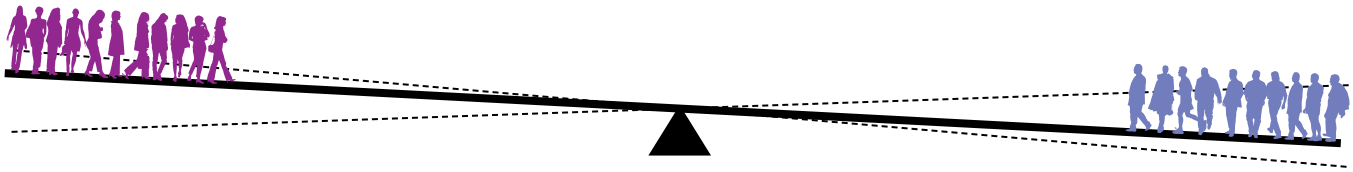

THE SEARCH FOR BALANCE

A study comparing scientific output by women in a range of countries highlights Brazil's improvement

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A report released by Dutch publisher Elsevier on March 8—International Women's Day—presents an unprecedented statistical comparison of the scientific output of men and women in 27 fields of knowledge. The study analyzed data from 11 countries and the European Union, demonstrating a general trend towards gender balance in science over the last 20 years. Between 1996 and 2000, women accounted for more than 40% of researchers in only one country: Portugal. Between 2001 and 2015, several other countries joined this club, including the United States, the United Kingdom, Australia, Canada, France, Denmark, and Brazil, as well as the European Union.

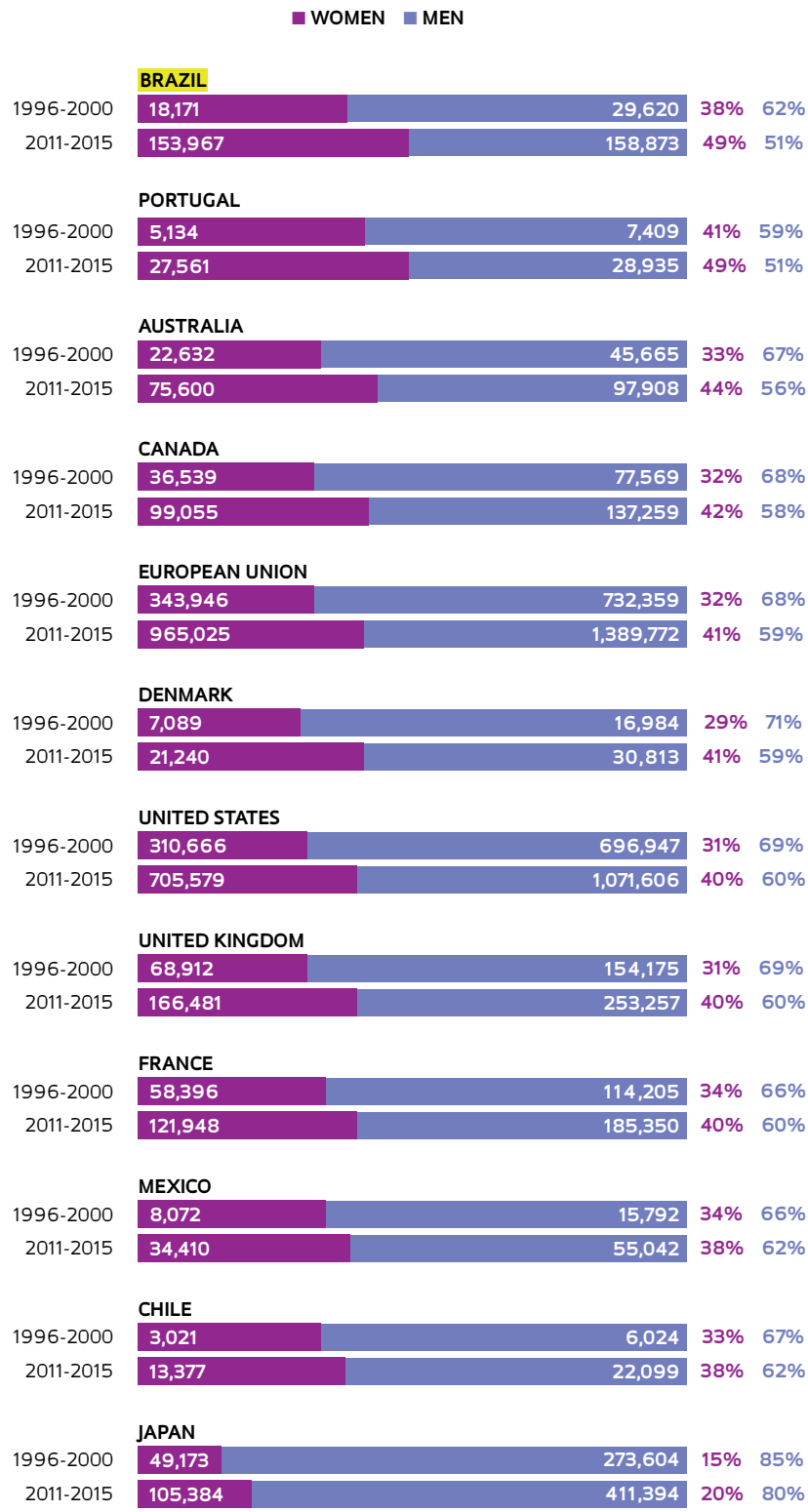
The full report is available at bit.ly/GeneroCiencia.

