. For academic economists on the tenure track with 2005-2011 PhDs, women have an average tenure rate that is 87% that of men with similar research productivity in similar institutions. Without controls for research productivity, the ratio was 81%, indicating that while publications are some of the story, there is still a substantial gender gap even in these more recent cohorts. Nevertheless, the gender gaps in tenure rates (not controlling for publications) are smaller than was observed in the SDR for earlier cohorts, although somewhat larger than the SDR estimates for PhDs received after 2000.

Because of the larger scope of the Academic Analytics data, we are able to separate out the more elite institutions (which Carnegie rates as 'very high research') from other academic institutions. The difference is striking. In very high-research universities (which employ more than 80% of academic tenure-track/tenured economists), there is only a small (and statistically insignificant) gender difference in tenure rates, with the women's rate 94.3% of that of men. However, for the other 20% in less research-oriented universities, not only does productivity play no part in the tenure decisions

according to our results but here women are at a huge disadvantage, obtaining tenure at only 57.7% the rate of men.

This recent evidence of the absence of substantial gender bias in research-intensive universities bodes well for the future of women academics in the field of economics. The continuing stark gender differences in tenure rates at universities where research is not rewarded are similar to the evidence of lower promotion levels (across many fields) in some European countries – particularly France and Italy – where academic promotion across different fields is decided by committees of insiders. (Lissoni et al. 2011, Regner et al. 2019). Women at these institutions can only hope that in the future, these universities also professionalise their promotion processes, basing tenure on objective criteria.

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Her other recent research focuses on immigration versus emigration of foreign students with advanced STEM degrees, where she has studied both their choices and the impact of these choices (including publications in *Review of Economics and Statistics*, *Research Policy*, and *Small Business Economics* and co-editing the 2020 NBER book *The Roles of Immigrants and Foreign Students in US Science, Innovation and Entrepreneurship*). She teaches econometrics and data analysis for business. In her spare time, Dr. Kahn serves as Board Chair of a non-profit vocational programme and school in Kenya (Jitegemee) and as a board member of a US NGO (Growth Sector) that teaches maths/STEM skills to disadvantaged students entering community colleges while giving support, networks and internships, and amuses her 20 month-old grandson.

14 The gender promotion gap: Evidence from central banking

Laura Hospido, Luc Laeven*, and **Ana Lamo***
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Economics remains a male-dominated field. In the US, women account for 28.8% of PhD graduates but a mere 13.9% of full professors in economics (CSWEP 2017). This under-representation of women is perhaps nowhere as visible as in central banks (OMFIF 2019). For instance, as of the date of writing, there is not a single woman on the 30-member General Council of the European Central Bank (ECB). A recent survey conducted by the American Economic Association (AEA) on the professional climate in the economics profession, paints a disheartening picture of an overly competitive and hostile environment for women (AEA 2019). What holds women back from pursuing a career in economics?

What is behind the under-representation of women in economics?

Several explanations may account for the lack of women in high-level positions in the economics profession. One possibility is that the pool of potential applicants is male-dominated. Despite recent efforts to turn the tide, women remain less likely to study economics, and macroeconomics in particular (Ginther and Kahn 2004). An alternative explanation is that women are less likely to apply for promotions because of gender differences in the preference for competitive environments (Niederle and Versterlund 2007) or in bargaining abilities in the labour market (Blackaby et al. 2005). The presence of children and trade-offs between family and career may also hold back women from pursuing promotions (Bertrand 2013). Finally, there may be gender-based discrimination in promotion decisions (Goldin and Rouse 2000).

Which of these explanations is more relevant? And can corporate diversity policies mitigate these biases? Despite a large body of literature on gender differences, there is no agreement on the importance of diversity policies and their impact on labour market outcomes.

