

Where are the Women? The Gender Gap within Intellectual Property

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Table of Contents

Introduction	511
I. Presenting the Problem.....	514
A. Women Inventors.....	514
B. Women in the Courtroom	515
C. Commercialization of Inventions by Women	516
II. The Gender Gap and Innovation.....	517
A. Economic Impacts.....	518
B. Systematic Bias.....	518
III. The Causes of Gender Gap.....	521
A. Education	521
B. The Workforce	522
C. Socialization and Social Biases.....	524
D. Composition of Inventor Teams	526
IV. Proposed Remedial Measures	527
A. Professor Burk’s Diversity Levers.....	527
B. Modified Public Domain.....	528
V. Proposed Solution.....	529
Conclusion.....	531

Introduction

The critical need for diversity remains an issue that society is unable to solve. Specifically, in the field of patent law, gender disparity persists.¹ While the cause is still unclear, women remain absent at every level of the patent system.² As a preliminary explanation, the limited number of women in science and engineering limits the pool of women available to participate in the patent system.³

¹ Dan L. Burk, *Diversity Levers*, 23 DUKE J. GENDER L. & POL’Y 25, 31–32 (2015).

² *Id.* at 31.

³ United States Patent and Trademark Office, *Progress and Potential: A profile of women inventors on U.S. patents*, 5 (February 2019) (“Naturally, when fewer women pursue careers in science and engineering fields, they will make up a smaller share of patent inventors.”) [hereinafter “PTO

At the inventorship level, women are named as inventors on patents at much lower rates than men.⁴ The United States Patent and Trademark Office (“PTO”) recently published a study on inventorship, focusing on the lack of diversity among inventors.⁵ The study highlights that, despite the increase in female participation in science and engineering occupations, females continue to invent at a lower rate than males.⁶ When measuring the inclusion of female litigators in the courtroom, the American Bar Foundation (“ABF”) performed an empirical study, measuring the participation of women and men as lead counsel and trial attorneys.⁷ Women are not only largely absent from the patenting process but also from the litigation that often ensues: The ABF Study indicates that only a small number of women have lead counsel positions in matters involving intellectual property rights.⁸

While the absence of women presents a social injustice, economic issues must also be considered.⁹ It is estimated that the limited presence of women in innovation represents a loss of 2.7 percent U.S. GDP per capita.¹⁰ Women are also less likely to commercialize their innovations, which may diminish the attraction of the patenting process to women.¹¹ Academics suggest that the decreased likelihood of women commercializing their patents is responsible for the economic impact caused by the gender gap in patenting.¹²

Moreover, the behavior exhibited by women may be attributed to socialization.¹³ Social bias that discourages women from taking ownership or embarking on creative endeavors may also affect other traditionally underrepresented groups such as minorities.¹⁴

While the socialization of women and social biases against women may explain some of the disparity among inventors, additional causes of the gender gap

Study”]. However, a new report published by the USPTO shows substantial advancement in this area after this was written. United States Patent and Trademark Office, *Progress and Potential: 2020 update on U.S. woman inventor-patentees*, <https://www.uspto.gov/ip-policy/economic-research/publications/reports/progress-potential>.

⁴ *Id.* at 3.

⁵ *Id.*

⁶ *Id.* at 3.

⁷ Stephanie A. Scharf & Roberta D. Liebenberg, *First Chairs at Trial, More Women Need Seats at the Table: A Research Report on the Participation of Women Lawyers as Lead Counsel and Trial Counsel in Litigation*, AM. BAR ASS’N., 7 (2015), https://www.americanbar.org/content/dam/aba/administrative/women/first_chairs_final.pdf [hereinafter “ABF Study”].

⁸ *Id.* at 10.

⁹ See Lisa D. Cook & Chaleampong Kongcharoen, *The Idea Gap in Pink and Black*, Nat’l Bureau of Econ. Research, 1 (2010), <https://www.nber.org/papers/w16331.pdf> (exploring patenting deficits among females and its related effects on commercialization).

¹⁰ Burk, *supra* note 1, at 33.

¹¹ Cook & Kongcharoen, *supra* note 9, at 3.

¹² See Burk, *supra* note 1, at 33.

¹³ See Cook & Kongcharoen, *supra* note 9, at 3, 17.

¹⁴ See Burk, *supra* note 1, at 25.

in innovation exist.¹⁵ These causes must be addressed in order to consider solutions to improve the representation of women. A failure to address these issues will prevent the patent system from effectively incentivizing innovation.

In response to the problem discussed above, this Note will discuss the gender disparity presented by both the PTO and ABF studies.¹⁶ It will examine the historically low numbers of female inventors and investigate the factors impacting female inventorship. Moreover, this Note will consider the involvement of women in other roles related to the patenting process, including as litigators, scientists, and engineers. Next, this Note will discuss the relationship between innovation and the gender gap. It will then explore the potential causes of the gender gap. As the solution is unlikely to be rooted in a singular cause, a wholistic understanding of the gender gap and factors impacting the inclusion of women is essential to understand any solution put forth. Finally, this Note will discuss remedial measures proposed by legal scholars to improve the gender gap, and I will put forth my proposed solution. I will elaborate upon a solution that includes earlier intervention, exposing students as young as five years old to courses in engineering to equip both genders equally with the skills required for a career in science. Additionally, such an approach may help minimize the impact of social biases, which are a significant hindrance for women interested in innovation. Concurrently with these efforts, additional literature and resources should examine the history of women in the patent system and measure the growing inclusion of women. This Note will also consider how disparate treatment of women in the workplace, specifically sexual harassment, may hinder the success of proposed solutions.

While this article will focus on the absence of women within the patent system, the underrepresentation of women in copyright and trademark is also an area of concern.¹⁷

Within the copyright and the trademark systems, data regarding the inclusion of women is even further limited.¹⁸ Unlike patents, copyrights are based on expressive work and do not require administrative formalities.¹⁹ The structure of the copyright system results in less available data to assess the copyright system, making empirical studies of gender more challenging.²⁰ Only limited information is available about the small percentage of women in copyright-intensive industries.²¹ Additional research studying the causes and repercussions of the gender disparity in copyright and trademark needs to be obtained before solutions can be considered in

¹⁵ *Id.* at 33.

¹⁶ For the purposes of clarity, this Note will use the words “women” and “females” interchangeably, setting aside distinctions between gender and sex.