The proportion of men versus women was measured by identifying and counting authors published in the journals indexed in Elsevier's Scopus database, which includes more than 62 million articles published in more than 21,500 scientific publications. Titled "Gender in the Global Research Landscape," the report highlights Brazil as one of the countries that has made the most progress, according to its indicators. "In Brazil and Portugal, women account for 49% of the researcher population, while in Japan, the proportion of women in science remains much lower," says microbiologist Holly Falk-Krzesinski, vice-president of academic relations at Elsevier and a member of the project team that produced the report, according to the website Inside Higher Ed. Brazilian authors published between 2001 and 2015 consisted of two nearly equivalent populations: 153,967 women and 158,873 men, accounting for 49% and 51% of the total, respectively. The proportion observed between 1996 and 2000 was 62% men and 38% women, although the indicators for the two periods cannot be directly compared because the number of Brazilian journals in the Scopus database at the end of the last century was much lower than at present.

Brazil also appears to be relatively balanced within a certain indicator subgroup. The presence of female authors in the field of engineering is one example. Of the total Brazilian output in this field between 2011 and 2015, women were the first or corresponding authors of 48% of papers—compared with a rate of 44% in the United Kingdom, 43% in the United States, and 35% in Japan. Another indicator analyzed was the number of female and male inventors, which was 19% women and 81% men in Brazil, less of an imbalance than in most other countries, except for Portugal, where 26% of inventors were women. In Japan, 8% of inventors were women, compared to 14% in the United States 14%—although in absolute terms, these two countries have 60 to 90 times more inventors than Brazil. The number of inventors is based on the number of patent applications registered on the World Intellectual Property Organization (WIPO) database.

MALE AND FEMALE RESEARCHERS

Evolution of the absolute number and percentage of authors of scientific papers in 11 countries and the European Union, distinguished by gender*



* The data refer to researchers who published papers and whose name and gender were declared on the Scopus database or were identified using other software

SOURCES SCOPUS, GENDERIZE, NAMSOR, AND WIKIPEDIA

Biologist and information scientist Jacqueline Leta, a professor at the Federal University of Rio de Janeiro (UFRJ) and an expert on gender issues in science, says that cultural traits and forms of scientific organization in the country may help explain why female researchers in Brazil seem to face fewer obstacles than those in other nations. "Women abroad may be less able to leave household tasks in the hands of others. In other countries, it is more difficult for women to delegate home and family issues," she says. Certain characteristics of the Brazilian scientific community, whose activity is highly concentrated in public institutions, may also be associated with more stable research careers for both men and women. "Our system is more rigid than other nations, where there is more research activity in industry, links with institutions are often temporary, and researchers have greater mobility between institutions and countries."

