



Cornell University

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“Enhancing Patent Diversity for America’s Innovators”

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Introduction

Thank you, Chairwoman Velázquez, Ranking Member Chabot and members of the Committee for inviting me to speak on this important topic: increasing diversity in innovation, entrepreneurship and patenting. I am incredibly honored to be here as a citizen, biomedical engineer, entrepreneur, and faculty member at Cornell University.

At Cornell, I focus my teaching efforts on cultivating women entrepreneurs in the sciences, where I serve as a Lecturer in the College of Engineering and SC Johnson College of Business, and direct a program called Women Entrepreneurs Cornell (W.E. Cornell) at Cornell's Center for Regional Economic Advancement. The program is in its second year, and I work with women entrepreneurs in STEM disciplines who are at all stages of their entrepreneurial journey, including several who are pursuing patents for their innovations. I am also an entrepreneur myself, and one of the few female faculty members teaching classes at the intersection of science, technology and entrepreneurship. I highlight this fact to emphasize the dearth of women that persists in STEM and entrepreneurship in both academia and private industry. In my testimony, I will focus primarily on the challenges facing women in becoming inventors and obtaining patents, and the existing research on these barriers as they apply to women. However, I want to acknowledge that gender diversity is just one facet of the diversity we seek in patenting. The challenges facing women also apply to other minority groups and are often felt even more acutely by men and women of color.

The women I mentor who pursue patents are in the minority at Cornell, as they are nationwide. Today, women make up just 12 percent of all patent inventors. That rate is higher at Cornell, where 23 percent of all patent disclosures come from female faculty, but still significantly below where we can and want to be.

Further, women hold only 5.5 percent of all commercialized patents or patents that make it to market. The Institute for Women's Policy Research estimated that on our current trajectory it will take until the year 2092 for women to reach parity with men in patenting rates.¹ Another group, comprised of top economists, estimates it will take until the year 2136 (116 years from now) to reach gender parity.² This is neither an acceptable status quo nor an acceptable rate of change.

The Decline in American Innovation

Why is it important to focus on increasing the number of women patent inventors in the United States? The answer is economic growth, including job creation.

Young firms have historically accounted for a disproportionate level of job creation in the U.S.³ More recently, however, top economists and other scholars have pointed to the decline in high-

¹ Institute for Women's Policy Research. "At the Current Rate, Women Inventors Will Not Reach Parity in Patenting Until 2092." July 21, 2016. Available online: <https://iwpr.org/at-the-current-rate-women-inventors-will-not-reach-parity-in-patenting-until-2092/>.

² The Equality of Opportunity Project. "Who Becomes an Inventor in America? The Importance of Exposure to Innovation." By Alex Bell, Raj Chetty, Xavier Jaravel, Enviana Petkova, and John Van Reenen. Available: http://www.equality-of-opportunity.org/assets/documents/inventors_summary.pdf

³ NBER Working Paper No. 21776. "Where has all the skewness gone? The decline in High-Growth (Young) Firms in the U.S." February 2016. Available online: <https://www.nber.org/digest/feb16/w21776.html>.

growth startup rates in the post-2000 period, a trend described as “pervasive” by observers.⁴ Researchers at the Brookings Institute and the Kauffmann Foundation found, based on an analysis of U.S. Census data, that the number of new companies as a share of all U.S. businesses has dropped by 44 percent since 1978.⁵

There is a way to help reverse this trend: increase the number of women and other underrepresented groups obtaining patents and starting valuable businesses. The U.S. Patent and Trademark Office (USPTO) stated in its 2019 report: “If women, minorities and low-income children were to invent patented technology at the same rate as white men from high-income (top 20 percent) households, the rate of innovation in America would quadruple.”⁶ Studies have also found that even though women patent less than men, the quality and impact of their patents are equal to or exceed those of men.⁷

The number of women obtaining patents has improved, albeit slowly, over the past 40 years. The share of patents with at least one female inventor has increased from five percent in 1976 to 21 percent in 2016. However, it is important to note that the rate of increase in that trend has slowed since 1998, and that there has not been a comparable increase in patents granted to female-only teams.