¹⁷ Kara W. Swanson, *Intellectual Property And Gender: Reflections On Accomplishments And Methodology*, 24 AM. U.J. GENDER SOC. POL’Y & L. 175, 183-84 (2015).

¹⁸ *Id.* at 184.

¹⁹ Dan L. Burk, *Bridging the Gender Gap in Intellectual Property*, WIPO Magazine (April 2018), https://www.wipo.int/wipo_magazine/en/2018/02/article_0001.html [hereinafter “WIPO Article”].

²⁰ *Id.*

²¹ *Id.*

these fields.²²

I. Presenting the Problem

The disparity between male and female inventors is nothing new. Between 1790 and 1859, only seventy-two patents were credited to women inventors.²³ During this same period, men obtained 32,362 patents.²⁴ Women continue to comprise a small minority of patent inventors.²⁵ The exclusion of this large group of potential inventors is preventing innovation.²⁶ Considering this problem, the PTO published a study focused on women inventors and women involved in science and engineering.²⁷ The following section discusses the results of the PTO's study.

A. Women Inventors

In February 2019, the PTO released a report on the trends and characteristics of U.S. women inventors named on U.S. patents granted from 1976 through 2016.²⁸ As the PTO does not collect information on the gender of patent inventors, the study utilized data on name-gender linked data to classify inventors as men or women based on their names.²⁹ While the number of patents with at least one female inventor listed has increased overall, the increase has been inconsistent over time.³⁰ Namely, the number of patents with at least one female inventor tripled between 1978 and 1997.³¹ However, that number only increased from 15 to 21 percent between 1998 and 2016.³²

In addition, compared to men, women are more likely to work on larger inventor teams.³³ In 1976, women comprised around 37 percent of gender-mixed inventor teams.³⁴ However, by 2016, women only accounted for 29 percent of gender-mixed inventor teams.³⁵ Despite the gradual increase of teams with at least one female inventor, the increased size of gender-mixed patent inventor teams has *decreased* the impact women have in patenting.³⁶ Women are the “shrinking minority” of inventors on these gender-mixed teams.³⁷ Moreover, the overall gender

²² See Swanson, *supra* note 17, at 185.

²³ PTO Study, *supra* note 3, at 3.

²⁴ *Id.*

²⁵ *Id.*

²⁶ See *id.* n.2 (noting “if women, minorities, and low-income children were to invent patented technology at the same rate as white men from high-income (top 20%) households, the rate of innovation in America would quadruple”).

²⁷ See *id.* at 3.

²⁸ *Id.*

²⁹ *Id.* at 13.

³⁰ *Id.* at 4.

³¹ *Id.*

³² *Id.*

³³ *Id.*

³⁴ *Id.* at 12.

³⁵ *Id.*

³⁶ *Id.*

³⁷ *Id.*

composition among inventors has not drastically changed.³⁸ As of 2016, only 12 percent of patent inventors were women.³⁹ Even when researchers control for other possible causative variables, such as age and institutional affiliation, research shows that female scientists patent less often than male scientists, even in areas of science with near-gender parity.⁴⁰ Professor Kara Swanson, a law professor whose research focuses on women, technology, and science, refers to this as not just a disparity, but a “chasm.”⁴¹

B. Women in the Courtroom

In a separate 2015 study, the ABF investigated the inclusion of women as litigators in the courtroom.⁴² The results of this study indicated that the participation of women in the courtroom generally, as well as for intellectual property matters, remained low.⁴³ An overview of the ABF Study follows.

This empirical study looked at the participation of women and men as lead counsel and trial attorneys in civil and criminal litigation.⁴⁴ The study revealed that women are consistently underrepresented in lead counsel positions in almost all types of cases.⁴⁵ The study noted that, despite women and men having graduated from law school in roughly equal numbers for decades, women have not maintained parity with their male counterparts as they progressed in their careers.⁴⁶ When considering all types of civil cases, men comprise 76 percent of lead counsel.⁴⁷ The ABF also measured the inclusion of women in suits involving different subject matter.⁴⁸ For suits involving intellectual property rights, males comprise 77 percent of lead counsel.⁴⁹ Regardless of the type of case, women are *never* more likely than men to be lead counsel.⁵⁰

In his article, *Diversity Levers*, Professor Dan Burk notes the absence of women at every level of the patent system.⁵¹ He states that women are absent at both the patent attorney and patent agent level, with men largely outnumbering women in both professions.⁵² Despite working in patent-intensive sectors, including fields such as engineering and physical sciences, women continue to acquire patents at lower rates than their male counterparts.⁵³

³⁸ *Id.* at 4.

³⁹ *Id.*

⁴⁰ Swanson, *supra* note 17, at 183.

⁴¹ *Id.*

⁴² ABF Study, *supra* note 7, at 3–4.

⁴³ *Id.* at 9–10.

⁴⁴ *Id.* at 4.

⁴⁵ *Id.*

⁴⁶ *Id.* at 5.

⁴⁷ *Id.* at 10.

⁴⁸ *Id.* at 11–12.

⁴⁹ *Id.* at 10.

⁵⁰ *Id.*

⁵¹ Burk, *supra* note 1, at 31.

⁵² *Id.*

⁵³ *See id.* at 32 (stating that the “lower rate” at which women acquire patents “does not appear to

C. Commercialization of Inventions by Women

In *The Idea Gap in Pink and Black*, Dr. Lisa D. Cook and Dr. Chaleampong Kongcharoen investigated gender and racial disparities in the commercialization of inventions.⁵⁴ Their study found that the differences between genders in the commercialization of inventions are lower than once thought.⁵⁵ Previous studies have attempted to explain the innovation gap, but the difficulty in quantifying commercialization prevented the data this study analyzed from being accessed until this point.⁵⁶ The authors noted the difficulty in identifying individual-level commercialization activity.⁵⁷ As a proxy, the study considered any “assignment to a corporation, university, organization, or anyone other than oneself” as commercial activity.⁵⁸ The authors reasoned that patent owners renew patents if the future value of the patent is higher than its renewal cost, and patents owned by firms are less likely to be expired than unassigned or individually owned patents.⁵⁹ The authors also applied a conservative approach in inventor-identification by considering all ambiguous names to be male when identifying female inventors.⁶⁰

In the paper, the authors identify two “critical endpoints” in the innovative process: basic scientific research and the commercialization of the invention.⁶¹ Over time, women have increased their participation at the research stage.⁶² As evidence, the paper notes the increase in the share of women receiving doctoral degrees in science and engineering.⁶³ The number of women who earned doctoral degrees in science and engineering increased from 9 percent of total doctoral degrees in 1970 to 40 percent in 2005.⁶⁴ In addition, women appeared to be increasingly involved in the commercialization of their inventions.⁶⁵ Between 1977 and 1982, women assigned 51 percent of their patents to firms; and by 1998, women had assigned 75 percent of their patents to firms.⁶⁶

Other studies have considered the merit or significance of research results among female researchers.⁶⁷ The suggestion is that the work done by women is not

have changed over time despite growing numbers of women entering these fields”).

