

GENDER & COLLABORATION

Lorenzo Ductor (Middlesex University London)

Sanjeev Goyal (University of Cambridge)

Anja Prummer (Queen Mary University)

INTRODUCTION

- Explore gender differences in research output and co-authorship patterns in economics
- Provide a systematic overview of gender disparities in economics over a 40 year period covering all existing journals
- Similar patterns emerge in sociology

FINDINGS

1. Fraction of women increased significantly from 1970 to 2011
2. Gender disparities in research output persists for various output measures
 - Research output as defined in Ductor, Goyal, van der Leij (2014)
 - Number of Papers
 - Citations
3. Gender differences in collaboration patterns remain stable:
 - Men have more co-authors than women
 - Women repeatedly work with the same co-authors
 - Women have tighter networks than men: clustering coefficient is larger for women
4. Homophily, a preference to collaborate with own gender, present

OUTLINE

1. Economics

1.1 Gender Differences in Research Output

1.2 Gender Differences in Co-Authorship Networks

1.3 Homophily

1.4 Gender Differences in Co-Authors' Characteristics

1.5 Robustness: Heterogeneity, Top Journals, Institutions

2. Sociology

DATA DESCRIPTION

- Publications by economists over 42 years, 1970-2011.
 - Data from EconLit database, a bibliography of journals in economics compiled by the editors of the Journal of Economic Literature.
 - Panel data start for each individual with first publication, lasts until last observed publication (or 2011).
 - US Social Security Administration records to determine the gender from first names
 - identify an author's gender if author's first name is associated with single gender in social security records at least 95% of the time
 - if this fails, google authors
- identify gender of 80% of economists in sample

RESEARCH OUTPUT

- average number of research papers per author is small
- long lags in publications

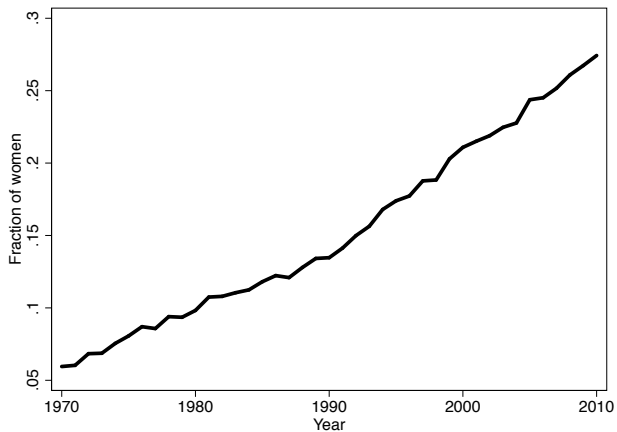
→ 5 year window

Robustness Check: 3- and 10-year windows

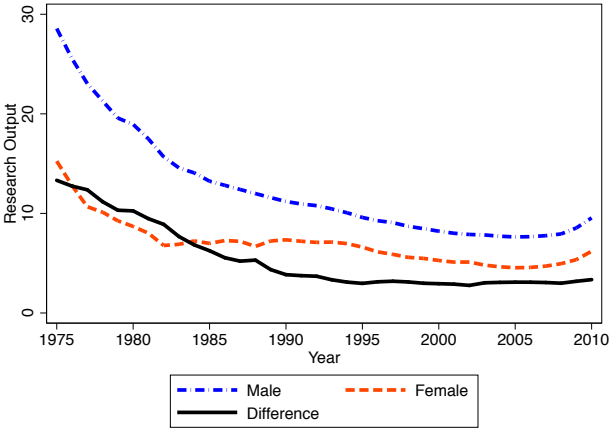
Research Output:

Number of publications during the period $t - 4$ to t , weighted by journal quality and discounted by the number of co-authors

WOMEN IN ECONOMICS: 1970-2010



AVG. RESEARCH OUTPUT ACROSS YEARS



Research Output Across Time

	(1)	(2)	(3)
Year/Gender:	Women	Men	% Difference
1971-1975	15.25	28.57	87%
1976-1980	8.69	18.94	118%
1981-1985	6.98	13.24	90%
1986-1990	7.35	11.20	52%
1991-1995	6.62	9.59	45%
1996-2000	5.27	8.21	56%
2001-2005	4.54	7.63	68%
2006-2010	6.20	9.55	54%
1970-2011	5.82	10.72	84%