Research shows that obtaining a patent is also tied to promotion and salary increases, so increasing the patent rate among women is critical to women moving into leadership roles across the board. For perspective, just 6.6 percent of Fortune 500 companies currently have a female CEO. Along with patents, diversity within an organization or team, including gender diversity, is associated with improved productivity, creativity, and increased profits.^{8 9 10} One of the best ways we can have diverse, higher performing innovation teams is to have more diverse innovators.

Further, patents are the foundation that help drive innovation in the United States. Recent research at MIT found that entrepreneurs who acquire patents and trademark protection were

⁴ Brookings Institute. “What’s Driving the Decline in the Firm Formation Rate? A Partial Explanation.” November 2014. By Ian Hathaway and Robert E. Litan. Available online: https://www.brookings.edu/wp-content/uploads/2016/06/driving_decline_firm_formation_rate_hathaway_litan.pdf

⁵ Inc. “American Entrepreneurship is Actually Vanishing. Here’s Why.” By Leigh Buchanan. May 2015. Available online: <https://www.inc.com/magazine/201505/leigh-buchanan/the-vanishing-startups-in-decline.html>

⁶ United States Patent and Trademark Office. Office of the Chief Economist. “Progress and Potential: A profile of women inventors on U.S. patents.” February 2019. Available online: <https://www.uspto.gov/sites/default/files/documents/Progress-and-Potential.pdf>

⁷ McMillan, G., Gender Differences in Patenting Activity: An Examination of US Biotechnology Industry, *Scientometrics*, 80, 683-691 (2009).

⁸ McKinsey & Company. “Why Diversity Matters.” By Vivian Hunt, Dennis Layton, Sara Prince. January 2015. Available online: <https://www.mckinsey.com/business-functions/organization/our-insights/why-diversity-matters>. Harvard Business Review. “Why Diverse Teams Are Smarter.” By David Rock and Heidi Grant. November 04, 2015. Available online: <https://hbr.org/2016/11/why-diverse-teams-are-smarter>.

⁹ Forbes “New Research: Diversity + Inclusion = Better Decision Making At Work”, Erik Larson, September 21, 2017, available online: <https://www.forbes.com/sites/eriklarson/2017/09/21/new-research-diversity-inclusion-better-decision-making-at-work/#532612474cbf>

¹⁰ Journal of Innovation: Organization & Management, 2013, “Gender diversity within R&D teams: Its impact on radicalness of innovation”, Cristina Díaz-García, [Angela González-Moreno](#), [Francisco Jose Sáez-Martínez](#), available online: <https://www.tandfonline.com/doi/abs/10.5172/impp.2013.15.2.149>

significantly more likely to achieve equity growth,¹¹ because patents are an important factor in an entrepreneur’s ability to seek venture capital. Founders who seek and acquire patents indicate strongly that they aim to create a high-growth, high-value company. In fact, high-growth ventures are responsible for 50 percent of job creation in the U.S.¹² Thus, if we agree that patenting is a strong indicator of high-growth business creation, and that high-growth, young firms create the most jobs in this country, then we necessarily must agree that patenting is critical to job creation, and ultimately economic growth.

The Patent Process: Barriers to Entry for Women

There are a few key reasons why women have struggled to gain ground in patenting, including systemic gender bias, an educational gap between women and men in patent-intensive fields, and a lack of access to mentoring and institutional resources, particularly in patent-intensive fields.

Starting with systemic gender bias, Jessica Milli, Study Director at the Institute for Women’s Policy Research in DC, says, “The reasons why women are so woefully underrepresented amongst patent inventors are complicated, but they likely mirror the challenges women face advancing in the workplace and – more specifically – in science, engineering and technology fields. Gender bias, societal expectations and challenging workplace environments have made it difficult for women to break into male-dominated STEM fields, many of which also happen to be the most patent-intensive.”¹³

We know from the USPTO report that women-only teams are less likely to apply for patents, more likely to be rejected in the patenting process, and are less likely to appeal when rejected.¹⁴ Gains in female participation in science, engineering, and entrepreneurship are not leading to broad increases in female patent inventors. This is despite the fact that women in the U.S. earn more than half of all academic degrees, from bachelors to doctoral degrees.¹⁵ Women are also racing to gender parity in STEM and entrepreneurship participation. For example, 39 percent of new entrepreneurs in 2016 were women; while in 2015, nearly half of all biological and life scientists were women. Overall, women made up 28 percent of the STEM workforce in 2015, and 40 percent of workers whose highest degree was in a science or engineering field.¹⁶

