

Analysis of Research Performance Through a Gender Lens

Holly J. Falk-Krzesinski, PhD (@hfalk14) | Vice President, Research Intelligence, Global Strategic Networks
On behalf of the report team

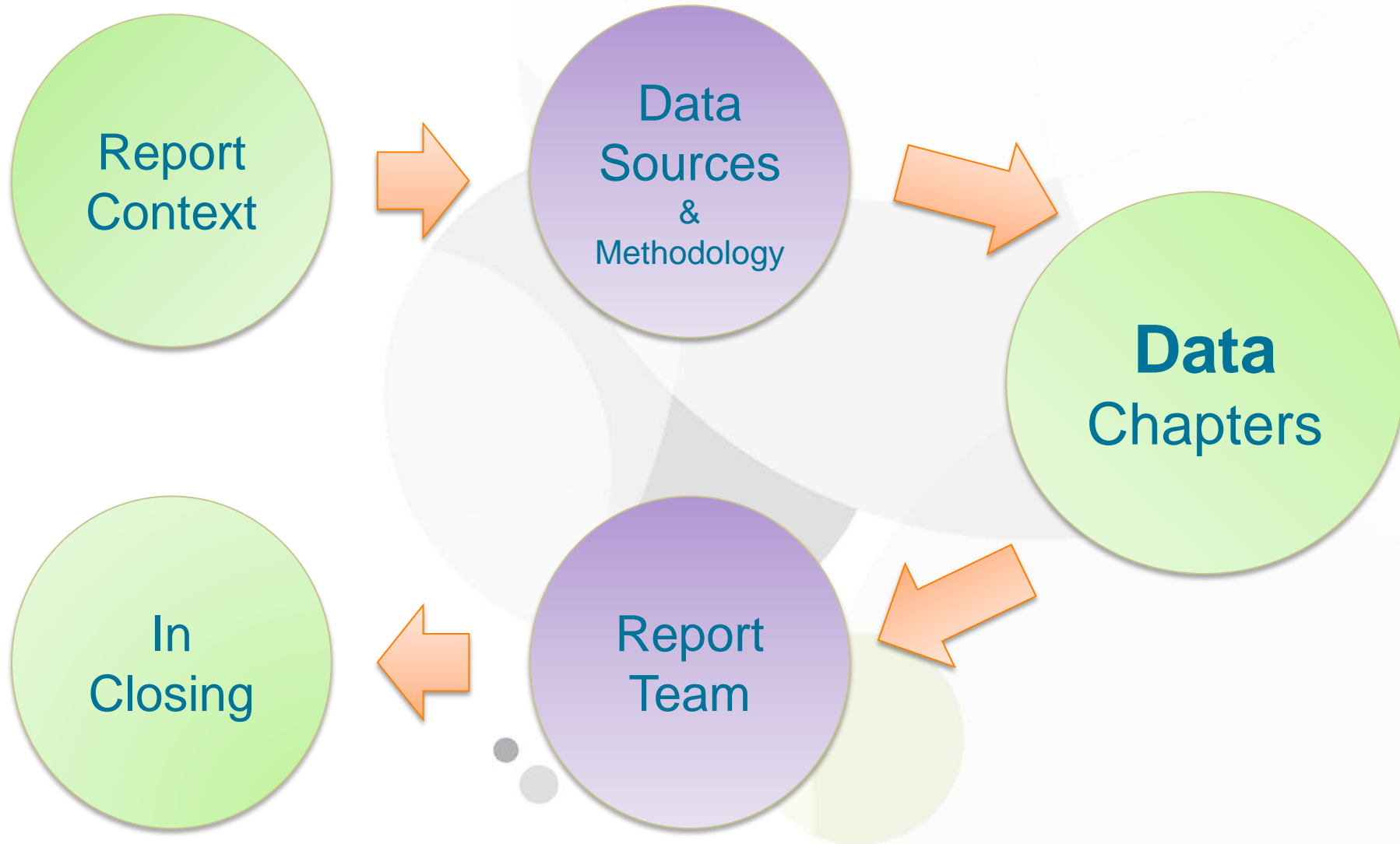
May 8, 2018 | 10th Annual NORDP Research Development Conference



Empowering Knowledge

*Gender in the
Global Research
Landscape*

Presentation Roadmap



Report Context

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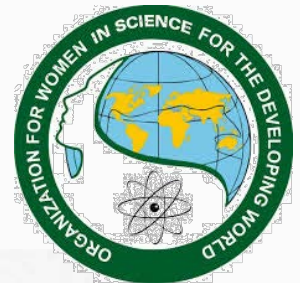
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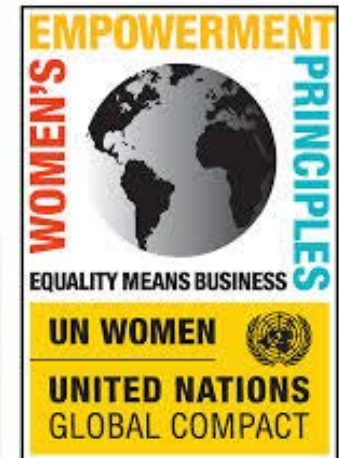
Advancing women scientists: grants for family friendly policies, career skills, dual career issues, recognition awards, benchmarking studies & boosting professional visibility through childcare grants.



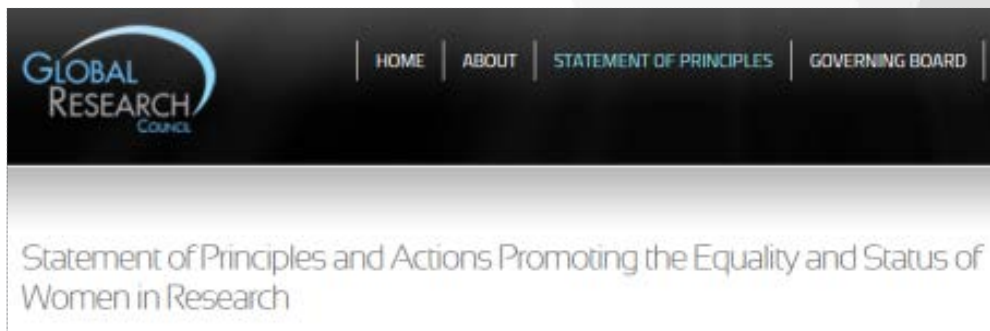
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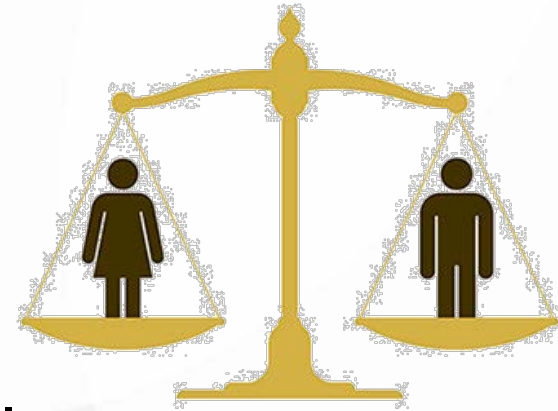