⁵⁴ See Cook & Kongcharoen, *supra* note 9, at 1. (outlining the increase of African American and women doctorates and the respective increase in commercialization of inventions from African Americans and women).

⁵⁵ *Id.*

⁵⁶ See *id.* at 5 (listing the forms of commercialization previously considered such as: licensing, the achievement of first sale, having a product under review, having a product in market, or having a start-up company).

⁵⁷ *Id.*

⁵⁸ *Id.*

⁵⁹ *Id.* at 6.

⁶⁰ *Id.* at 5.

⁶¹ *Id.* at 1.

⁶² *Id.*

⁶³ *Id.*

⁶⁴ Cook, *supra* note 9, at 1.

⁶⁵ *Id.*

⁶⁶ *Id.*

⁶⁷ See WIPO Article, *supra* note 1919 (rebutting the suggestion that the work done by women is less

significant enough to merit successful patenting or commercialization.⁶⁸ However, the gender gap is not seen in other metrics for research significance, such as research grant awards.⁶⁹ Thus, the gap in patenting cannot be attributed to the lack of merit or significance of research performed by females.⁷⁰

While this Note primarily focuses on the gender gap, it is important to note that racial minorities are similarly excluded from the patenting process.⁷¹ Certainly, this racial gap also inhibits innovation under the patent system. Like the trends seen with gender, African-Americans have increasing participation at the two critical endpoints identified by the authors: research and commercialization.⁷² From 1970 to 2005, the share of African-Americans receiving doctoral degrees in science and engineering increased from less than 0.01 percent to 4 percent.⁷³ In terms of commercialization, African-Americans assigned only 44 percent of their patents to firms in 1975.⁷⁴ By 2000, 56 percent of patents by African-American inventors were assigned to firms.⁷⁵ Despite these increases, the absolute values indicate that the widespread exclusion of African-Americans continues to hinder the innovative process.⁷⁶

While the exclusion of racial minorities presents concerns for innovation, the focus of this paper will remain on the gender gap in innovation. However, approaches discussed herein as means to correct the gender gap may also address racial disparities because many women are also members of racial minorities groups. A discussion on the challenges faced by women attempting to innovate will address the lack of diversity in the patent system with the largest impact. The following section will explore the effect that the gender gap in patent law has on innovation.

II. The Gender Gap and Innovation

Within the field, it is generally accepted that the low rate of women inventors represents a serious failure in the effectiveness of patent law's incentive to innovate.⁷⁷ The following discussion will review the relationship between innovation and gender, focusing on the economic impacts and systematic bias present in patent law.

significant).

⁶⁸ *Id.*

⁶⁹ *Id.*

⁷⁰ *Id.*

⁷¹ See Cook & Kongcharoen, *supra* note 9, at 3 (stating patent commercializing activity differs along gender and racial lines).

⁷² *Id.* at 1.

⁷³ *Id.*

⁷⁴ *Id.*

⁷⁵ *Id.*

⁷⁶ See *id.* at 2.

⁷⁷ See Jennifer Hunt et al., *Why are women underrepresented amongst patentees?*, 42 RESEARCH POLICY 831, 831 (2013) (stating that the gender gap is an inefficient use of female innovative capacity).

A. Economic Impacts

The patent system needs to be refined to properly encourage women to innovate at the same rate as men.⁷⁸ Innovation is a driver of economic growth.⁷⁹ When innovation is occurring, economic growth is at its highest.⁸⁰ In 2010, President Obama “called into doubt whether the United States was innovating at its fullest potential.”⁸¹ In 2007, a report by the National Academy of Sciences stated that “the committee is deeply concerned that the scientific and technological building blocks critical to our economic leadership are eroding.”⁸² Overall, the report urges that, to solve this problem, the “share of women in science and engineering” needs to increase.⁸³

Many scholars, including Professor Burk, discuss the economic impact that the gap in innovation is creating.⁸⁴ Professor Burk notes that women who obtain patents are less likely to commercialize these patents via licensing or product development compared to their male counterparts.⁸⁵ The gap in innovation represents an estimated loss of 2.7 percent of U.S. GDP per capita.⁸⁶ The gap in innovation may also be contributing to other socially harmful consequences, such as a failure to properly address women’s health through patented inventions.⁸⁷

B. Systematic Bias

Scholars argue that a systematic bias exists within patent law is preventing it from optimally encouraging innovation.⁸⁸ This Note will focus on three points. First, it will consider whether patent law is socially neutral. Second, it will explain the potential patent law has to reinforce gender norms. Finally, this Note will consider whether the PTO and courts have a bias against women and their patents.

To many observers, patent law may appear to be socially neutral, especially in comparison to other areas, such as family or employment law.⁸⁹ Despite the gender gaps, many observers do not associate intellectual property law with race, gender, or any other historically disadvantaged social classification.⁹⁰ Professor Burk presents an interesting example of how the idea of patent law as socially neutral may be a misconception.⁹¹ Namely, he discusses the controversy regarding a combination

⁷⁸ *See id.*

⁷⁹ *Id.*

⁸⁰ *Id.*

⁸¹ *Id.*

⁸² *Id.*

⁸³ *Id.*

⁸⁴ *See, e.g.,* Burk, *supra* note 1, at 33.

⁸⁵ *Id.* at 32.

⁸⁶ *Id.* at 33.

⁸⁷ *See* Rembrand Koning et al., *Female Inventors and Inventions in 19-124* (Harvard Bus. Sch., Working Paper 1, 2019).

⁸⁸ *See* Burk, *supra* note 1, at 29–31 (discussing the gender bias present in patent law).

⁸⁹ *Id.* at 29.