GENDER DIFFERENCES IN OUTPUT MODEL

$$q_{it} = \alpha + \rho F_i + C_{it}\omega + \sum_{l=1}^L \beta_l JEL_{lit} + \mu_t + \varepsilon_{it}$$

- F_i : female dummy
- C_{it} : career time dummies for differences in experience
- JEL_{lit} : field dummies for differences in specialization
- Standard errors clustered by author

Alternative Specifications: Random Effects, Correlated Random Effects

GENDER DIFFERENCES IN OUTPUT

VARIABLES	(1) Output	(2) Output	(3) # Papers	(4) $\frac{\text{Output}}{\text{\#Papers}}$	(5) $\frac{\text{Citations}}{\text{\#Papers}}$
Female	-3.654*** (0.249)	-2.049*** (0.229)	-0.480*** (0.028)	-0.225*** (0.048)	-0.577*** (0.161)
Obs.	240,897	240,897	240,897	240,897	240,897
Career FE	NO	YES	YES	YES	YES
Year FE	NO	YES	YES	YES	YES
JEL FE	NO	YES	YES	YES	YES

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Gender Differences in Research Output

- Academic publishing changed: dramatic increase in number of journals, articles
- Significant increase in the number and share of women
- Gender differences in output remain large, independent of measure used (research output, # papers, citations)

OUTLINE

1. Economics

1.1 Gender Differences in Research Output

1.2 **Gender Differences in Co-Authorship Networks**

1.3 Homophily

1.4 Gender Differences in Co-Authors' Characteristics

1.5 Robustness: Heterogeneity, Top Journals, Institutions

2. Sociology

CO-AUTHORSHIP NETWORK

- Authors as nodes
- Collaborations as links
- Networks defined over a 5-year period
- *Degree*: number of co-authors in period $t - 4$ to t
- *Clustering*:
Share of co-authors that are themselves collaborators
- *Strength of Tie*:
Number of papers co-authored with same co-authors, normalized by total number of papers within a five year period

NETWORK STRUCTURE & RESEARCH OUTPUT: PREVIOUS WORK

Lindenlaub and Prummer 2014:

- Higher centrality is associated with higher performance in uncertain environments, such as research
- Tighter networks lead to lower performance in these environments

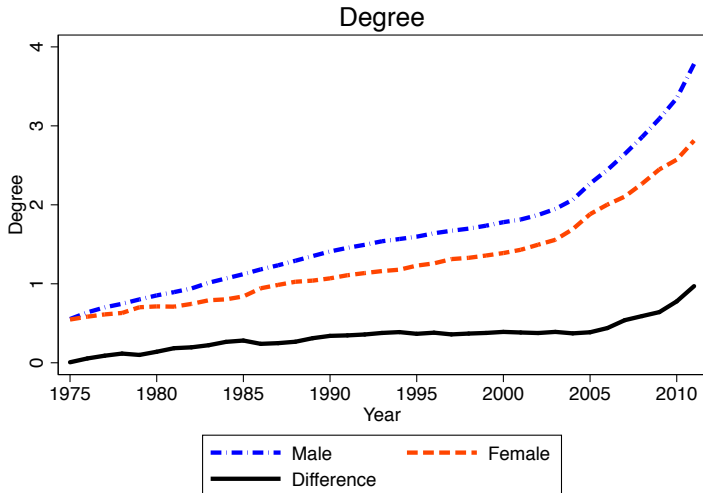
Ductor et al 2014:

- Degree associated with higher output
- Strength of Ties related to lower output
- Clustering correlated with lower output

→ Gender Differences in Network Patterns?