Addressing gender balance at the ECB

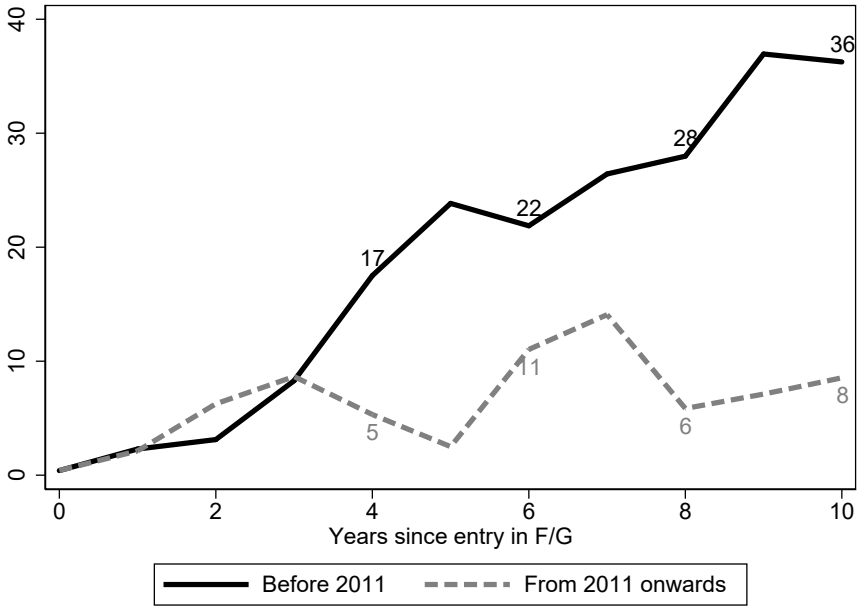
In a new paper (Hospido et al. 2019), we analyse the career progression of men and women at the ECB, using confidential anonymised personnel data from professional staff during the period 2003-2017. Our analysis focuses on expert staff across four different salary bands representing, different levels of seniority (expert, senior expert, principal expert, and advisor) in the policy areas, the research department, and the statistics department. These are business areas across which we observe considerable flows of staff over time. Within this selected group, we focus on a broadly homogeneous pool of staff in terms of human capital and experience, ensuring comparability across individuals.

We find that a wage gap emerges between men and women within a few years of hiring, despite broadly similar entry conditions in terms of salary levels and other observables. One important driver of this wage differential is the presence of children. We also find that women are less likely to be promoted to a higher salary band up until 2010, when the ECB issued a public statement supporting diversity and took several measures to support gender balance. Following this change, the promotion gap disappears.

Figure 1 shows in more detail that this change in diversity policies had material effects on gender differences in promotion outcomes. The figure focuses on promotions from salary band F/G, which is the entry-level salary band for professional economists at the ECB. The gender gap in promotions is defined as the difference in the promotion rates of men and women. The promotion gap narrowed from 2011 onwards, following the policy change. While prior to 2011, the gender promotion gap stood at over 36% after ten years since entry, this gap decreased to about 8% on average after 2011, or a decline of about 80%.

Using 2012-2017 data on promotion applications and decisions, we explore the promotion process in depth, and confirm that during this most recent period, women are as likely to be promoted as men. This results from a lower probability of women applying for promotion, combined with a higher probability of women being selected conditional on having applied. We coin this reluctance to apply for promotions the ‘gender applications gap’. Following promotion, women perform better in terms of salary progression, suggesting that the higher probability of being selected is based on merit, not positive discrimination. We do not find evidence that the composition of the selection committee, including the fraction of women on the panel, alters these results. Taken together, these results point to the effectiveness of corporate diversity policies in reducing gender bias in promotions and lend support to supply-side explanations for the existence of remaining gender differences in promotion outcomes.

Figure 1 Gender gap in the probability of promotion from salary band F/G (before 2011 and from 2011 onwards)



We make three contributions to the literature:

- First, we are the first to exploit the complete personnel records of a large organisation to analyse gender bias in career progression and promotion decisions. This allows a more comprehensive analysis of career progression across various job levels within an organisation, in contrast to much of the literature that focuses on gender differences at corporate board or leadership levels.
- Second, in contrast to much of the literature on promotion decisions, we simultaneously consider the role of promotion applications and decisions when identifying the drivers of the promotion gap. Analysing promotion decisions without accounting for gender gaps in applications would bias the results. We are able to do so because we have information on both promotion applications and decisions, while existing literature has focused on only one of these dimensions.
- Third, we exploit a change in the ECB's gender policy to assess the impact of corporate diversity policies on promotion outcomes. While the economics literature has assessed the impact of gender quotas for corporate board seats on corporate decisions, to our knowledge we are the first to consider the impact of broad-based corporate diversity policies on female labour market outcomes.

Policy implications

Our results suggest that institutional efforts to reduce the gender promotion gap may have to include measures aimed at lowering the barriers to women to seek and apply for promotion opportunities. Such measures could range from offering assertiveness and interview training courses, to enhanced child support benefits and services. More generally, efforts to curb the overly competitive and hostile environment in the profession seem desirable. Understanding the main drivers of the observed gender promotion gap is critically important to improve our understanding of how we can close the gender gap and ensure that women are adequately represented.

Authors' note: The views expressed are those of the authors and do not necessarily reflect those of the ECB, the Banco de España or the Eurosystem.