⁹⁰ *Id.*

⁹¹ *Id.* at 29–30.

drug.⁹² The combination drug provided unexpectedly good results among African-American patients, despite each individual drug being well known in the art to treat congestive heart failure for Caucasian patients.⁹³ In order to overcome an obviousness rejection, the applicant argued that the treatment data showed unexpectedly good results among African-American patients.⁹⁴ The combination drug “could only be judged [. . .] non-obvious, if the baseline for judging obviousness is the effect of the drugs in the majority Caucasian population.”⁹⁵ In order for the results to be considered “unexpected or surprising,” the African-American population must be considered outside the norm.⁹⁶ Accordingly, the inventor amended the patent’s claims to “restrict its scope to a method of treating hypertension in the [African-American] population.”⁹⁷ This instance exemplifies the interaction of social class and patentability.⁹⁸

In this example, the examination of obviousness “intersects with social classification to set a racial baseline for patentability.”⁹⁹ Professor Burk states that the “patent is in some sense premised upon the marginalization or ‘othering’ of the African-American social grouping.”¹⁰⁰ Professor Swanson notes that “there is no such thing as neutral law—that law replicates existing social hierarchies, and we need to look at all bodies of law carefully to see what power hierarchies they create and what subordination they promote if we want to promote equality instead.”¹⁰¹

Professor Burk also argues that patent law is reinforcing gender norms.¹⁰² The metrics of the patent statute assume a “particular mode of thinking” that occurs by means of “certain analytical and rational processes.”¹⁰³ Yet, women are often socialized to approach problem-solving differently from their male counterparts.¹⁰⁴ The following point exemplifies the ability intellectual property law has to further gender norms.

In an example involving the use of copyright law in Ghana, the author discusses the sale of machine-made cloth that incorporates patterns resembling those in traditionally-made fabrics.¹⁰⁵ When local weavers invoked statutes intended to protect traditional crafts and knowledge, those laws appeared to function as intended.¹⁰⁶ However, when considering the broader impact, it appeared that these

⁹² *Id.*

⁹³ *Id.* at 30.

⁹⁴ *Id.*

⁹⁵ *Id.*

⁹⁶ *Id.*

⁹⁷ *Id.*

⁹⁸ *Id.*

⁹⁹ *Id.*

¹⁰⁰ *Id.*

¹⁰¹ Swanson, *supra* note 17, at 182.

¹⁰² Burk, *supra* note 1, at 30.

¹⁰³ *Id.* at 31.

¹⁰⁴ *Id.*

¹⁰⁵ WIPO Article, *supra* note 19.

¹⁰⁶ *Id.*

laws were helping to reinforce long-standing gender disparities.¹⁰⁷ The weaving industry in Ghana is traditionally considered a male occupation.¹⁰⁸ And the laws being invoked were being implemented by male weavers against female small business operators.¹⁰⁹ While the male weavers were lawfully protected under intellectual property law, the result was a reinforcement of the gender disparity within the community.¹¹⁰ If not allowed to enter the weaving industry, women are unable to make innovations to weaving, own businesses, or elevate their status within their community.¹¹¹

Moreover, the courts may be influenced by a gender bias.¹¹² Professor Swanson considers femininity in the context of the canonical case from 1881 involving a corset.¹¹³ The accused infringer claimed that the patent was invalid based on prior use of the corset by the patentee's female friend for many years prior to patenting.¹¹⁴ Professor Swanson notes the oddity of the case.¹¹⁵ The Court employed a case involving undergarments (fairly private pieces of clothing) to broaden the public use doctrine.¹¹⁶ The use deemed public involved the exchange of undergarments between two unmarried individuals.¹¹⁷ While the two would later marry, Professor Swanson believes the Court ignored the femininity of the patent owner's friend in order to avoid using patent law to sanction alleged extralegal sexual activities between her and the patentee.¹¹⁸ "The choice ultimately came down to considering one woman's underwear public or acknowledging and rewarding a sexual intimacy of many years between two unmarried people."¹¹⁹

Further, gender bias may also be impacting the inventions allowed by the PTO.¹²⁰ Dr. Foster discusses how the types of patents allowed may be impacting female inventorship rates.¹²¹ Gendered forms of labor and creativity, typically associated with women, are often considered to be "in the public domain" and

¹⁰⁷ *Id.*

¹⁰⁸ *Id.*

¹⁰⁹ *Id.*

¹¹⁰ *Id.*

¹¹¹ *See id.*

¹¹² Kara Swanson, *Getting a Grip on the Corset: Gender, Sexuality, and Patent Law*, 23 *YALE J.L. & FEMINISM* 57, 89 (2011).

¹¹³ *Id.* (analyzing *Egbert v. Lippmann*, 104 U.S. 333 (1881) (holding that the use of a corset was public and rendered the patent invalid)).

¹¹⁴ *Id.* at 103.

¹¹⁵ *Id.* at 68.

¹¹⁶ *Id.* at 70.

¹¹⁷ *Id.* at 72–73.

¹¹⁸ *Id.* at 115.

¹¹⁹ *Id.*

¹²⁰ *See* Laura A. Foster, *Situating Feminism, Patent Law, and the Public Domain*, 20 *COLUM. J. GENDER & L.* 262, 309–11 (2011) ("Discourses of feminization shape what counts as valuable knowledge worthy of promoting and protecting through private property ownership, versus knowledge that should be relegated to the public domain as raw material open to exploitation by others.").

¹²¹ *Id.*

excluded from protection.¹²² For example, design patents on clothing are unlikely to be patented because clothing is considered functional rather than innovative.¹²³ Additionally, patents on recipes, while possible, are often hard to obtain and defend against claims of anticipation.¹²⁴ Because of the high costs of obtaining a patent, inventors are deterred from patenting inventions that are difficult to obtain *and* defend, and the knowledge related to cooking or clothing remains available in the public domain.¹²⁵ Legal historian, Professor Deborah J. Merritt, attributes some of these actions to the PTO's unconscious bias against women's patent applications.¹²⁶ While the patent system may appear neutral and without bias, this system, which is intended to encourage innovation for all, facilitates the exclusion of women.¹²⁷

III. The Causes of Gender Gap

While the effects of the gender gap are difficult to measure, a careful examination of the causes of this gap may help to devise potential solutions. Scholars have identified many potential causes for the gender gap within patent law.¹²⁸ Therefore, the following sections will include a discussion of the causes of the gender gap. This list is not comprehensive as a complete list could be the subject of an entire other note.