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Elsevier Gender Working Group

- Apply **analytics** to gender issues
- Increase **gender diversity** for journal editorial boards and speakers/panelists at Elsevier conferences
- Enhance **gender equity** within Elsevier management ranks and across the organization



Answering the Call for Data

National Institutes of Health addresses the science of diversity

Hannah A. Valentine^{a,1} and Francis S. Collins^b

^aChief Officer for Scientific Workforce Diversity, US National Institutes of Health, Bethesda, MD 20814; and ^bDirector, US National Institutes of Health, Bethesda, MD 20814

Edited by Inder M. Verma, The Salk Institute for Biological Studies, La Jolla, CA, and approved August 26, 2015 (received for review May 14, 2015)

The US biomedical research workforce does not currently mirror the nation's population demographically, despite numerous attempts to increase diversity. This imbalance is limiting the promise of our biomedical enterprise for building knowledge and improving the nation's health. Beyond ensuring fairness in scientific workforce representation, recruiting and retaining a diverse set of minds and approaches is vital to harnessing the complete intellectual capital of the nation. The complexity inherent in diversifying the research workforce underscores the need for a rigorous scientific approach, consistent with the ways we address the challenges of science discovery and translation to human health. Herein, we identify four cross-cutting diversity challenges ripe for scientific exploration and opportunity: research evidence for diversity's impact on the quality and outputs of science; evidence-based approaches to recruitment and training; individual and institutional barriers to workforce diversity; and a national strategy for eliminating barriers to career transition, with scientifically based approaches for scaling and dissemination. Evidence-based data for each of these challenges should provide an integrated, stepwise approach to programs that enhance diversity rapidly within the biomedical research workforce.

diversity | scientific workforce | underrepresentation in science | culture | biomedical research

Despite longstanding efforts, diversifying the biomedical research workforce remains an elusive goal, and large sectors of the US population remain underrepresented. These sectors include several racial/ethnic groups; economically disadvantaged individuals; people with disabilities; and women. Certain racial/ethnic groups are represented only minimally in biomedical research: of the nation's scientific research faculty positions, 4% are African American, 4% are Hispanic, 0.2% are Native American, and 0.1% are Hawaiian/Pacific Islander (1). There has been little increase in representation of

Existing evidence suggests that enhancing and sustaining diversity requires an integrated set of interventions that—much like the task of biomedical research itself—relies on a reasoned, evidence-based approach that is rooted in the scientific method. Herein, we identify the need for scientific approaches that address four crosscutting diversity challenges: (i) research to support or refute evidence that diversity among scientists enhances quality and outputs of the research itself; (ii) evidence-based approaches to recruitment and training, including defining “effective research experiences and mentoring”; (iii) interventions that mitigate individual and

Challenge 1: Among Scientists, What Is the Impact of Diversity on the Quality and Outputs of Research?

A literature base outside biomedicine indicates that diversity has a variety of beneficial effects, but more research is needed to support or refute evidence that diversity among scientists enhances quality and outputs of the research itself. Many research scholars approaching diversity have done so from a wide range of fields outside of biomedicine, including sociology, psychology, economics, education, team science, leadership, career development, and others. This research has

Valentine, H.A., and Collins, F.S. (2015). National Institutes of Health addresses the science of diversity. *Proc. Natl. Acad. Sci.* 112(40), 12240–12242.

“...solid body of evidence to understand the impacts of diversity...”

EDITORIAL

Intentional equity

Over a decade ago, when I was chief scientist at the U.S. National Aeronautics and Space Administration, I spoke at a conference called Women and Science: Celebrating Achievements, Charting Challenges. I lauded women working in astrophysics, government, and science policy in the United States and elsewhere, but said that progress was mixed—the veneer of success for women across the sciences, and in science leadership, was too thin across the globe. What has changed since then? Cultural barriers, a lack of enlightened policies, and the need for role models and support systems still exist worldwide. However, today there is good reason to be optimistic. The international scientific community is coming together intentionally to acknowledge and tackle gender equity.

ing of leading industrial nations, is encouraging G7 nations to lead efforts in “inclusive innovation” to ensure that everyone accesses and benefits from science and technology. Further, the final G7 report encourages the development of “policy and working environments in which equal opportunity allows women to exert their abilities [and] advance their career prospects.” Such changes help STEM equality and will attract and

retain talented women in STEM careers.

What about the United States? Women now earn about half of all science and engineering bachelor's degrees, yet they account for only 30% of the U.S. science and engineering workforce. In some STEM fields, such as mechanical engineering, the percentage of women is in the single digits. NSF will continue to advance equity through data-driven decision-making. Our Career-Life Balance Initiative, for example, mitigates factors that can negatively affect women's ability to carry out research, especially during the early years of their careers. NSF's ADVANCE program encourages universities to use institutional



France A. Córdova is director of the U.S. National Science Foundation, Arlington, VA, USA.



“...global equity for women in science...is a call to action...”

stein Forum (NEF) in Africa, where I was on a panel discussing women in science, technology, engineering, and mathematics (STEM) fields. Scientists, engineers, and

Córdova, F.A. (2016). *Intentional equity*. *Science* 353(698), 427.

“NSF will continue to advance equity through data-driven decision-making.”

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We help institutions and
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Gender Disambiguation

Scopus[®]



genderize.io

NamSor



Comparator Selection

- Global coverage
- Countries/regions with high research output
- Each with at least one comparable comparator
- Applicability of our gender disambiguation methodology
- At least two countries from each major region
- A practical limit in a single report given our analyses



Gender in the Global Research Landscape Report



- **Evidence-informed** introduction
- **Data** chapters
 - Overview of **research performance** (outputs, quality, and impact) through a gender lens;
 - Gender comparison of **social aspects of research**, including leadership, collaboration, and mobility;
 - Snapshot of **published gender research** as a discipline



