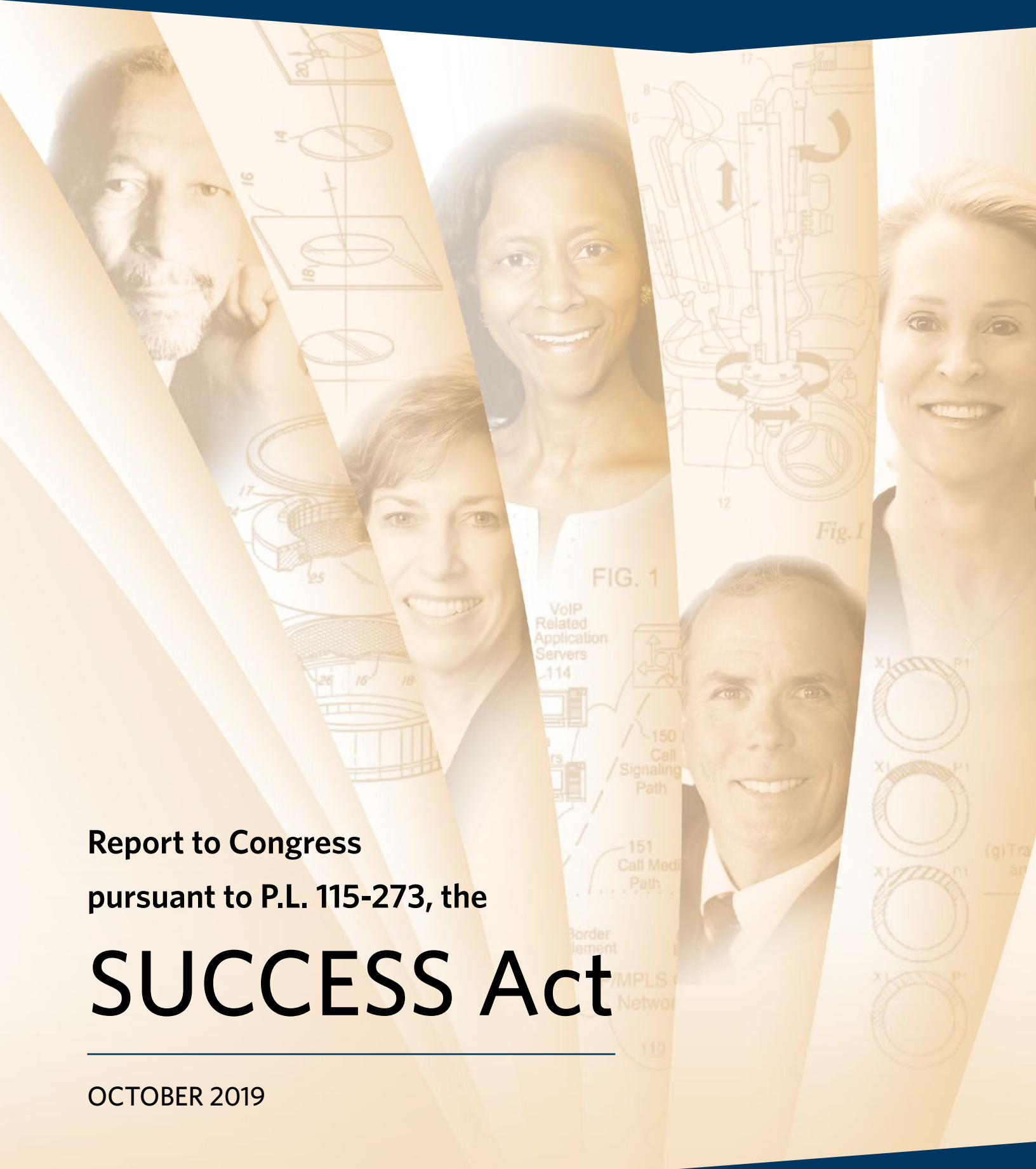

Report to Congress

pursuant to P.L. 115-273, the

SUCCESS Act

OCTOBER 2019

UNITED STATES
PATENT AND TRADEMARK OFFICE

uspto

The United States Patent and Trademark Office (USPTO) and the Small Business Administration (SBA) thank the hearing participants and members of the public who submitted written comments for their contributions of time and expertise to this study. The USPTO and the SBA also thank Dr. Neviana Petkova at the U.S. Department of Treasury, Dr. Michael Andrews at the National Bureau of Economic Research, Professor Lisa Cook at Michigan State University, and Professor Ufuk Akcigit at the University of Chicago for contributing data and expertise.