A. Education

A commonly identified cause of the gender gap is the pool of women within the science and engineering fields.¹²⁹ Women continue to enter science and engineering fields at a substantially lower rate than men.¹³⁰ The failure to attract women into these fields “undoubtedly contributes” to fewer patents being granted to women inventors.¹³¹ Yet, women have been graduating from college at rates higher than men for many years.¹³² Women account for 60 percent of college graduates across all degree fields.¹³³ However, in science, engineering, technology, and mathematics (STEM) degrees, women account for just 31 percent of college graduates.¹³⁴ Research suggests that increasing the number of women seeking undergraduate degrees in STEM may not entirely address the gender gap in the

¹²² *Id.* at 309–10.

¹²³ *Id.*

¹²⁴ *Id.* at 310.

¹²⁵ *Id.*

¹²⁶ *Id.* at 315.

¹²⁷ WIPO Article, *supra* note 19, at 7; *see* Burk, *supra* note 1, at 29.

¹²⁸ *See* Burk, *supra* note 1, at 33 (“The causes of the patent gender gap are likely complex, arising from an intricate milieu of deeply-seated social factors. Women may have been socialized to take fewer risks, to push their projects less aggressively, and to think about commercialization of their work less often than their male counterparts.”).

¹²⁹ *Id.* at 32.

¹³⁰ *Id.*

¹³¹ *Id.*

¹³² PTO Study, *supra* note 3, at 5 n.7.

¹³³ *Id.*

¹³⁴ *Id.*

commercialization of inventions.¹³⁵ Increases in advanced engineering degrees may have a more significant impact on the number of women commercializing their inventions.¹³⁶

Yet, the lower number of women seeking STEM degrees only partially accounts for the disparity.¹³⁷ The rate of women inventors does not reflect the increasing number of women obtaining degrees in STEM or entering the STEM workforce.¹³⁸ Therefore, additional causes must be explored to better understand why women are still less likely to invent or commercialize their inventions via licensing or product development compared to their male counterparts.¹³⁹

B. The Workforce

The PTO study reviewed the gender disparity within the workforce as a factor that “shape[s] the opportunities for women to become patent inventors.”¹⁴⁰ Within the workforce in 2015, women comprised 28 percent of the total number of people employed in science and engineering fields.¹⁴¹ This indicates that women graduating with STEM degrees are largely entering the workforce in that same field.¹⁴²

As fewer women than men are pursuing careers in these fields, it is reasonable to expect the percentage of women inventors to be lower because science and engineering fields produce the most patentable inventions.¹⁴³ Yet, the percentage of women inventors (12 percent) is less than half the percentage of women in the workforce in related fields.¹⁴⁴ Women are participating in the workforce at a much higher rate than the rate at which they invent patented inventions.¹⁴⁵

However, within certain engineering disciplines, the percentage of women in the workforce more closely resembles the overall inventorship rate of women.¹⁴⁶ Still, the female share of inventors in mechanical engineering patents has only recently *increased* to 8 percent.¹⁴⁷ Because the electrical and mechanical arts are the most patent-intensive fields,¹⁴⁸ addressing the gender disparity within the engineering workforce, rather than STEM generally, may have a more direct impact

¹³⁵ See Cook & Kongcharoen, *supra* note 9, at 22.

¹³⁶ See *id.*

¹³⁷ See Burk, *supra* note 1, at 32.

¹³⁸ See *id.*

¹³⁹ *Id.*

¹⁴⁰ PTO Study, *supra* note 3, at 5.

¹⁴¹ *Id.*

¹⁴² This is my own observation based on the number of STEM degrees earned by women (31 percent) and the number of women entering the science and engineering workforce (28 percent). While some women do not enter the field, it appears that a majority are entering the workforce after earning a degree in the field.

¹⁴³ PTO Study, *supra* note 3, at 5.

¹⁴⁴ See *id.*

¹⁴⁵ *Id.*

¹⁴⁶ See *id.* at 5, 8.

¹⁴⁷ *Id.* at 8.

¹⁴⁸ Hunt, *supra* note 77, at 832.

on the number of women inventors.¹⁴⁹ Further, women are only patenting in the fields where females have patented before, rather than entering male-dominated fields.¹⁵⁰ Therefore, without an effort to include women in the most patent-intensive fields, the rate of female inventorship is unlikely to increase.

When generating a solution, it may be helpful to consider a field with a significant percentage of women within the workforce, such as the biological and life sciences field.¹⁵¹ Within this field, women comprise nearly 50 percent of the workforce.¹⁵² Accordingly, women inventors participate more actively in the drug and medical field than other U.S. inventors.¹⁵³ Moreover, women have received a higher share of life science degrees and a relatively lower share of engineering degrees since 1970.¹⁵⁴ The increased inclusion of women in the biological and life sciences field exhibits that women can successfully participate in the innovation process. Therefore, additional research into the discrepancy among the different STEM fields may help when designing a solution.

Moreover, certain assignees exhibit higher rates of women inventors, which indicates that employers may be influencing inventorship rates by gender.¹⁵⁵ Previous studies found that women were more likely to be inventors on patents granted to public or not-for-profit organizations because these organizations offer more opportunities for women.¹⁵⁶ The PTO study reported that the share of women inventors is trending up for all assignee types, especially in universities, hospitals, and public research organizations, which show the greatest improvements.¹⁵⁷ Because businesses account for most of the patenting in the United States, it is unlikely that women will be able to patent at the same rate as men if the different inventor rates between businesses and not-for-profit organizations do not change.¹⁵⁸ Businesses must take it upon themselves to expand women's participation in innovative activity.¹⁵⁹

Finally, the disparate treatment of women in the workplace may be impacting the ability of women to partake in the innovation process. Recently, sexual harassment has become an area of frequent discussion.¹⁶⁰ A 2018 report from the

¹⁴⁹ PTO Study, *supra* note 3, at 5.

¹⁵⁰ *Id.* at 8.

¹⁵¹ *Id.* at 6.

¹⁵² *Id.*

¹⁵³ Cook & Kongcharoen, *supra* note 9, at 8.

¹⁵⁴ *Id.*

¹⁵⁵ *See* PTO Study, *supra* note 3, at 8–9. Like the PTO's analysis, this Note assumes that the results of the women inventors by assignee are indicative of the practices by employers as assignees are often the employers of inventors.

¹⁵⁶ *Id.* at 9.