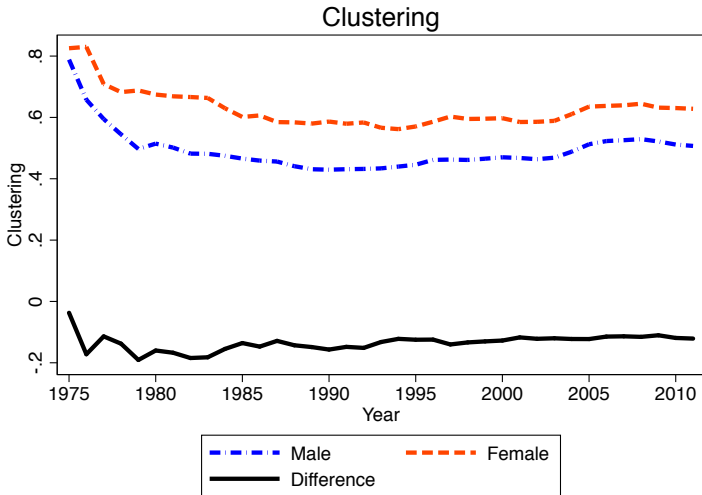
DEGREE AND GENDER ACROSS TIME

→ gender gap in number of distinct co-authors increasing



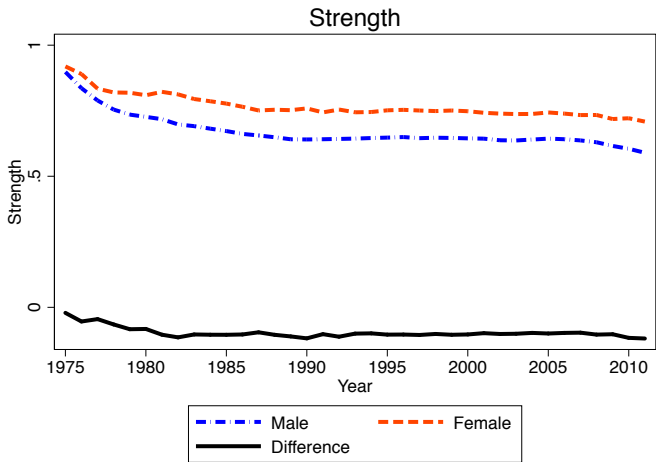
CLUSTERING ACROSS TIME

→ women have persistently tighter networks than men



STRENGTH ACROSS TIME

→ women collaborate more often with the same co-authors



GENDER DIFFERENCES IN NETWORKS

	Degree	Strength	Clustering
Female	-0.407*** (0.030)	0.165*** (0.011)	0.066*** (0.010)
Degree			-0.238*** (0.005)
Past output _{t-5}	0.007*** (0.0004)	-0.156*** (0.006)	-0.053*** (0.003)
Observations	394,113	316,145	226,078
Number of authors	56,949	48,936	38,757
Career FE	YES	YES	YES
Year FE	YES	YES	YES
JEL FE	YES	YES	YES

*** p<0.01, ** p<0.05, * p<0.1

SUMMARY: GENDER & NETWORK CHARACTERISTICS

- Women work with fewer distinct co-authors than men:
lower degree
- Women have tighter networks: higher clustering coefficient
- Women work repeatedly with the same co-authors:
higher strength of ties

→ BUT: share of single-authored papers is similar for men and women

OUTLINE

1. Economics

1.1 Gender Differences in Research Output

1.2 Gender Differences in Co-Authorship Networks

1.3 **Homophily**

1.4 Gender Differences in Co-Authors' Characteristics

1.5 Robustness: Heterogeneity, Top Journals, Institutions

2. Sociology

HOMOPHILY

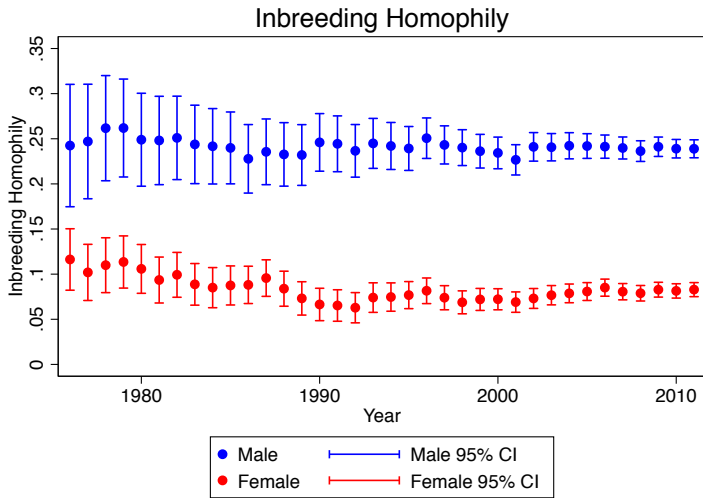
Do economists display homophily? Preference for collaborating with same gender?