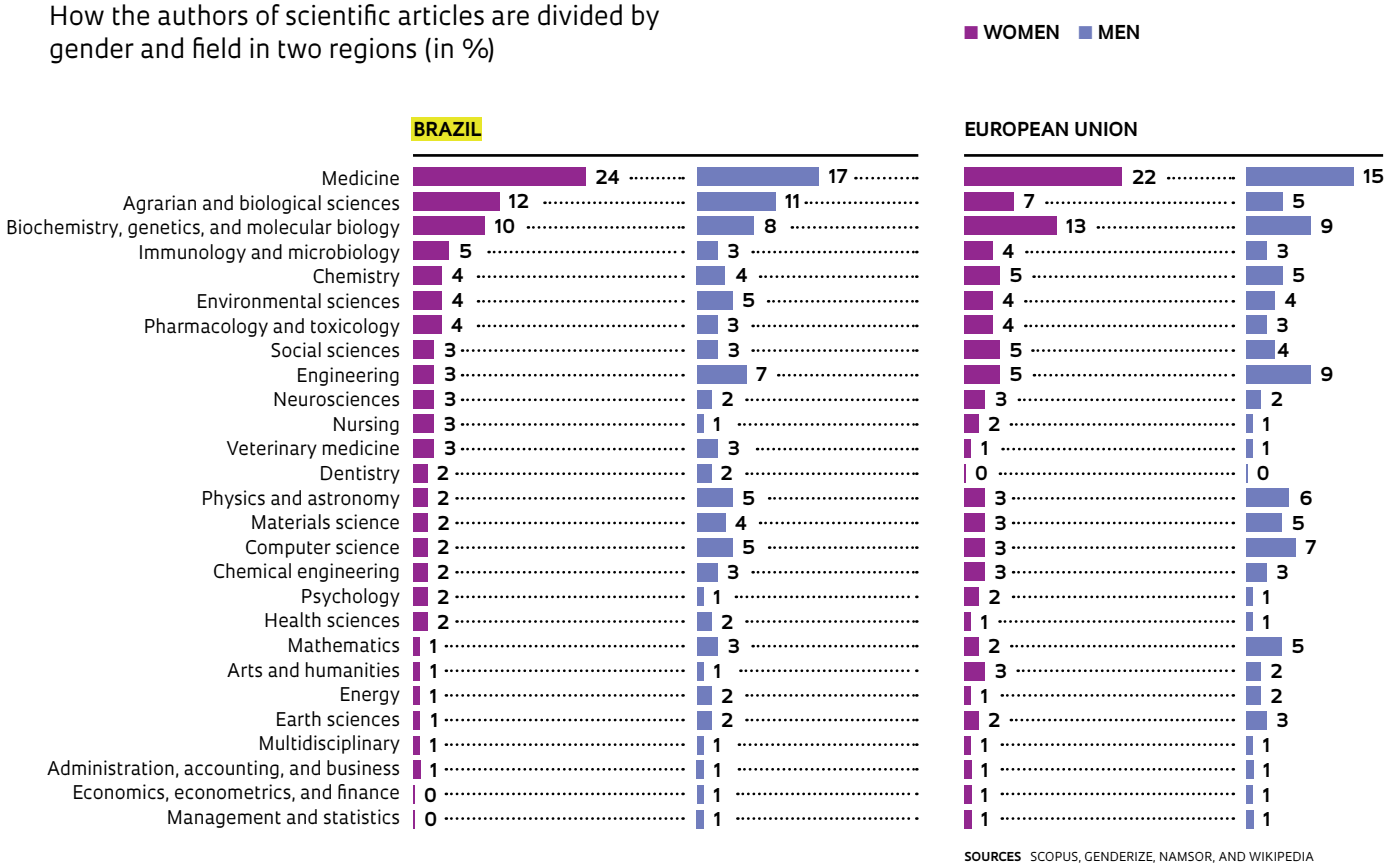
However, this stability does not favor a more egalitarian division in the occupation of university positions, says the researcher. Eight years ago, she conducted a study that analyzed 1,946 professors at UFRJ and concluded that, with the exception of the arts, humanities, and languages, the percentage of women involved in graduate research was always lower than the proportion of women as professors. "UFRJ has never had a female dean. There were two female candidates in the last selection process, both very qualified, but in the end, a man was given the position," she says.