Inquiries concerning this report should be directed to the USPTO Office of Governmental Affairs at (571) 272-7300 or congressional@uspto.gov

Notable inventors featured on the cover

The front cover of this report highlights a few notable inventors and their patents who are represented in this report. From left to right:

- James E. West (U.S. Patent No. 3,118,022 for electret microphone)
- Ellen Ochoa (U.S. Patent No. 4,838,644 for optical systems for performing information processing)
- Marian Rogers Croak (U.S. Patent No. 7,715,368 for text-to-donate technology)
- Rory Cooper (U.S. Patent No. 9,254,234 for robotic strong arm)
- Frances Arnold (U.S. Patent No. 6,153,410 for directed evolution of enzymes)

Thank you to the National Inventors Hall of Fame, NASA, U.S. Department of Veterans Affairs, and Marian Rogers Croak for the use of these images.
Learn more at www.invent.org, www.nasa.gov, www.herl.pitt.edu, and www.witi.com.

Report to Congress | October 2019

Study of Underrepresented Classes Chasing Engineering and Science Success

SUCCESS Act of 2018

United States Patent and Trademark Office

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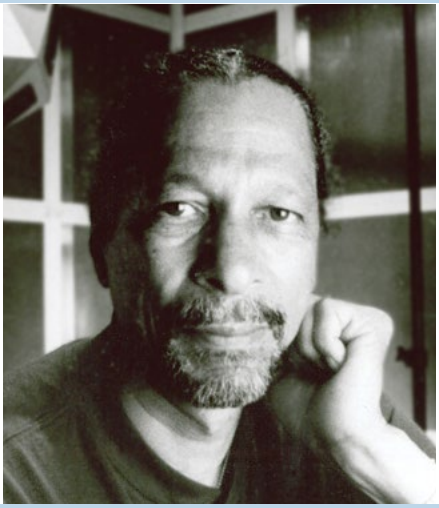
Executive summary

America's long-standing economic prosperity and global leadership in innovation depend on a strong and vibrant innovation ecosystem. To maximize the potential of the nation, it is critically important that all Americans have the opportunity to innovate, seek patent protection for their inventions, and reap the rewards from innovation through entrepreneurship and commercialization. This includes underrepresented groups based on demographic characteristics, geography, and economic conditions.

The Study of Underrepresented Classes Chasing Engineering and Science Success (SUCCESS) Act requires the Director of the United States Patent and Trademark Office (USPTO), in consultation with the Small Business Administration (SBA), to identify publicly available data on the number of patents annually applied for and obtained by women, minorities, and veterans and the benefits of increasing the number of patents applied for and obtained by women, minorities, and veterans and the small businesses they own. The USPTO is also required to provide legislative recommendations on how to encourage and increase the participation by these groups as inventor-patentees[1] and entrepreneurs.

U.S. Patent No. 3,118,022



James E. West

Electret microphone

In 1962, James West and Gerhard Sessler patented the electret microphone while working at Bell Laboratories. The microphone became widely used in everyday items such as telephones, hearing aids, and more because of its high performance, accuracy, and reliability, in addition to its low cost, small size, and light weight. A U.S. Army veteran, West is the recipient of over 200 U.S. and foreign patents.

Learn more at www.invent.org
Photo courtesy Bell Labs

To prepare this report, the USPTO reviewed available literature and input from the public, sought comments through a Federal Register Notice and held three public hearings. The literature review drew principally on peer-reviewed academic studies, as well as government reports and other academic literature analyzing, to the extent available, the participation of women, minorities, and veterans in the U.S. patent system. Nearly two hundred studies were initially identified through the literature search criteria, with about 50 studies cited in this report.[2] Thirty-six individuals and organizations provided oral comments at the public hearings. The USPTO also received 69 written comments in response to the Federal Register Notice.

Findings

The USPTO finds that there is a limited amount of publicly available data regarding the participation rates of women, minorities, and veterans in the patent system. However, the limited information that does exist, including the comments that the USPTO received, indicates that women and minorities are underrepresented as inventors named on U.S. granted patents.

