

A data-backed study on
gender differences in
mathematics publication
patterns

by [Helena Mihaljević-Brandt](#), [Lucía Santamaría](#), [Marco Tullney](#)



EWM Meeting in Bonn (2013)

There is a **systemic gender imbalance** in the distribution of mathematics researchers.

A **solid publication record** is a key factor in achieving and sustaining a successful academic career.

Do women and men in mathematics differ regarding their publication patterns?

Have these differences changed over time?

How might they contribute to the gender gap in mathematics?

Our goals

Provide hints and insights about the status of women mathematicians in the publication landscape.

Identify research questions which could provide additional substantial insights by scanning a rather **broad set of determinants** for scholarly productivity.

Four dimensions

- research activity over time
- choice of journals and their perceived quality
- collaboration through coauthorship
- distribution across specialisation fields

Big data

Our study is based on zbMATH, one of the most comprehensive metadata sources on mathematical publications.

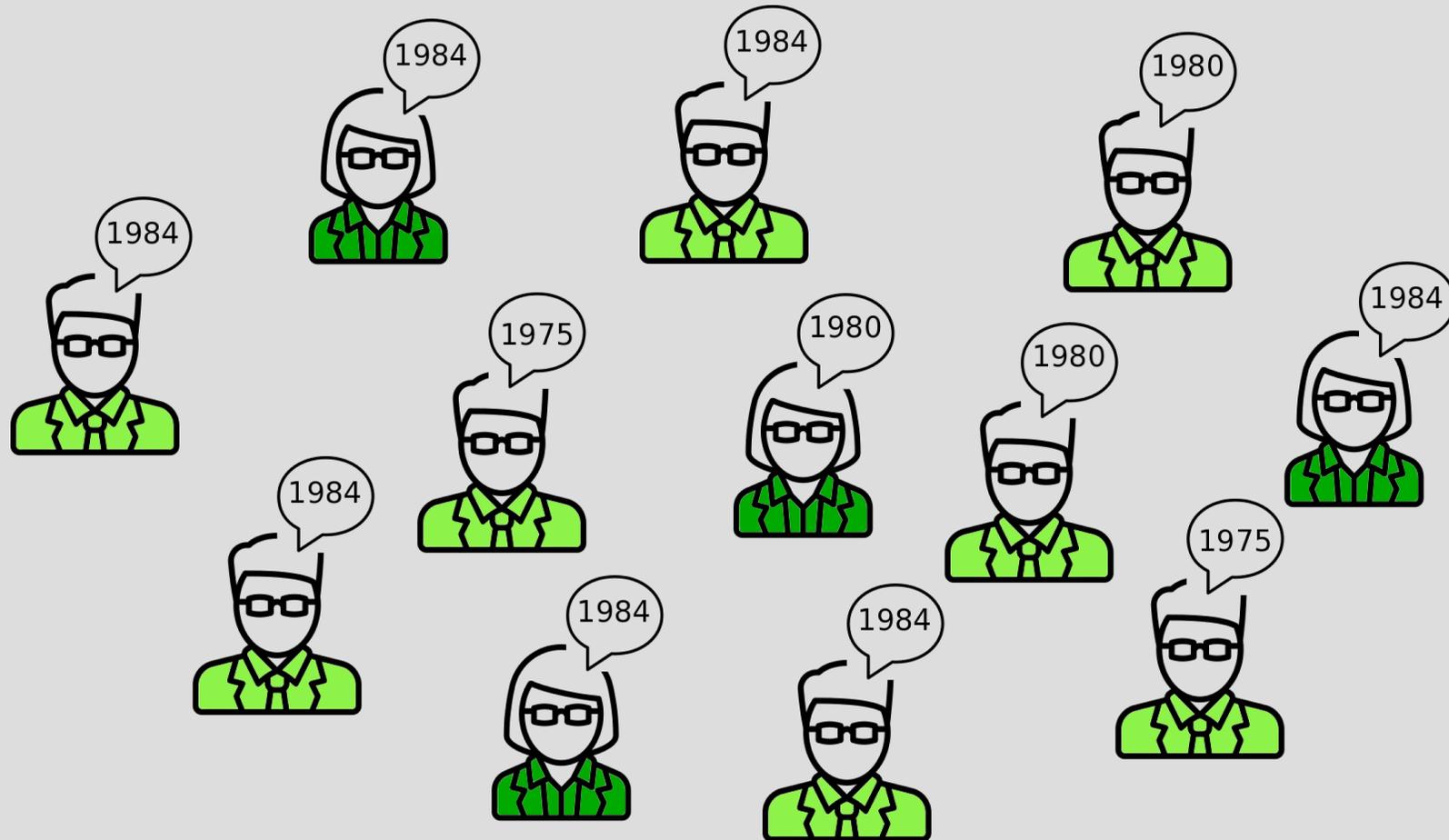
Using the authors' first names we algorithmically infer the gender of ~150.000 mathematicians active since 1970.