Data Chapters: A Focus on Innovation

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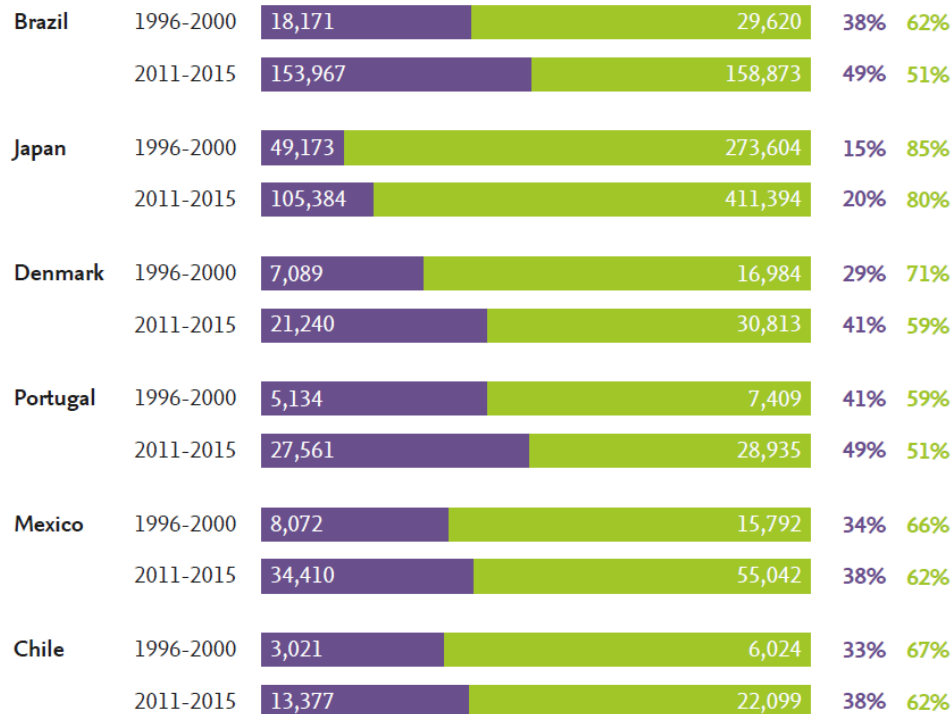
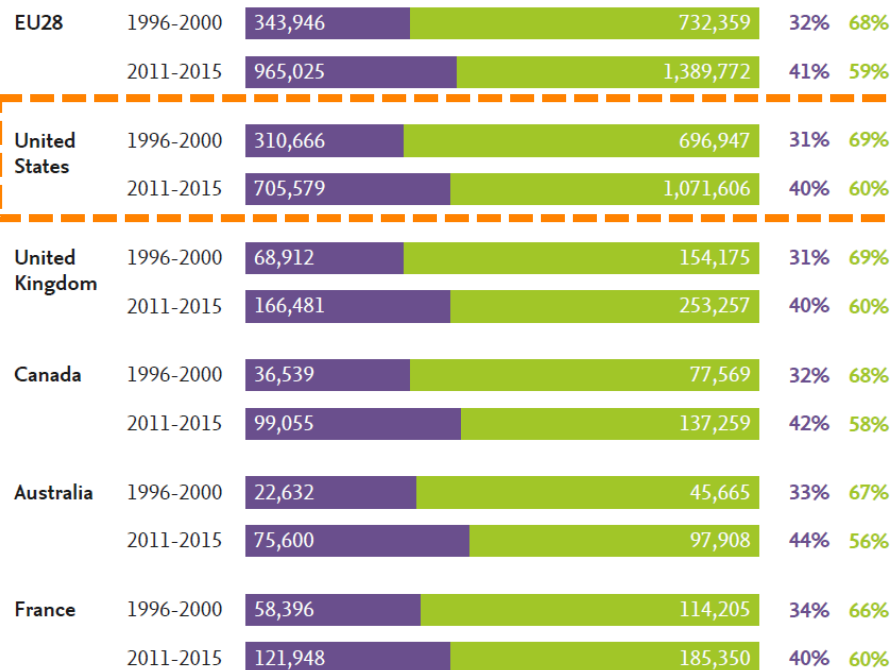


CHAPTER 1

The global research landscape through a gender lens

Proportion and Number of Researchers by Gender

PROPORTION OF WOMEN AND MEN
(AMONG NAMED GENDERED AUTHOR PROFILES)



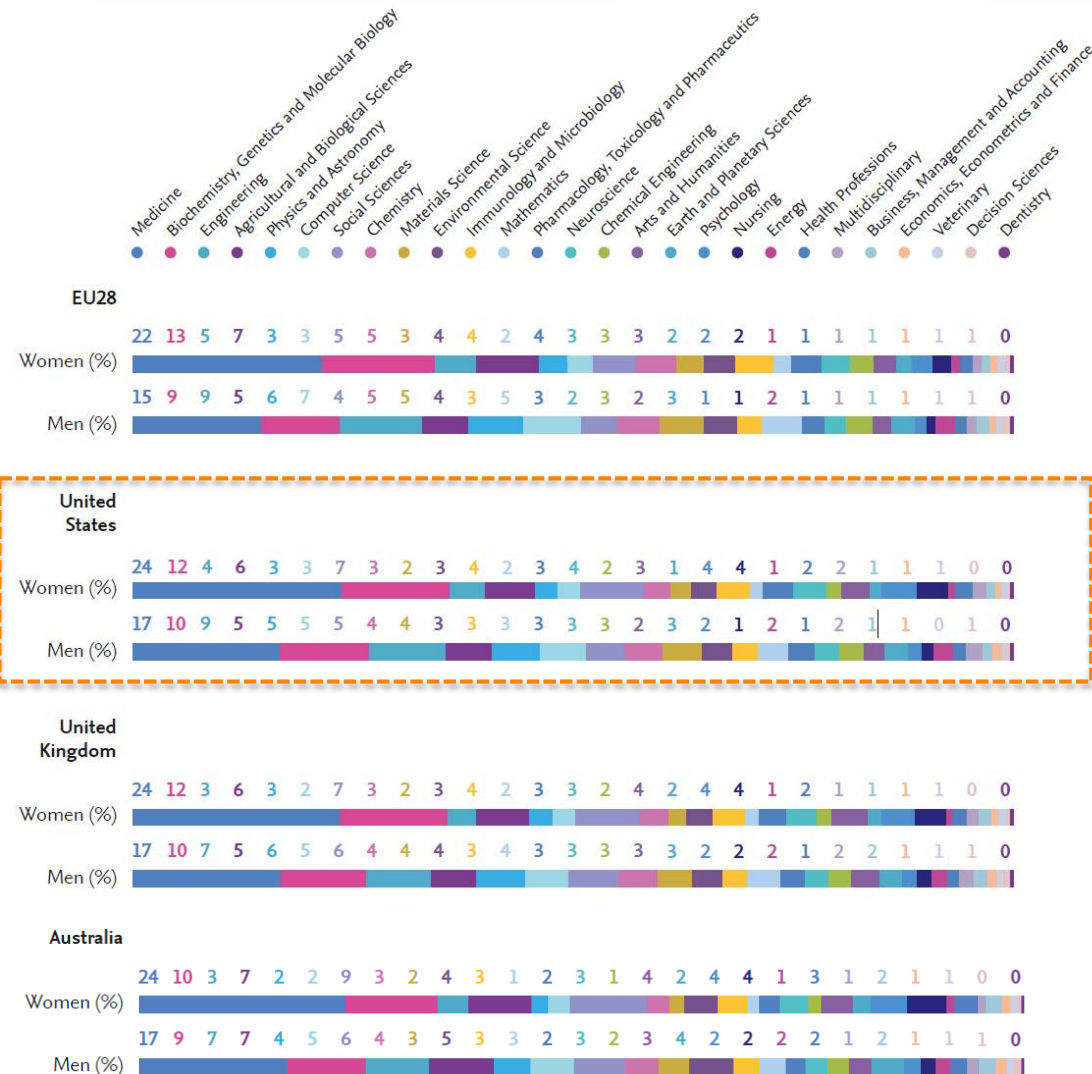
- Proportion of women among researchers and inventors is increasing
- Women comprise more than 40% of researchers in nine regions in 2011-15
- In the US, **40%** of researchers are women, an increase of 9 percentage points since 1996-2000

