

## **(NO) WOMEN IN STEM: AN ECONOMIC PERSPECTIVE TO THE SCIENTIFIC GLASS CEILING**

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DOI: 10.46609/IJSSER.2023.v08i09.037 URL: <https://doi.org/10.46609/IJSSER.2023.v08i09.037>

Received: 2 September 2023 / Accepted: 20 September 2023 / Published: 3 October 2023

### **ABSTRACT**

Women have steadily been rising to the top in the fields of humanities, arts, and education, but women in STEM are severely underrepresented. Children in schools are exposed to the idea that entering the fields of STEM, whether it be academic or professional, is easier for a man. This kind of forced linear thinking limits female students from pursuing their interests in STEM-related fields. A sore lack of role models in these fields adds to women's mindsets that they cannot achieve what men do. Today, even though there are women who have managed to reach and break through the metaphorical 'glass ceiling', they do not get equal treatment. They are subjected to lower positions in the workplace, and lesser pay, among a host of other discriminatory actions. Societal norms in many countries state that women must sacrifice their academic or professional pursuits to focus on their families, which is one of the many possibilities why they fail to climb the ladder to the top. This paper attempts to explore the reasons behind the continued dearth of women's participation in STEM-related fields.

**Keywords:** glass ceiling, STEM, gender, women, discrimination

### **1. Introduction**

Across mediums of entertainment, scientific intellectuals, and geniuses are typically portrayed as men. Sheldon Cooper from The Big Bang Theory and Indiana Jones are some of the most popular characters that represent STEM on TV and in cinema. This gendered depiction in TV shows is a sorrowful reflection of the gender stereotypes that are rampant worldwide. Studies have applied the Draw-A-Scientist Test, better known as the DAST method, in research experiments conducted in schools. This experiment was conducted among students from kindergarten to high school, and almost all the participants' drawings of scientists were male. There were very few drawings of women scientists. (Makarova et al., 2019) The propagation of

these ideas to future generations strengthens the belief and cements the idea that women have not had and will not have much impact on the sciences.

The glass ceiling is described by Bertrand (2018) as a phenomenon that represents the upper part of the earnings distribution. Despite decades of progress, women are still underrepresented in STEM-related fields, even if they have ample expertise and experience.

Gender constructs are largely bipolar, implying that what is masculine is not, and cannot be feminine and vice versa, (Deaux & LaFrance, 1998) leading to society accepting it as the whole truth. These beliefs spread a stereotypical image of STEM being a male domain, which in turn affects young people's career choices, leading women not to take up STEM, further reinforcing the belief that women cannot be a part of STEM, (Nosek et al., 2009) and the cycle continues. This couldn't be further from the truth, and yet the world does not give credit where it is due to scientists like Madam Curie, who was indirectly responsible for saving millions of lives through her discovery of radioactivity. This, however, is not an outdated issue; it is still prevalent today with talks of equal rights fading into the background when faced with facts. Anshuman Das (2023) for an article in the Financial Express said that many young girls refrain from furthering their interests in the sciences as it is seen as more of a "man's world", leading women to be discriminated against, repeating the vicious cycle.

With unbridled discrimination like this, several problems arise. One of the most blatantly obvious problems is the fact that scientific fields do not develop quickly as they lack diversity in their thinking. As men are the significant players partaking in the area, it slows down the process of evolving concepts and efficiency (Bertrand, 2018), as well as widening the gap between men and women economically.

Another problem is that the lack of female participation negatively impacts economic growth. According to a paper published by the University of Chicago called "The Glass Ceiling", Bertrand (2018) writes that only approximately a quarter of the US GDP for the past few decades can be attributed to women and other minorities whose participation in the workforce was previously restricted. This paper attempts to demonstrate that a lot of work done by women goes ignored, leading to a decline in the perception of the importance of women in the economy and society.

## **2. Background**

Gender is one of the main components of an individual's identity, and the binary of male-female or masculine-feminine is enforced from a very young age. (Nentwich & Kelan, 2014; West & Zimmerman, 1987) It impacts social perceptions, values, behavior, education, and career practices. In careers other than STEM, women have been rising to the top at a steady pace, but

have been marginalized in the fields of STEM for a long time. Some of the reasons behind these situations are societal norms, stereotypical beliefs of what a woman is capable of and should be doing, and a sore lack of female role models in STEM. These aspects may lead to women suppressing their ambitious nature and lowering their expectations to succeed professionally in STEM fields.