RESULTS

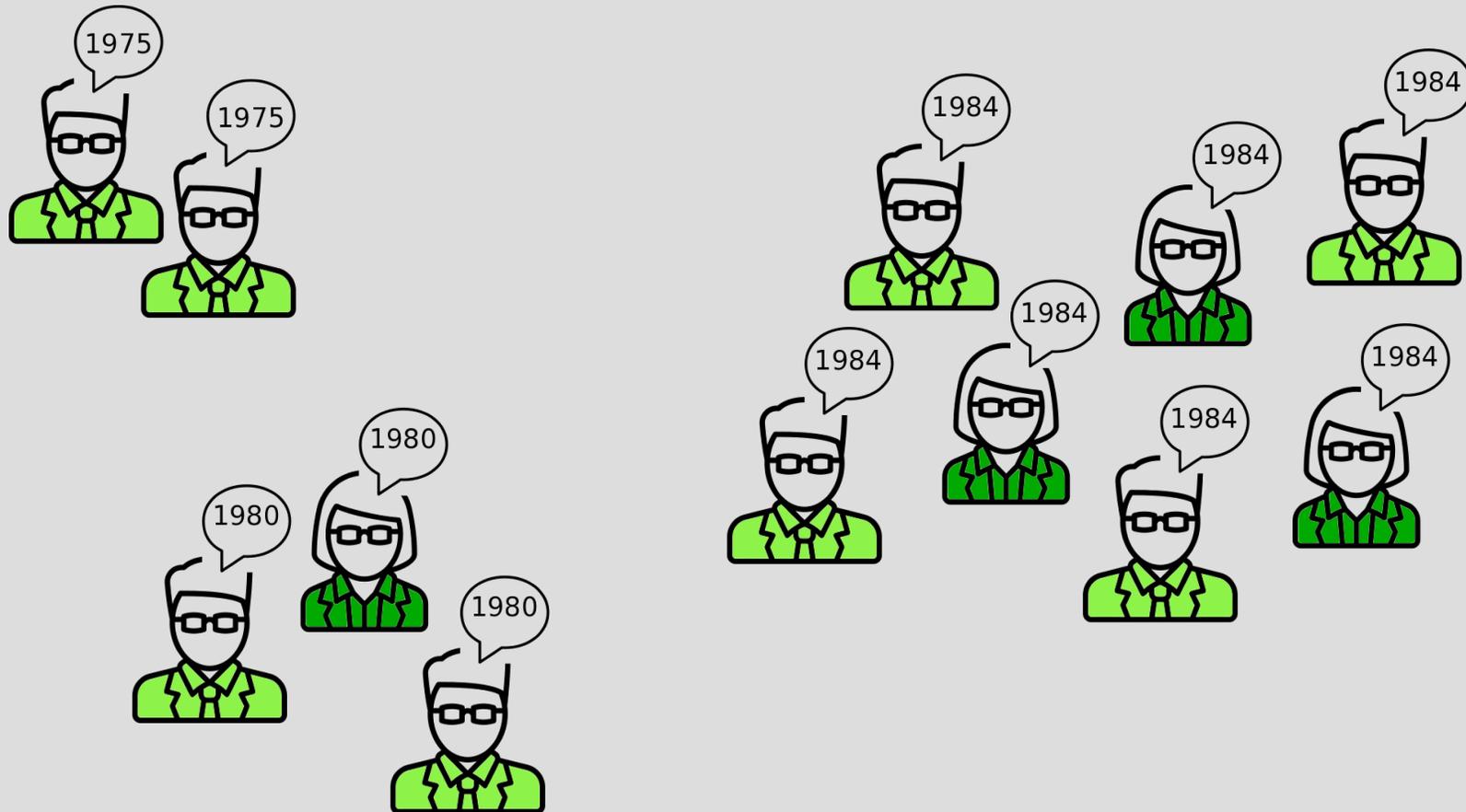
RESEARCH ACTIVITY OVER TIME

Is it only a **matter of time** until gender equality will be achieved in the higher academic ranks?

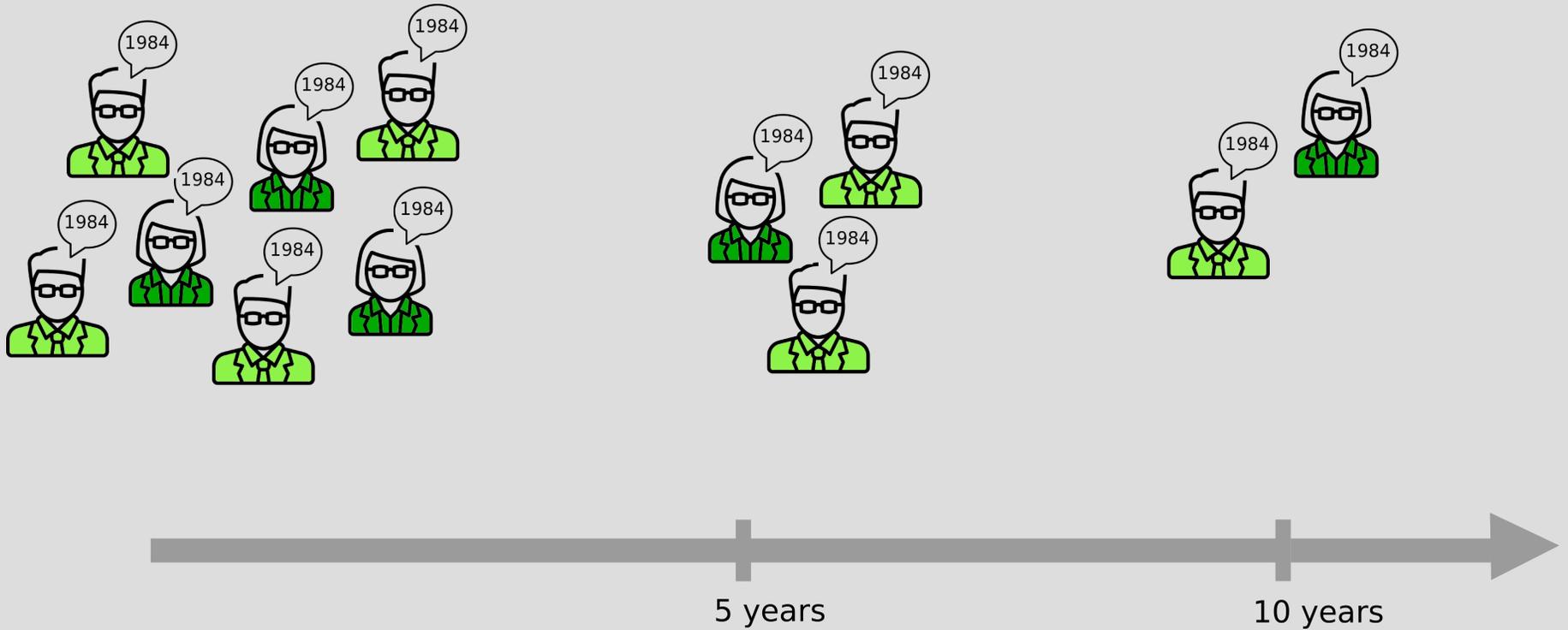
Take as many mathematicians as possible ...