The bulk of the existing literature focuses on women, with a very small number

1 Inventor-patentees are inventors who choose to pursue patent protection for their invention(s).
2 A full description of our literature search strategy is contained in Appendix B.

of studies focused on minorities, and only some qualitative historical information on U.S. veteran inventor-patentees. The most recent study, published by the USPTO in February 2019, focuses on women inventor-patentees and finds that women comprised 12% of all inventors named on U.S. patents granted in 2016. While the USPTO does not collect demographic information, it was able to infer the gender of inventor-patentees using a name-based attribution algorithm. No similar numbers are available for minorities or veterans. Overall, there is a need for additional information to determine the participation rates of women, minorities, and veterans in the patent system.

Applying for and receiving a patent confers many potential benefits to individual inventors and to the companies they own or work in. Inventor-patentees may experience personal benefits, including improved prestige, income and job-related opportunities. Applying for and obtaining a patent helps individuals and companies gain access to financial capital, find licensees, stimulate innovation, and facilitate growth. Some of these benefits are documented by empirical studies, but few studies characterize these benefits specifically for women, minorities, or veterans, or for the companies women, minorities, or veterans own.

This report also summarizes the literature regarding external factors faced by potential inventor-patentees in three broad areas: (1) social norms and education, (2) institutional norms and practices, and (3) resource availability and access.

Both the USPTO and the SBA have ongoing programs to help meet the needs of potential inventor-patentees and entrepreneurs, which are highlighted in this report. For instance, in the area of access to finance, the USPTO offers discounted fees to individuals and small firms and maintains a number of targeted programs such as the Pro Bono Program, the Law School Clinic Program, and the Pro Se Assistance Program. These programs demystify the patent application process by providing under-resourced inventors across the U.S. with opportunities to secure legal assistance for their patent needs. Likewise, the SBA maintains dedicated assistance through the Small Business Development Centers as well as such programs as the Federal and State Partnership (FAST) program and the Community Advantage pilot loan program.

USPTO initiatives

The USPTO conducts a robust array of programs and services geared toward individuals and small businesses from all backgrounds who are just getting started in inventing and patenting, many of which are described in this report. The USPTO plans to enhance and expand upon its existing programs and services in at least the following ways:

1. Collaborative intellectual property (IP) program
   While corporations are the largest patent filers, available evidence shows these organizations have some of the lowest participation rates for women inventor-patentees. To address this issue, the USPTO plans to create an IP toolkit for corporate employee inventors to help demystify the patent process and encourage greater participation.

2. Award program
   To recognize significant efforts by individuals and/or organizations in accelerating diversity among entrepreneurs, the USPTO plans to develop an award.

3. Creation of a council for innovation inclusiveness
   The USPTO plans to establish a council consisting of representatives from the general public, private corporations, academia, nonprofit organizations, and the U.S. government to help develop a national strategy for promoting and increasing the participation of underrepresented groups as inventor-patentees, entrepreneurs, and innovation leaders.

4. Expansion of USPTO educational outreach programs for youth and teachers
   The USPTO will continue and expand its programs and partnerships to promote entrepreneurship and innovation in science, technology, engineering, and math (STEM) fields through resources, activities, or other mechanisms for engagement with youth such as after-school programs, partnerships with libraries or other community-based organizations.

5. Workforce development
   The USPTO plans to work with other relevant agencies to help develop workforce training materials with information on how to obtain a patent, and the importance of invention and IP protections, for inclusion in the administration's workforce development training initiative. These materials support the Trump Administration's efforts through the National Council for the American Worker to equip America's students and workers to compete and win in the global economy.

6. Increase professional development IP training for educators
   The USPTO will work with appropriate federal agencies to partner in developing training materials to help elementary, middle, and high school teachers incorporate the concepts of invention and IP creation and protection into classroom instruction.

Legislative recommendations

Pursuant to the requirements of the SUCCESS Act, the USPTO submits the following legislative recommendations for increasing the participation of women, minorities, and veterans as inventor-patentees and entrepreneurs:

1. Enhance USPTO authority to gather information
   Currently the USPTO collects the full name, residence, and mailing address of each inventor-patentee; it does not collect demographic information. To help address the dearth of information on the participation of women, minorities, and veterans as inventor-patentees, Congress could authorize a streamlined mechanism for the USPTO to undertake a voluntary, confidential, biennial survey of individuals named in patent applications that have been filed with the USPTO.

   In so doing, care must be exercised to avoid the perception that demographic or other personal information might be used in the examination of patent applications, which could discourage underrepresented groups from filing and obtaining patents in the first place.

2. Enhance authority for federal interagency data sharing and cooperation
   To address the lack of information on the participation of women, minorities, and veterans as inventor-patentees, Congress could encourage the sharing of federal data and support enhanced cooperation among the USPTO and other federal agencies.