¹¹ NBER Working Paper No. 26073. “Passive Versus Active Growth: Evidence from Founder Choices and Venture Capital Investment. Christian Catalini, Jorge Guzman, Scott Stern. July 2019. Available online:

https://www.nber.org/papers/w26073?utm_campaign=ntwh&utm_medium=email&utm_source=ntwg18

¹² Journal of Economic Perspectives, Vol. 28, No. 3, Summer 2014, pgs. 3-24. Decker, Ryan; Haltiwanger, John; Jarmin, Ron; Miranda, Javier. “The Role of Entrepreneurship in U.S. Job Creation and Economic Dynamism.” Available online: <https://pubs.aeaweb.org/doi/pdfplus/10.1257/jep.28.3.3>.

¹³ Marketwatch “Why are just 12 percent of inventors with a U.S. patent women?”, March 8, 2019, available online: <https://www.marketwatch.com/story/just-12-of-american-inventors-with-a-us-patent-are-women-2019-02-15>.

¹⁴ Nature Biotechnology. Jensen, Kyle; Kovzeacs, Balázs; Sorenson, Olav. 05 April 2018. “Gender differences in obtaining and maintaining patent rights.” Summary available online: <https://insights.som.yale.edu/insights/why-do-women-inventors-win-fewer-patents>

¹⁵ National Center for Education Statistics. Table 318.10. Degrees conferred by post-secondary institutions, by level of degree and sex of student: Selected years, 1869-70 through 2027-28. Available online:

https://nces.ed.gov/programs/digest/d17/tables/dt17_318.10.asp?current=yes

¹⁶ National Science Board Science and Engineering Indicators 2018. Available online:

<https://www.nsf.gov/statistics/2018/nsb20181/report/sections/science-and-engineering-labor-force/highlights>.

Second, despite the growing number of women in STEM fields, the largest attainment gap between women and men is the number of women filing patents in patent-intensive fields, such as mechanical and electrical engineering. At Cornell University, where I teach, 50 percent of all undergraduate engineering students are women. But getting more women into STEM fields is not enough. Jennifer Hunt and team found that only seven percent of the gender gap in commercialized patents may be attributed to women's lower probability of having a STEM degree. The real gap comes from the rate of women involved in patent-intensive fields, such as electrical and mechanical engineering.

Further, the USPTO report suggests that women are pursuing patents at higher rates in academia and public research institutions than they are within private industry.¹⁷ Given that the vast majority of patents go to business and private industry, this presents a challenge to gender parity.¹⁸ According to a National Science Foundation (NSF) report, private sector companies received 85 percent of all patents granted to U.S. patent holders, individuals received nine percent of patents granted, and the academic sector received just four percent of patents.¹⁹ The evidence suggests, including at Cornell, that women are pursuing innovation and patents within academia—at public research institutions and as individuals—at higher rates than in private industry, therefore more attention should be focused on supporting potential women inventors and entrepreneurs outside of private industry.

The high cost of patenting is likely a reason why private industry is dominant in filing for and obtaining patents. While not representative of all companies, *Inc* magazine said, “IBM spends more than \$6 billion a year on R&D and has an in-house staff of more than 370 patent lawyers...and many large companies have recently spent billions buying up patent portfolios to protect them from lawsuits by other corporations.”²⁰ The cost of filing for and obtaining a patent (and defending one in some cases) is highly variable, but for individuals the costs can range from \$5,000 to more than \$20,000 depending on the complexity of the technology to be patented. For individuals, the cost almost always falls directly on the inventor. This presents an added burden for women inventors seeking patents in several systemic ways, including the wage disparity among genders, meaning they are less financially able to bear the costs of patenting. Further, fewer women receive venture capital or seed stage investment from any source – a challenge that acts as a barrier at all stages of the entrepreneurial journey. Women also bear a disproportionate share of the responsibility for child-rearing and in some cases the costs of childcare, further stressing their finances and ability to pursue the patenting process.