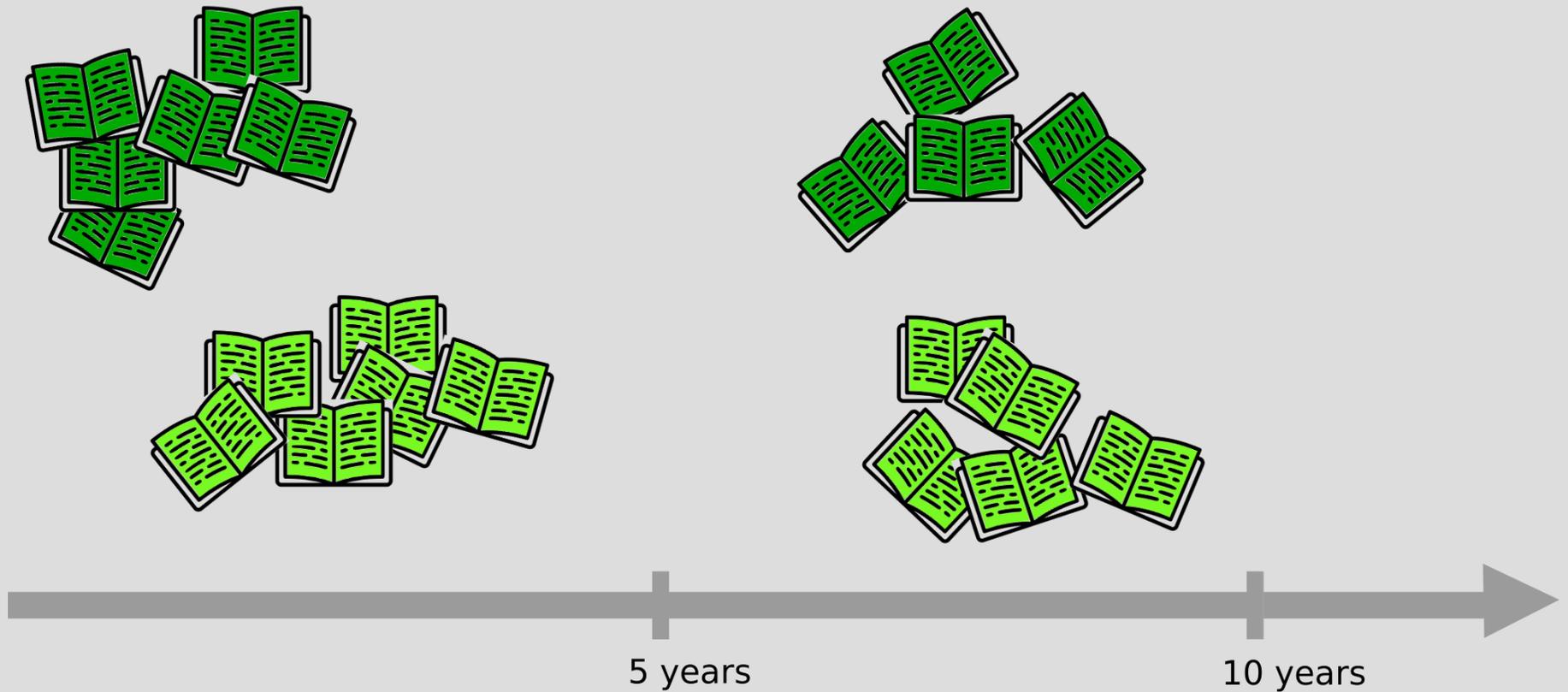
... group them into cohorts ...



... and follow them over time ...



... and check, e.g., the average number of papers they write.