¹⁵⁷ *Id.*

¹⁵⁸ *See id.*

¹⁵⁹ *See id.*

¹⁶⁰ *See* Susan Dominus, *Women Scientists Were Written Out of History. It's Margaret Rossiter's Lifelong Mission to Fix That*, SMITHSONIAN MAGAZINE (2019) ("But the mistreatment of women in science and other professions had already caught fire in the public imagination with the rise of the

University of Texas system found that this concern was especially present in academia.¹⁶¹ “. . . [A]bout 20% of female science students, more than 25% of female engineering students, and more than 40% of female medical students had experienced sexual harassment from faculty or staff.”¹⁶² One historian suggests that sexual assault and harassment must have been more prevalent than history suggests.¹⁶³ Mary Susan Lindee, a science historian from the University of Pennsylvania, believes that, despite the lack of administrative records, harassment “must have been everywhere.”¹⁶⁴ As the fear of sexual harassment is a reality faced by many women entering male-dominated fields, any solution to the gender gap must also consider the prevalence of sexual assault and harassment in education and the workforce.

C. Socialization and Social Biases

Professor Burk points to the socialization of women as another explanation for the gender gap.¹⁶⁵ Women have been socialized to “take fewer risks, to push their projects less aggressively, and to think about commercialization of their work less often than their male counterparts.”¹⁶⁶ Professor Burk also states that, while this may be done intentionally or inadvertently, women are excluded from opportunities and institutions that facilitate opportunities for innovation.¹⁶⁷ He argues that the impediment to female participation in the entire patent system is rooted in social biases and historical subordinations.¹⁶⁸ Within the patenting process, female inventors are more likely to face disapproval and resistance and have less access to expertise and resources that are necessary to complete the patenting process.¹⁶⁹

Drs. Cook and Kongcharoen also address socialization as a cause of the gender gap within the commercialization of patents.¹⁷⁰ The authors cite a study that suggests that female scientists may have different attitudes towards risk and competition that may impact their commercial activity.¹⁷¹ Additional studies show that women in STEM fields have developed social responses that discourage participation in patenting and commercializing their research.¹⁷² According to these reports, women are less likely to consider commercializing their inventions and are less comfortable marketing themselves and their work to potential business partners, compared to their male counterparts.¹⁷³

#MeToo movement.”).

¹⁶¹ *Id.*

¹⁶² *Id.*

¹⁶³ *Id.*

¹⁶⁴ *Id.*

¹⁶⁵ See Burk, *supra* note 1, at 33.

¹⁶⁶ *Id.*

¹⁶⁷ *Id.*

¹⁶⁸ *Id.*

¹⁶⁹ *Id.*

¹⁷⁰ Cook & Kongcharoen, *supra* note 9, at 2–3.

¹⁷¹ *Id.* at 4.

¹⁷² WIPO Article, *supra* note 19.

¹⁷³ *Id.*

Further, a study from 2005 by Jerry Thursby and Marie Thursband suggested that the socialization of women may be reducing the likelihood of disclosure among female academics.¹⁷⁴ The study measured disclosures between 1983 to 1999 and found that female academics were less likely than their male colleagues to disclose inventions to their university technology transfer office.¹⁷⁵

Negative stereotypes about women may be limiting their ability to become inventors.¹⁷⁶ Historically, women are treated as an “outsider” or “stranger.”¹⁷⁷ Research has shown that individuals influenced by stereotypes view men as more proactive and competent in general and highly competent in the things that “count most” in society.¹⁷⁸ Conversely, women are viewed as less competent and better at traditionally feminine, communal tasks that are less socially valued.¹⁷⁹ Drs. Cook and Kongcharoen also reiterated the finding that social networks and venture capitalists view women inventors differently from men.¹⁸⁰ These stereotypes prevent women from participating and commercializing their work.¹⁸¹

Belief in these social biases is so powerful that it can influence behavior merely because individuals perceive that *others* are influenced by these biases.¹⁸² In the legal profession, where the impressions of clients, judges, and the public are extremely important, these stereotypes will have a strong impact on the ability of women to be equally involved in any legal aspect of innovation. For example, a client may not want a female attorney defending the validity of a patent if the judge does not view a woman as equally competent as a male attorney, regardless of the merit of the argument.

Another cause for the gender gap is that there are fewer opportunities for women to pursue endeavors outside of traditional occupations through entrepreneurship.¹⁸³ Entrepreneurs are statistically very likely to develop patented inventions to protect their investment. However, female scientists and engineers are often excluded from the social networks that enable the commercialization of inventions.¹⁸⁴ As an example, Professor Burk finds that women are less likely to be invited to sit on prestigious scientific boards or advisory panels.¹⁸⁵ Women often do not have the social connections that men have, which are often vital to innovative development.¹⁸⁶ It is through interactions that scientists are likely to meet potential

¹⁷⁴ Foster, *supra* note 120, at 316.

¹⁷⁵ *Id.*

¹⁷⁶ Yu Meng, *Collaboration patterns and patenting: Exploring gender distinctions*, 45 RESEARCH POLICY 56, 57 (2016).

¹⁷⁷ *Id.* at 12.

¹⁷⁸ *Id.*

¹⁷⁹ *Id.*

¹⁸⁰ Cook & Kongcharoen, *supra* note 9, at 3.

¹⁸¹ Meng, *supra* note 1766, at 12.

¹⁸² *Id.*

¹⁸³ PTO Study, *supra* note 3, at 5.

¹⁸⁴ WIPO Article, *supra* note 19.

¹⁸⁵ *Id.*

¹⁸⁶ Burk, *supra* note 1, at 33.

innovation partners.¹⁸⁷ Without these connections, women may face more difficulty securing funding critical to patenting and commercializing their inventions.¹⁸⁸ The low numbers of women successfully commercializing their inventions at the same rate as men may be significantly impacting the desire or motivation of women to become inventors or entrepreneurs.¹⁸⁹ The incentive behind gaining a patent is often economic, and, if women are less successful on commercial endeavors, they are certainly less like to have faith in the patent system.¹⁹⁰ Without addressing the differences in the ability of women to successfully commercialize inventions, the disadvantages of women in the patent system will continue.

The contributions of women to technological innovation have been historically overlooked.¹⁹¹ For example, the Matilda Effect, named after suffragist Matilda Gage, whose own work was overlooked by historians, refers to the phenomena of men receiving credit for work done by female scientists.¹⁹² Gage asserted that, contrary to popular belief, Eli Whitney was not the inventor of the cotton gin.¹⁹³ He merely manufactured the cotton gin after being given very specific directions by its actual inventor, Catharine Littlefield Greene, a widow of a Revolutionary War general.¹⁹⁴ Gage believes that Greene did not attempt to patent her invention to avoid ridicule for her attempt to partake in industry.¹⁹⁵ The historical exclusion of women in technology has likely further prevented society from viewing women as capable of contributing to the innovative process.