THE LEAKY PIPELINE

A lack of women in positions of prestige is a problem in many countries. The Elsevier report refers to this phenomenon as a "leaky pipeline," suggesting that while academics of each gender begin academia together, the proportion of women decreases at each career stage. In an interview published in the report, James Stirling, provost of Imperial College, UK, discusses this problem: women account for 35% of undergraduates in the institution's science, technology, engineering, and mathematics programs, but only 15% of professors in these fields are female. "Not enough women are coming in to STEM subjects, and when they do come in, they are not reaching the highest ranks in the pro-

ON THE TREE OF KNOWLEDGE

How the authors of scientific articles are divided by gender and field in two regions (in %)



SOURCES SCOPUS, GENDERIZE, NAMSOR, AND WIKIPEDIA

fession," he says. As well as participating in a program designed to strengthen the commitment to gender equality in UK research institutes, Imperial College wants to combat the prejudices hindering women in recruitment and career advancement. "It is an unconscious bias, but it can be combated through training programs." While there is a gender balance among Brazilian authors in general, the situation depends on the discipline under analysis. In a phenomenon common to other countries, women in Brazil account for only 23% of authors in the field of computer science, 24.8% in mathematics, 28.2% in economics, and 33% in physics and astronomy. In other fields, such as nursing (72.9%), immunology and microbiology (58%), neurosciences (55.8%), and medicine (55.4%), they are the majority. The report notes that the percentages of female representation were lower between 1996 and 2000 than between 2011 and 2015. In engineering, the proportion of Brazilian authors was 16% between 1996 and 2000, rising to 29% in the more recent period. "'This relatively rapid change over time disputes previous suggestions of 'sex differences in general intelligence with a male advantage appearing in adolescence' and suggests instead that the problem is social and cultural in nature," states the report.

WOMEN PUBLISH FEWER ARTICLES THAN MEN BUT THERE IS NO EVIDENCE THAT THIS AFFECTS CITATIONS

Sociologist Maria Teresa Citeli notes that there are specific explanations for the higher number of females in some fields. "In the past, it was said that the greater participation of women in certain fields, such as developmental biology, was related to female characteristics, such as motherhood. But the fact is that the field of biology was developing at a time when women were entering the labor market. It is easier to enter a nascent field," says Teresa, who was a researcher in the Department of Science and Technology Policy at the University of Campinas (UNICAMP).