Researchers = Authors who have published **articles, reviews, and conference proceedings** indexed in Scopus

■ Women ■ Men

Distribution of US Researchers Scholarly Output by subject area for each gender, 2011-2015

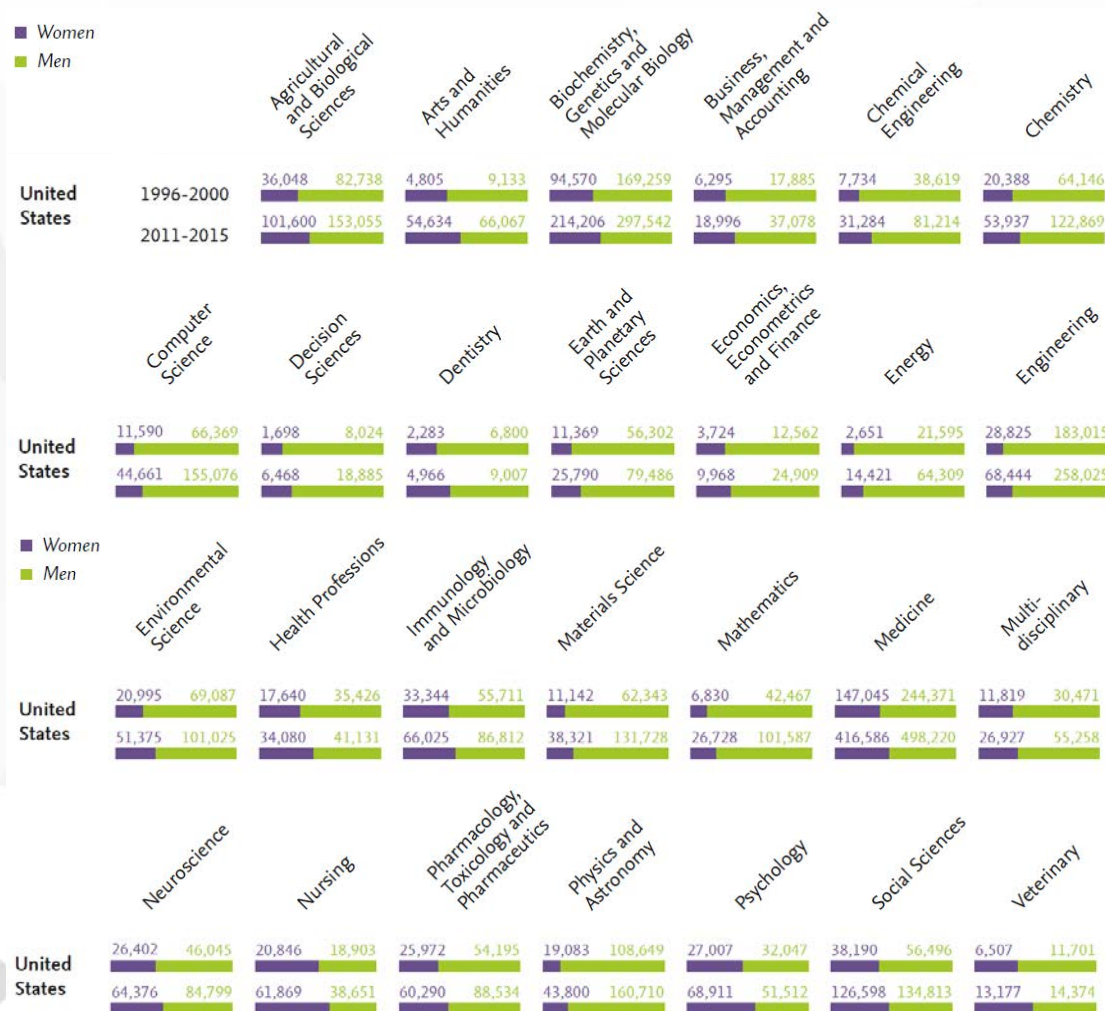
- 24% of women authors' scholarly output was in journals in the **Medicine** category, compared to 17% of men authors
- By contrast, 9% of men authors' scholarly output was published in journals belonging to the **Engineering** subject category compared to 4% of women authors



Proportion and Number of US Researchers

by gender and subject area

- Lower **proportion of women among researchers** for most comparators:
 - Energy (18%)
 - Engineering (21%)
 - Mathematics (21%)
 - Physics & Astronomy (21%)
- Majority of researchers are women in:
 - Nursing (62%)
 - Psychology (57%)
- Fields in which **women comprise nearly half of researchers**:
 - Social Sciences (48%)
 - Veterinary Sciences (48%)
 - Medicine (46%)
 - Health Professions (45%)
 - Arts & Humanities (45%)



Scholarly Output Per Researchers *by gender and comparator*

- Men publish slightly more papers on average than women in the majority of comparators and the US
- Both men and women see a minute decline in average number of papers per researcher over time