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15 Unintended consequences of a gender-neutral academic personnel policy

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The path to tenure at a top research university can be particularly difficult for women, because the pre-tenure years often coincide with prime childbearing years. Assistant professors are evaluated for tenure near the end of a fixed probationary period of roughly seven years. This probationary period gives assistant professors time to produce a portfolio of work that signals their true productivity. At the end of this probationary period, those productive enough to receive tenure have job security for life whereas those who fail to earn tenure are fired. The fixed length of the 'tenure clock' disadvantages people who experience a large, temporary negative productivity shock, such as having a child. In part for this reason, women are less likely than men to have children before tenure, and the gender gap in tenure rates is larger for those with children (Mason and Goulden 2002).

To reduce the work-family trade-off for faculty, universities have implemented several family-friendly policies over the last few decades. One of these policies, stopping the tenure clock, is specifically targeted toward assistant professors in order to better account for these family-related productivity shocks that are particularly costly before the tenure decision. Tenure clock stopping policies allow new parents to stop or extend their tenure clock, usually by one year for each child. By extending the tenure clock, new parents have extra time to conduct research and to try to publish before applying for tenure. Importantly, these policies are separate and independent of leave-taking policies, meaning that assistant professors do not face a trade-off between forgoing income while on parental leave and gaining the extra time on their tenure clock.

Tenure clock stopping policies now exist at most research universities. Some policies only apply to mothers, but gender-neutral policies that provide equal one-year extensions to both new mothers and new fathers are now much more common. If the tenure clock

is stopped, departments and outside reviewers are supposed to ignore the additional time spent as an assistant professor. In other words, the assistant professor should not be expected to do any further research during the extra year. However, it is not clear if evaluators actually follow these instructions.

The effects of these gender-neutral tenure clock stopping policies likely depend on how the assistant professors change their research strategies knowing that they might lengthen their tenure clock in the future, how they use the additional time, and how the extra time is evaluated at the tenure decision. If the productivity loss associated with having a child is higher for women than men on average, these policies will benefit fathers more than mothers. Gender-neutral clock stopping policies could even make mothers worse off if they now look relatively less productive compared to their male colleagues.

We evaluate the effects of these gender-neutral tenure clock stopping policies on tenure and publication rates among assistant professors hired at a top-50 US economics department between 1980 and 2005. We estimate these effects by comparing tenure rates before and after these policies were adopted within a university, relative to trends in tenure rates at similar institutions that did not adopt or change a policy. This allows us to control for characteristics of the department – such as its tenure standard and prestige – as well as measures of individual productivity including the rank of their PhD programme and prior publications.

We find that gender-neutral tenure clock stopping policies substantially increase the gender gap in tenure rates at top-50 US economics departments. Specifically, men are 17 percentage points more likely to get tenure in their first job once there is an established gender-neutral clock stopping policy in place, while their female counterparts are 19 percentage points less likely to get tenure in their first job. Rather than levelling the playing field for women, these policies actually increase the gender gap in tenure rates.

What can explain these large differential effects on the tenure rates of men and women in top-50 US economics departments? We show that men exposed to gender-neutral policies at these institutions are more likely to publish in prestigious journals, whereas their female counterparts are not. In economics, having one additional article published in a top journal is often enough to change the tenure decision from negative to positive. The publishing process in economics is also very slow – it sometimes takes several years to get an article published. If men anticipate having more time before the tenure decision, they might choose a riskier publication strategy by initially targeting higher quality journals with lower acceptance rates. Women, who may not anticipate spending as much of the extra year working, might not pursue this risky publication strategy.

Changes in fertility may also explain why gender-neutral clock stopping policies affect tenure rates. Although we only have fertility data for a subset of our sample, we find descriptive evidence that pre-tenure fertility rates are higher at universities with gender-neutral clock stopping policies. Women exposed to these policies are 12 percentage points more likely to have a child within five years of receiving their PhD, and have 0.23 more children on average within that time period. Men are 11 percentage points more likely to have a child and have 0.18 more children within the first five years of their career. There is no change in the number of children ever born for either men or women, suggesting that gender-neutral clock stopping policies induce assistant professors to shift the timing of their fertility rather than increase total fertility.

Having a child is likely to be more costly for women than men. Only women experience the physical toll of pregnancy, often accompanied by further health complications at birth. Mothers are solely responsible for breastfeeding, and often provide the majority of early-life care. By giving men the same benefit at a lower cost, it is perhaps unsurprising that gender-neutral clock stopping policies have the unintended consequence of adversely affecting women.

