Finance and Economics Discussion Series

Federal Reserve Board, Washington, D.C.
ISSN 1936-2854 (Print)
ISSN 2767-3898 (Online)

Measuring Inclusion: Gender and Coauthorship at the Federal Reserve Board

Deepa D. Datta, Robert J. Vigfusson

2024-091

Please cite this paper as:
Datta, Deepa D., and Robert J. Vigfusson (2024). "Measuring Inclusion: Gender and Coauthorship at the Federal Reserve Board," Finance and Economics Discussion Series 2024-091. Washington: Board of Governors of the Federal Reserve System, https://doi.org/10.17016/FEDS.2024.091.

Measuring Inclusion: Gender and Coauthorship at the Federal Reserve Board*

Deepa D. Datta† Robert J. Vigfusson‡

November 7, 2024

Abstract

Relative to diversity, inclusion is much harder to measure. We measure inclusion of women in economics using novel data on coauthoring relationships among Federal Reserve Board economists. Individual coauthoring relationships are voluntary, yet inclusion in coauthoring networks can be central to research productivity and career success. We document *gender affinity* in coauthoring, with individuals up to 34 percent more likely to have a same-gender coauthor in the data relative to what would be predicted by random assignment. Because women account for under 30 percent of Federal Reserve Board economists, gender affinity in coauthoring relationships may reduce research opportunities for women relative to their men peers. Whereas commonality of research interests is not sufficient to explain observed gender affinity in coauthoring, we find that paper outcomes may encourage gender affinity, in that papers authored by only men are more downloaded and more likely to be published than papers by mixed-gender teams. Gender affinity may contribute to the gender gap in authoring as well: women make up only 23 percent of authors in the later part of our sample, about 4 percentage points below their share of the economist population. We estimate that reducing gender affinity by men could eliminate between 1.5 to 3 percentage points of the gender gap in observed research output by women. Our findings on gender affinity in coauthoring provide an empirical assessment of the state of inclusivity in economics.

JEL Classification: A14, J16, E58.

Keywords: central banks, coauthoring networks, diversity, gender affinity, inclusion, leaky pipeline.

*We thank Carolyn Davin, Joshua Hu, Jessica Liu, Grace Lofstrom, and Aditya Pande for excellent research assistance. We also thank Anusha Chari, Paul Goldsmith-Pinkham, Erin Hengel, Sune Karlsson, Shelly Lundberg, and Jenna Stearns for generously sharing their data with us, and thank Giulia Sestieri and Abigail Wozniak for helpful comments and discussions. This work is not related to Robert's position at Amazon. The views in this paper are solely the responsibility of the authors and should not be interpreted as reflecting the views of Amazon and its subsidiaries or the Board of Governors of the Federal Reserve System or of any other person associated with the Federal Reserve System.

†Board of Governors of the Federal Reserve System. Email: deepa.d.datta@frb.gov.

‡Amazon. Email: robvig@amazon.com.

1 Introduction

Relative to diversity, inclusion is much harder to measure. Yet, inclusion is central to success in the economics profession. Professional networks provide crucial support including much needed critical feedback on research, conference and seminar invitations, and access to a potentially "hidden curriculum" for navigating issues related to the publication process or career advancement.

In this paper, we measure inclusion of women in economics using coauthoring relationships among economists at the Board of Governors of the Federal Reserve System (Federal Reserve Board, or FRB). Coauthoring relationships are an informative measure for inclusion. Coauthoring relationships are voluntary, so they measure individual preferences. Coauthoring relationships are time intensive, as individual projects take months to years from inception to realization. As such, coauthoring provides a deep and costly measure of true inclusion. Finally, coauthoring relationships are important. Finding coauthors is a big help to research productivity, and, conversely, barriers to coauthorship may impede productivity and career progression. Given that only 28 percent of economists at the Federal Reserve Board are women, gender affinity in coauthorship selections may lead to fewer collaboration opportunities for women, resulting in women having lower observed productivity as measured by the number of working papers per person.

Although we document evidence of gender affinity among economists at the Federal Reserve Board, our work should not be interpreted as showing that the Federal Reserve Board faces greater inclusion challenges than at universities or other institutions. Indeed, we show that, unlike universities—where the so-called "leaky pipeline" results in lower women's representation among senior professors than among junior professors—the Federal Reserve Board has roughly the same level of women's representation at all levels of seniority. In addition, the large population of over 100 women economists at the Federal Reserve Board also provides more same-gender coauthoring opportunities for women than at smaller institutions. Further, we identify that one potential motivation for gender affinity by men could be that gender affinity seems to improve men's chances of journal publication. Given that others have found broad evidence of gender bias in the journal publication process (Hengel, 2022; Hengel and Moon, 2023; Alexander et al., 2023; Card et al., 2020), this driver of gender affinity likely applies at all research institutions and universities.

Using web-scraped data, we construct a new data set of economists at the Federal Reserve Board over the past two decades. We combine these data with information on FRB working papers to study gender inclusivity in coauthorship patterns. We find that, over the past 20 years, FRB men have consistently displayed a high degree of gender affinity, coauthoring more frequently with other men than would be expected based on random matching. Among two- and three-authored papers, about 25 percent more of them are authored by men-only teams relative to what would be expected by random chance. We find evidence of gender affinity among women as well, especially

in the past decade, when the number of FRB women economists increased relative to earlier years. Overall, both men and women are up to 34 percent more likely to have a same-gender coauthor in the data relative to what would be predicted by random assignment. The net effect of gender affinity is to increase the gender gap in authoring with women making up only 23 percent of authors in the later part of our sample, about 4 percentage points below their share of the economist population. Motivated by these findings, we develop a model of coauthor team formation and show that eliminating gender affinity could reduce the gender gap in research paper production by up to 3 percentage points.

One might question whether the observed gender affinity is driven by men and women being different either in their research interests or the frequency of their social or professional interactions. We find that these gender affinity results hold up even after controlling for other variables that predict coauthorship, most notably using data on organizational structure that reflect commonality of research interests as well as high likelihood of collaborating on policy questions.

We also examine paper outcomes, including both downloads in the first year after release and probability of publication in a journal. We find that outcomes may encourage gender affinity. Papers authored by only men get more downloads and are more likely to be published than mixed-gender teams. Although women-only teams used to get fewer downloads than those by mixed-gender teams, that penalty has disappeared over the past decade. However, papers by women-only teams are still less likely to be published than those by mixed-gender or men-only teams.

Lastly, in addition to measuring coauthoring relationships and paper outcomes, we examine how FRB economists' authoring profiles change over time, conditioning on early-career paper writing. We find little difference between men and women in the rate of coauthoring and writing in the first three years at the Federal Reserve Board. However, we find that women who either do not write papers in their first three years or write papers but do not coauthor with other FRB economists are much less likely to write papers in subsequent years than men with similar profiles. Although we are sensitive to the risks of selection, these findings highlight a potential upside of encouraging coauthorship for early-career economists.

To support our empirical work, we construct a data set of over 3,600 working papers published by the Federal Reserve Board and over 2,000 individuals, including internal and external coauthors on these papers and additional information on all FRB economists since 2003. Consequently, an additional contribution of our work is this constructed data set of economists, gender tags, and some professional history, including Ph.D. year and working papers. The number of economists at the Federal Reserve Board makes it at least one of the largest concentrations of Ph.D. economists at one institution. FRB economists are active researchers, and the Federal Reserve Board typically

is among the top 20 economic institutions, when ranked by research output.[1] A benefit of using our data for this and future research is that FRB economists constitute a large population within a relatively homogeneous environment. In particular, the variation in responsibilities and resources across the hundreds of FRB economists is much smaller than differences across a similar-sized group of university professors that would be spread across many institutions.

Our findings of gender affinity and a lack of inclusion highlight challenges for both the careers of individual women economists and the Federal Reserve Board as an institution.

Although there are many ways to progress at the Federal Reserve Board, research output is an important factor in promotion decisions for economists.[2] Given the importance of research, we have identified two barriers in producing and publishing research that can harm women's careers at the Federal Reserve Board. First, gender affinity reduces women's opportunities to build coauthorship networks, which as shown in Ductor (2015) and Ductor et al. (2023) can harm research productivity. In particular, Ductor et al. (2023) estimates that, for their sample, differences in coauthorship networks explain 18 percent of the gender gap in research output. These effects from smaller networks may be particularly harmful given the trend towards more coauthorship.[3]

Second, our finding that women-only teams are less likely to be published highlights a challenge with basing internal promotion decisions on external validation such as peer-reviewed publications. Even when an internal goal is to be gender neutral, relying too heavily on external validation for promotion decisions may introduce gender bias if the external validation process is biased.

Beyond being a problem for individual women economists, limited gender inclusivity in coauthoring could be a broader concern for the Federal Reserve Board as an institution. As Hospido et al. (2022) note, "given the influence central banks wield over the economic well-being of the public at large, a better understanding of the factors that hold back women at these institutions is of great importance." More broadly, Chair Jerome Powell has said that diversity and inclusion make the Federal Reserve System stronger by providing a richer pool of experience that reflects more points of view and can help Federal Reserve leadership make better decisions. He notes: "If we are inclusive in our work, listening hard to a wide range of views and learning from different

[1] See RePEc (n.d.), "Top 10% Economic Institutions, as of June 2024," IDEAS database, webpage, https://ideas.repec.org/top/top.inst.all.html.

[2] As highlighted in a recent FRB Office of the Inspector General report, it is a common view within the Federal Reserve Board that the skills acquired through independent research strengthen other economic analysis (Lyons et al., 2021).

[3] In our data, we observe a steady trend toward more coauthorship. Solo-authored papers have declined from 57 percent of papers before 1990 to just 23 percent of papers since 2010, and three-authored papers have increased from 6 to 28 percent.

experiences, then we will reap the benefits of diversity."[4] Consequently, the lack of inclusivity suggested by coauthoring relationships at the Federal Reserve Board is worth investigating, as it could potentially diminish women's contributions or career progression and thus the overall strength of the Federal Reserve Board.

Although our paper is unique in its use of FRB coauthoring relationships to measure inclusion relative to a random benchmark, other papers have also studied gender representation amongst economists at either the Federal Reserve System or in academia. For example, Datta and Tzur-Ilan (2024) use our data on FRB economists and research papers combined with analogous data from the 12 regional Federal Reserve Banks to study research and policy output. They find similar levels of women's representation as well as a similar research output gap as we find here, but find no gender gap in policy output, highlighting the gender gap in independent research rather than all economic analysis. Azzimonti-Renzo et al. (2023) also study the 12 regional Federal Reserve Banks and find similar levels of women's representation, as do Auriol et al. (2022) in their study comparing U.S. and European economics departments. Davies (2022) illustrates similar patterns of gender sorting among authors of working papers published by the National Bureau of Economic Research (NBER). Sherman and Tookes (2022) report that women in finance tend to have fewer coauthors overall, but more women coauthors, than their men peers. Ductor et al. (2023) find that women in economics have fewer collaborators, collaborate more often with the same coauthors, and have more clustering within coauthors. Further, they find that all these characteristics are associated with lower overall productivity.

Lastly, McDowell et al. (2006) study coauthorships in published papers among American Economic Association members for six years between 1964 and 1998. They model the joint decision to coauthor and publish and then attribute women's lower coauthoring rates as arising from their lower rate of publication. By contrast, we view the lower rate of publication among women as potentially an outcome of lower coauthoring.

Our work complements these papers by studying economists all working within a single institution and by reviewing working papers, which are not subject to the potential gate-keeping elements of peer-reviewed publications. Previous findings of gender affinity within broad academic networks may plausibly be driven by differences in institutional resources or social networking constraints. By contrast, our findings apply within a single institution and even within small teams of economists sorted by research interests and so point to inclusion affecting collaboration and hence research productivity even beyond factors such as institutional rank or social network opportunities.

[4]See Jerome H. Powell (2018) "Chairman Powell's Message to Federal Reserve System Staff on Diversity and Inclusion," October 9, quoted text on p. 2, https://www.federalreserve.gov/mediacenter/files/chairman-powell-diversity-transcript-20181009.pdf.