	Men	Women
Population Share	72.72%	27.28%
Men's Collaborators	81.01%	18.99%
Women's Collaborators	67.28%	32.72%
Inbreeding Homphily	0.3039	0.0748

→ *Inbreeding Homophily*:

- Share of same type connections, relative to the share of same type in the population
- Inbreeding homophily for women if share of female collaborators is higher than the share of women among economists, otherwise inbreeding heterophily

INBREEDING HOMOPHILY ACROSS TIME



HOMOPHILY: MODEL

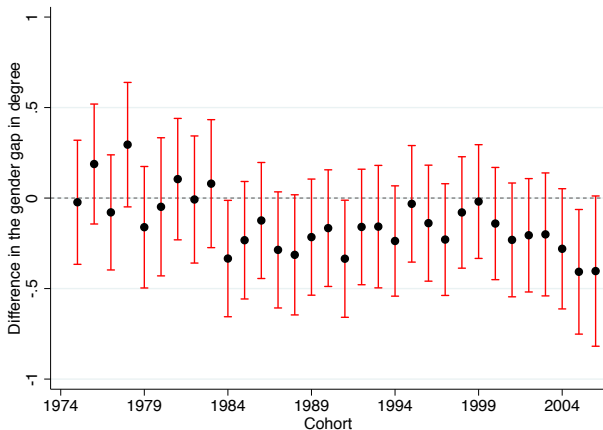
Does an increase in the share of women change collaboration patterns?

Predictions of Currarini, Jackson and Pin (2009)

1. larger group forms more connections: higher degree
2. as the share of women increases, differences in degree decrease

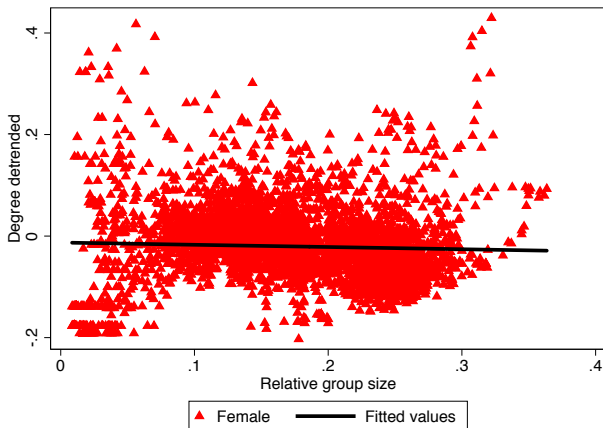
HOMOPHILY: VARIATION IN COHORTS

- in 1974: women have .14 fewer co-authors than men
- Difference in the number of co-authors has been increasing



HOMOPHILY: VARIATION ACROSS FIELDS

- Variation in gender shares using the first two digits of the JEL codes to define 124 different fields
- Pooling all the years and detrending degree



OUTLINE

1. Economics

1.1 Gender Differences in Research Output

1.2 Gender Differences in Co-Authorship Networks

1.3 Homophily

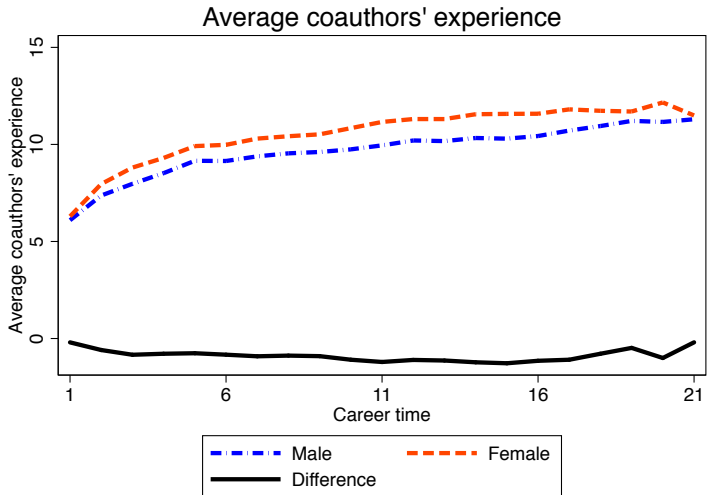
1.4 **Gender Differences in Co-Authors' Characteristics**

1.5 Robustness: Heterogeneity, Top Journals, Institutions

2. Sociology

DIFFERENCES IN EXPERIENCE

Women's co-authors are more senior than men's.