While gender-neutral tenure-clock-stopping policies help men and hurt women in their first job at a top-50 US economics department, the policies do not cause women to leave the profession altogether. In fact, there is no significant impact on the probability of eventually earning tenure at any college or university for either men or women. But as almost all moves are to less prestigious institutions, the increased churning is certainly not costless.

It is important to note that our study only focuses on the effects of these policies on assistant professors of economics. It is possible that gender-neutral clock stopping policies could have different effects in other disciplines. For example, the additional time on the clock may be less important in disciplines where taking several post-doc positions before becoming an assistant professor is common. Other fields which put more emphasis on publishing books or obtaining grants may also experience different effects due to these policies. More work is needed to assess the impact of gender-neutral tenure clock stopping policies across disciplines.

What is clear is that these policies have unintended consequences that hurt at least some women, and it is likely that the mechanisms driving these results are not specific to economics. Our results suggest the need to rethink the design of gender-neutral tenure clock stopping policies. While policies that apply to both mothers and fathers encourage paternal involvement in childcare and reduce the stigma associated with gendered take-up, they can also have significant adverse consequences for women. One potential alternative to the current gender-neutral clock stopping policies is to redesign

benefits to better align with the gendered costs of pregnancy, childbirth, and early-life care. By giving women longer clock extensions than men or tying these policies to other benefits such as more generous course releases associated with pregnancy, it may be possible to design more equitable family-friendly policies.

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16 Gender bias in student evaluations of teaching

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The empirical evidence regarding the existence of gender biases in student evaluations of teaching (SET) in different contexts has grown in recent years. Faced with mounting pressure to avoid making discriminatory personnel decisions about tenure, promotions, and retention of academic staff, universities are struggling to find solutions to the problem. Some research results suggest best practices can reduce gender biases in SETs, but more research is required to assess whether and how these biases can be eliminated.

Many universities throughout the world use student evaluations of teaching. SETs generally serve two goals: to help instructors improve their courses from one year to the next, and to provide information to administrators regarding an instructor's quality of teaching. Universities often rely on SET scores for personnel decisions, including tenure decisions, promotions, and retention of adjunct faculty. As the stakes are high for instructors and the quality of instruction, the extent to which universities can use SETs as an objective measure of teaching effectiveness is a major issue in higher education.

In recent years, the research has been growing concerning different types of biases, including gender biases, that may impact SET scores. In the economics literature, two papers in particular provide causal evidence of the existence of gender biases in SET scores, using quasi-experimental datasets from European universities: in France (Boring 2017) and in the Netherlands (Mengel et al. 2018). Both papers find similar results. They find evidence of gender biases against female instructors. In both papers, male students are the ones driving the gender biases, giving higher scores to male instructors on average, despite no evidence that male students learn more with male instructors. In Boring (2017), the bias meant that male instructors were more likely to receive 'excellent' ratings than similarly competent female instructors. Both papers argue that women may have to increase time spent on teaching to improve their scores, in order to counter these gender biases. This time spent on teaching is detrimental to other activities – research in particular. Two other recent economics studies using

observational datasets find similar results: in another Dutch university (Wagner et al. 2016), and in Switzerland (Funk et al. 2019).

Causal analyses using data from US universities are harder to conduct, which is unfortunate given the importance of SETs in personnel decisions there. Contrary to many European university systems, students in US universities are generally free to pick their courses and instructors, which creates a selection bias, limiting the scope for clean identification strategies.

Nonetheless, there is some evidence that gender biases are an issue in US universities as well. For instance, the American Economic Association's Professional Climate Survey (2019) included a question on biases in SETs: 47% of female economists answered that they had 'personally experienced discrimination or unfair treatment with regard to course evaluations', compared to only 8% of male economists.

A few controlled experiments conducted in the US also point towards the existence of gender biases in SETs. For instance, one study is an experiment with an online course, in which a male and a female instructor communicated with students through a learning management system (MacNell et al. 2015). Each instructor was responsible for two groups of students. Since they had no direct contact with students, the instructors swapped identities for one of their two groups. They co-ordinated their actions in order to avoid differences in teaching style. For instance, both instructors graded assignments at the same time. The authors find that students gave lower SET scores to the (perceived) female instructor even on objective criteria, such as how prompt the instructor was in grading assignments.

The growing evidence regarding the existence of gender biases in SETs is putting pressure on universities regarding their use of SETs for personnel decisions. In a recent op-ed (Owen 2019), economics Professor Ann Owen argued that universities are increasingly under threat of class-action lawsuits. Some researchers in sociology have created a petition for that purpose.

What can universities do to tackle the problem of gender biases in SETs? There is no easy solution unfortunately. Adjusting scores for biases is nearly impossible to do, because they depend on many factors and are context specific (Boring et al. 2016).