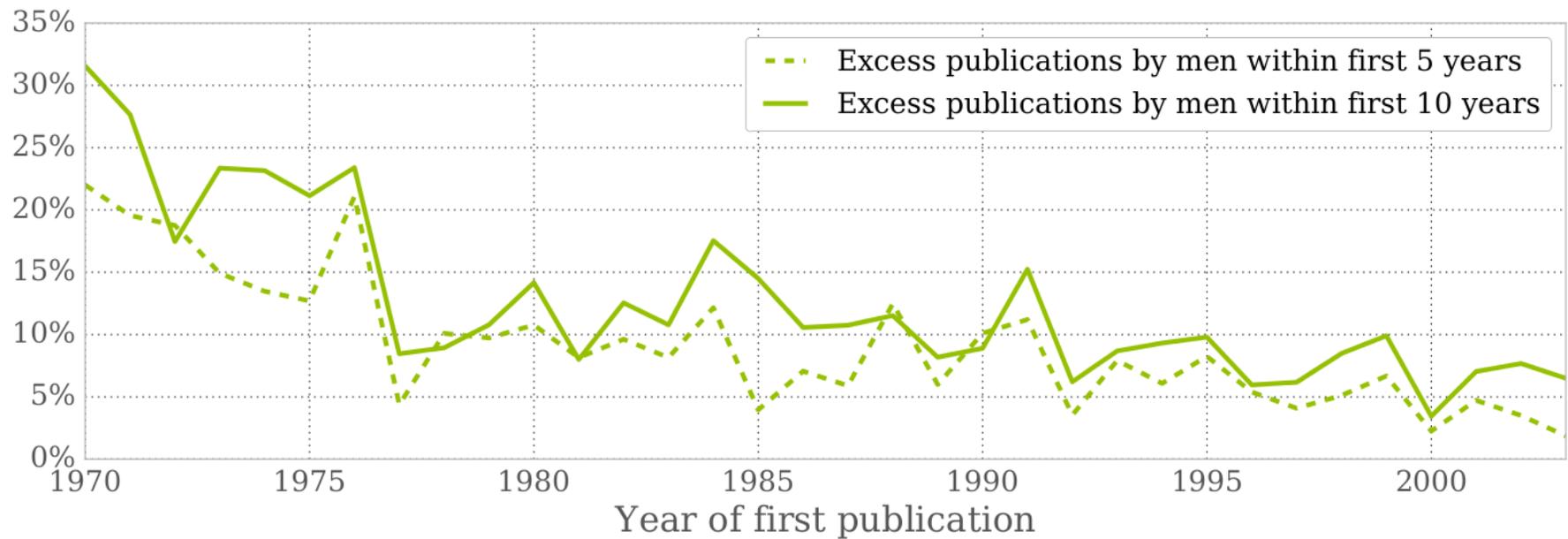


Women mathematicians have tripled their number since 1970

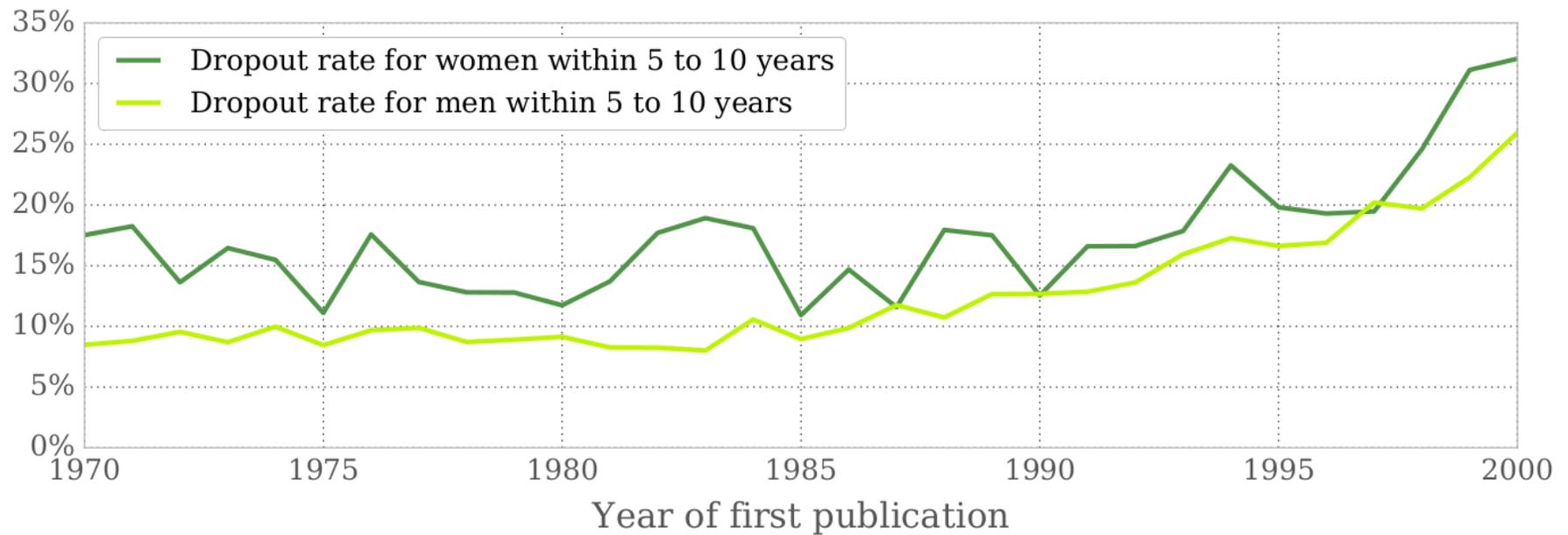
Roughly **20%** of all authors with careers lasting at least 10 years that started publishing in the late 1990s are women.

However, this is still far from the percentage of women that pursue mathematics education at the undergraduate level.

Women publish less than men at the beginning of their careers



Women leave academia at a higher rate than men



CHOICE OF JOURNALS
AND THEIR PERCEIVED
QUALITY

The perceived quality of journals, measured in terms of **journal rankings**, is one of the most common means of evaluating the academic output of a researcher.

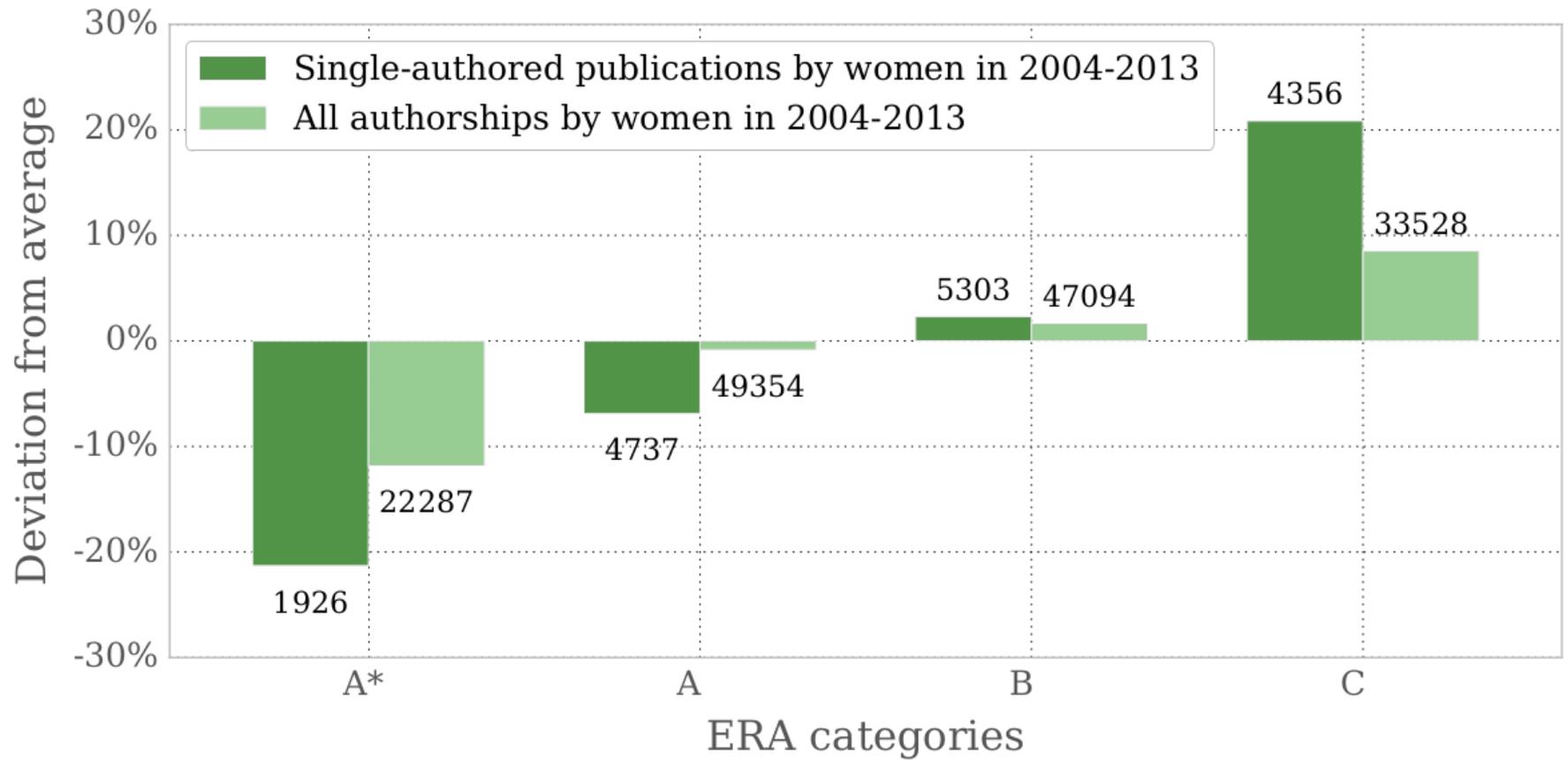
Due to the relevance of such metrics for the academic career, we investigate how the gender groups are represented in journals of different ranks,