¹⁷ United States Patent and Trademark Office. Office of the Chief Economist. “Progress and Potential: A profile of women inventors on U.S. patents.” February 2019. Available online:

<https://www.uspto.gov/sites/default/files/documents/Progress-and-Potential.pdf>.

¹⁸ National Science Board: Science and Engineering Indicators 2018. Chapter 8: Invention, Knowledge Transfer, and Innovation. Appendix Table 8-1. Available online:

<https://www.nsf.gov/statistics/2018/nsb20181/report/sections/invention-knowledge-transfer-and-innovation/invention-united-states-and-comparative-global-trends>.

¹⁹ National Science Board: Science and Engineering Indicators 2018. Appendix Table 8-1.

²⁰ Inc. “How the Current Patent System Actually Hurts Inventors.” Nick Skillicorn. Aug. 31, 2016. Available online: <https://www.inc.com/nick-skillicorn/how-the-current-patent-system-actually-hurts-inventors.html>.

A 2019 brief published by economists at Moody’s Analytics calls childcare a “serious financial burden” for American families, and noted that childcare “crimps the ability of parents to work,” a fact that “weighs on the economy,” wrote the authors.²¹ Women inventors participating in entrepreneurship programs at Cornell have pointed to childcare costs as a key barrier to pursuing patenting, from the cost of childcare prohibiting them from devoting more time to developing their prototypes and technology, to the financial constraints posed by the balancing high cost of both patenting and childcare.

Third, existing research suggests that a lack of exposure to female patent inventor role models and mentors, particularly in fields that are more patent-producing intensive, is inhibiting the growth of female innovation, including limiting women’s ability to go after seed funding and venture capital.²² Exposure to innovation begets innovation – and research by leading economists has found that gender matters in that exposure.

Speaking from personal experience, my mother was an electrical engineer and constantly exposed me to STEM fields growing up. Her example created a pathway for me, which I hope to pass on to my daughter, who is here with me today. Active and engaged role models are critical to illuminating the path for women to engage in innovation, patenting, and entrepreneurship. According to one report “Who Becomes an Inventor in America? The Importance of Exposure to Innovation”, “women are more likely to invent in a given technology class if they grew up in an area with many female inventors in that technology class. Growing up around male inventors has no impact on women’s propensity to innovate.”²³

This is consistent with the USPTO finding that women inventors are increasingly concentrated in specific technologies and types of patenting organizations, suggesting that women are specializing where female predecessors have patented rather than entering into male-dominated fields or firms.²⁴ Lack of exposure to a network of inventors means that applying for a patent can be a daunting, seemingly insurmountable process. As a practical example, access to a network of investors is critical to securing venture funding, just as it is for applying for and obtaining patents. Lack of access to mentors, resources and a network similarly presents steep barriers to entry for women and minorities attempting to apply for and obtain patents.

Case Study: Sarah Reyes

To highlight some of the ways we can better support women applying for patents, the experience of one of our recent Ph.D. STEM graduates provides a good example.

²¹ Moody’s Analytics. “Universal Child Care and Early Learning Act: Helping Families and the Economy.” February 2019. By Mark Zandi, Chief Economist and Sophia Koropecykj, Managing Director. Available online: <https://www.economy.com/mark-zandi/documents/2019-02-18-Child-Care-Act.pdf>.

²² United States Patent and Trademark Office. Office of the Chief Economist. “Progress and Potential: A profile of women inventors on U.S. patents.” February 2019. Available online: <https://www.uspto.gov/sites/default/files/documents/Progress-and-Potential.pdf>.

²³ The Equality of Opportunity Project. “Who Becomes an Inventor in America? The Importance of Exposure to Innovation.” By Alex Bell, Raj Chetty, Xavier Jaravel, Enviana Petkova, and John Van Reenen. Available: http://www.equality-of-opportunity.org/assets/documents/inventors_summary.pdf

²⁴ United States Patent and Trademark Office. Office of the Chief Economist. “Progress and Potential: A profile of women inventors on U.S. patents.” February 2019.