Alternatively, it may be possible to reduce biases. One way consists in making students aware that biases can influence how they evaluate instructors. In a field experiment conducted in France, Arnaud Philippe and I tested two different treatments designed to reduce biases in SET scores (Boring and Philippe 2019). The administration of the university sent two email messages to different groups of students, in an

experimental design which enabled us to conduct a difference-in-difference analysis. The first treatment was a normative statement, in which the administration reminded students not to discriminate. We find no effect of this normative statement on student evaluations. The second treatment was more informative: the administration augmented the normative statement by giving students precise research findings on how students (male students in particular) at the same university had been biased in previous years against female instructors. This treatment reduced gender biases in SET scores. Male students in particular responded to the message by increasing their scores towards female instructors. The informative email seems to have continued to generate effects in the following semester, without having to remind students of its content.

Why did this informational treatment work, and not the normative treatment? The normative statement was unlikely to trigger awareness the way that the informative statement did. Indeed, students are unlikely to realise that biases are driving their evaluations of instructors, as biases are generally unconscious. An awareness-raising campaign is more likely to produce an effect if it makes biases conscious through pertinent information. Also, anecdotal evidence suggests that the informational message triggered discussions between students. These peer discussions may partly explain the effect.

Another possible reason why this treatment worked is that none of the current students who were evaluating instructors were directly being accused of discriminating. Nonetheless, the students could identify enough with the peers from the research study, as they were from the same university, and the evaluations were for the same courses. Providing information about potential biases in this indirect way is unlikely to lead to pushback from students.

Finally, the message was sent by the administration, and not directly by instructors. Some instructors, in particular women and other instructors who feel they might be discriminated against, may be uncomfortable discussing these results themselves.

Simple nudges may also help. For instance, an experimental study in the US conducted in sociology suggests that gender biases are more or less strong depending on the scale that universities use (Rivera and Tilcsik 2019). The authors find that in the most male-dominated fields, gender biases were stronger when instructors were rated on a 10-point scale compared to a 6-point scale. The shorter scale also helped to reduce the gender stereotypes of ‘brilliance’.

Universities worldwide have a clear interest in reducing gender biases in SET scores. Some fields are leading the change in practices. On September 9, 2019, the American

Sociological Association published a formal statement to push for changes in the way that departments use SETs. They make five recommendations:

1. Ask for student experiences, and pay attention to framing of instruments
2. Diversify evidence of teaching effectiveness
3. Do not compare scores between instructors
4. Provide relevant information (such as response rates, distributions of scores, etc.)
5. Train evaluators

Economists could use these recommendations to initiate a more in depth conversation on ways to reduce the impact of biases in general in SET scores, and the extent to which SETs measure teaching effectiveness. Indeed, gender biases are not the only biases that affect SET scores. For instance, there is evidence that SET scores can even be influenced by cookies. In a randomised controlled trial conducted in Germany on medical students, researchers found that providing cookies to students during one course generated an increase in SET scores, including on criteria such as the quality of the course content (Hessler et al. 2018).

SET scores are unlikely to ever measure teaching effectiveness objectively. Nonetheless, there are ways to improve how universities use them, such that some groups of instructors are not treated unfairly.

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Part V: What else can we do?

17 Mentoring matters for women in economics

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Research shows that women's representation in academic economics has stalled since 2000 in comparison to marked progress for women in other science disciplines (Lundberg and Stearns 2019, Kahn and Ginther 2018, CSWEP Annual Report 2019). Researchers have highlighted numerous barriers to women's progress in the profession, such as reduced access to mentoring and social networks, as well as possible biases in the refereeing process (see Lundberg and Stearns 2019 for a review). The recent American Economics Association (AEA) climate survey prompted the past, current, and future presidents of the Association to acknowledge that 'many members of the profession have suffered harassment and discrimination during their careers, including both overt acts of abuse and more subtle forms of marginalisation' (Blanchard et al. 2019).

The barriers facing women in the economics profession are not new. In order to facilitate success of junior economists, in 2004, the AEA's Committee on the Status of Women in the Economics Profession (CSWEP) designed and implemented the national CeMENT workshop to provide participants with senior female economist role models to transmit information about what it takes to be successful, and to build the peer networks of female junior faculty working in similar research areas.[1] Each workshop followed the AEA annual meetings and lasted two days. Participants were arranged into small groups (4-5 participants and 1-2 mentors) based on research interests. Since applications exceeded available positions in the workshop, qualified applicants were randomly assigned to participate in the treatment group or the control group within each field of economics. Each workshop held biannually between 2004-2014 had between 40-50 participants. Our interim analysis of the first three cohorts indicated

1 CSWEP also ran regional workshops for economists outside research universities which were not evaluated by random assignment.

that the CEMENT programme increased the number of publications and the number of federal grants for treated individuals (Blau et al. 2010).