The divergence between predicted and observed gender sorting in coauthorship may also provide insight into the state of inclusivity in the profession. Our finding that a lack of gender inclusivity in coauthoring harms women suggests that a lack of inclusivity in a broader set of professional interactions, such as conference and seminar invitations or informal social networking, could also be harmful. Indeed, Chari and Goldsmith-Pinkham (2017) find that among prestigious conferences organized by the National Bureau of Economic Research, when a woman organizes the program, the share of women on the program is higher. Additionally, Wu (2018) finds that in discussions on a popular online economics forum, postings about women tend to highlight physical appearance, personal information, and sexism, whereas those about men are more academically or professionally oriented.

Our results are also limited to findings on gender due to data limitations but may indicate lack of inclusivity across a wider range of personal and professional characteristics, such as race, ethnicity, nationality, university affiliation, and even socioeconomic diversity. Such lack of inclusivity may be related to the finding by Stansbury and Schultz (2023) that U.S. economics Ph.D. recipients, especially those from higher-ranked programs, are substantially less likely to have parents without a college degree than Ph.D. recipients in other disciplines. This lack of diversity may be driven by lack of inclusion in our profession and also may be indicative of the importance of inclusion and access for professional success.

The remainder of the paper is organized as follows: Section 2 describes our data collection and construction, and Section 3 summarizes our findings on gender gaps in representation and research output. We outline our models of coauthorship team formation in Section 4 and then further examine how team formation may be affected by institutional organization and overlapping research interests in Section 5. Section 6 studies paper outcomes, and Section 7 presents how coauthoring can affect career progression. Section 8 concludes.

2 Data construction

Our data on coauthorship comes from observing working papers in the International Finance Discussion Papers (IFDP) and Finance and Economics Discussion Series (FEDS) working papers series. Papers released in the FEDS and IFDP series are subject to internal peer-review, and the views expressed represent views of the staff and do not indicate concurrence either by other members of FRB staff or by the Board of Governors. We obtain the paper titles and authors from the RePEc (Research Papers in Economics) website, which lists more than 1,300 IFDP and 2,300 FEDS working papers, or about 3,650 papers total (LogEc, 2022a,b). Using the FRB website, we also associate each of these papers with a publication year, ranging from 1971 to 2022 for the IFDP series and 1987 to 2022 for the FEDS series (Board of Governors of the Federal Reserve System,

2022a,b). Each paper is written by between 1 and 14 authors, and, in sum, our data set has 2,379 unique authors across these 3,650 papers.

Although FRB economists do not have a specific requirement to produce working papers, research output does factor into economist promotion decisions. Research output includes both FEDS and IFDP releases, as well as papers released in other working papers series (such as those affiliated with the Federal Reserve Banks or the National Bureau of Economic Research), conference presentations, and peer-reviewed publications. Although our data only includes those working papers and publications which are at some point released as a FEDS or IFDP working paper, our exclusion of those peer-reviewed publications and working papers which are not part of the FEDS and IFDP series likely does not skew our analysis. Anecdotally we find that most FRB economists release most of their working papers through the FEDS or IFDP series.

Next, we generate a list of past and present FRB economists, based on archived versions of the FRB public website (Board of Governors of the Federal Reserve System, 2022c). We use the Wayback Machine, which crawls the internet to capture and archive webpages as they are at certain points in time, often multiple times a month (Internet Archive, 2019). Using Python, we scrape each of these captures to collect the names of all FRB economists listed at each point in time. Given the appearance and disappearance of individuals from the website over time, the web scraping allows us to track economists' starting years and departure years (if applicable), giving us individuals' length and timing of service. We scrape over 200 captures of the FRB website from March 2003, when it is first listed in the Wayback Machine, to April 2022, giving us 730 economists who were employed at the Federal Reserve Board at some point over this period (Board of Governors of the Federal Reserve System, 2002, 2022c).

The webpages also provide important information on additional covariates, including detailing the FRB organizational structure and economists' Ph.D. years and universities. In particular, websites report economists' division and section affiliations. During our sample period, the majority of FRB economists are assigned to one of four divisions: Research and Statistics, Monetary Affairs, International Finance, and (since 2011) Financial Stability. Additionally, our data set includes economists working in three other divisions: Consumer and Community Affairs, Supervision and Regulation, and Reserve Bank Operations and Payment Systems.[5]

Within divisions, economists are divided into sections that are organized by research interests and policy responsibilities, with section membership typically assigned based on economists' primary research interests. For example, both of the current authors were previously members of a section that covers developments in U.S. trade and commodity prices and have coauthored work on

[5]The website also lists the Division of Board Members, which includes advisers to members of the Board of Governors. As all the individuals publicly listed in the Division of Board Members also have other division affiliations, we omit this division from our analysis.

these topics (e.g., Datta et al. (2021)). In contrast, other sections focus on other areas of interest, such as developments in labor markets or capital markets. Economists can switch sections and divisions over time, though many economists spend large parts of their careers in a single section. As is evident from this paper, section membership does not require economists to work exclusively on topics relevant to the section's focus.

As we will show below, having common section membership is an important determinant of whether two economists coauthor. Its importance is likely determined by two factors: greater common research interests and greater familiarity. Section membership increases familiarity through assigned policy collaborations, as economists typically work most closely with other members of their own section. Additionally, common section membership typically increases physical proximity. An economist's office is generally located near those of other section members, and especially before the COVID-19 pandemic, economists spent much of the workweek in their offices.

Overall, the web-scraped data have several advantages and some disadvantages relative to administrative data, e.g. from human resources. The main advantage is that the web-scraped data are not confidential and so can be shared much more readily. The main disadvantage is that website updates beyond dates of FRB employment are self-managed. As such, an economist's promotion and section affiliation may not be reflected on the website until some time has passed. Consequently, we use all of the information from the FRB website that we can trust as accurate and timely, such as service dates and section and division affiliation. However, to avoid introducing biases that could arise from potential gender differences in self-reporting, we do not use any information that could be subject to self-reporting bias or delay, such as promotions or the precise timing of section and division affiliation. Importantly, this feature of the data requires us to define section and division membership or affiliation as non-time-varying and inclusive of everyone who was ever listed as being in that section or division. Future work that uses these data should be mindful of these challenges.

Combining our set of working paper authors with our set of FRB economists, we have about 2,400 unique individuals in our sample. Of the 730 FRB economists in our data, 617 are also authors of working papers.

We gender tag these individuals using a variety of methods. In addition to using personal knowledge and picture identification from the current FRB website, we supplement the data with the gender tags generated by Chari and Goldsmith-Pinkham (2017) and Hengel (2022). Next, as in Chari and Goldsmith-Pinkham (2017), we gender tag individuals using the Tang et al. (2011) gender dictionary. The dictionary lists first names along with a count of individuals self-reporting as men and women with each name, using Facebook as an underlying source. From these counts, we generate the probability that a name is associated with being a man or a woman. If a name is associated with one gender at least 95 percent of the time, we use that gender assignment.

Finally, we do web searches to identify individuals who remain untagged by these sources. Of the 2,400 individuals in our data set, around one-third are identified by existing economist data sets, one-third are identified using the Tang et al. dictionary, and one-third are manually identified, meaning they are tagged using our personal knowledge of the individuals, picture identification, or by finding pronoun references in internet searches. Overall, we have 536 women and 1,843 men.

To investigate the accuracy of our gender tagging, we consider the subset of individuals listed as FRB economists on the Wayback Machine capture from January 20, 2017 (Board of Governors of the Federal Reserve System, 2017). For these individuals, we generate manual gender tags using personal knowledge and picture identification, and compare these tags with those produced by the Tang et al., Chari and Goldsmith-Pinkham, and Hengel dictionaries. We find that of these 406 economists, 171 were tagged by the Chari and Goldsmith-Pinkham and Hengel dictionaries, and 184 were tagged by the Tang et al. dictionary, leaving 51 untagged. Our manual gender tagging (based on personal knowledge as well as picture identification) agreed with all 44 of the overlapping tags generated from the Hengel dictionary, with 147 of 149 of the overlapping tags generated from the Chari and Goldsmith-Pinkham dictionary and with 314 of 316 of the gender tags generated from the Tang et al. dictionary.[6] We conclude from this investigation that the use of the three dictionaries provides fairly accurate gender tags, making our data set of economists with gender tags a substantial contribution to further research on gender issues in the economics profession.

3 Data summary

3.1 Gender of potential coauthors

Before considering the patterns of coauthorship across genders within FRB working papers, we first document the share of women economists at the Federal Reserve Board. As 42 percent of FRB working paper authors are external coauthors, we also document the share of women economists in a few other relevant external populations.

As shown in Table 1, of the 730 FRB economists in our sample, 191 are women, equivalent to about 26 percent. Figure 1 shows that the number of economists at the Federal Reserve Board roughly doubles over our sample period, from about 225 in 2004 to nearly 450 in 2021. As seen in Figure 2, over this period the share of women economists rises from just below 25 percent in 2004 to nearly 30 percent in 2013 before falling back slightly to 27 percent in 2021. Given this slightly

[6] A common error was for individuals with the first name "Michele," prompting us to manually gender tag all individuals with this first name in our data set.

larger share and growing economist population, the *number* of FRB women economists more than doubles over this 20-year period.

The share of women within each hiring cohort has varied widely, reaching below 15 percent and above 40 percent in multiple years. Figure 3 shows the number of men and women hired by the Federal Reserve Board in each year, while Figure 4 shows the number of *net hires* by the Federal Reserve Board in each year, which accounts for the departures of men and women economists. Between 2003 and 2013, the share of hired economists that are women is well above 25 percent, while the share of departing economists that are women is around 25 percent. In the last part of the sample, however, the women's share of departing economists rises and the women's share of new hires falls back, contributing to the slight decline in the share of women economists at the Federal Reserve Board.

How do these numbers compare with the share of women economists in the profession? As noted in the 2023 Annual Report by the Committee on the Status of Women in the Economics Profession (CSWEP), the share of women tenured and tenure-track economists at U.S. universities was about 23.9 percent in 2023, ranging from 17.5 percent of full professors to 33.5 percent of assistant professors (Chari, 2023). Women were 37.2 percent of all non-tenure-track faculty. Additionally, in 2023, 31.9 percent of U.S. Ph.D.'s in economics were granted to women. Based on these numbers, the share of women economists at the Federal Reserve Board seems to be similar to the share of women economists in comparable academic institutions.[7]

One key difference between the Federal Reserve Board and academia, however, is the share of women at various levels of seniority. Others have found that the share of women declines when moving from more junior to more senior faculty in academic departments (Chari, 2023; Lundberg and Stearns, 2019). In contrast, we find that women are similarly represented at the lower and higher levels of seniority at the Federal Reserve Board (see Figure 5). Having less of a "leaky pipeline" at the Federal Reserve Board than in academia may reflect the structure of the Federal Reserve Board. Because career success at the Federal Reserve Board can be gained through high performance measured using both external and internal metrics (such as briefings to policy-makers, forecast memos, or analytical contributions to current policy questions), biases in external validation such as publication and tenure review processes—as found by Hengel (2022), Sarsons (2017), Sarsons et al. (2021), and Card et al. (2020)—may be less of a headwind than elsewhere in the profession.

Another important characteristic of economists at the Federal Reserve Board is the high share of economists in the fields of macroeconomics and finance. These fields have a lower share of women than economics as a whole. For example, Chari and Goldsmith-Pinkham (2017) show that the macroeconomics and finance subfields of economics tend to have a lower share of women

[7]Bayer and Rouse (2016) have additional discussion on the state of diversity in the economics profession.

than microeconomics at the NBER Summer Institute. Based on data from Lundberg and Stearns (2019), we observe that about 25 percent of dissertations in macroeconomics and finance between 1990 and 2015 were written by women. The Federal Reserve Board having just over 25 percent women in recent years seems about in line with these statistics and is also consistent with findings by Azzimonti-Renzo et al. (2023) on gender representation across Federal Reserve Banks.