Dr. Sarah Reyes developed a countertop breast milk pasteurizer and is in the process of filing for a utility patent. Dr. Reyes participated in a number of our programs at Cornell University and in Ithaca's community, including W.E. Cornell, and two other accelerator programs supported by funds from the National Science Foundation's I-Corps Site program—Cornell's eLab business accelerator, and Rev: Ithaca Summer Hardware Accelerator, whose founding was funded by the US EDA's i6 program. Through these programs, she was introduced to one of Cornell's Entrepreneurs-In-Residence who helped connect her to a patent attorney.

Dr. Reyes is currently in the patent application process, which will cost between \$4,000 and \$8,000 for the utility patent filing fee, a prior art search with attorney opinion, the legal fees surrounding preparing and submitting the utility patent application by a licensed patent attorney knowledgeable about the technology used in her product, and the USPTO fees. Dr. Reyes was awarded \$5,000 through the Cornell eLab accelerator which she will use to apply for her patent and cover the costs mentioned above. Without this, she said it would have been unlikely she would be able to cover the full cost of applying for her patent. She will be responsible for covering the balance of the patent cost beyond the \$5,000 in eLab funding she received.

Dr. Reyes has a 17-month old and two children in elementary school. Her childcare costs average \$2,000 a month, leaving her with few financial resources to pursue a patent. In speaking with her about her patent journey, she said, "Quite honestly, one of the biggest barriers I have as a woman in trying to get my invention off the ground is the burden of childcare, and the cost of childcare."

Dr. Reyes told us she was lucky because she was embedded in an ecosystem that helped facilitate connections, provided a network to patent attorneys, and gave her access to funds to file her patent. While this is an example of what success looks like, it also sheds light on a number of issues faced by women applying for patents. In general, the cost of filing a patent is highly variable, but is almost always too expensive for an individual to shoulder.

While the cost of childcare is not the only reason women face difficulties or are deterred from pursuing entrepreneurship and applying for patents, it is an example of hurdles adding to the real costs of pursuing entrepreneurship, innovation and patents. Many entrepreneurs, but parents in particular, have to make tradeoffs with both their time and their savings, producing seemingly insurmountable barriers to the patenting process. The high cost of patenting can act as a serious deterrent without the right connections to patent attorneys and resource support. This is further validated by a 2011 study which found that patenting rates for women academics with children are lower than men and women faculty without children, while male academics increase patenting activity with parenthood.²⁵

Policy Recommendations

1. Develop on-ramp programs dedicated to increasing women's and minority's exposure to the patent and commercialization process.

²⁵ Whittington, K.B., 2011. Mothers of invention? Gender, motherhood, and new dimensions of productivity in the science profession. *Work and Occupations*, 38(3), pp. 417-456.

2. Direct resources to sectors in which women are currently pursuing patents, as well as high volume patent-producing fields such as electrical and mechanical engineering.
3. Connect on-ramp program participants with resources at the university, community and federal level, including NSF, SBA, and EDA commercialization initiatives.
4. Integrate women and minority role models into programming.
5. Create structures and support for deliberately recruiting women and minorities into on-ramp and federal commercialization programs.
6. Expand existing cost reduction policies to include women and minority entrepreneurs.

First, we need to develop tailored on-ramp programs that are dedicated to increasing women's and minorities' exposure to the patent and commercialization process. At Cornell University, we developed W.E. Cornell, which is a cohort-based commercialization program to increase exposure and form a community of STEM-based women who are looking to learn the process for patenting and commercializing their innovations. We recruit women to join and we provide them with a series of workshops, programming and networking opportunities that improve their ability to navigate the commercialization process.

Programs like W.E. Cornell help increase the number of women and minorities pursuing patents and commercialization. In these tailored on-ramp programs, participants get exposed to the process of applying for patents along with other components of the commercialization process, and the programs provide direct access to funding, resources, and a network to support them. Similar to Dr. Reyes' example above, these newly proposed on-ramp programs can connect cohort members to trusted, vetted patent attorneys to help apply for patents and get through the process. I recommend the Small Business Administration (SBA) and USPTO consider a joint program which would create funds for these on-ramp programs specifically focusing on women and minorities. This program can be an outgrowth of the existing SBA Growth Accelerator or EDA i6 program, which provides funding for the nation's most innovative and promising small business accelerators and incubators.