Our new paper, Ginther et al, (2020) evaluates differences between the treatment and control groups of the six CeMENT cohorts in academic employment, tenure status, publications and grants. Our individuals are observed from four to fourteen years post-intervention through the autumn of 2018, allowing us to examine long-run outcomes such as tenure. In order to conduct our analyses, we scraped publication data from *Web of Science* and cross-checked these publications with curriculum vitae (CVs) where available. In addition, we matched individuals to grant data retrieved from the National Science Foundation and the National Institutes of Health. We verified tenure status using CVs or by contacting individuals directly. We used measures developed by Kalaitzidakis, Stengos, and Mamuneas (2003) to obtain a world ranking of institutions in economics for PhD-granting institutions and current employers. Although our treatment and control groups were well-balanced, several members of the control group reapplied and some were eventually treated. As a result, we used instrumental variables to estimate the intent-to-treat (ITT) where the treatment assignment of the first application was used as an instrument for eventual treatment. Our estimation sample includes 368 observations divided between 205 participants in the treatment group and 163 non-participants in the control group.

Table 1 shows the main results from our paper. We estimated the probability of being employed in tenure stream academia, tenure stream academia in a top-100 ranked department, being tenured, tenured in a top-30 ranked department, tenured in a top-50 ranked department, tenured in a top-100 ranked department, tenured in an unranked (201+) department, and the last observed job being non-academic. Participation in the mentoring workshop increased the probability of having a tenure stream job by 10.7 percentage points (pp), or 14.5% relative to the mean and the probability of having a tenure stream job in a top-100 institution by 16.3 pp or 57.1%. With respect to tenure itself, the treatment increased the probability of a tenured job in an institution ranked in the top 30 by 6.7 pp (77.0%) and increased the probability of tenure in a top-50 ranked institution by 9.0 pp (72.0 %). At the same time, participants had a significantly lower probability of having a tenured position at a 200+ (unranked) institution; this probability was reduced by 11.9 pp (63.3 %). These offsetting effects help explain why the 'Any Tenure' coefficient is small and statistically insignificant. The treatment also significantly lowered the probability of holding a nonacademic job by 9.3 pp or 39.7% relative to the mean.

Table 1 IV Estimates of intention to treat effects on outcomes

	Tenure Stream	Top 100 Tenure Stream	Any Tenure	Tenured Top 30	Tenured Top 50	Tenured Top 100	Tenured 201+	Last Job Non-Academic
Treated	0.107**	0.163***	-0.044	0.067*	0.090**	0.070	-0.119**	-0.093*
	[0.055]	[0.056]	[0.057]	[0.034]	[0.040]	[0.047]	[0.048]	[0.052]
Constant	0.693***	0.341**	-0.115	-0.015	-0.251**	-0.107	-0.127	0.210
	[0.167]	[0.171]	[0.175]	[0.105]	[0.122]	[0.145]	[0.147]	[0.160]
R-squared Mean	0.037	0.039	0.176	0.067	0.095	0.068	0.056	0.042
Dep. Var.	0.739	0.285	0.549	0.087	0.125	0.185	0.188	0.234

Note: There are 368 observations. Standard errors in brackets. All regressions include dummy variables for each cohort and for years 8 to 16+ since PhD. R-squared for the first stage is 0.816. F-statistic for the first stage regressors is 86.21. * p<.10, **p<.05, ***p<.01.

We also explored potential mechanisms for the tenure stream and tenured results. Our intent to treat estimates show that National Science Foundation (NSF) or National Institutes of Health (NIH) grants increased by 14.4pp (52.6%, p<0.12) and pre-tenure publications increased by 1.5 publications (20.6% compared to the mean, p<0.05). We categorised publications into the top 5 journals (*AER*, *QJE*, *JPE*, *Econometrica*, and *ReStud*), rank 2 (other highly ranked) journals (e.g. *RESTAT JOLE*, *JMCB*, etc), and rank 3 (other refereed) journals. The number of pre-tenure top 5 publications increased by 0.22 (69.3% compared to the mean) for the treated group (p<0.05). Women in the treated group had 0.49 more rank 2 publications (20.4% compared to the mean) in highly regarded journals (p<0.09). Finally, the treated women had 0.81 additional rank 3 publications (17.3% compared to the mean) in refereed journals (p<0.13). When we controlled for pre-tenure publications and grants, the probability of receiving tenure in a top 30 department falls by half and is no longer significant. However, the estimated effect of holding tenure in a top 50 department remains marginally significant. These estimates suggest that in addition to its effect of increasing publications and grants, the workshop may have provided additional tools such as role models, networks and information about how to navigate the system that facilitated tenured success for the treated women.