OUTLINE

1. Economics

1.1 Gender Differences in Research Output

1.2 Gender Differences in Co-Authorship Networks

1.3 Homophily

1.4 Gender Differences in Co-Authors' Characteristics

1.5 **Robustness: Heterogeneity, Top Journals, Institutions**

2. Sociology

ROBUSTNESS

- Top Authors: gender differences in networks persist for most productive women
- Career Time: gender differences in networks stable across career time
- Top journals: 4* REF journals, results also emerge in this sample
- Institutions: controlling for institutions does not change results
 - Institution with lower Repec ranking have higher share of women
 - Women not less likely to move institutions conditional on past output
 - Women more likely to co-author with those from the same institution
- Network disparities greater among active economists (those who publish at least one paper per year)

OUTLINE

1. Economics

1.1 Gender Differences in Research Output

1.2 Gender Differences in Co-Authorship Networks

1.3 Homophily

1.4 Gender Differences in Co-Authors' Characteristics

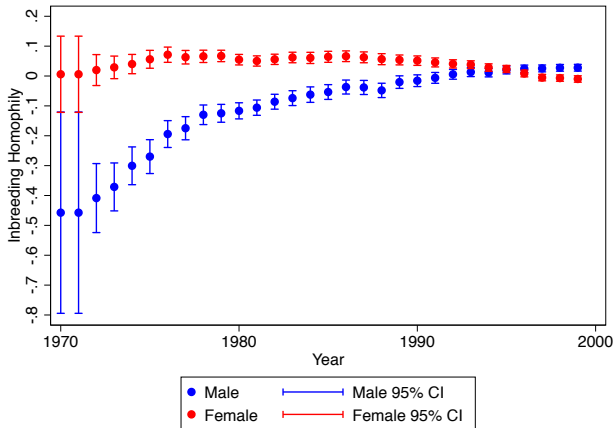
1.5 Robustness: Heterogeneity, Top Journals, Institutions

2. **Sociology**

ECONOMICS AND SOCIOLOGY

- Despite increase of share of women, gender gap in output persists
- Gender differences in collaboration patterns
 - Women tend to have fewer distinct co-authors, are more likely to collaborate with the same co-authors repeatedly, and tend to have overlapping co-authorship patterns
 - Share of co-authored papers for men and women is same
 - Women tend to collaborate with more senior co-authors
- Economists display homophily, sociologists do not

HOMOPHILY ACROSS TIME SOCIOLOGY



WHAT EXPLAINS THESE PATTERNS?

Risk taking due to

- Different beliefs, perceptions and payoff structures
- Family constraints as background risk
- Preferences

DIFFERENCES IN RISK TAKING PREDICTS

1. Men have a higher output and variance:

- Men's research output on average 50% higher than women's
- Women's variance in output 50% lower than men's

→ Prediction consistent with data

2. Women have more senior co-authors

- More senior co-authors are safer choice as both gender attitudes and ability established
- More senior co-authors may help overcome adversities in environment

→ Prediction consistent with data

DIFFERENCES IN RISK TAKING PREDICTS COLLABORATION NETWORKS

1. Women choose to work with same co-authors repeatedly:
 - Choice between new co-author or old co-author
 - Old co-authors is less risky as already well known→ Lower risk taking leads to higher strength of ties
2. Women choose to work with collaborator's co-authors
 - Women can rely on collaborators to introduce them
 - Common collaborators can vouch for a new co-authors→ Lower risk taking leads to higher clustering coefficient
3. Women have fewer distinct co-authors
 - Selecting new authors with little knowledge about attitudes and ability less a risky undertaking→ Lower risk taking leads to lower degree

CONCLUSION

- Share of women in economics has increased significantly
- Output gap between men and women remains pronounced
- Distinct collaboration networks of men and women
- Homophily present
- Women's co-author more senior, female co-authors less productive
- Patterns carry over to sociology, with exception of homophily
- Potential explanation: risk taking