Finally, when considering the share of women among external coauthors, we might expect that because FRB economists write more papers in macroeconomics and finance than in other subfields, the share of women among external coauthors is likely to be a bit below the share of women economists in all fields. Additionally, given that FRB economists are sorted into groups based on similar fields of interest and expertise, we might expect to find a lower propensity to overcome gender affinity among external coauthorships than internal coauthorships. Indeed, among external coauthors of FRB working papers, we find that about 18 percent are women.

3.2 Section demographics

Having common section membership is an important determinant of whether two economists coauthor, as individuals in the same section are likely to have shared interests, high likelihood of policy work collaboration, and physical proximity of offices. We find that, on average, FRB economists have about nine unique coauthors, of whom about 56 percent are other FRB economists. Among an individual's set of FRB economist coauthors, we find that, on average, about 80 percent share a division affiliation and about 50 percent share a section affiliation. Similarly, in the observed coauthorship pairs among FRB economists, we find that over 85 percent share a division affiliation and nearly 60 percent share a section affiliation.

Given the high rates of coauthorship within sections, understanding the size and gender distribution across sections is informative. Though the number of sections has varied over time, the number of economists per section has remained relatively constant, with most sections having around 5 to 10 economists each. Sections do get reorganized from time to time, infrequently merging with other sections or being renamed, and, more frequently, being divided into multiple sections. Additionally, the Division of Financial Stability was established only in 2011. At the start of our sample in 2003, the three main research divisions ranged from 6 to 12 sections each.[8] At the end of our sample in 2022, the four main research divisions range in size from 5 to 17 sections each, and the three smaller divisions range from 3 to 6 sections each. Including all 7 divisions in our sample, we have 56 sections at the end of the sample and about 60 sections over our whole sample period.

[8]Though all these divisions have administrative and technology sections, we count here sections that have economists as members.

Economists sometimes move across sections and divisions over their career. On average, about 85 percent of economists have just one division affiliation, though some have two or three. About 60 percent of economists have just one section affiliation, nearly 25 percent have two, and the remainder have three or more. Additionally, because our definition of section affiliation includes anyone who is ever affiliated with a section, the median section size is 14, and the interquartile range is 9 to 26.

Women economists' share of section membership varies across sections. The distribution of the share of women across sections ranges fairly evenly between 0 and 50 percent. The share of women in the section is less than 10 percent for about 15 percent of sections. Another 17 percent of sections have more than 40 percent women. As we discuss further in Section 5.1, this dispersion across sections has implications for the likelihood that men and women coauthor. However, this dispersion does not explain our findings of gender affinity.

3.3 Number of papers

To study the rate of paper production, we first define an "authorship" as a unique paper-author observation. That is, a solo-authored paper produces one authorship, while a two-authored paper produces two authorships, one for each author. Under this definition, we abstract from the number of coauthors on each paper in the sense that an individual gets a single authorship from each paper, whether that paper has 1 or 10 coauthors.

As shown in panel A of Table 1, of the 730 FRB economists in our sample, 191 are women, equivalent to about 26 percent. Including data through 2022, the median number of authorships is 4, while the means are about 6.3 for men and 4.5 for women. The table also reports statistics in 2003 and 2021 in panels B and C. Of the 221 economists employed in 2003, 53 are women, equivalent to 24 percent. For this sample of individuals, the median number of authorships is 8 for men and 5 for women, and the means are 10.8 for men and 6.5 for women. These statistics indicate that there are some extremely productive men economists, raising the mean number of authorships. In addition, these numbers are higher than in panel A because they reflect all the working papers that these economists have produced before 2003 and through the past 20 years. Panel C provides summary statistics for economists employed in 2021. Here, 112 of the 425 economists are women, or 26 percent of the population. Given that many of the economists in this sample are just starting their publishing careers, the median number of papers is 4 for men and women, and the means are 5.9 for men and 5.0 for women.

Figure 6 shows the distribution of the number of authorships by gender. For this figure, we restrict the sample to the 307 FRB economists employed at the start of 2022 who have at least three years of FRB service. We find that the share of women with no authorships is substantially

higher than the share of men with no authorships, while the reverse is true for individuals with 11 or more authorships.[9]

Figure 7 compares the share of women economists at the Federal Reserve Board in a given year to women's share of authorships for papers published that year. Women's share of all authorships in our data set and women's share of authorships by FRB economists both rise from about 15 percent in 2004 to about 25 percent most recently. This increase takes the women's share of authorships from well below to nearly equal to the share of women economists at the Federal Reserve Board.

Overall, these statistics point to a higher rate of paper production by men than by women at the Federal Reserve Board. In our investigation of coauthorship, these differences may be an important related variable. Namely, the lower rate of observed paper production by women may be driving the coauthorship result or could be the result of it. Further, these outcomes are shaped by many covariates that may also differ by gender within the set of FRB economists, including age, years at the Federal Reserve Board, years since earning a Ph.D., likelihood of remaining at or departing the Federal Reserve Board, and the split between policy and research efforts and assignments. In our models of coauthoring that follow, we can choose the parameter representing the share of women among potential coauthors. Though other choices are possible, our benchmark metrics are based on the assumption that the share of available women coauthors is equal to the share of women in the FRB economist population.

4 Modeling coauthorship team formation

In this section, we first document the size and gender composition of coauthoring teams. Next, we model coauthoring team formation.

Table 2 presents the distribution of papers for the 2004-12 period and the 2013-21 period.[10] Notably, the average number of authors per paper has increased over time. The share of solo-authored papers has fallen from 33 to 22 percent, while the share of papers with three or more authors has risen from 30 to 43 percent.

Table 2 shows a modest increase in the share of two- and three-authored papers with majority or all women authors and the associated decline in the share of papers written by majority or all men. These statistics are consistent with the increasing share of women economists, as well as the rise in the share of women's authorships over time.

[9] In this sample, 21 men and 11 women have 0 authorships, and 53 men and 13 women have 11 or more authorships.

[10] We separated the sample after 2012 for two reasons. First, the step-up in hiring beginning in 2011 (seen in Figure 3) did increase the share of women economists by 2013 (as seen in Figure 2). Second, tests for a structural break in estimating our model described in Section 4.2 indicated a break in the sample in the middle of the sample range. Given that the break date was estimated imprecisely, we found breaking our full sample at the halfway mark to be a reasonable and convenient choice.

Now that we have documented the distribution of paper coauthorships, an obvious next question is whether the observed outcomes display gender affinity. To address this question, we find it useful to present some models, which, under certain assumptions, create mappings between the observed distribution of coauthorship teams and the share of women economists in the population.

We present two such models of increasing complexity. We present first a simple model of random matching and follow with a more complex model with coauthor team formation. The estimated models imply that the observed outcomes show greater gender affinity in team formation than what might be expected with random matching.

4.1 Random assignment conditional on number of coauthors

The first model is simple. It takes as given the number of authors on an individual paper. Conditional on this number of authors, we assume that the authors for a paper are chosen at random and independently from the pool of possible authors, with a fixed probability of an author being a woman. We then determine how frequently different gender combinations are observed under this model of random assignment and compare with the observed outcomes in our data.

The calculations underlying the model are a straightforward application of the binomial distribution for a random variable X, representing the number of women authors on a paper, with parameters n for the total number of authors on a paper and f for the probability that a single draw from the pool of authors is a woman.

Consider the case for a two-authored paper ($n = 2$). The probability that both authors are women ($X = 2$) is

$$\Pr(X = 2|n = 2) = f^2.$$

Further, the probability of both authors being men is just the probability of no authors being women,

$$\Pr(X = 0|n = 2) = (1 - f)(1 - f).$$

Finally, the probability of one author being a woman is

$$\Pr(X = 1|n = 2) = 2f(1 - f).$$

More generally, for an n-authored paper, the probability of having k women authors is

$$\Pr(X = k|n) = \binom{n}{k} f^k (1 - f)^{n-k}.$$

For very large n, a hypergeometric distribution would better reflect that we draw from the pool of authors without replacement (i.e., an author can be listed only once per paper). However, as n is

typically small relative to the population, the binomial distribution seems a reasonable approximation.

Given this model of random assignment, Table 2 reports the model share for each coauthoring team size. These shares are calculated as the predicted probability of observing the different gender groupings, under the assumption that f equals the observed population value. For these predicted values, we use the observed 25.4 percent women share of all FRB economists from 2004 to 2012 and 27.6 percent women share of FRB economists from 2013 to 2021. The table also reports the observed counts and shares of coauthor groupings. Relative to the benchmark of random assignment, the observed frequencies of two- or three-authored papers by all men are about 10 to 12 percentage points higher than would be expected. In sum, about 25 percent more of these papers are authored by men-only teams relative to what would be expected by random chance.

The next section presents an expanded model, which can fit all of the observed groupings jointly.

4.2 Modeling the joint distribution

To help us better understand the observed outcomes, our next model enriches the assumption of random assignment by moving toward a model of team formation for coauthoring relationships. Additionally, this model allows us to estimate the joint distribution across different sizes of coauthor teams rather than separately estimating the distribution for each fixed number of authors.

In this model, we first assume that every coauthoring relationship begins with a single author initiating a project. With a defined gender-specific probability, this author either solo-authors the paper or coauthors the paper with others. The coauthors are again chosen at random. However, conditional on the gender of the first author, we include a preference parameter that can increase or decrease the probability of choosing a woman coauthor.

4.2.1 Model setup

Given a population of authors, let a fraction f be women and a fraction $1 - f$ be men. Assume that a first author initiates a project. With probability g, the first author is a woman, and with probability $1 - g$, the first author is a man. A special (but reasonable) case of this model is that the probability of the first author being a woman is equal to the fraction of women in the population, $g = f$. In our more general model setup, we allow for heterogeneity in the rate at which men and women initiate projects. In particular, this setup allows us to model the case in which the share of women-initiated projects is lower than women's population share.

A woman who initiates a project will, with probability $c_w(0)$, write the paper by herself. With probability $1 - c_w(0)$, she will seek out coauthors. Let $c_w(n)$ be the probability of a woman having

n coauthors. A man with a project will, with probability $c_m(0)$, write the paper just by himself. With probability $1 - c_w(0)$, he will seek out coauthors. Let $c_m(n)$ be the probability of a man having n coauthors.

A first-author woman has a propensity p_w to favor women coauthors, and a first-author man has a propensity p_m to favor women coauthors. These propensities imply that a woman will match with a woman coauthor with probability $p_w f$ and a man will match with a woman coauthor with probability $p_m f$. Values p_w and p_m below 1 imply that the probability of matching with a woman coauthor is below the frequency of women in the population. In addition, the values of p_w and p_m can vary from 0 (will not have a woman as a coauthor) to $1/f$ (will only have a woman as a coauthor).

Given this notation, we can calculate the probability of having k women authors on an n-authored paper. As a first step, it is useful to calculate separately the probabilities of having k women authors on an n-authored paper, conditional on the gender of the author who initiates the project (i.e., the "first" author):

$$\Pr(X = k, n | First = W) = c_w(n-1) \begin{pmatrix} n-1 \\ k-1 \end{pmatrix} (1 - p_w f)^{n-k} (p_w f)^{k-1}$$

$$\Pr(X = k, n | First = M) = c_m(n-1) \begin{pmatrix} n-1 \\ k \end{pmatrix} (1 - p_m f)^{n-k-1} (p_m f)^{k}$$

Combining these two conditional distributions, we denote the unconditional distributions as:

$$\Pr(X = k, n) = g \Pr(X = k, n | First = W) + (1 - g) \Pr(X = k, n | First = M).$$

To better illustrate this model, consider a special case in which the choice is between having one or two authors on a paper. In such a case, the value of $c_m(1)$ equals $1 - c_m(0)$ and $c_w(1)$ equals $1 - c_w(0)$. Additionally, in our data, we cannot tell if a woman asks a man to coauthor or a man asks a woman to coauthor; we just see a man and a woman working together. As such, we will use $\{w, m\}$ to indicate the states wm and mw. In such a scenario, we have the following outcomes.