Programs that focus specifically on increasing female and minority involvement in entrepreneurship and innovation are critical to increasing diversity in patenting. We also need to focus on building these programs in ecosystems that already have the foundation and resources to help inventors innovate, including but not limited to: academic R&D spending, supportive faculty, labs, and other infrastructure available at universities, and to fund programs in a diverse set of communities beyond the technology bubbles we see in the coastal United States. Federal dollars should be directed to communities outside of these technology bubbles to increase rates of commercialization and job creation more evenly across the United States.

Second, we need to focus on recruiting women and minorities to these on-ramp programs in academic sectors where we know women are pursuing patents – such as the life sciences – and increase exposure to patent-intensive fields, such as electrical and mechanical engineering, where women are currently in less numbers and find it more difficult to enter.

Third, these on-ramp programs should be feeders to existing entrepreneurship initiatives in the university, community or region. The entrepreneurship initiatives in the Upstate and Southern Tier regions of New York are based mainly at academic institutions and in community-based

business accelerators or incubators; they are largely supported by state funds and direct contributions from universities, as well as federal incubator and accelerator programs like the US Economic Development Administration's i6 program or the Small Business Administration's Growth Accelerator program. NSF also provides significant support through its I-Corps program for the commercialization of technology and cultivation of entrepreneurs in the academic space. By pairing these feeder programs with existing entrepreneurship initiatives, this does not cannibalize the number of women and minorities in the current programs, but, instead, helps existing programs further diversify, faster.

Pairing on-ramp programs with federal NSF Innovation or I-Corps programs – which are working to translate academic R&D from federally funded labs to the marketplace – has been successful at Cornell in supporting entrepreneurs in STEM to connect to Small Business Innovation Research (SBIR) grants. SBIR grants provide research and development funds to some of the best early-stage innovation concepts in small businesses, which are promising but too high risk for private investors. SBIR funds help bridge this funding gap to allow small businesses to reach technical and customer milestones, thus helping them to realize impact and obtain further follow-on investment. NSF has pointed to the I-Corps program as a significant contributing factor to successful SBIR applications, increasing the amount of seed-stage funding going to inventors and entrepreneurs in STEM. In 2019, entrepreneurs at Cornell supported by the Upstate New York I-Corps Node, won \$1.45 million in SBIR grants. As a result of the on-ramp program from NSF to SBIR pipeline, more women and minority entrepreneurs are gaining access to federal commercialization support.

Fourth, these targeted programs should contain role models who have recently obtained a patent to help guide aspiring entrepreneurs and inventors through the system. Ideally, peer role models have a similar background to the on-ramp cohort members and can help entrepreneurs overcome challenges of specific industries or domain areas. As noted earlier, gender and race-specific exposure to role models is necessary, and research supports its efficacy.

Fifth, there needs to be deliberate recruitment of women and other underrepresented entrepreneurs to these targeted on-ramp programs. Based on past initiatives and speaking with people leading entrepreneurship efforts in several locations across the country, I know from personal experience that we need to dedicate the time and resources to proactively and personally invite, meet, and encourage women to apply. Success of these on-ramp programs require dedicated program administrators actively seeking individuals by participating in research labs, attending faculty and lab meetings, and being a member of the community to invite women into supportive on-ramp programs. “If you build it, they will come” does not work – achieving the desired increase in diversity requires paid support for dedicated personnel to actively attract and recruit program participants. In addition, Congress should dedicate resources for on-ramp program administrators to study metrics and outcomes of these programs to inform and scale best practices and future policy recommendations.

Finally, the cost of applying for a patent is a significant deterrent for many women and minorities. Tailored programs and entrepreneurship initiatives should consider specific funding for patent support to cover the costs of applying for patents and hire the appropriate patent legal counsel. The USPTO currently has a graduated and reduced fee schedule for small entities and

micro-entities to defray the costs of patenting, which should be extended to women and minorities.

In conclusion, thank you again for the invitation to testify. I am deeply honored to be part of this conversation. Let's tackle this together to bring untapped talent into the innovation sphere, and ultimately bring more equitable and just economic prosperity across our nation. I would be happy to answer any questions you may have.