Anshuman Das in his Financial Express article, says the gender gap is alarming as it highlights how women are at a high risk of being left behind and ignored in a rapidly expanding, digitally-driven workforce that is constantly changing. Companies and educational institutions should, according to Das, attempt to increase the number of women involved in STEM-related areas. This will bring about fresh perspectives, innovative ideas, and productivity, benefitting not just the individuals, but the organizations on the whole, all the while giving women financial competence.

Historically, several examples can be considered to gauge the systemic underestimation that women have gone through in their professional lives. In France, women workers, regardless of their jobs, were called *ouvrières*, which, when translated, had the connotation of a factory worker. In Milan, during the Industrialization period, women workers were registered solely as *casalinghe*, or housewives, rather than workers. (Cammorosano, 1999) Women in Catalonia, in the 1920s, faced a different issue; once their children were old enough to bring in wages themselves, there was a decline in the number of women who were employed, strengthening the social reality of the “male-breadwinner”. (Borderias, 2012) Female STEM students, according to a study by Nosek et al. (2002), are more likely to reinforce gender stereotypes and have difficulties associating themselves with STEM-related majors, associating the subjects with the male gender instead.

An OECD report from 2017, titled “The Pursuit of Gender Equality: An Uphill Battle”, found that predictions regarding changes in gender-based discrepancies in academic and occupational choices and opportunities suggest that this segregation in the education and labor markets will remain the same, not allowing women to make any headway academically and economically.

The theoretical framework of Gottfredson (2002, 2005) illustrated how occupational aspirations are developed from early childhood based on stereotypes, with the comparison of self-image and the image of the occupation the child is leaning towards. There is a potential gap in matching the two images, leading to children placing heavy emphasis on the ‘right’ or ‘wrong’ sex type of occupation, which becomes more important than their interests.

The lack of female participation as scientists is not the only major issue, another matter is the lack of female representation in data collection. The European Union’s project named

GENDERMACRO sought to integrate gender and family differences in surveys for economic studies. This change allowed them to better understand the impact families and women have on the economy, for example, different buying patterns and domestic violence patterns, to name a few.

This project was undertaken to fight the bias in STEM that assumes male-based polls are universal. GENDERMACRO has successfully demonstrated the opposite and now actively petitions the scientific community to account for such differences in their own studies. GENDERMACRO is complemented by the paper "Gender History and Labour History" where it is mentioned that many experts struggle to identify and acknowledge the work that is done by women, including household work.

There is no set definition of what can be called women's work, and perhaps that is the reason women's employment is a grey area even today. Women workers have, on many occasions, mobilized and organized protests to get the recognition and pay that is rightfully theirs. Some of the major strikes included tobacco workers in Lebanon during the postwar period, strikes in Australia and New Zealand during the 1890s, and Poland in 1951. (Vigna et al., 2013)

Some social movements or rallies held by women have been successful, but it is not always the case, even though women contesting their repression and breaking out of the docile, meek image that society has of them is a powerful move. Challenging gender norms in an attempt to get their warranted compensation, whether that is payment or dues in terms of rights, is women's commendable way of standing up for themselves. These movements have proved that women are willing to even get violent if need be, but they will not be passive.

Women's social movements throughout the 20th century and following the Women's Suffrage have strived for one primary goal- to change the status of women from wives and mothers to citizens and people (Berkovitch, 1999) who earn. Even though the number of female students enrolling in schools and colleges is on the rise, it was observed that the increase took place in fields like humanities, social sciences, and education, and not in STEM. (Bradley, 2000; Kelly, 1989)

Intellectual movements like these, related to the education and careers of women, rallying for more female representation in STEM, are generally smaller in size, concentrated in specific locations, and are not as risky as revolutionary social movements. However, the outcome can neither be classified as positive nor negative. Women's movements are generally unanticipated and the results are a hit or miss. Some institutions might be successful in improving women's admissions in STEM majors, and some might never see any improvement.

In terms of women in STEM participating in international research and collaborating with other researchers, the future could be bright, despite its negatives. Female participation in STEM-related fields is increasing, albeit slowly, and yet, female scientists are to occupy more junior positions, receive lower salaries, and be promoted slower than their male counterparts. (Holman & Morandin, 2019)

It has been claimed by Holman et al. (2018) that “despite recent progress, the gender gap appears likely to persist for generations” and “the gender gap will not close without further reforms in education, mentoring, and academic publishing”. Although the wide gender disparity gap may never be bridged, it can be considered a step in the right direction.