State	Symbol	Probability
Man writes alone	m	$(1 - g) c_m(0)$
Man writes with man	mm	$(1 - g) c_m(1)(1 - p_m f)$
Woman and man write together	$\{w, m\}$	$g c_w(1)(1 - p_w f) + (1 - g) c_m(1) p_m f$
Woman writes with woman	ww	$g c_w(1) p_w f$
Woman writes alone	w	$g c_w(0)$

4.2.2 Empirical application

Using the data reported in Table 2, we can calculate the relative frequency of each outcome. Define the value of $z(n,k)$ equal to the observed frequency of n-authored papers that have k women authors. For example, based on Table 2, for the early sample, the value of $z(1,0)$ is 0.27, which is the number of solo-authored papers by men (227) divided by the total number of papers (854).

Define a vector θ to represent the model parameters $\{f, g, p_w, p_m, c_w(.), c_m(.)\}$. We estimate the value of θ as the solution to a two-step generalized method of moments (GMM) estimation exercise. We first estimate the θ that minimizes the following loss function, $L(\theta)$:

$$L(\theta) = \sum_{n=1}^{3} \sum_{k=0}^{n} \left(z(n,k) - \Pr(X = k, n|\theta) \right)^2 .$$

This loss function is the sum of squared differences between the observed frequency of n-authored papers that have k women authors and the model-implied frequency with parameter vector θ. Our estimated model parameters are the elements of the value of θ that minimizes this sum of squared differences. We then use this estimated θ to construct a weighting matrix W based on a stacked vector version of $(z(n,k) - \Pr(X = k, n|\theta))$ for n from 1 to 3 and k from 1 to n.[11] We then estimate the value of θ that minimizes the standard second-stage GMM loss function using the weighting matrix W and the stacked vector of moments. We do this calculation for the full sample and then separately for our early and late samples. The results are reported in Table 3.

First, consider the results reported for the early sample, in row 2 of Table 3. For this sample, the estimate for g is substantially lower than f, suggesting that the share of projects initiated by women is lower than their representation in the population. The values of p_w and p_m are both below 1. As the estimated values of p_m and p_w are both around 0.8, we find that both men and women are a bit less likely to match with a woman coauthor relative to the women's share of the population. In particular, these values of p_m and p_w are consistent with women coauthoring at a frequency equivalent to them making up only $p_m f \approx p_w f \approx 0.8 * 0.254$ of the population, which would be only about 20 percent. These results suggest that both men and women are making choices that result in a lack of inclusion of women in coauthoring relationships. The last column of the table reports the estimated share of authorships by women, given the estimated model parameters. Consistent with Table 2 and Figure 7, in this earlier sample, women are underrepresented as coauthors.

As we turn to the results for the 2013-21 sample in row 3, a few changes are notable. Although f and g are both somewhat higher, the estimated share of projects initiated by women is $g = 0.241$, which remains lower than the share of women in the population, $f = 0.276$. The value of p_w is

[11] We use data on papers with up to three authors. With four authors, the large number of moments relative to parameters resulted in the loss function becoming multi-modal. As such, we focus on the three-author case here.

now above 1, suggesting that women are more likely to coauthor with each other than would be suggested by chance and perhaps pointing to more inclusive behavior by women towards other women. These results are again consistent with Table 2. Additionally, we see that p_m is still well below 1, which implies that men initiating projects are less likely to match with a woman coauthor than would be suggested by random assignment.

One open question is whether a low value of p_m represents men displaying less inclusive behavior, by not asking women to coauthor, or else some other form of an unsuccessful match, including women declining to coauthor with men, or projects failing. If women are declining proposed matches, then, in the 2004-2012 sample, where the estimated value of p_w is also less than 1, it may be the case that either both men and women were not asking women to coauthor or else women were rejecting overtures from both men and women. In contrast, in the 2013-2021 sample, the estimated value of p_w is greater than 1, while the estimated p_m is still below 1. In this period, both men and women seem to be making choices that exhibit gender affinity and therefore limit the number of mixed-gender teams. Given our estimated p_w of 1.34, the probability of a woman having a woman coauthor is 34 percent higher, reaching 37 percent as compared to the population share of 28 percent. Likewise for men, p_m being 0.64 boosts the probability of a man having a man as a coauthor from 72 to 82 percent.

These model estimations can be used to provide insights on policy strategies to boost women's authorships. As reported in row A of Table 3, given the large share of projects initiated by men, an intervention that increases p_m to 1 would boost the share of women's authorships by 3.8 percentage points to 26.8 percent, closer to women's 27.6 percent share of the population. As shown in row B, a similar intervention increasing p_m to 1 while also reducing p_w to 1 would similarly boost the share of women's authorships by 3.2 percentage points to 26.2 percent. Although such outcomes may be appealing, designing interventions aimed at boosting p_m would require further understanding of why it is currently low. Recent research has found a downtick in mixed-gender collaboration after the focus on sexual harassment triggered by the "Me Too" movement (Gertsberg, 2022), which the author attributes to senior men potentially avoiding working with more junior women to avoid the risk of being accused of improper behavior. Our own results above do find an increase in women's gender affinity that could also reflect this evolution. If a low p_m results from men failing to invite women to coauthor, then efforts to increase inclusivity in coauthoring relationships could be helpful. Alternatively, a low p_m resulting from women declining opportunities to coauthor with men may be optimal for women given evidence in the literature that women get less credit for projects coauthored with more senior men colleagues (Sarsons, 2017).

Other policy intervention options would be to boost either g or p_w. Boosting g to equal f seems a reasonable goal and worth investigating. However, this strategy results in a smaller change than boosting p_m. Setting g equal to f (row C) boosts women's authorships to 25.1 percent, 2.1

percentage points above the late sample estimate. Here, too, understanding why g is currently less than f should be done before launching an intervention. Women may be choosing to initiate fewer research projects than men (resulting in a value of g less than f) because they face a different risk-return trade off between investment in research and policy than men. Supporting this hypothesis, Datta and Tzur-Ilan (2024) report that, in contrast to the observed gender gap in research output, there is little to no gap in policy output between men and women in the Federal Reserve System. One possible reason for this difference is that women may find that their policy work is evaluated more fairly than external academic research. Indeed, it has been found that women authors are often held to higher standards in academic research (Hengel, 2022; Hengel and Moon, 2023; Card et al., 2020). Alternatively, g may be less than f because women have fewer hours to devote to research projects, either because they may be assigned more policy work or because they have fewer additional hours outside of the workday for research, perhaps due to to greater parenting or other domestic responsibilities.[12]

Finally, boosting p_w would also increase women's authorships. Boosting p_w could be interpreted as one purpose of networking events such as the CSWEP's CeMENT: Mentoring for Junior Faculty program (Ginther et al., 2020). However, a substantial increase in p_w would be required to materially change the share of women's authorships. For example, as reported in row D, boosting p_w by 50 percent to about 2.0 would result in women's share of authorships increasing 3.4 percentage points to 26.4 percent. Such an intervention would reduce the gender gap in paper production, but the women's share of authorships would remain below women's share of the economist population. If p_m remains well below 1, only interventions that boost both g and p_w (row E) would result in women's share of authorships being close to the 27.6 percent women's share of the population.

5 The determinants of coauthorships

Given these estimates of observed gender affinity, we now dive deeper into the association between gender affinity and other determinants of coauthorship. In particular, we use the structure of the Federal Reserve Board to understand whether observed gender affinity may result from confounding factors including common research interests and increased interaction.

This section provides empirical evidence regarding the likelihood that two FRB economists coauthor a paper, when conditioning on several characteristics including gender, seniority, and section membership. We find that coauthorship increases when potential collaborators finish graduate school at a similar time. We also find that coauthorship rises with common section membership,

[12]Though our sample of FRB economists are generally salaried employees who are expected to work 40 hours per week, it is common for employees to report working more than 40 hours per week for the purpose of devoting more hours to research work. If men work more additional hours than women, they may have more hours to devote to research.

which reflects a higher likelihood that two individuals will have common research interests and be assigned to work together on policy assignments. Lastly, we find that even when controlling for these factors, we still observe a greater likelihood of coauthoring between same-gender pairs.

5.1 Data

We define the set of observed coauthorships as all the pairwise collaborations in our set of FRB working papers. For example, a two-authored paper generates one observed pair of coauthors, or one coauthorship observation. A three-authored paper generates three pairwise coauthorships and so forth. In our data on over 3,600 FRB working papers, we have nearly 2,250 unique authors and about 4,700 unique coauthorships. Of these, 617 are FRB economist authors and around 1,500 coauthorships are between two FRB economists; the remainder are associated with external collaborators or FRB coauthors who are not FRB economists, such as research assistants.

To investigate the determinants of coauthoring relationships, we need the set of *potential* coauthorship pairs, including those that are not observed in the working papers data set. To take advantage of the rich data set we have constructed, we focus on coauthorships among FRB economists for whom we have covariates such as section affiliation and year of Ph.D. completion. Additionally, because we find that 83 percent of observed FRB coauthorships are for individuals who share a division affiliation and that 99 percent are for individuals whose tenure at the Federal Reserve Board overlaps, we further limit the set of potential coauthorships to pairs of FRB economists who have overlapping division affiliations and FRB tenure. Given these definitions, we have about 40,000 unique potential coauthorships, of which about 1,200, or about 3 percent, are observed in the data. These 1,200 coauthorships result from matching among 487 FRB economists. These 487 individuals exclude those economists who never author any papers, have only solo-authored papers, or whose coauthors include only external collaborators.

Before estimating a model to study the likelihood of observing potential coauthorships in the data, we make a few observations on the joint variation between gender and two other characteristics that strongly influence coauthorships: joint section membership and similarity of Ph.D. cohort.

First, just over half of FRB coauthorships are between individuals who share section membership. Further, among same-division coauthorships, 63 percent are between same-section individuals. The share of women differs widely across sections, and men are more likely to be in sections with a lower share of women. This dispersion has implications for coauthorship matching. Although the Federal Reserve Board is 26.5 percent women, restricting the set of coauthors to only one's own section would result in some observed gender affinity for both men and women. Suppose a man randomly chooses to coauthor with another economist in his own section. The

fraction of those random coauthor selections that would be with a woman is 0.263. In contrast, if a woman randomly matches with another economist in her own section, the fraction of those random matches that would be with a woman is 0.280. (These results are calculated assuming self-matching is not allowed.) As such, although section affinity does explain some gender affinity, its role does not seem to be dominant. For example, as reported in Table 3, the estimated values of $p_m f$ and $p_w f$ in the late sample are equivalent to men drawing from a pool that is only 17.7 percent women and women drawing from a pool that is 37.0 percent women. These shares are much more disparate than what would be implied by gender dispersion across sections. Furthermore, as we show below, observed gender affinity persists even within sections.

Second, we observe that 30 percent of coauthorships are between individuals whose Ph.D. cohorts are three or fewer years apart. As such, we include data on cohort similarity as an additional explanatory variable, so that we do not attribute to gender affinity that which may be driven by cohort affinity. We show below that cohort similarity predicts coauthorship. However, it does not explain gender affinity. Although cohort affinity is an interesting topic, it is beyond the scope of the current paper to explore fully.[13]

5.2 Linear probability model

We now study the determinants of coauthorship using a linear probability model. This model will allow us to consider multiple determinants of coauthorship at once, so that we can investigate gender affinity in the context of other features of the data, including section affinity and cohort affinity. Formally, we let Y_{ij} be the binary outcome variable for coauthorship, where $Y_{ij} = 1$ if individuals i and j coauthor at least one paper together and $Y_{ij} = 0$ otherwise.

In our model, we let Y_{ij} depend on various predictor variables. First, in our baseline model, we include an indicator variable for whether individuals i and j have overlapping section affiliation (I_{ij}^S). Second, because we observe that individuals are more likely to coauthor with others in a similar Ph.D. cohort, we include in our model the variable $\textit{CohortDifference}_{ij} = |PhD\,year_i - PhD\,year_j|$, which measures the absolute value of the difference in Ph.D. graduation year between the two individuals.