D. Composition of Inventor Teams

Finally, the PTO's study indicates that the composition of inventor teams may be impacting the rate of inventorship by women.¹⁹⁶ Women are patenting on increasingly larger, gender-mixed inventor teams.¹⁹⁷ Since 1976, studies show that women are more likely to collaborate with other patent inventors and participate on teams of four or more inventors.¹⁹⁸

However, gender diversity among gender-mixed patent inventor teams has declined.¹⁹⁹ In 1976, women comprised 37 percent of gender-mixed inventor teams;

¹⁸⁷ WIPO Article, *supra* note 19.

¹⁸⁸ See PTO Study, *supra* note 3, at 6.

¹⁸⁹ See Meng, *supra* note 176, at 56 ("Since commercial involvement is assumed to closely related to established status and a high level of publication productivity and women are generally less successful on these aspects, scholars worry that the change toward commercialization would reinforce women's disadvantages in the profession of science.").

¹⁹⁰ See *id.*

¹⁹¹ See Dominus, *supra* note 160 (discussing Matilda Gage, whose own work was overlooked by historians).

¹⁹² *Id.*

¹⁹³ *Id.*

¹⁹⁴ *Id.*

¹⁹⁵ *Id.*

¹⁹⁶ PTO Study, *supra* note 3, at 12.

¹⁹⁷ *Id.* at 11–12.

¹⁹⁸ *Id.* at 11.

¹⁹⁹ *Id.*

however, in 2016, women only accounted for 29 percent of gender-mixed teams.²⁰⁰ Women are the “shrinking minority” of inventors on these gender-mixed teams.²⁰¹ Despite the number of patents with at least one woman inventor increasing from 7 percent in the 1980s to 21 percent in 2016, the share of inventorship among women is only 12 percent as of 2016.²⁰²

When comparing single-sex to mixed-sex patent teams, Drs. Cook and Kongcharoen also highlighted the difference in team attitudes toward commercializing their patents.²⁰³ Female-only teams assign their patents to firms 42 percent of the time, compared to the 74 percent assignment rate for all-male teams and the 80 percent assignment rate for gender-mixed teams.²⁰⁴ More than half of the patented products by women-only teams are not assigned to any organization.²⁰⁵ Despite women-only teams assigning their patents at approximately half the rate of male-only teams, the presence of women on inventor teams increases the likelihood of assignment.²⁰⁶ As assignment rate is highest for mixed-gender teams, commercialization appears most promising with diverse inventor teams.²⁰⁷

A variety of factors may be impacting the rate of women inventors. While these many factors make finding a solution more difficult, a careful consideration of each factor is necessary to understand and address any solution put forth to correct such a complex issue.

IV. Proposed Remedial Measures

The following text includes a discussion of the remedial measures proposed by scholars to narrow the gender gap among inventors.

A. Professor Burk’s Diversity Levers

First, Professor Burk proposes the use of policy levers.²⁰⁸ He defines policy levers as doctrinal standards that are mutable to the characteristics of recent technologies, new industries, and the changing circumstances of existing industries.²⁰⁹ He suggests that the patent system must provide the incentives necessary to commercialize by considering the challenges faced by each industry.²¹⁰ As Congress cannot foresee the challenges that each industry will face, the patent statute must be equipped to “allow ongoing modulation” to ensure that a reward is available to meet the needs of different economic contexts.²¹¹

²⁰⁰ *Id.*

²⁰¹ *Id.*

²⁰² *Id.* at 4.

²⁰³ Cook & Kongcharoen, *supra* note 9, at 9.

²⁰⁴ *Id.*

²⁰⁵ *Id.*

²⁰⁶ *Id.*

²⁰⁷ *See id.*

²⁰⁸ Burk, *supra* note 1, at 3433.

²⁰⁹ *Id.*

²¹⁰ *Id.*

²¹¹ *Id.*

In its current form, the patent system allows for different tailoring tools to vary the characteristics of patents by industry.²¹² Namely, Professor Burk points to the “person having ordinary skill in the art” standard under obviousness as an example.²¹³ This standard requires tailoring the legal standard to each specific technology as obviousness may vary depending on how the person having ordinary skill in the art is defined.²¹⁴ The ability to apply a flexible standard for obviousness ensures that patents are being granted when they are truly inventive.²¹⁵ Professor Burk believes that including such flexible standards more extensively in patent law would give decision makers the ability to tailor each statute to meet the needs of diverse industries and other social impediments in innovations.²¹⁶

After reviewing the measure argued by Professor Burk, my critique is that it is not necessarily feasible. Gaining a legislative consensus is a challenging task, especially for a complex system like patent law. Therefore, I question the ability to implement such a drastic change within patent law.

B. Modified Public Domain

Dr. Foster proposes another remedial measure.²¹⁷ She suggests adjusting the patent system to include a flexible concept of a public domain—one that considers complex, gendered social relations.²¹⁸ In an effort to encourage innovation, scholars have proposed contractual agreements for “science commons,” which place research findings in the public domain.²¹⁹ Yet, the benefits of a public domain do not benefit all groups equally.²²⁰ Specifically, women scientists are not equally included in collaborations.²²¹ The values of “sharing and openness” within science do not benefit everyone equally.²²²

Dr. Foster argues that any theorization of an open public domain must address the norms of western science and the structural inequalities preventing women from accessing scientific knowledge.²²³ For example, more robust notions of authorship would help protect the technology invented by women, particularly indigenous women, under a public domain.²²⁴ However, it is extremely difficult to establish a public domain that satisfies the needs of specific groups.²²⁵ For example, the idea put forth to protect indigenous women is to limit or abolish patent rights as these

²¹² *Id.* at 34–535

²¹³ *Id.* at 35.

²¹⁴ *Id.*

²¹⁵ *Id.*

²¹⁶ *Id.*

²¹⁷ Foster, *supra* note 120, at 270.

²¹⁸ *Id.*

²¹⁹ *Id.* at 277.

²²⁰ *Id.* at 280.

²²¹ *Id.*

²²² *Id.* at 281.

²²³ *Id.* at 282.

²²⁴ *Id.* at 297.