Our research shows the positive impacts of mentoring for the retention of women in academic economics careers. It is remarkable that this two-day workshop intervention has had such long-lasting effects on women's careers. We know from experience that many CeMENT participants have remained in contact after the workshop for several years and have used this network for advice and support. Our results underscore the

importance of mentors and networks for facilitating women's success in economics. We conclude that the CeMENT programme has yielded positive outcomes for women and should continue to be supported as an approach to contribute to the diversity of the economics profession.

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Acknowledgements

We are grateful to the many women who have volunteered their time to participate in this experiment. We are grateful to the National Science Foundation (SBE-0317755) and the American Economic Association for their financial support of the mentoring workshops and to the National Science Foundation (SES-1547054) for funding this evaluation; and to Daniel Newlon, Alice Hogan, Nancy Lutz, and John Siegfried, for supporting this programme. Gwyn Loftis, and Pat Fisher provided invaluable help with the initial implementing the workshops. Many students have helped with data collection and analysis over the years but we would like to single out Molly Schnell and Rina Na for special thanks. Any errors are our own responsibility.

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18 Proven strategies for making economics work for women

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The economics profession is in the midst of a gender 'reckoning' that has increased interest in addressing the under-representation of women at all levels of our field (Smith 2018, Tankersley and Scheiber 2018, Casselman et al. 2020). Fortunately, there is a growing body of research that has evaluated strategies for attracting and retaining women in economics and similar disciplines. Much of this research has used the tools of rigorous policy evaluation, including randomised controlled trials (RCTs), to evaluate interventions, so that we now have high-quality evidence that can help identify approaches that are likely to be effective. In my article *Fixing the leaky pipeline: Strategies for making economics work for women at every stage* (Buckles 2019), I draw upon this work to provide a toolkit for those who want to increase the representation of women in economics. Here, I want to highlight three of the most promising interventions from that toolkit for which the evidence of efficacy is strong and the estimated benefits are large relative to their costs. I also provide some general guidance for implementing these and other interventions.

Three success stories

First, as part of Tatyana Avilova and Claudia Goldin's Undergraduate Women in Economics Challenge (2018), Hsueh-Hsiang Li at Colorado State University conducted an RCT to evaluate an information intervention among students in an undergraduate Principles of Economics course (Li 2018). Sections of the course were assigned to one of three groups. Students in sections in the first group received information about career prospects and average earnings for economics majors, along with a description of the grade distribution for the course. Women whose grades were above the median at the midterm also received an email encouraging them to major in economics. Sections in the second group received this treatment, and all women were also invited to a series of mentoring activities. Sections in the third group (the control group) received no treatment. Women with midterm grades above the median who received either the full

or partial treatment were about six percentage points more likely to major in economics, from of a base of about 13%. These students were also more likely to say that they expected to enjoy studying and working in economics in a follow-up survey, and that they believed they could succeed in economics. (There was no statistically significant difference in the effect of full or partial treatment, perhaps because take-up of the mentoring activities was very low). This low-cost information intervention appears to have had large effects on undergraduate women's engagement with economics.

Second, programmes designed to reduce gender bias in the academic hiring process have proven to be effective at increasing the number of women who are hired. In an RCT at the University of Wisconsin-Madison involving 92 academic departments in fields involving science, technology, engineering, and mathematics, half of the study's departments were randomly chosen to participate in a series of workshops on gender bias, while the other half served as a control group. The treatment group not only saw an increase in faculty members' awareness of gender bias issues and 'self-efficacy to engage in gender-equity promoting behaviors' in the short term (Carnes et al. 2015), but also increased the proportion of women hired after the intervention by 18 percentage points (Devine et al. 2017). In departments where women were under-represented, there was an increase in the probability of making a job offer to a woman (Fine et al. 2014). Similar interventions at Montana State University and the University of Michigan also led to increases in offers to women and to increases in the probability that female candidates accepted those offers (Smith et al. 2015, Stewart et al. 2004).