Turning to the gender-related terms, we first include indicator variables for whether individuals i and j are both men (I_{ij}^M) or both women (I_{ij}^W). These variables allow us to estimate whether same-gender affinity differs between men and women. Next, we also include interaction terms between the same-gender indicator variables and the same-section indicator variable to investigate

[13] In particular, our evidence of cohort affinity would need to be reconciled with previous studies that have found that having more senior coauthors is associated with higher research output (Ductor et al., 2023).

whether gender affinity is stronger within sections:

$$Y_{ij} = \beta_0 + \beta_1 I_{ij}^S + \beta_M I_{ij}^M + \beta_{MS}(I_{ij}^M * I_{ij}^S) + \beta_W I_{ij}^W + \beta_{WS}(I_{ij}^W * I_{ij}^S) + \beta_2 \textit{CohortDifference}_{ij} + \epsilon_{ij}. \quad (1)$$

5.3 Linear probability model results

Overall, we find that the strongest determinant of coauthoring is whether individuals are in the same section. Beyond this variable, we also find that the probability of coauthoring increases when individuals are the same gender. In addition, the likelihood of coauthoring increases when two individuals are from similar Ph.D. cohorts. We look at each of these results in turn using the baseline result from our linear probability model, as reported in column 2 of Table 4. Additionally, we note that the marginal effects from our variables of interest cannot be read directly from the estimated coefficients of the linear probability model given the interaction terms included in the regression. Consequently, in Table 5, we report the likelihood of coauthorship given same or different section affiliations, conditional on the pair of individuals being the same gender or different genders. Using these likelihoods, we then report the increase in the likelihood of coauthorship when moving from different to same sections.

First, we find that the likelihood of coauthorship is most affected by overlapping section affiliation. As shown in column 2 of Table 4, on average, two different-gender individuals are 7.2 percentage points more likely to coauthor when they are in the same section. Overall, being in the same section is by far the strongest predictor of observed coauthorship: It makes two individuals around *five times* as likely to coauthor, as seen in the final column of Table 5.

The importance of section affiliation is not surprising, as the structure of the Federal Reserve Board is such that individuals with similar research interests are likely to be in the same section. Furthermore, being in the same section increases the likelihood of collaboration on policy work as well as physical office proximity, both of which would tend to increase research collaboration. Indeed, 52 percent of unique FRB coauthorships (for which we have section information) are between individuals who share section membership.

Second, we also find that individuals are more likely to coauthor with their peers. The likelihood of coauthorship declines as individuals' Ph.D. years grow further apart: We find that a pair with an additional year between Ph.D. cohorts is about 0.1 percentage point less likely to coauthor together. Although the cohort effect is statistically significant, gender and section affinity seem to play a larger role.

Third, even when focused on individuals within the same section, and after controlling for Ph.D. cohort, we still find that the likelihood of coauthorship increases further when the individuals

are the same gender. Relative to section members that are a mixed gender pair, the probability that two men in the same section coauthor is 0.9 percentage point higher and the probability that two women in the same section coauthor is 1.5 percentage points higher. These are statistically significant and sizable changes in the probability of coauthoring.

The gender affinity within a section can be illustrated by the marginal effects between counterfactuals. To calculate these marginal effects, we use the average value of three years of cohort difference. As reported in Table 5, when using these values, we determine the predicted likelihood of coauthorship for a different gender pair in the same section is 9.0 percent. This estimate increases to 10.1 percent for two men and 10.3 percent for two women. These differences are a sizable change in the probability of coauthoring. Based on Table 5, the probability of matching with anyone outside of one's section is low and does not actually differ much whether the other person is the same or different gender. However, within a section, the probability of matching increases substantially when the person is the same gender.

As such, although section membership is an important determinant of coauthorship, it does not fully explain observed gender affinity. Instead, even when economists are in the same section, gender affinity seems to affect the probability of matching.

In response to our initial finding of gender affinity in Table 3, it has been suggested that men and women might have different and incompatible research interests. However, as Table 5 establishes, even if two economists have been assigned to the same section in large part due to their research interests and, as such, are much more likely to coauthor, gender affinity still plays a role in determining the probability that they will coauthor. Though observed gender affinity may still reflect differences in research interests, controlling for section does narrow the extent to which research interests can explain the observed patterns.

Figure 8 provides an illustration of this gender affinity. In this figure, each section is represented by two observations, or data points. For each point, the y-value represents the mean share of women coauthors, aggregated across women section members (red triangles) or men section members (black circles). The x-value of each observation is the fraction of women affiliated with that section. We can see a positive correlation in the observations, indicating that for both men and women, as the fraction of women in the section increases, the fraction of women among section members' coauthors also tends to increase. The red and black regression lines affirm this association, given their positive slope coefficients. That said, we can also see that the red triangles tend to have higher y-values than the black circles, indicating that for a given level of women's representation within a section (x-values), we tend to see women in the section (in red) having more women coauthors than men in the section (in black). Overall, the higher y-values for the red triangles relative to the black circles illustrate gender affinity in coauthorships, even within sections.

5.4 Counterfactuals

Given these results, it is natural to ask the questions: If we were able to reduce the gender divide and encourage more inclusion in coauthorship selections, how many more collaborations would be observed, and how many more papers might be produced?

One way to estimate the role of the gender divide would be to take the set of potential collaborations between mixed-gender pairs and apply higher probabilities of them resulting in a coauthorship, based on the estimates for same-gender pairs. For example, we have 12,390 pairs in our sample with different sections and different genders. If these pairs were to coauthor at the same rate as the different section and *same* gender pairs, we would see 19 additional coauthorships, which is an 11.6 percent increase in coauthorships among these pairs. If we apply a similar counterfactual to the 3,010 pairs in our sample with the same section and different genders, and assume that they were to coauthor at the same rate as the same section and *same* gender pairs, we would see another 33 additional coauthorships. Combining these with the 19 additional coauthorships from among different-section pairs, we obtain a total boost of 52 additional coauthorships among different-gender pairs, equivalent to an increase of 12.4 percent.

Notably, these 52 additional pairs of coauthors could each collaborate on more than one paper. Among the coauthoring pairs in our regression sample, we observe, on average, about 1.5 papers per unique pair. Consequently, we might expect these 52 new unique coauthoring relationships to be associated with 78 new coauthorships and as many as 78 new papers. Furthermore, adding these 78 new authorships for men and women would eliminate about 1.5 percentage points of the 4.8 percentage point gap between women's share of authorships and their representation in the economist population, a substantial change given that women are 26.5 percent of the population.

We can also evaluate this counterfactual in the context of the gender affinity observed in the distribution of teams in Table 2. We noted earlier that among two- and three-authored papers, the observed count of all-men groups was about 10 to 12 percentage points higher than the model prediction. Under the counterfactual described here, by adding 78 new papers authored by mixed-gender teams, we would reduce the gap between observed and model predictions by about 3.5 percentage points. Overall, this indicates that overcoming gender affinity would result in about a 30 percent reduction in the gap between observed outcomes and model predictions under random assignment.

Of course, these numbers are only an estimate and do not reflect any resource constraints in producing papers. However, these counterfactuals are a good way to quantify the potential effect of reducing gender affinity and increasing inclusion in coauthorship selections on the rate of paper production by men and women. Additionally, we note that these counterfactual estimates are somewhat smaller than those one we obtain in Section 4.2.2, reflecting the differences in counter-

factuals and models. However, the main finding that reducing gender affinity would boost women's share of authorships by 1.5 to 3 percentage points is common across counterfactuals.

6 Coauthorship and paper outcomes

We have shown that observed gender affinity in the coauthorships data cannot be explained by similarity of field of interest or likelihood of policy interactions, as proxied by section membership. Gender affinity also cannot be explained by similarity in Ph.D. cohort. We next turn to considering whether observed gender affinity is consistent with choices in coauthor selection that may be taken to maximize research outcomes. We consider two outcomes: first, how many times a paper is downloaded in its first 12 months of being made publicly available and, second, whether a working paper ever gets published in a journal.[14] If papers with same-gender coauthorship groupings tend to have more downloads, or a higher likelihood of publication, then gender affinity could be driven by a desire to maximize research outcomes rather than the authors having gender bias personally. We find that both downloads and probability of publication could lead men to favor men-only teams, potentially resulting in less inclusion of women in coauthoring networks. Though women do not pay much of a price in terms of downloads for a women-only team, there may be some penalty to women-only teams associated with the probability of publication.

For our first investigation of outcomes, we use data on how frequently each working paper is downloaded in the first 12 months after the paper is posted. The data on downloads are particularly useful because they can provide a metric of research success or impact in the absence of the potential gatekeeping effects associated with the peer-review process, which has been shown in some cases to require higher standards for women authors (Hengel, 2022; Hengel and Moon, 2023; Alexander et al., 2023; Card et al., 2020).[15] Our data on downloads are from the LogEc website. LogEc reports downloads for all papers that are available through the RePEc web services, which includes all FRB working papers.[16] A disadvantage of using LogEc data is that they only count downloads that originate via a paper's RePEc listing. As such, we do not know about downloads that occur by someone going directly to the FRB working paper website. However, this restriction is offset by several advantages. First, the download counts are available to the public, including the number of downloads over the first 12 months after posting to the RePEc website, which, for

[14]To match sample periods in our earlier analysis, we focus on working papers posted in or after 2004. We also end the sample in 2019 so that we may observe publication outcomes in the few years after working papers are posted.

[15]Although downloads are likely less affected by gatekeeping behavior in the economics profession, differences in downloads can also reflect gender differences in the size, reach, or use of professional networks. Given that Ductor et al. (2023) have found that women tend to have smaller networks, download counts may still be lower for women, even conditional on research quality.

[16]For more on LogEc, see LogEc (2022), "About LogEc," webpage, `https://logec.repec.org/about.htm`.

FRB working papers, closely matches release dates.[17] Second, and more importantly, LogEc takes steps to ensure data quality, including making sure that reported downloads reflect downloads by humans rather than by automated web mapping services ("robots").[18] As reported in Table 6, we find that papers are downloaded about 38 times, on average, in their first year of publication.

We regress downloads per paper on an intercept term along with indicator variables for men-only and women-only teams. We control for the number of coauthors as well, with a variable that counts "additional authors" (after the first one). Table 7 reports the results. In the first column, we see that a paper by a two-authored mixed-gender team would have about 32 downloads, while a men-only team would have almost 9 more downloads and a women-only team would have about 2 fewer downloads. Having additional coauthors does boost the number of downloads. In the second column, we can see that the penalty in terms of downloads for being a women-only team was greater in the early sample. In the third column, we can see that for the late sample, the penalty for being a women-only team disappears.

As such, in the early sample, a coauthoring team of two men gets about 25 percent more downloads in the first year than a mixed-gender or women-only team of two. Additionally, by the late sample, downloads for a women-only team do not differ greatly from those for a mixed-gender team. As such, these results are consistent with the explanation that publication outcomes may be driving choices that result in gender affinity. In particular, these results are consistent with our estimated model findings of women not having gender affinity in the early sample and having gender affinity in the late sample and with men having gender affinity in both early and late samples.

We next look at how gender groupings shape publication success. Our publications data are from RePEc. These data provide a mapping between FRB working papers and peer-reviewed publications, allowing us to measure whether each paper is eventually published and the time elapsed between the posting of a working paper and its eventual publication. We repeat the same regressions as for downloads but change the outcome variables to, first, an indicator variable for whether a paper is ever published and, second, to two additional outcomes that measure whether a paper is published within or after two years from the working paper publication year. Results are reported in Table 8.

First, to understand the baseline, Table 6 shows summary statistics for paper outcomes. We find that about one-third of working papers are eventually published, and the majority of these are

[17] A special thanks to Sune Karlsson, who gave us the ability to query the data on downloads in the first 12 months from LogEc. Subsequent to our request, LogEc now provides this information for all working paper series.