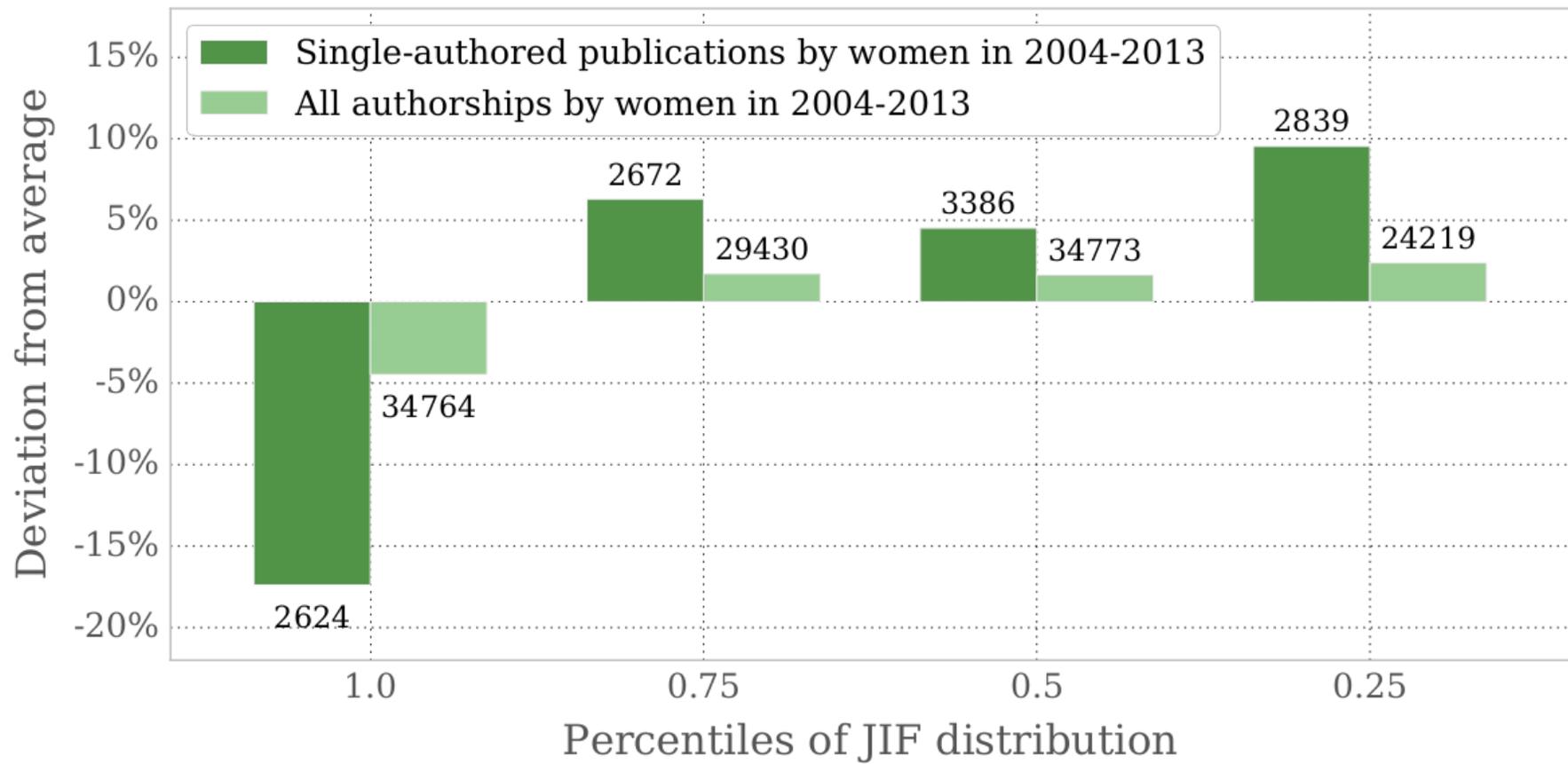
despite all the legitimate objections to particular and general shortcomings of these measurements.

ERA vs. Journal Impact Factor

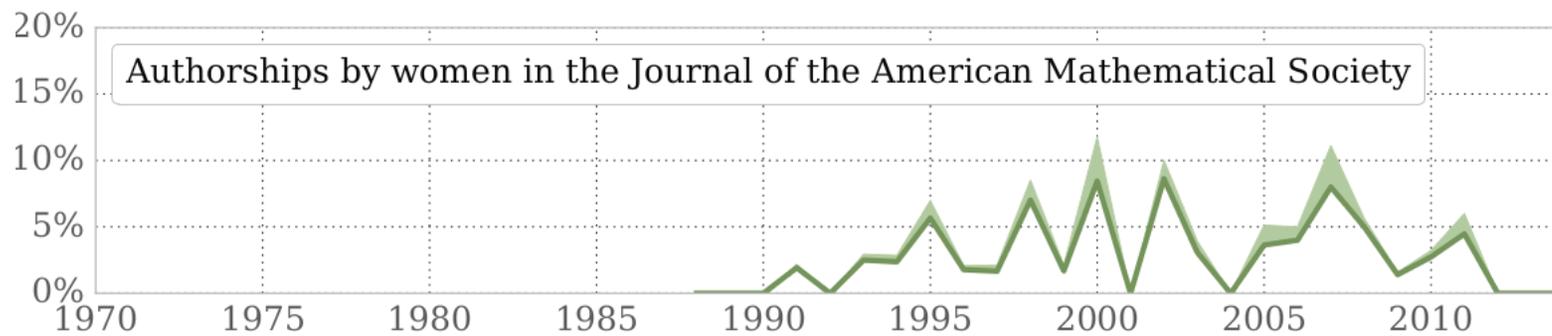
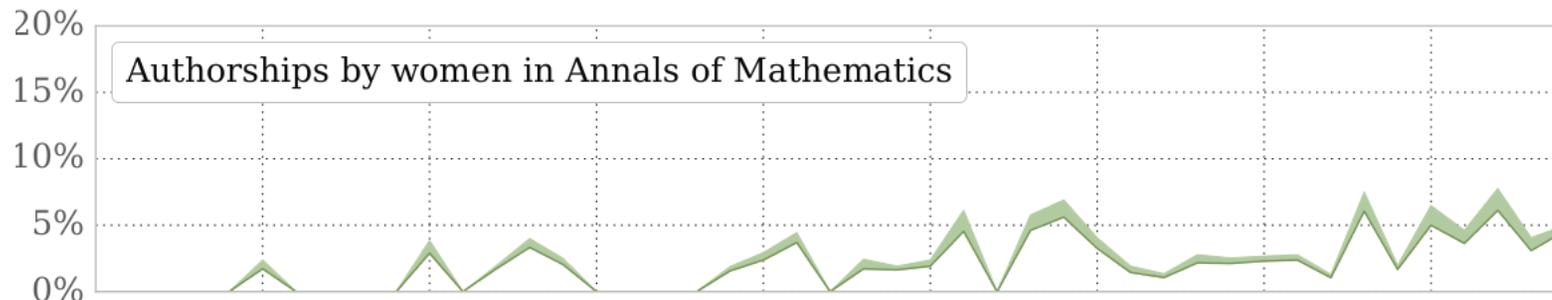
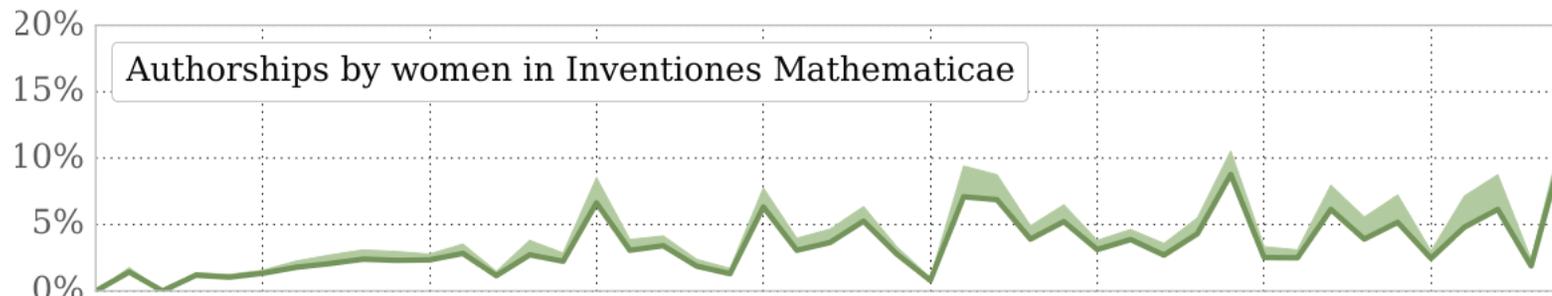
Journal	JIF	ERA
Statistical Methods in Medical Research	4.472	B
Journal of the Royal Statistical Society. Series B. Statistical Methodology	3.515	A*
Annals of Mathematics. Second Series	3.236	A*
Publications mathématiques	2.882	A*
Statistical Science	2.738	A
Biostatistics	2.649	A*
Journal of the American Mathematical Society	2.556	A*
Fixed Point Theory and Applications	2.503	B
Acta Mathematica	2.469	A*
Inventiones Mathematicae	2.364	A*