Download Impact

by gender and comparator

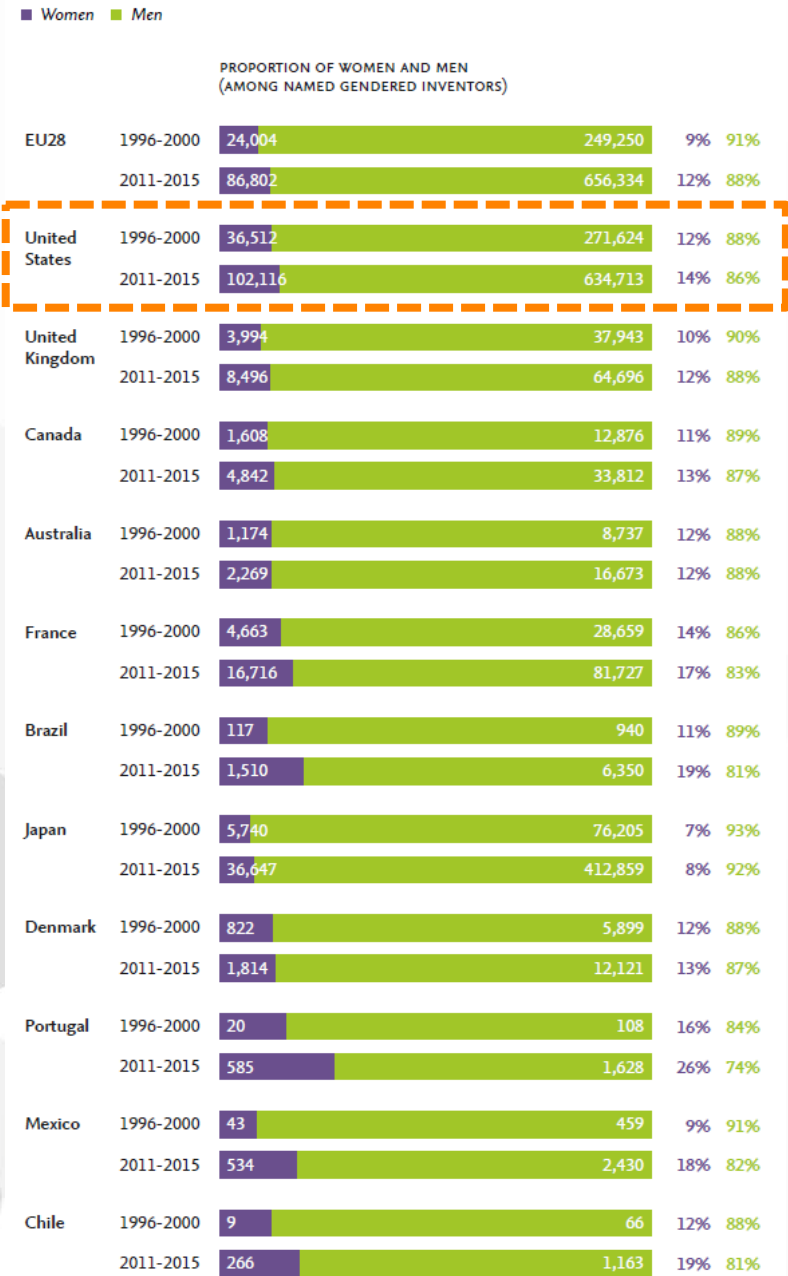
- The **US is the only comparator country in which the FWDI for women is higher than for men**
- No evidence that the inequalities in the representation of women researchers across countries and fields and in their scholarly output affect how their research is read or built on by others



Proportion and Number of Inventors

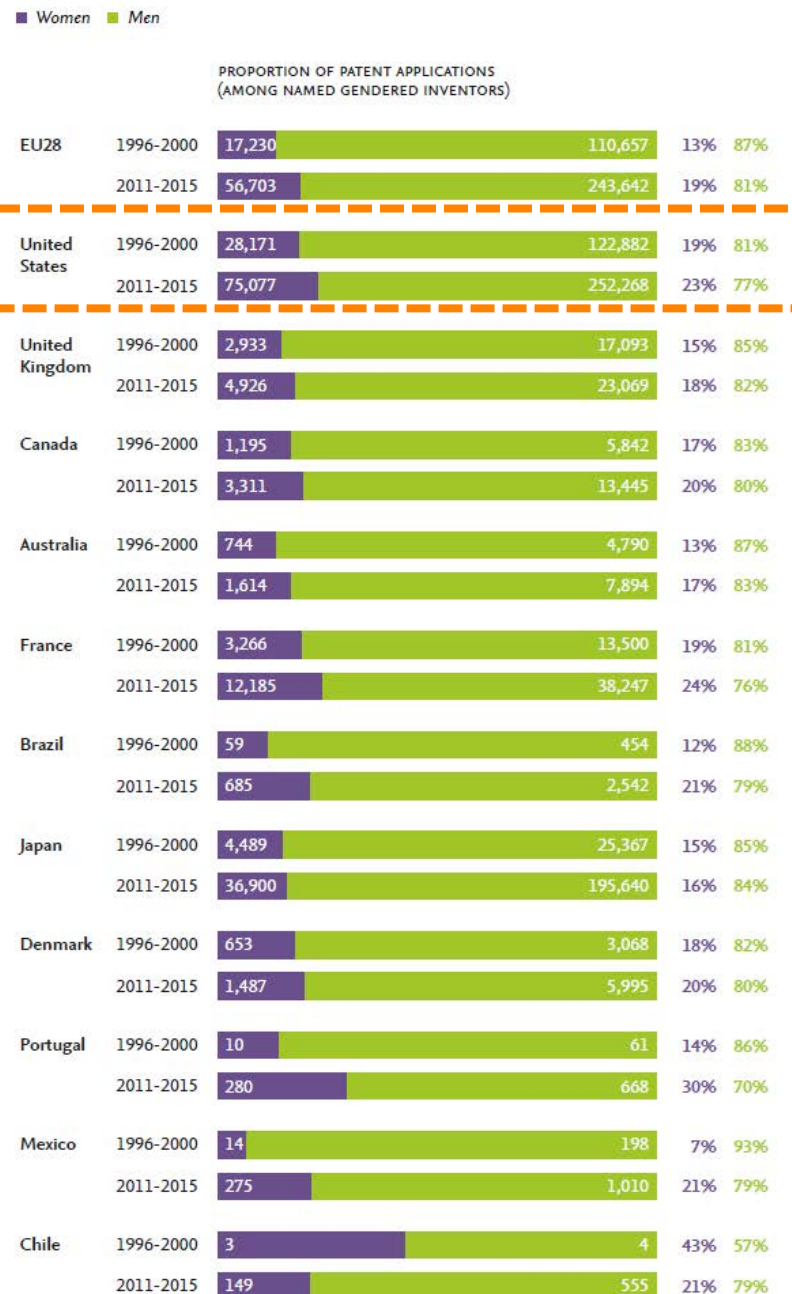
by gender and comparator

- Amongst inventors, women are **generally under-represented**: women represent no more than 26% (Portugal) of inventors in 2011-2015
- In the US, women represent 14% of inventors in 2011-2015, up from 12% in 1996-2000
- The number of women named on patent applications is nearly 3X as high in 2011-2015
- For all reported comparators, there is an improvement in gender balance between the analyzed periods



Proportion of Patent Applications by gender and comparator

- For the US, the percentage of patent applications that include at least one woman among inventors increased from 19% to 23% in 2011-2015 (globally 19% to 28%)
- Higher proportion than the EU, UK, Canada, Australia, Brazil, Japan, Denmark, Mexico, Chile
- Observe an increase for all comparator countries and regions
- For most, the share of patents with at least one woman named among the inventors is about twice as high as the share of women among inventors