[18] We compared internal FRB data from Google Analytics with RePEc data and found that the RePEc data are more plausible. For example, Google Analytics frequently reported that a number of older vintage papers each got downloaded the same number of times a month, which seemed unlikely. For more on RePEc, see RePEc team (2009), "How Abstract Views and Downloads Are Counted," *RePEc Blog*, September, 19, `https://blog.repec.org/2009/09/19/how-abstract-views-and-downloads-are-counted/`.

published within two years of the working paper being posted. The number of authors on each paper has risen from about 2.1 authors per paper, on average, in the early sample to 2.4 in the late sample.

Turning to the regression results, we see in the last line of Table 8 that each additional coauthor increases the likelihood of publication by around 10 percentage points, which is a large effect since it boosts the likelihood of publication from 28 percent for a two-authored, mixed-gender team, to 38 percent for a three-authored team. We also find that the men-only teams have an 11 percentage point higher likelihood of publication. These results hold up even when we look at the early sample or the late sample.

The regression results also suggest that women-only teams have a 7 percentage point lower likelihood of publication, though this estimated penalty is not statistically significant. Additionally, it does seem notable that the reduction in downloads for women-only teams relative to mixed-gender teams diminishes greatly between the early and late sample. In contrast, the publication outcomes for women-only and mixed teams are little changed between the early and late sample. This discrepancy between downloads and publication outcomes is suggestive that the peer-review process may be changing more slowly than other aspects of the profession and is consistent with other papers finding greater obstacles for women in the publication process (Hengel, 2022; Hengel and Moon, 2023; Card et al., 2020; Alexander et al., 2023).

To better understand these final results, we also report in Table 8 the results for the same regressions but with outcome variables of either the likelihood of publication within two years or for publication after two years. (In the latter set of regressions, we limit the sample to those papers that are not published within two years.) Focusing on the late sample, we find that papers with men-only authoring teams do not have a higher likelihood of publication within two years relative to mixed teams. However, turning to the likelihood of publication after two years, we do see a positive coefficient for the men-only indicator and a near-zero coefficient for the women-only indicator. That is, we find that men-only teams may have more persistence in publication efforts relative to mixed and women-only teams, and this persistence drives the higher likelihood of publication for papers overall.[19] This finding of greater persistence is consistent with the finding by Shastry and Shurchkov (2024) that after receiving a paper rejection from a peer-reviewed journal, women assistant professors perceive a significantly lower likelihood of subsequently publishing the paper in any leading journal than comparable male assistant professors.

[19] Although beyond the scope of this paper, it would be good to understand whether this increased persistence is rewarded with higher-ranking publications or just more publications. For example, Ginther and Kahn (2004) find that women in the 1989 cohort of assistant professors have 0.3 fewer top-10 publications and 3.8 fewer articles in other journals 10 years into their careers. Sherman and Tookes (2024) find that women finance professors have a similar number of top publications as men finance professors but fewer publications outside of the top three finance journals and top five economics journals.

Overall, our results suggest that gender affinity in coauthoring by men may be consistent with a desire to maximize research outcomes as measured by downloads, as well as likelihood of publication. Notably, these results point to a perhaps lesser-studied consequence of potential gender bias in the publication process. If biases in the referee and citation process lead to worse outcomes for women, then as collaborators seek to maximize outcomes, they may be swayed toward less inclusive practices to avoid exposing their project to these biases.

7 Career progression

Given our results, what advice can we give central banks and others that want to increase both diversity and inclusion in their institutions? Although the number of women economists has increased at the Federal Reserve Board, the share of economists that are women has not increased. The Board has taken a number of steps to support diversity. However, if one measures inclusion by whether women and men are likely to coauthor papers together, then inclusion has not increased much at the Federal Reserve Board. Our work cannot determine what causes the lack of inclusion; however, it clearly has consequences.

Our model shows how gender affinity in coauthorship selections may result in lower observed productivity among women, as measured by the number of working papers per person. This finding is particularly important for understanding career progression, as research output is often cited as an important input into promotion decisions. Additionally, to the extent that there is learning by doing in research, barriers to finding coauthors in early years may result in lower productivity throughout a person's career. Our data in Table 9 provide some supportive evidence. As seen in row 2c of the table, of the men and women who write papers but do not coauthor with other FRB economists in their first three years of FRB employment, women are much more likely to not write additional papers in the next three years. Furthermore, as seen in row 3c of the table, of the men and women who do not produce papers in the first three years of FRB employment, women are much more likely to not write in the next three years as well. These results suggest that policies encouraging coauthorship, especially for early-career economists, could boost research productivity.

Finally, given that our work in Section 6 shows that the external market may reward men-only teams with more downloads and publications, the Federal Reserve Board and other similar institutions should evaluate their internal evaluation processes to identify and reward quality research to ensure that internal processes do not merely magnify external biases. Internal rewards could encourage inclusion by countering the way in which external markets reward gender affinity in coauthorship groupings.

8 Conclusion

This paper shows that the observed distribution of coauthorship groupings across genders differs from predictions based on random assignment. By modeling coauthor team formation, we show that, in recent years, the observed groupings are consistent with parameters that imply sorting within gender. That is, relative to random assignment, men tend to coauthor more with other men, while women coauthor more with other women. That said, the modal coauthor for both a woman and a man is still a man, consistent with men's greater share of the FRB economist population.

Although we focus on gender inclusivity in this paper due to data limitations, the results may be informative for other types of inclusivity (or insularity) in coauthorships, or even inclusivity in general within the economics profession. We note that assortative matching in coauthor relationships may also occur along other characteristics, including common language, nationality, university, physical location, or interests. As it has been previously documented that diverse groups have better outcomes in a variety of settings, barriers to coauthorship with dissimilar individuals may result in worse outcomes over time.

References

Alexander, D., Gorelkina, O., Hengel, E., and Tol, R. (2023). Gender and the Time Cost of Peer Review. Tinbergen Institute Discussion Papers 2023-044/V, Tinbergen Institute.

Auriol, E., Friebel, G., Weinberger, A., and Wilhelm, S. (2022). Underrepresentation of Women in the Economics Profession more Pronounced in the United States Compared to Heterogeneous Europe. *Proceedings of the National Academy of Sciences*, 119(16).

Azzimonti-Renzo, M., Jarque, A., and Wyckoff, A. (2023). How Are Women Represented in Economic Research at the Fed? *Economic Brief*, 23(40).

Bayer, A. and Rouse, C. E. (2016). Diversity in the Economics Profession: A New Attack on an Old Problem. *Journal of Economic Perspectives*, 30(4):221–42.

Board of Governors of the Federal Reserve System (2002). Economists, by Name. webpage, `http://www.federalreserve.gov/research/name.htm`. Accessed December 13, 2019, via `https://web.archive.org/web/20030306075802/http://www.federalreserve.gov:80/research/name.htm`.

Board of Governors of the Federal Reserve System (2017). The Economists. webpage, `https://www.federalreserve.gov/econresdata/theeconomists.htm`. Accessed December 13, 2019, via `https://web.archive.org/web/20170120163259/https://www.federalreserve.gov/econresdata/theeconomists.htm`.

Board of Governors of the Federal Reserve System (2022a). Finance and Economics Discussion Series (FEDS). webpage, `https://www.federalreserve.gov/econres/feds/all-years.htm`. accessed April 21, 2022.

Board of Governors of the Federal Reserve System (2022b). International Finance Discussion Papers (IFDP). webpage, `https://www.federalreserve.gov/econres/ifdp/all-years.htm`. accessed April 21, 2022.

Board of Governors of the Federal Reserve System (2022c). Meet the Economists. webpage, `https://www.federalreserve.gov/econres/theeconomists.htm`. Accessed May 12, 2022, via `https://web.archive.org/web/20220401063559/https://www.federalreserve.gov/econres/theeconomists.htm`.

Card, D., DellaVigna, S., Funk, P., and Iriberri, N. (2020). Are Referees and Editors in Economics Gender Neutral? *Quarterly Journal of Economics*, 135(1):269–327.

Chari, A. (2023). Report of the Committee on the Status of Women in the Economics Profession. In Johnson, W. R. and Lippert, T., editors, *AEA Papers and Proceedings*, volume 113, pages 815–839.

Chari, A. and Goldsmith-Pinkham, P. (2017). Gender Representation in Economics across Topics and Time: Evidence from the NBER Summer Institute. Working Paper 23953, National Bureau of Economic Research.

Datta, D. D., Johannsen, B. K., Kwon, H., and Vigfusson, R. J. (2021). Oil, Equities, and the Zero Lower Bound. *American Economic Journal: Macroeconomics*, 13(2):214–253.

Datta, D. D. and Tzur-Ilan, N. (2024). Gender Gaps in the Federal Reserve System. Working paper.

Davies, B. (2022). Gender Sorting among Economists: Evidence from the NBER. *Economics Letters*, 217:110640.

Ductor, L. (2015). Does Co-authorship Lead to Higher Academic Productivity? *Oxford Bulletin of Economics and Statistics*, 77(3):385–407.

Ductor, L., Goyal, S., and Prummer, A. (2023). Gender and Collaboration. *Review of Economics and Statistics*, 105(6):1366–1378.

Gertsberg, M. (2022). The Unintended Consequences of #MeToo: Evidence from Research Collaborations. Cambridge Working Papers in Economics.

Ginther, D. K., Currie, J. M., Blau, F. D., and Croson, R. T. A. (2020). Can Mentoring Help Female Assistant Professors in Economics? An Evaluation by Randomized Trial. In Johnson, W. R. and Herbert, G., editors, *AEA Papers and Proceedings*, volume 110, pages 205–09.

Ginther, D. K. and Kahn, S. (2004). Women in Economics: Moving Up or Falling Off the Academic Career Ladder? *Journal of Economic Perspectives*, 18(3):193–214.

Hengel, E. (2022). Publishing while Female: Are Women Held to Higher Standards? Evidence from Peer Review. *Economic Journal*, 132(648):2951–2991.

Hengel, E. and Moon, E. (2023). Gender and Equality at Top Economics Journals. Working paper.

Hospido, L., Laeven, L., and Lamo, A. (2022). The Gender Promotion Gap: Evidence from Central Banking. *Review of Economics and Statistics*, 104(5):981–996.

Internet Archive (2019). Wayback Machine. webpage, `https://web.archive.org/`. accessed December 13, 2019 and April 21, 2022.

LogEc (2022a). International Finance Discussion Papers - Top 5000 Working Papers for the 12 Months from First Access/Download through RePEc. webpage, `https://logec.repec.org/scripts/seritemstat.pf?topnum=5000&mrange=No&fm=&lm=&fromstart=Yes&ms=12&sortby=ld&h=repec%3Afip%3Afedgif&.submit=New+List&.cgifields=mrange&.cgifields=fromstart`. accessed April 21, 2022.

LogEc (2022b). International Finance Discussion Papers - Top 5000 Working Papers for the 12 Months from First Access/Download through RePEc. webpage, `https://logec.repec.org/scripts/seritemstat.pf?topnum=5000&mrange=No&fm=&lm=&fromstart=Yes&ms=12&sortby=ld&h=repec%3Afip%3Afedgif&.submit=New+List&.cgifields=mrange&.cgifields=fromstart`. Accessed: 2022-04-21.

Lundberg, S. and Stearns, J. (2019). Women in Economics: Stalled Progress. *Journal of Economic Perspectives*, 33(1):3–22.

Lyons, C., Wilderman, A., Fortson, M., Lewis, S., Luckman, A., Shapiro, E., Rogers, T., and VanHuysen, M. (2021). The Board Economics Divisions Can Enhance Some of Their Planning Processes for Economic Analysis. Technical Report 2021-MO-B-001, Federal Reserve Board Office of the Inspector General.

McDowell, J. M., Singell Jr, L. D., and Stater, M. (2006). Two to Tango? Gender Differences in the Decisions to Publish and Coauthor. *Economic Inquiry*, 44(1):153–168.

Sarsons, H. (2017). Recognition for Group Work: Gender Differences in Academia. *American Economic Review*, 107(5):141–145.

Sarsons, H., Gërxhani, K., Reuben, E., and Schram, A. (2021). Gender Differences in Recognition for Group Work. *Journal of Political Economy*, 129(1):101–147.