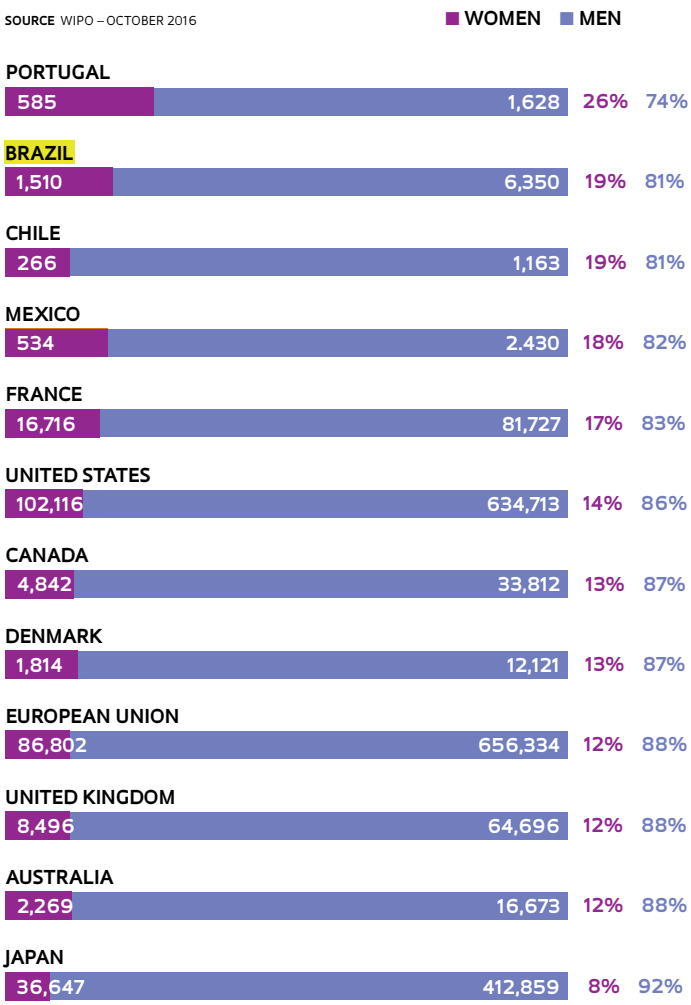
COLLABORATIONS

The Elsevier report presents further conclusions on the performance of women in science. It shows that female researchers publish less than men in general, although there is no evidence that this affects citations and downloads of their articles. In Brazil, the mean number of articles published by women between 2011 and 2015 was 1.2, compared

GENDER AND INNOVATION

Absolute number and proportion of inventors by gender between 2011 and 2015

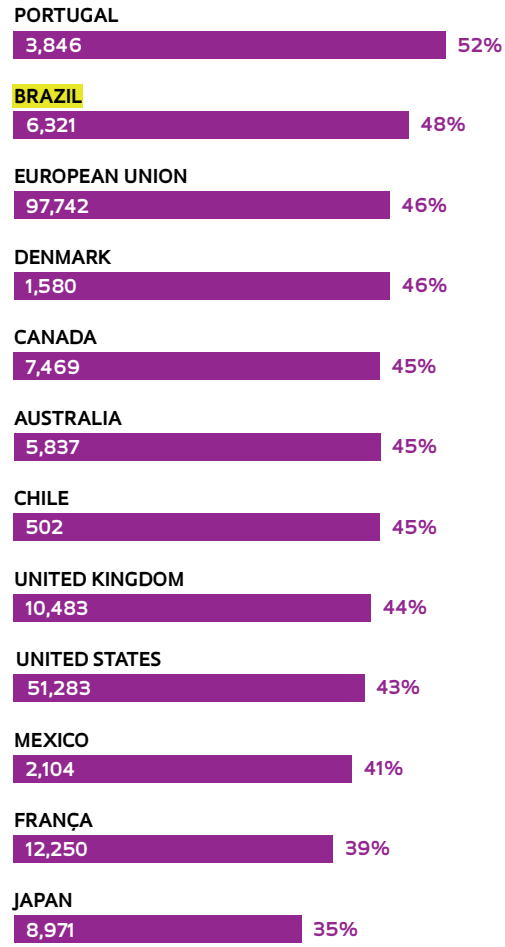
SOURCE WIPO – OCTOBER 2016



WOMEN IN ENGINEERING

Number and percentage of articles in the field of engineering, where the first author and/or corresponding author are female

SOURCES SCOPUS, GENDERIZE, NAMSOR, AND WIKIPEDIA – FROM 2011 TO 2015



with 1.5 articles published by men. This score is low compared to other nations: Denmark and Australia averaged 2.2 articles for women and 2.8 for men. The study also indicates that women generally have less professional experience abroad than men and tend to establish fewer scientific collaborations. Finally, female scholarly output has a slightly greater tendency to focus on interdisciplinary fields.

One notable aspect of the survey is its methodology. Although the first name on a scientific paper is usually represented only by an initial, Scopus maintains a record of authors and their full names. However, information about the gender of each researcher is not always available, so that in such cases, other sources are needed. The study used the Genderize database, which contains thousands of names from 79 countries and the proportions of men and women with each specific name. This was used to calculate the probability that a researcher was female or male, given their name. Not all registered authors were included in the study. A gender was attributed to an author only when the name appeared on Genderize at least five times, and the chance that it was male or female was over 85%. Another data source, called NamSor, uses sociolinguistic data to help identify a name based on the researcher's country—for example, an author named Andrea is probably a man in Italy but more likely a woman in other countries.

"Most previously published articles used small samples or case studies precisely because of the difficulty obtaining comparable data from several countries, but Elsevier has come up with a way to overcome this barrier," says Jacqueline Leta. Teresa Citeli believes we need to know more about this methodology before we can properly incorporate it into studies of science and gender. "This is an innovative approach with eloquent and favorable conclusions on the increasing presence of women in science. The result also has political implications, because it could lead to more women starting careers in science." ■