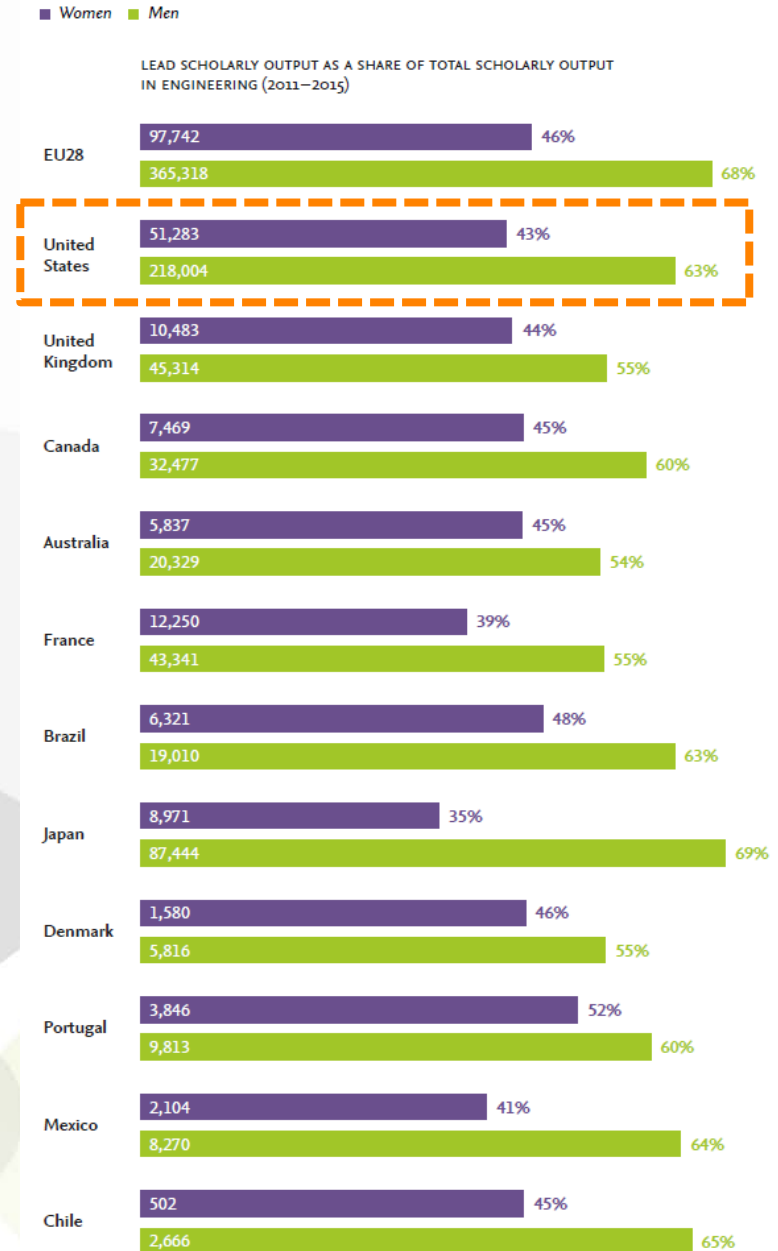
CHAPTER 2

Gender and research leadership, collaboration, interdisciplinarity, and mobility

Leadership

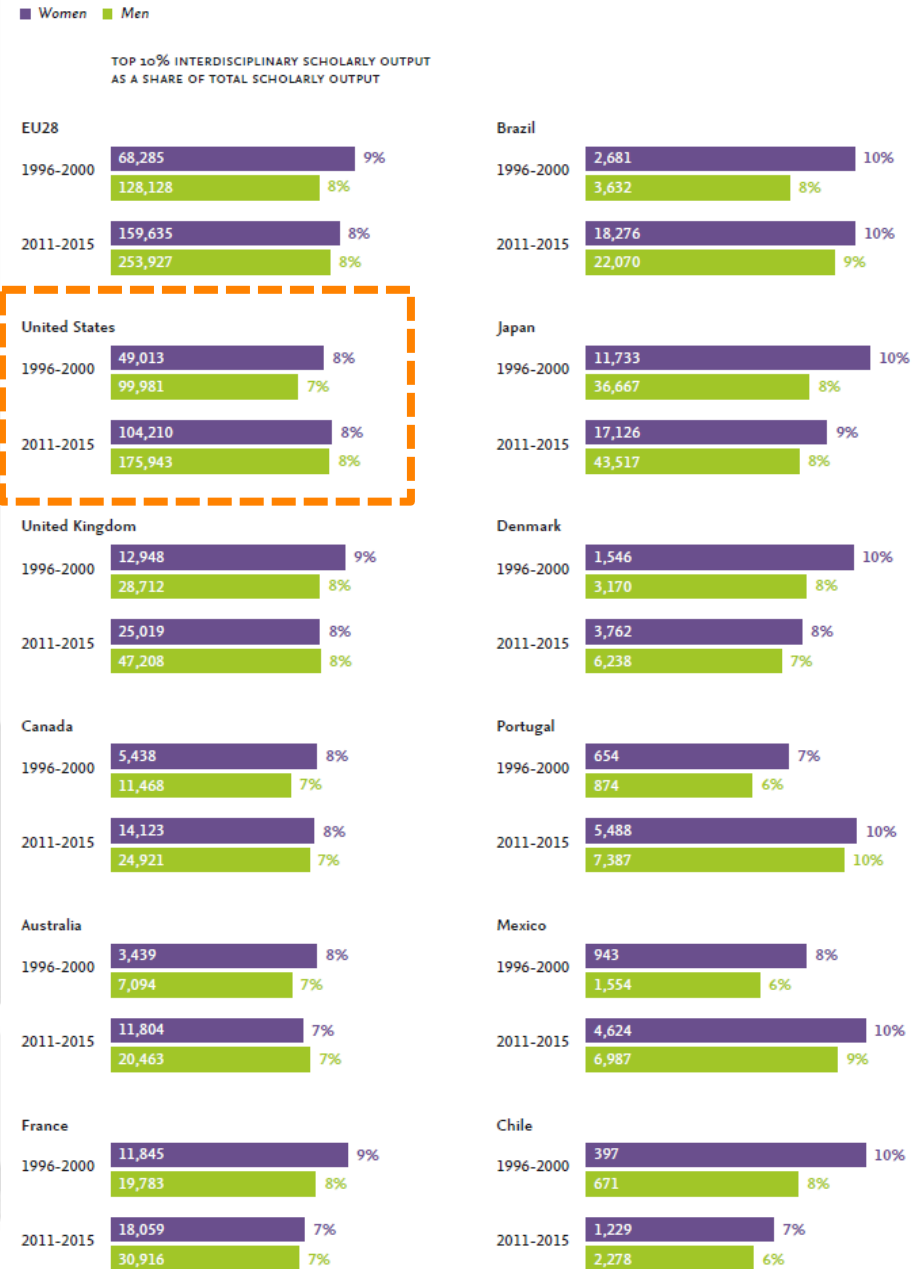
First & corresponding authorship *Engineering (2011-2015)*

- Women researchers significantly outnumbered by men in engineering: 79% of researchers in the US are men
- **When men appear as authors in Engineering papers, they are more likely to take the first or corresponding author position**
- In the US, women are first or corresponding author on 20% fewer papers than men



Interdisciplinary Research

- The proportion of output that belongs to the top 10% interdisciplinary output is 8% for both women and men in the US
- **Women tend to have the same or a slightly higher share than men of interdisciplinary research across all comparators**
- For most, the proportion decreases for women and increases for men over time



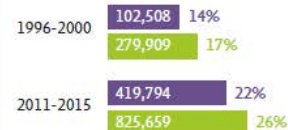
International Collaboration

- US has relatively low shares of papers reflecting international collaboration for both men and women
- Scholarly output reflecting international collaboration increased for all comparators as a proportion of total scholarly output
- For all, including the US, women's scholarly output is less likely to result from international collaboration than men's