Shastry, G. K. and Shurchkov, O. (2024). Reject or Revise: Gender Differences in Persistence and Publishing in Economics. *Economic Inquiry*, 62(3):933–956.

Sherman, M. G. and Tookes, H. (2022). Female Representation in the Academic Finance Profession. *Journal of Finance*, 77(1):317–365.

Sherman, M. G. and Tookes, H. (2024). Gender Balance in the Academic Finance Profession. *CSWEP News*, 2:15–18.

Stansbury, A. and Schultz, R. (2023). The Economics Profession's Socioeconomic Diversity Problem. *Journal of Economic Perspectives*, 37(4):207–30.

Tang, C., Ross, K., Saxena, N., and Chen, R. (2011). What's in a name: A study of names, gender inference, and gender behavior in facebook. In Xu, J., Yu, G., Zhou, S., and Unland, R., editors, *Database Systems for Advanced Applications*, pages 344–356. Springer Berlin Heidelberg.

Wu, A. H. (2018). Gendered Language on the Economics Job Market Rumors Forum. In Johnson, W. R. and Markel, K., editors, *AEA Papers and Proceedings*, volume 108, page 175–79.

A Figures

Figure 1: Number of economists at the Federal Reserve Board

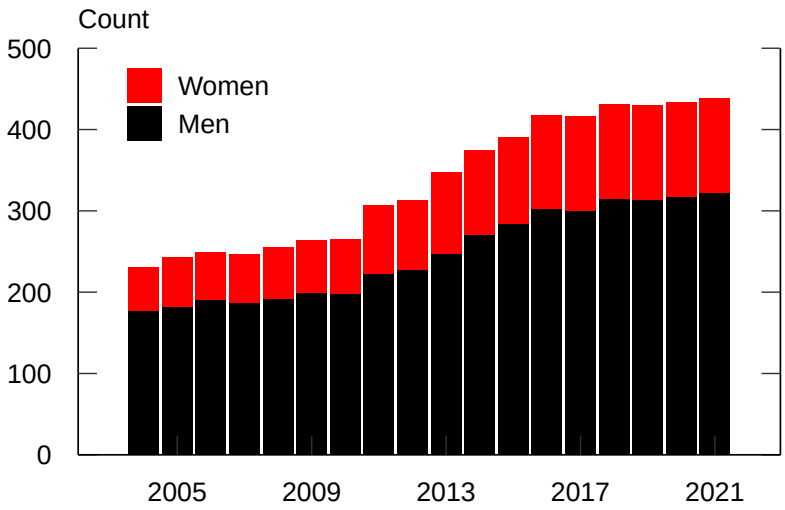


Figure 2: Women economists at the Federal Reserve Board

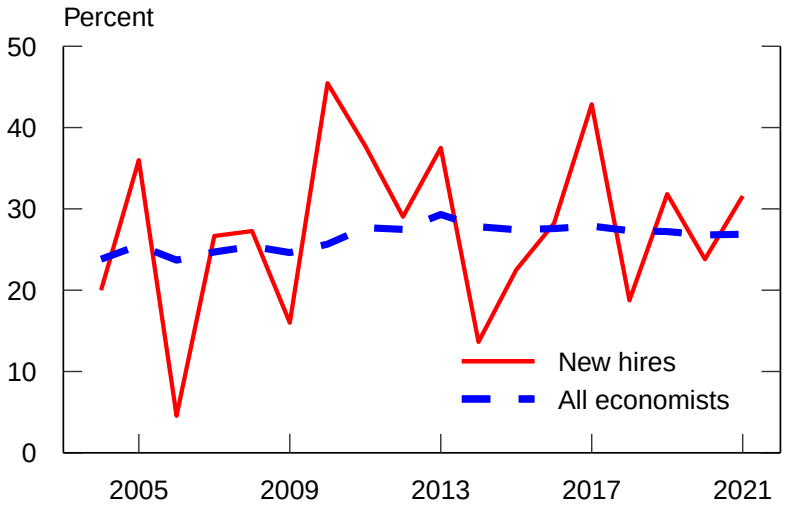


Figure 3: Hiring at the Federal Reserve Board

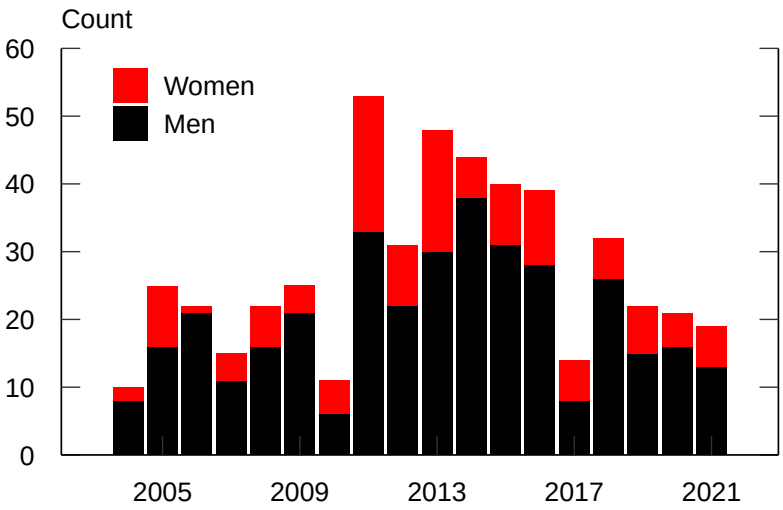


Figure 4: Net hiring at the Federal Reserve Board

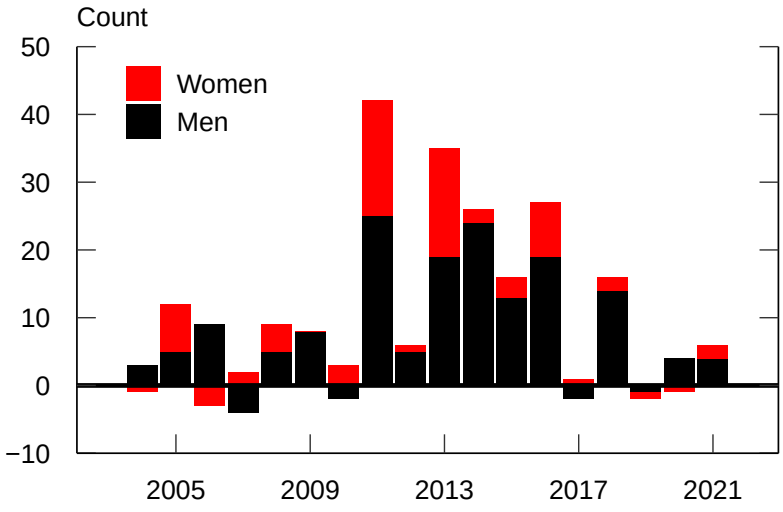
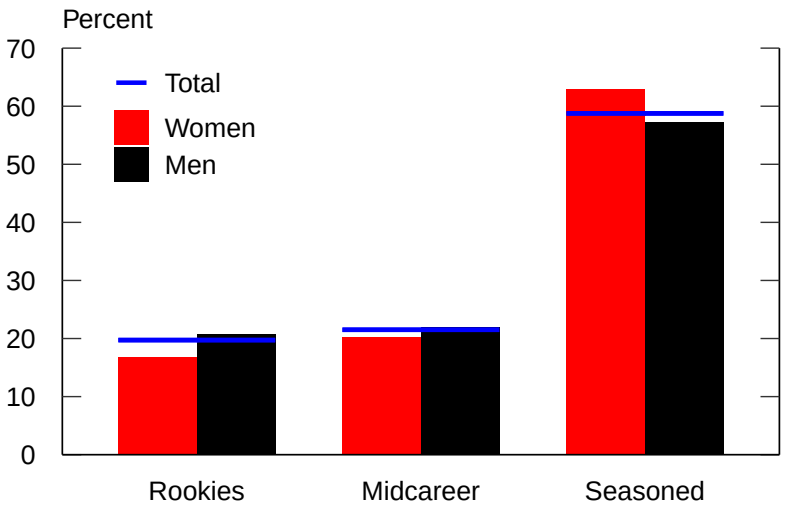
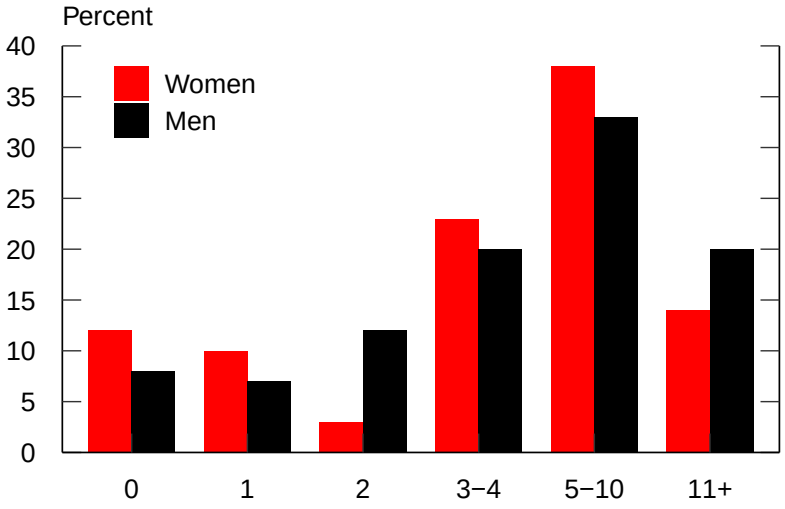


Figure 5: Economist experience distribution, 2004-21



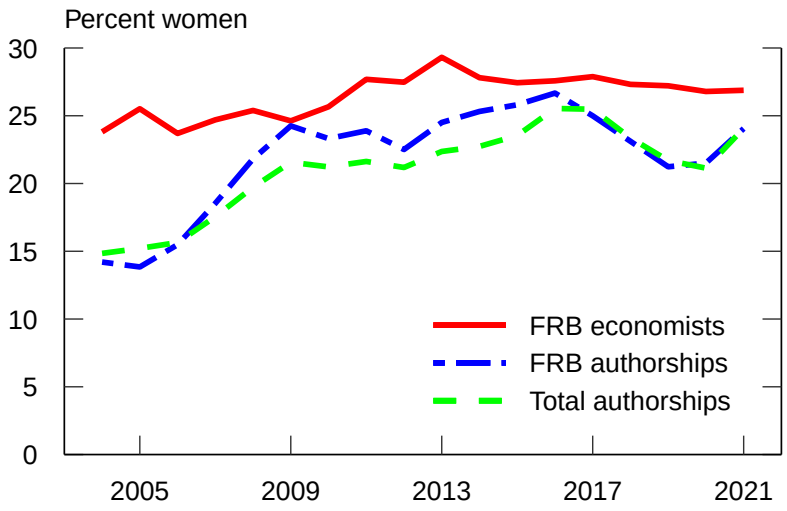
Note: Bars show the distributions of years of experience for economist-year observations between 2004 and 2021. Experience is defined as years since Ph.D. graduation. Rookies are defined as those with 3 or fewer years since Ph.D. graduation, midcareers are those with 4 to 7 years of experience, and seasoned economists are those with at least 8 years of experience.

Figure 6: Distribution of papers per person, by gender



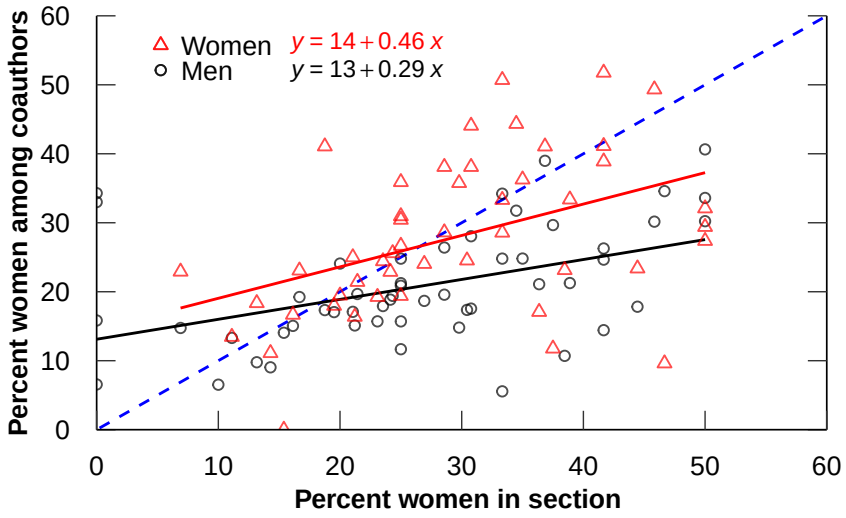
Note: Percentage of women and men economists, categorized by the number of papers. Sample is restricted to Federal Reserve Board economists employed at the start of 2022, with at least 3 years of service.