### **3. Discussion**

STEM education patterns in women have mostly stayed the same over time. A report by the American Association of University Women published in 2010 called “Why So Few? Women in Science, Technology, Engineering and Mathematics” illustrated the frustrating dilemma:

The number of women in science and engineering is growing, yet men continue to outnumber women (...) In elementary, middle, and high school, girls and boys take math and science courses in roughly equal numbers, and about as many girls and boys leave high school prepared to pursue science and engineering majors in college. Yet fewer women than men pursue these majors (...) Women’s representation in science and engineering declines further at the graduate level and yet again in the transition to the workplace. (p. 15)

The persistence of gender perceptions in education contributes to the spread of stereotypical beliefs that women naturally fit the mold of human-centered fields and men fit the more technical and intensive fields. (Charles & Bradley, 2009) Some of the major reasons behind the gender disparities in STEM-related fields are that girls’ interests in the fields are majorly shaped by their environments and negative mindsets, and that bias, whether conscious or unconscious, curtails women’s progress and advancement. (Charles & Bradley, 2009)

Skewed gendered segregation of career paths has forced society to believe that women will likely not succeed in STEM fields. In Judith Glazer-Raymo’s opinion, the metaphorical glass ceiling is made up of implied norms and distorted, unrealistic expectations, which hinder women from reaching the top of academic professions. (1999) Although women have been taking up more positions in recent times, they tend to be more prominent in fields like nursing, library science, and education as compared to the male-dominated fields of business, medicine, law, and technology. (Reskin & Roos, 1990) These fields recompense their employees better, and with the low number of women employed, the disproportionate economic compensation only increases.

There is gender disparity in education, employment, productivity, pay scale, and work flexibility, lessening the options for women to enter the fields of STEM. Although women may be just as competent as men, several women have family commitments and are unable to devote the time to fulfill organizational requirements and participate in research. On occasion, a woman might choose to take a career break to focus on their personal life, which poses a problem to most organizations' view of sustained performance. (Xie & Shauman, 1998) This, in turn, affects opportunities for women to advance in their professions. (Carroll & Hannan, 2000)

The existing imbalance of gendered labor furthers the economic disparity between men and women. A report by the World Bank, published in 2020, explored data from across the globe to understand the constant gender gap in STEM. The report sought to comprehend why girls, even though they outperform boys in standardized tests in schools, voluntarily or involuntarily choose not to continue in STEM fields for their higher studies.

An interesting phenomenon they discovered was how a country's rising income leads to a rising percentage of women who are unlikely to study STEM. The biggest takeaway was still the same as every research study conducted on similar lines. Eliana Rubiano Matulevich, co-author of the report said, "...stereotypes and biases are important drivers of gender gaps in STEM."

COVID-19 added to the already long list of problems that women face while studying and working in STEM-related fields. Owing to the pandemic and what was in place earlier, women are more likely to be the primary caregivers in their families, as compared to men. (Krukowski et al., 2020) Women have always had the responsibility of caregiving placed on their shoulders. Even today, following decades of change, most women who are primary providers of the house are appreciated.

Through research conducted during the pandemic, it became clear that women contributed fewer manuscripts than their male coworkers (Squazzoni et al., 2021) due to being otherwise occupied, keeping up with the expectations of helping out around the house and taking care of the family.

Several women managed to fight all odds and break the glass ceiling. Professor Julienne Stroeve is an Arctic researcher, investigating how climate change affects the Arctic and its surroundings, and the overall impact on the planet. Dr. Laura Danly is the curator of Griffith Observatory, and she develops exhibits, planetarium shows, and programs about astronomy. She started as a researcher on the subject and gradually began proposing experiments along with making observations about the cosmos. Dr. Sophia Yen revolutionized access to birth control pills in the US. Along with a friend, she set up Pandia Health, a startup that provides a seamless experience for accessing pills. They replaced the long, physical process of having to go to a pharmacy every

month, and took everything online. Now, people can get an online prescription or consultation and the pills are delivered right to their doorstep. (Aschim, 2018)

#### **4. Conclusion**

This paper has attempted to shed light on some of the issues that are faced by women in the STEM world. These problems must be dealt with, as it is the development of one's understanding of the universe that hangs in the balance. It is not only necessary to help economic development, but also to help young girls realize that they can achieve whatever they wish to pursue and are not restricted to stereotypical jobs and industries.

Empowering women to pursue their STEM-related interests will be beneficial not only for them but for academia and the workforce as a whole. This would be advantageous for women to help bridge the dismaying gap in economic polarity. More women being admitted into STEM-related fields is a substantial step that must be taken to provide women with opportunities to break the glass ceiling.

The evidence provided by countless studies and reports all conclude and point to the same thing—women being given equal access to resources and opportunities in STEM assures them that they will be participating in the advancement of the global economy. Removing the social barriers of gender bias and stereotypes can help create a strong workforce that functions holistically, generating intelligent solutions to everyday problems.

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