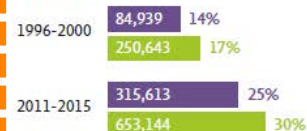
■ Women ■ Men

SCHOLARLY OUTPUT RESULTING FROM INTERNATIONAL COLLABORATION AS A SHARE OF TOTAL SCHOLARLY OUTPUT

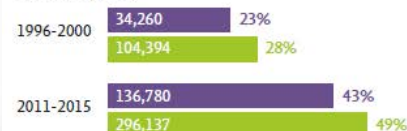
EU28



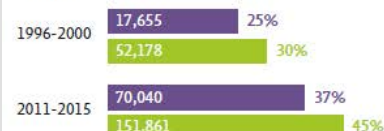
United States



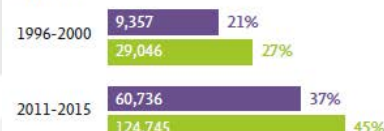
United Kingdom



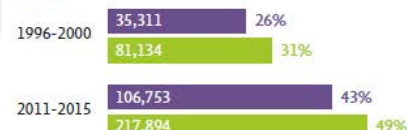
Canada



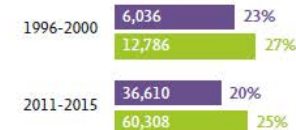
Australia



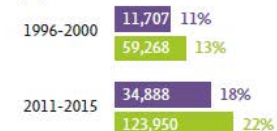
France



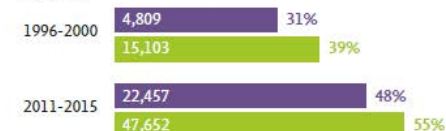
Brazil



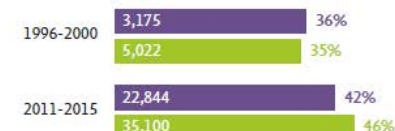
Japan



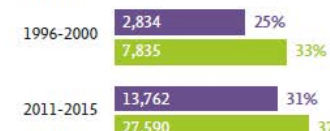
Denmark



Portugal



Mexico

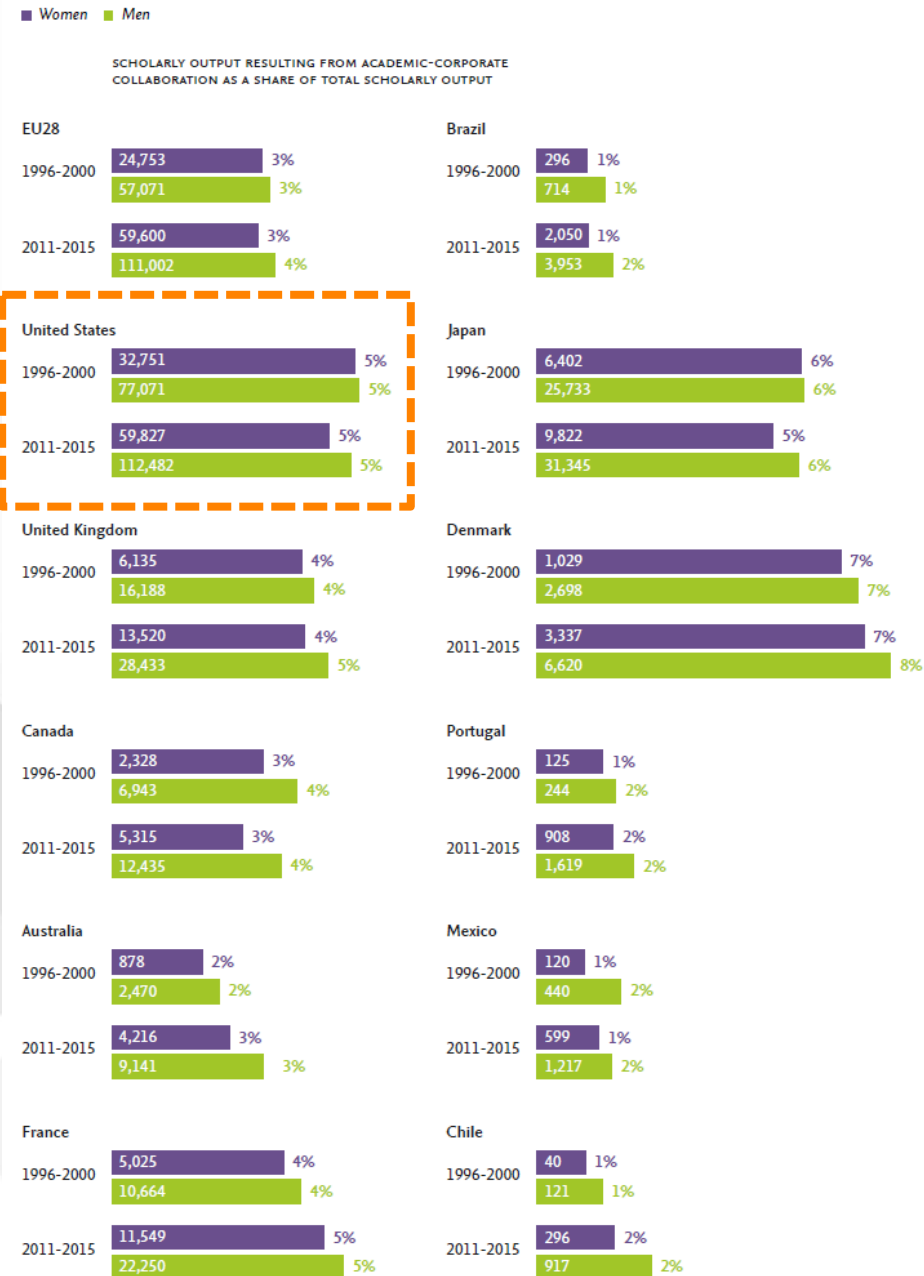


Chile



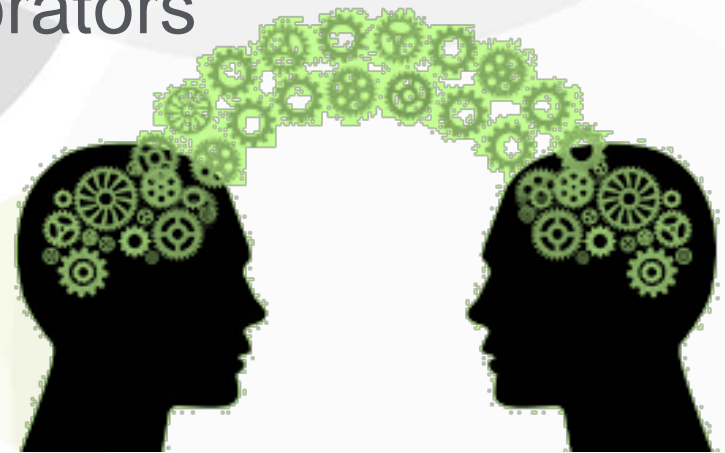
Academic-Corporate Collaboration

- US has relatively high shares of papers reflecting academic-corporate collaboration for both men and women
- The proportion of scholarly output resulting from academic-corporate collaboration is similar for women and men and men
- For most comparators, the proportion of cross-sector collaboration increases slightly between periods for both men and women.