Third, targeted mentoring has been suggested as a potential tool for advancing women's careers by reducing information asymmetries, providing a support system, or connecting women with role models (Meschitti and Lawton-Smith 2017, Croson and McGoldrick 2007). Since 2004, the American Economic Association's Committee on the Status of Women in the Economics Profession has conducted two-day mentoring workshops, known as CeMENT, for junior women with research-focused jobs. Participants in the programme are organised into small groups by research field, with each group including both senior mentors and junior mentees. The groups offer feedback on one another's work. Participants also attend panel discussions on issues such as publishing, promotion, and work-life balance. The founders of the CeMENT programme took advantage of the fact that the programme was oversubscribed to conduct an RCT—the scarce spots were allocated randomly, which created treatment and control groups that have now been followed for several years after the workshop. A study evaluating intermediate outcomes for the first two cohorts of participants showed promising results (Blau et al. 2010). Three years after the programme, participants in the treatment group had 1.622 more publications and 0.09 more top-tier publications than the control sample on average. For the first cohort, outcomes were also observable

five years after treatment, and the effects on total and top-tier publications was 2.677 and 0.200, respectively. A follow-up study shows that participants were more likely to receive tenure in a top-50 department, and that the effect is mostly (but not entirely) explained by the increase in publications (Ginther et al. 2020). Given this success, the CeMENT programme has expanded over the years. Initially a biannual event, it is now held annually, with separate workshops for faculty from institutions with and without doctoral programmes.

Applying what we've learned

Each of these three interventions targeted a different population of women – undergraduate women, job candidates, and junior women already in research jobs, respectively. However, there are pieces of each intervention that could be adapted for different audiences or purposes. The information intervention at Colorado State could be replicated for high school economics students; the anti-bias training that affected the decisions of hiring committees could also be useful for promotion committees; the CeMENT workshops could be adapted for graduate students, associate professors, or for those in the government or technology sectors. The success of these programmes should inspire innovation – and ideally, further evaluation.

I do want to emphasise that while many of the interventions discussed here have been shown to yield important benefits, they also have costs. The CeMENT mentoring programme requires a significant time investment from its mentors and even more from its organisers; anti-bias training can be expensive and requires faculty time; even lower-cost information interventions require time to plan and manage. As Bayer and Rouse (2016) argued, the entire profession is likely to benefit from a more diverse membership, as the range of views that are represented expands and group dynamics and decision-making improve. The costs of working toward that goal should not fall on the shoulders of women and under-represented groups alone.

Finally, while this article and my 2019 paper highlight interventions that have been evaluated in a way that allows for credible estimation of a causal effect, those willing to work toward greater diversity and inclusion in economics should not ignore the wealth of resources that describe thoughtful and inventive strategies that do not yet meet this standard (see Buckles (2019) for some examples). Research in this area faces several challenges to causal identification – it can be difficult to find reasonable comparison samples, treatments are often bundled, and outcomes can be difficult to measure or take years to be realised. Even in cases where a 'gold standard' randomised trial was used to evaluate an intervention, questions about external validity and replicability

remain. As a result, we will likely have to try some things without knowing for certain that they will work. This is especially true at the mid-career and K-12 stages, where rigorous evidence on effective strategies is virtually non-existent. But this challenge also presents an opportunity for the profession to put its policy evaluation toolkit to work to advance knowledge, by building evaluation into implementation of policies or by finding creative ways to evaluate interventions after they have occurred.

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About the author

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Women are substantially under-represented in the field of economics. Few women reach senior positions in the profession, even though over the last few decades, between 30% and 35% of PhDs in economics have been earned by women. Women in economics face clear barriers to field entry and professional success that are distinct from those in other mathematics-focused fields. Women also appear to face implicit bias in the assessment of their research and other professional contributions that limit their success and persistence in the field

This book, featuring leading experts on the issue of gender in economics, examines the role and progress of women in professional economics, reviews the barriers women that face at various stages of the training and promotional pipeline, evaluates programmes designed to support and encourage female economists, and discusses the benefits of greater gender equality across the economics research professions.

Beginning with an overview of the representation of women in economics departments in the United States and in Europe, the opening chapters highlight the scarcity of Black women in American economics and provide some background on the 'first gender reckoning' of economics. Later chapters examine the forces that discourage women from majoring in economics as undergraduates and how they might be combatted, and on the paths to success for female graduate students. The book also documents differential treatment of women in the evaluation of research for publication and acceptance at conferences, as well as gender differences in collaborative networks that may affect research productivity. The 'leaky pipeline' in economics is reviewed, with a focus on the promotion gender gap in academics and central banking, and institutional factors that contribute to that gap, including gender bias in student evaluations and the inequitable consequences of gender-neutral tenure-clock-extension policies. The concluding chapters returns to policies and programmes that can support women and combat bias at all stages of the professional pipeline in economics.

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ISBN 978-1-912179-27-5
9 781912 179275 >

CEPR Press