²²⁵ *See id.* at 308.

rights are often used as tools to exploit indigenous women.²²⁶ Yet, this solution would leave at least two groups of women dissatisfied: the women currently reaping the benefits of the patent system and the indigenous women who seek to obtain intellectual property rights to their creative works.²²⁷ In light of these challenges, Dr. Foster believes that gendered social relations must be considered before implementing public domains.²²⁸

Similar to the measure argued by Professor Burk, I question the feasibility of the modified public domains argued by Dr. Foster. Gaining a consensus may be even more difficult for this measure as it requires a more complex solution. The consideration of gendered social relations and the needs of specific groups would leave Congress with the nearly impossible job of crafting a statute that appropriately responds to each group's concerns.

V. Proposed Solution

As an alternative, I suggest a different approach to address the gender gap within the innovation process. Based upon the factors discussed above, I believe that the most promising way to increase female participation in innovation is to address the education gap in a more expansive and targeted way. This approach draws on my experiences as an engineer within the intellectual property legal community and knowledge supplemented by my own research and personal discussions with academics in the field.

Professor Jennifer Hunt similarly believes that the first step to increasing female patenting rates is to increase women's representation in engineering, especially in the electrical and mechanical arts as these are the most patent-intensive fields.²²⁹ She also suggests that encouraging women to take jobs involving design and development would increase the participation of women as inventors because these are the most patent-intensive jobs.²³⁰ Drs. Cook and Kongcharoen considered the rate of women obtaining doctoral degrees in science and engineering and found that more advanced training in engineering corresponds with better commercial outcomes for women.²³¹

Based on this research, increasing the number of women seeking advanced degrees in engineering appears to be the easiest way to improve the inclusion of women in the innovation process. However, recent studies show that, despite increasing female participation in the workforce and all levels of education, women are not participating in the patenting and commercialization of inventions at the same rate.²³² Similarly, the rise in female law school graduates has not increased the

²²⁶ *Id.*

²²⁷ *See id.*

²²⁸ *Id.* at 313.

²²⁹ Hunt et al., *supra* note 77, at 832.

²³⁰ *Id.*

²³¹ Cook & Kongcharoen, *supra* note 9, at 3.

²³² PTO Study, *supra* note 3, at 5; Cook, *supra* note 9, at 1.

participation of women in the lead counsel position.²³³ The solution cannot rest in higher education alone.

This observation suggests that efforts must begin earlier. Women are unlikely to suddenly desire an engineering degree and seek a career as a scientist or entrepreneur if this concept is only presented as an option upon entering college or graduate school. Therefore, programs need to be implemented earlier. Upper and lower-level schools must provide engineering courses and activities to *all* students.

First and foremost, these courses would give both genders the skills necessary to complete science and engineering degrees. Longitudinal comparisons show that *early* exposure to innovation fosters innovation later in life.²³⁴ Second, these courses would socialize both men and women to view women as equally capable of having a career in STEM. Over time, women would no longer be viewed as “outsiders” or less competent. Earlier programs including both men and women could be an effective way to alter the socialization differences between genders. Beginning as a young girl, women could consider and potentially decide to pursue a degree in science and engineering. As women are increasingly represented in engineering, the social bias will decrease, giving women the opportunity to patent and commercialize inventions at the same rates as men. While this solution does not address the distinct commercialization practices between men and women, the inclusion of curricula encompassing basic business practices within the proposed engineering courses would provide women with the skills to also commercialize their inventions.

The proposed changes will take many years of implementation to make a significant difference in the inclusion of women. And, the success of this program may also be delayed due to the workplace environment. For example, sexual harassment may hinder the ability for women to advance in certain roles, which is necessary for women to be equally included in the innovation process.²³⁵ To address these concerns, further studies should investigate the mechanisms implemented by countries with higher participation of women as inventors.²³⁶ Notably, countries with a higher participation of women as inventors are also the most active patenting countries.²³⁷ Perhaps increasing general patenting rates will improve the inventorship rate of women.

Concurrently with these efforts, additional research needs to be conducted to better identify the cause of the gender gap within innovation. In 2015, Professor

²³³ ABF Study, *supra* note 7, at 5.

²³⁴ WIPO Article, *supra* note 19.

²³⁵ See Dominus, *supra* note 160 (citing a study by the University of Texas reporting on the prevalence of sexual assault in engineering academics).

²³⁶ Gema Lax Martínez et. al, *Identifying the Gender of PCT inventors* 9 (WIPO Economic Research Working Papers 33, 2016) (“Typically, China and the Republic of Korea have a higher gender balance in international patenting, as 50% of all international applications included women inventors for the period of 2011-2015.”).

²³⁷ *Id.* at 21.

Swanson compiled a bibliography on legal literature related to intellectual property and gender.²³⁸ Her research only uncovered 41 pieces of literature relevant to intellectual property and gender in the United States and Canada.²³⁹ Research on female scientists and inventors from the past may motivate aspiring inventors and scientists to further their studies and careers. Historians can help to correct the record of female inventors and scientists.²⁴⁰ Any additional research will further discussions and questions about gender and the inclusion of women in intellectual property. I believe my proposed solution to be the simplest and most effective way to give women the skills necessary to become increasingly involved in the innovation process. The inclusion of women in the patent system is essential to ensuring the patent system is optimally encouraging innovation.

Conclusion

While the cause of the gender gap in patent law is unclear, the effects of the problem are too severe to ignore. At all levels of innovation, women are underrepresented.²⁴¹ While the lower representation of women gaining STEM degrees may explain some of the gender gap in the innovation process, additional causes are implicated and must be addressed to improve the representation of women. Women continue to be excluded from the innovation process, particularly in the role of inventor.²⁴²

A founding principal of the patent system is to encourage innovation.²⁴³ However, that cannot be accomplished without encouraging women to equally contribute to the innovation process. Therefore, a careful analysis of the numerous factors contributing to this low rate must be performed. My own cursory analysis indicates that early, proactive steps toward female inclusion can reduce the gender gap, specifically for inventorship, and increase the pool of innovators. Additionally, this proposed solution would socialize men and women to view women as competent scientists and businesspeople. However, concerns within the workplace may require additional measures to ensure women are able to participate. As the increase of women in STEM occupations continues, society will similarly see an increase in female inventors and overall improvement in the ability of the patent system to encourage innovation.

²³⁸ See Swanson, *supra* note 17, at 195—98.

²³⁹ *Id.* at 195.

²⁴⁰ See Dominus, *supra* note 160.

²⁴¹ See Burk, *supra* note 1, at 25.

²⁴² See PTO Study, *supra* note 3, at 3.

²⁴³ See U.S. CONST. art. I, § 8, cl. 8 (stating that the US Constitution grants the enumerated power “To promote the progress of science and useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries”).