Figure 7: Authorships by year and gender



Note: Federal Reserve Board (FRB) authorships and total authorships series represent 3-year moving averages.

Figure 8: Share of women among coauthors and section members



Note: Each section is denoted by a red triangle that represents women affiliates and a black circle that represents men affiliates. The x-value of each observation is the fraction of women affiliated with that section. The y-value represents the mean share of women coauthors, when averaging across section members of a particular gender. We can see a positive correlation in the observations, indicating that for both women and men, as the fraction of women in the section increases, the fraction of women coauthors also tends to increase. The red and black lines represent gender-specific regressions, which indicate that the fraction of women coauthors rises with the women's share of section membership. The dashed blue line represents the line along which the percent women among coauthors is equal to the percent women in the section.

B Tables

Table 1: FRB economists and working paper production

A. Economists ever employed, 2003–22			
		Cumulative authorships	
Gender	Economists	Mean	Median
Men	539	6.3	4
Women	191	4.5	3
All	730	5.8	4

B. Economists employed in 2003			
		Cumulative authorships	
Gender	Economists	Mean	Median
Men	168	10.8	8
Women	53	6.5	5
All	221	9.8	7

C. Economists employed in 2021			
		Cumulative authorships	
Gender	Economists	Mean	Median
Men	313	5.9	4
Women	112	5.0	4
All	425	5.7	4

Note: Table shows mean and median number of working papers authored by men and women. In panel A, we report average values for working papers published through 2022 for all Federal Reserve Board (FRB) economists in our data set, which includes anyone employed at any time over 2003-22. In panels B and C, we report average values for FRB economists employed in 2003 and 2021, respectively. Whereas panel B captures for one cohort the authorships cumulated over a long period, panel C demonstrates the distribution of observed authorships among the population at a point in time.

Table 2: Coauthorship distribution

	Early sample (2004–12)				Late sample (2013–21)			
	Observed Papers		Model	Diff.	Observed Papers		Model	Diff.
Authors	Count	Share	Share		Count	Share	Share	
1 author	**278**	**33**			**254**	**22**		
Man	227	82	75	7	193	76	72	4
Woman	51	18	25	-7	61	24	28	-4
2 authors	**319**	**37**			**411**	**35**		
Men	216	68	56	12	264	64	52	12
Mixed	88	28	38	-10	115	28	40	-12
Women	15	5	6	-2	32	8	8	0
3 authors	**193**	**23**			**344**	**29**		
Men	99	51	42	10	171	50	38	12
Majority men	74	38	42	-4	108	31	43	-12
Majority women	19	10	14	-5	52	15	17	-1
Women	1	1	2	-1	13	4	2	2
4+ authors	**64**	**7**			**163**	**14**		
Men	23	36	31	5	52	32	28	4
Majority men	29	45	42	3	78	48	42	6
Mixed	7	11	22	-11	24	15	24	-9
Majority women	5	8	5	3	9	6	6	-1
Women	0	0	0	0	0	0	1	-1
All	**854**	**100**	**25**	**75**	**1172**	**100**	**28**	**72**

Note: The bolded rows report the observed count and share of papers for each possible team size. The remaining rows report, for each team size, the observed count and share for each possible gender composition, conditional on team size. These rows also report the model predicted share for each possible gender composition, conditional on team size. For these predicted values, we use the observed parameters of 25.4 percent women in 2004-12 and 27.6 percent women in 2013-21. Lastly, the "Diff." column reports the difference in observed minus model shares in percentage points. Positive values for these differences indicate the observed share is higher than the model prediction.

Table 3: Estimated model

Estimation	f	g	p_w	p_m	W-Authorships
Unrestricted model estimates					
1. Full Sample (2004-21)	0.265	0.209	1.282	0.716	0.219
2. Early sample (2004–12)	0.254	0.184	0.853	0.739	0.193
3. Late sample (2013–21)	0.276	0.241	1.341	0.641	0.230
Counterfactuals using late sample data					
A. $p_m = 1$	0.276	0.241	1.341	1.000	0.268
B. $p_m = p_w = 1$	0.276	0.241	1.000	1.000	0.262
C. $g = f$	0.276	0.276	1.341	0.641	0.251
D. $p_w = 2.012$	0.276	0.241	2.012	0.641	0.264
E. $g = f$, $p_w = 2.012$	0.276	0.276	2.012	0.641	0.280
F. $g = f$, $p_m = p_w = 1$	0.276	0.276	1.000	1.000	0.280

Note: Model parameters are estimated using data on women's representation, as reported in the first column, and the data reported in Table 2 for papers with up to 3 authors. The final column of the table reports the estimated share of authorships by women based on the model parameters.

Table 4: Linear probability model of coauthorship

	1	2
Same Section	7.78	7.18
	(37.39)	(21.05)
Both Men	0.39	0.21
	(2.19)	(1.04)
Both Men*Same Section		0.90
		(2.04)
Both Women	0.12	−0.18
	(0.33)	(−0.45)
Both Women*Same Section		1.47
		(1.68)
Cohort Difference	−0.07	−0.07
	(−7.19)	(−7.18)
Constant	1.95	2.06
	(11.01)	(11.19)
Observations	39,976	39,976

Note: The pool of potential coauthors includes all Federal Reserve Board (FRB) economists for whom we have Ph.D. year and section affiliation data and who have coauthored with another FRB economist. We construct pairwise combinations of these individuals and restrict the pool of potential pairs to those pairs of individuals with overlapping division affiliation and overlapping FRB tenure. T-statistics are reported in parentheses.

Table 5: Section and gender affinity

Likelihood of coauthorship, given:	Section affiliation		Marginal effect of moving from different to same section	
	Different	Same	Percentage points	Percent
Different gender	1.84	9.02	7.18	389.23
Both men	2.05	10.13	8.08	394.04
Both women	1.67	10.31	8.65	518.90
Memo: Weighted average	1.95	9.72	7.77	399.45

Note: Uses column 2 of Table 4 as baseline and conditions on average value of 3 years of cohort difference.

Table 6: Summary statistics for publication outcomes

	Full sample		Early sample		Late sample	
	Mean	St.dev.	Mean	St.dev.	Mean	St.dev.
Downloads	38.23	32.73	40.08	34.48	36.52	30.94
2-author mixed teams	31.56	28.01	33.47	31.96	29.69	23.54
Publication	0.36	0.48	0.39	0.49	0.33	0.47
Publication within 2 years	0.22	0.42	0.24	0.43	0.21	0.41
Number of authors	2.23	1.18	2.08	1.04	2.37	1.28
Count	1776	NA	854	NA	922	NA

Note: Full sample includes papers posted from 2004 to 2019; early sample includes papers posted from 2004 to 2012; and late sample includes papers posted from 2013 to 2019.
NA: Not applicable.

Table 7: 12-month downloads

	Full sample	**Early sample**	**Late sample**
Intercept	28.92	31.15	26.31
	(12.73)	(8.93)	(8.84)
Men-only	8.88	7.99	9.62
	(4.58)	(2.63)	(3.88)
Women-only	−1.58	−4.45	1.37
	(−0.48)	(−0.84)	(0.33)
Additional author	3.31	3.80	3.36
	(3.53)	(2.59)	(2.78)
Observations	1,776	854	922

Note: Full sample includes papers posted from 2004 to 2019, early sample includes papers posted from 2004 to 2012, and late sample includes papers posted from 2013 to 2019.

Table 8: Likelihood of publication

	Full sample			Early sample			Late sample		
	Ever publish	Within 2 years	After 2 years	Ever publish	Within 2 years	After 2 years	Ever publish	Within 2 years	After 2 years
Intercept	0.18	0.12	0.05	0.18	0.11	0.06	0.16	0.12	0.03
	(5.47)	(4.22)	(1.68)	(3.70)	(2.52)	(1.22)	(3.58)	(3.14)	(0.74)
Men-only	0.11	0.04	0.10	0.15	0.08	0.12	0.08	0.01	0.09
	(3.90)	(1.70)	(3.86)	(3.53)	(2.17)	(2.87)	(2.05)	(0.28)	(2.74)
Women-only	−0.07	−0.07	0.004	−0.04	−0.05	0.02	−0.08	−0.08	0.004
	(−1.57)	(−1.77)	(0.09)	(−0.61)	(−0.81)	(0.35)	(−1.29)	(−1.52)	(0.09)
Additional author	0.10	0.07	0.06	0.11	0.08	0.07	0.10	0.07	0.06
	(7.52)	(5.98)	(4.65)	(5.53)	(4.20)	(3.64)	(5.71)	(4.55)	(3.49)
Observations	1,776	1,776	1,378	854	854	652	922	922	726

Note: Full sample includes papers posted from 2004 to 2019, early sample includes papers posted from 2004 to 2012, and late sample includes papers posted from 2013 to 2019.

Table 9: Coauthoring and career progression

Years 1-3			Years 4-6		
	Men	Women		Men	Women
1. Coauthors	27	25			
			1a. Coauthors	71	74
			1b. Writes	5	0
			1c. Does not write	11	11
			1d. Exits	12	15
2. Writes	40	37			
			2a. Coauthors	58	50
			2b. Writes	16	15
			2c. Does not write	15	25
			2d. Exits	11	10
3. Does not write	19	23			
			3a. Coauthors	39	20
			3b. Writes	9	4
			3c. Does not write	39	64
			3d. Exits	12	12
4. Exits	13	14			

Note: Includes Federal Reserve Board economists starting after March 2003 and before January 2017.

C Additional figures and tables

Table A.1 reports summary statistics for downloads within the first year of a paper being posted, tabulated by coauthor composition.[1] The distribution of downloads is heavily right skewed. For the full sample, the median number of downloads is 30, the mean number of downloads is 38, and the top 10 percent of papers have at least 75 downloads. Because papers with more coauthors automatically have a broader network of colleagues, it is perhaps unsurprising that we see downloads rising slightly with the number of coauthors. Although we observe that solo- and two-authored papers by men tend to have more downloads than those authored by women, this pattern does not hold once we expand to papers with more coauthors.

Table A.1: Distribution of downloads per paper

	Paper	12-month downloads		
Authors	Count	Mean	Median	P90
1 Author	**497**	**36**	**28**	**68**
Man	392	39	30	76
Woman	105	26	23	44
2 Authors	**655**	**37**	**29**	**75**
Men	436	40	33	76
Mixed	178	32	23	70
Women	41	33	27	53
3 Authors	**454**	**40**	**33**	**81**
Men	233	36	32	75
Majority men	151	28	21	59
Majority women	59	45	35	93
Women	11	44	15	54
4+ Authors	**170**	**43**	**35**	**81**
Men	58	42	36	74
Mixed	112	43	34	83
All	**1776**	**38**	**30**	**75**
Men	1119	36	32	75
Majority men	151	28	21	59
Mixed	290	41	32	79
Majority women	59	36	26	72
Women	157	29	23	47

Note: Sample includes papers posted from 2004 to 2019. Summary statistics are rounded to nearest integer.

[1] Although we have data on downloads for all FRB working papers, the trends in observed downloads indicate that this measure is most likely useful for papers posted after 2002. We further limit the sample to begin in 2004, to be consistent with the period for which we have the highest-quality data on individual covariates, and to end in 2019, to be consistent with the period for which we study publication outcomes.