High-ranked mathematics journals
publish less articles by women





Women are drastically
underrepresented in three top-ranked
journals



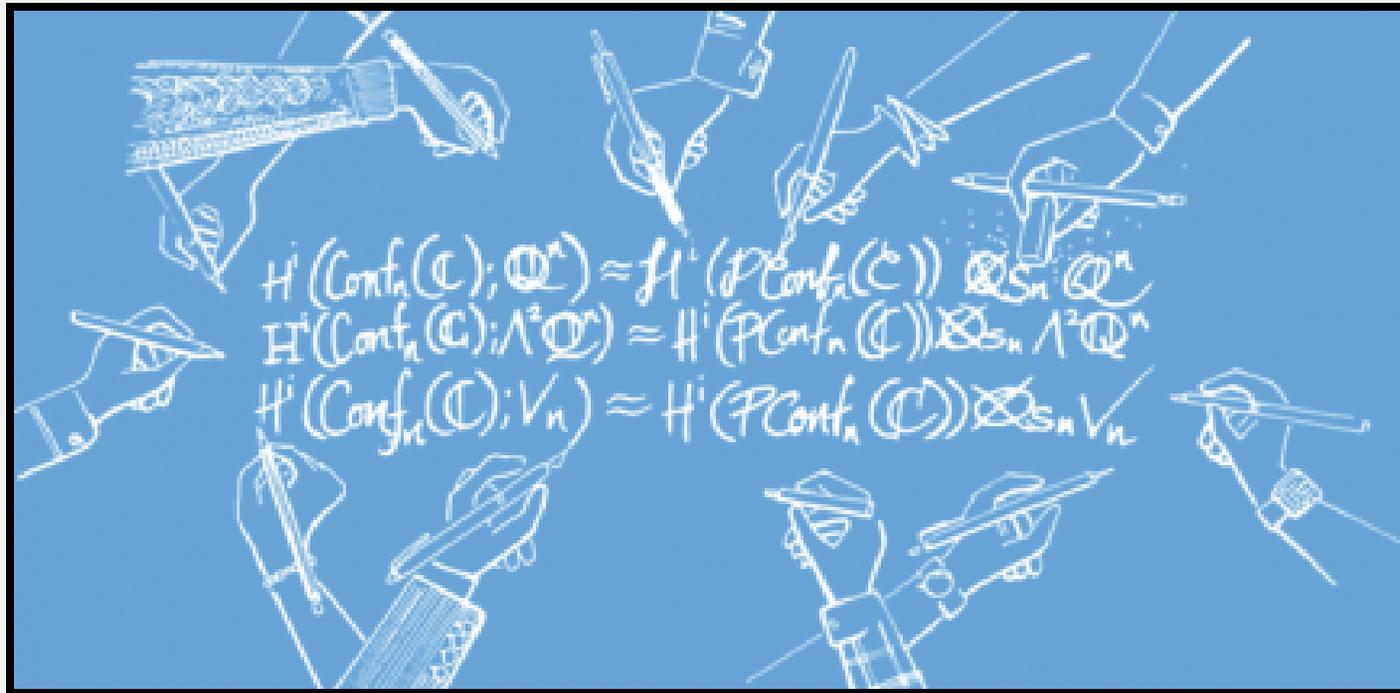
COLLABORATION
THROUGH
COAUTHORSHIP



individual capabilities

independence

ready for a faculty position



more powerful

more fun

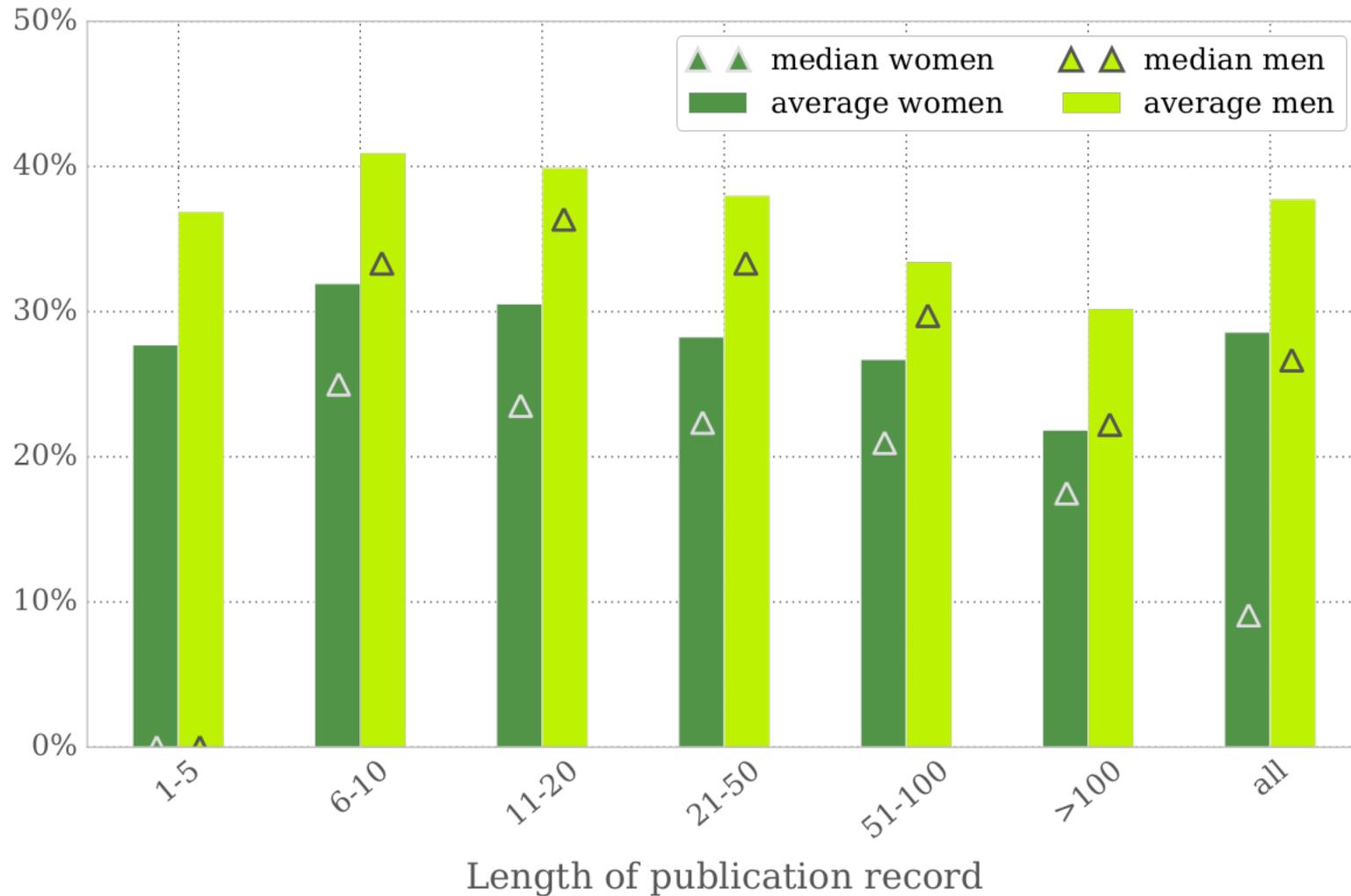
networks help to advance careers

We apply the following two metrics:

- share of single-authored publications
- number of distinct coauthors ("network size")

Women publish less single-authored
papers