Knowledge Exchange Metrics

- Research articles cited in patents
- Patents citing published articles
- Patent citations received by an institution
- Downloads of articles by industry
- Top Industry Collaborators
- Top Potential Industry Collaborators
- Cross-sector Mobility



Report Team

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GENDER INSTITUTE

Expert Interviews

INTERVIEW



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INTERVIEW



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INTERVIEW



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In Closing

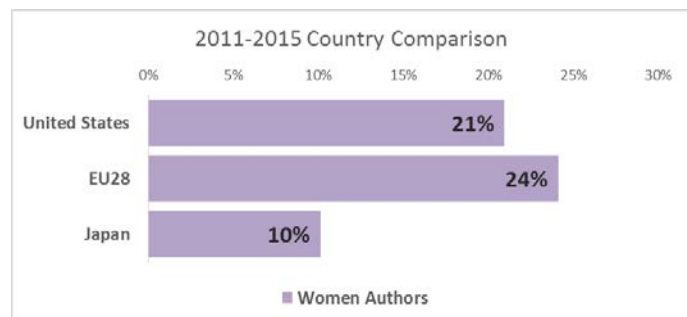
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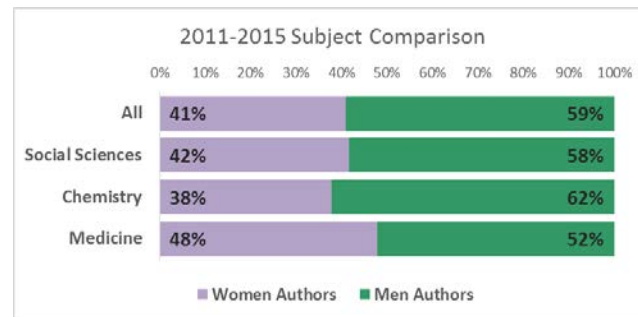
Select and compare **subjects** and **countries/regions** of interest to see the representation of women and men among researchers (examples below):

Engineering:



Country/Region	Women %	Men %	Women Authors	Men Authors	Total Authors
United States	21%	79%	68,444	258,025	326,469
EU28	24%	76%	123,336	388,259	511,595
Japan	10%	90%	13,730	121,451	135,181

EU28:



Subject	Women %	Men %	Women Authors	Men Authors	Total Authors
All	41%	59%	965,025	1,389,772	2,354,797
Social Sciences	42%	58%	124,113	173,275	297,388
Chemistry	38%	62%	122,524	202,089	324,613
Medicine	48%	52%	567,539	616,840	1,184,379

- Access to the shares of women and men among researchers for **27 subject areas (ASJC 27)** across **43 countries/regions**
- Generate **charts and tables** showing comparisons of subjects/regions at the click of a button
- The tool provides subject-specific benchmarks to help us **analyse and contextualise gender balance on our editorial boards**.

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Thank you!

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Gender in the Global Research Landscape

Elsevier's comprehensive report on research performance through a gender lens, [Gender in the Global Research Landscape](#), spans 20 years, 12 geographies, and 27 disciplines. This global study draws upon data and analytics, a unique gender disambiguation methodology, and involvement of global experts. Illustrated below are some of the report's key findings.

NEW METHOD & RESEARCH BY ELSEVIER

>40%
Women

Comparator countries and regions analyzed where women comprise more than 40% of researchers.

1996-00



Portugal

2011-15



US



EU28



UK



Canada



Australia



France



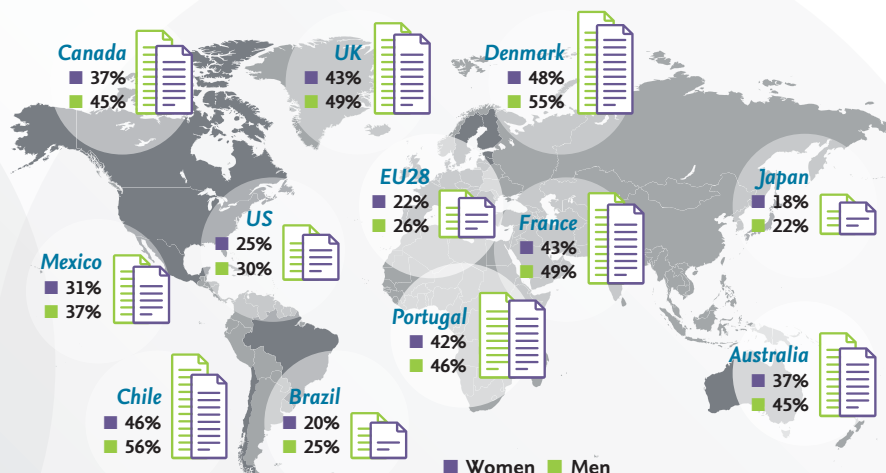
Brazil



Denmark



Portugal



■ Women ■ Men

Proportion of scholarly output resulting from international collaboration 2011-15

Among researchers in the selected comparator countries or regions, women are slightly less likely to collaborate internationally on research papers.

There is incremental progress towards gender balance in research

Between 1996-2000 and 2011-2015, the proportion of women among researchers increases in all 12 comparator countries and regions.

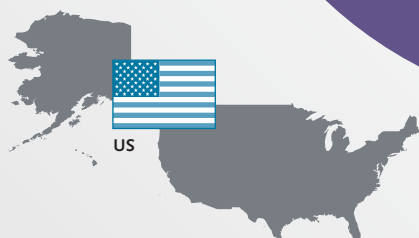
The share of women among researchers differs across fields of research: Health and Life Sciences fields are found to have the highest representation of women.

Women's scholarly output includes a slightly larger proportion of highly interdisciplinary research than men's.

Women are slightly less likely than men to collaborate across academic and corporate sectors on papers.

Among researchers, women are generally less internationally mobile than men.

Although women tend to publish fewer research articles than men, their articles are downloaded and cited at similar rates, and at slightly higher rates in the US.



Field-Weighted* Download Impact in the US by gender 2011-15

■ 1.12
■ 1.08



Field-Weighted* Citation Impact in the US by gender 2011-15

■ 1.57
■ 1.52



■ Women ■ Men

* Field-Weighted Impact indicators normalize the data to account for different download and citation rates and practices across articles' fields, types, and ages.

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In Japan, the number of women in research is relatively low; however their scholarly output tends to be higher than that of the men.

Proportion of researchers by gender 2011-15

Women: **1/5**



Scholarly output per researcher 2011-15

■ Women
■ Men



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