On average, **women** (**men**) write **29%** (**38%**) of their scientific records as single authors.



52% (61%) of **women** (**men**) mathematicians publish at least one article alone.

33% (43%) of the first publications of **women** (**men**) are single-authored.

Women's and men's coauthor networks are of similar size

Women and men collaborate with a comparable number of different co-authors.

When measuring w.r.t. time instead of the total number of publications, networks of women are even slightly smaller.

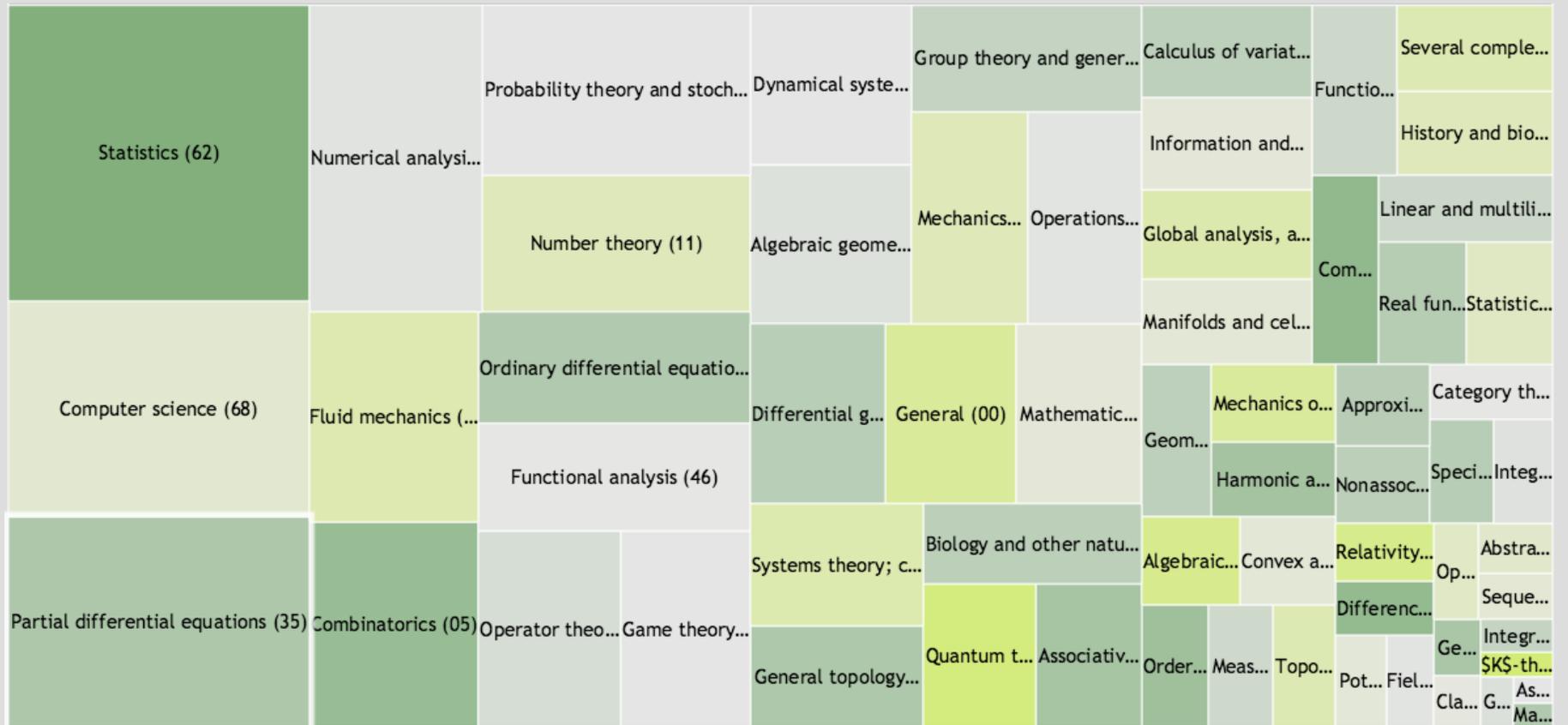
Women's collaboration seems to be at the expense of their own single-authored publications.

DISTRIBUTION ACROSS SPECIALISATION FIELDS

We study topical distribution in terms of MSC 2010

- Level 1 (63 classes)
 - Algebraic Geometry (14)
 - Partial Differential Equations (35)
 - Combinatorics (05)
 - ...
- Level 2 (528 topic-based classes)
 - Cycles and Subschemes (14C)
 - Elliptic Equations and Systems (35J)
 - Graph Theory (05C)
 - ...

Women's distribution across
research fields is not
homogeneous

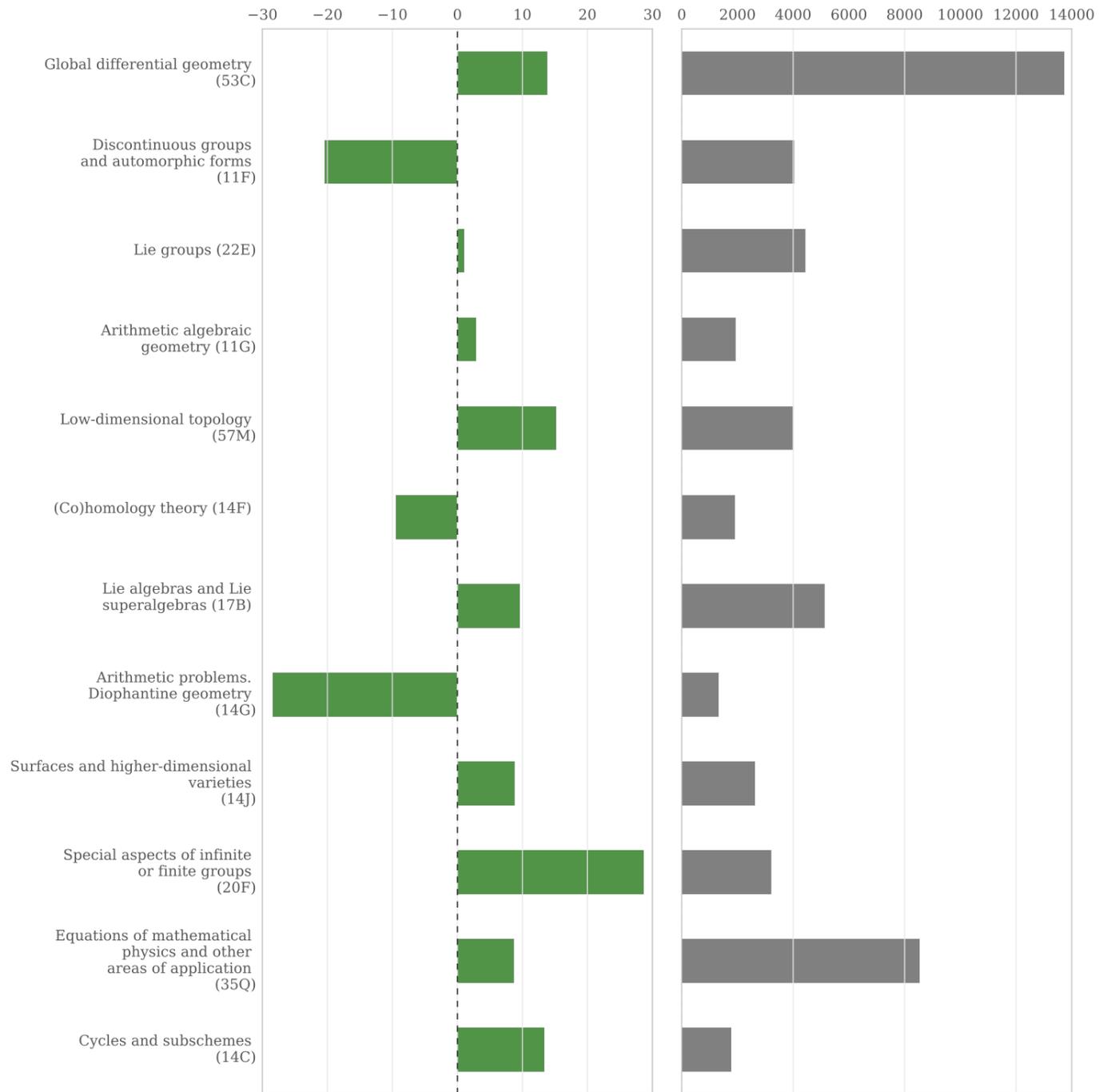


Is the **choice of research areas** a reason for the underrepresentation of women in *Annals*, *J. AMS* and *Inventiones*?

Topical Bias

5 level-1-classes cover more than **50%**
of all articles

More than **1/3** of all articles is covered
by only **12** level-2-classes



What we did

We have studied authors and publications in all areas of mathematics research between 1970 and 2014

We have looked into variations in publication patterns between men and women regarding various facets

We report significant differences among genders in various aspects with strong impact on academic careers

Further research

Study the *why* by, e.g., concentrating on certain samples, particular journals and editorial policies, inclusion of additional data sources, improvement of data, etc.

Particular questions

- Do women simply submit less articles to prominent journals or are their manuscripts more often rejected?
- With whom do women and men collaborate? What role is played by gender, academic position or country of the collaborators?
- What motivates women to enter a certain research area? How important are role models, mentoring, etc.? Do new and emerging areas produce a different mind-set and are hence more attractive for women scientists?

THANK YOU