3. Expand the purposes/scopes of relevant federal grant programs
   To encourage more participation by women, minorities, and veterans, Congress could expand the authorized uses of grants and funds in appropriate federal programs to include activities that promote invention and entrepreneurship, as well as the protection of inventions and innovations using intellectual property among underrepresented groups.

4. Create a commemorative series of quarters and postage stamps to be placed in circulation
   To increase the nation's awareness of invention, Congress could authorize the creation of a set of innovation quarters and postage stamps to be released into circulation that feature a spectrum of American inventor-patentees from a variety of backgrounds, including those from underrepresented groups.

5. Support exhibits at national museums featuring inventors/entrepreneurs
   Congress could encourage national museums to feature exhibits that highlight the contributions to U.S. invention and entrepreneurship by individuals from underrepresented groups.

Introduction

> In today's highly competitive global economy, it's more important than ever that all Americans who are willing to work hard, persevere, and take risks have the opportunity to innovate, to start new companies, to succeed in established companies, and ultimately, to achieve the American dream. To maintain our technological leadership, the United States must seek to broaden our intellectual property ecosystem demographically, geographically, and economically."
>
> ***— Andrei Iancu***
>
> Under Secretary of Commerce for Intellectual Property and Director of the United States Patent and Trademark Office

America's long-standing economic prosperity and global leadership depend on a strong and vibrant innovation ecosystem. As a central institution in this ecosystem, the United States Patent and Trademark Office (USPTO) plays an important role in shaping the nature and extent of America's future prosperity. Likewise, the Small Business Administration (SBA) further helps to fuel innovation for America's small businesses. To maximize the potential of the nation, it is critically important that all Americans have the opportunity to innovate, seek patent protection for their inventions, and reap the rewards from innovation through entrepreneurship and commercialization.

Innovation in the United States is highly concentrated, and vast swaths of our population are not fully participating. This includes underrepresented groups based on demographic characteristics, geography, and economic conditions. A recent study of more than one million inventor-patentees shows that, among women, minorities, and individuals from low income families, there are many "lost Einsteins"—that is, high-ability individuals who would have contributed valuable inventions had they been exposed to invention and innovation as children (Bell et al. 2019). The findings indicate that increasing the rate of invention by women, minorities, and individuals from low-income households, could quadruple the total number of inventor-patentees[3] in America.

The Study of Underrepresented Classes Chasing Engineering and Science Success Act of 2018, or the "SUCCESS Act," directs the Under Secretary of Commerce for Intellectual Property and Director of the U.S. Patent and Trademark Office, in consultation with the Administrator of the SBA, to prepare a report that:

1. identifies publicly available data on the number of patents annually applied for and obtained by women, minorities, and veterans,

2. identifies publicly available data on the benefits of increasing the number of patents applied for and obtained by women, minorities, and veterans and the small businesses owned by women, minorities, and veterans,

3. provides legislative recommendations for how to promote the participation of women, minorities, and veterans in entrepreneurship activities, and to increase the number of women, minorities, and veterans who apply for and obtain patents.

In response to the SUCCESS Act, the USPTO implemented an extensive outreach strategy to engage the public and collect information. A Federal Register Notice was issued on April 26, 2019, requesting public comment on a variety of issues including, but

3 Inventor-patentees are inventors who choose to pursue patent protection for their invention(s).

not limited to, the availability of public data on the demographics of U.S. inventor-patentees, and the benefits of increasing the participation of women, minorities, and veterans as inventor-patentees and entrepreneurs.[4] Members of the public had the opportunity to provide oral comments at three public hearings that took place in May and June at locations in California, Michigan and Virginia.[5]

Thirty-six individuals and organizations provided oral comments. The public also had the opportunity to submit written comments by June 30, 2019. The USPTO received 69 written comments. Further, to facilitate public participation, the USPTO developed webpages to describe the requirements of the SUCCESS Act; to provide registration and related information to support the public hearings and written comments; and to communicate the oral and written responses to the public through links to video recordings, transcripts, and the written comments.[6]

The USPTO outreach and study process involved a number of other components including social media posts, consultations with USPTO organizations associated with underrepresented groups, direct communications to stakeholders through mailing lists such as the recipients of the Patent Alert service, which includes over 43,000 subscribers, and direct engagement with researchers. For instance, Dr. Lisa Cook of Michigan State University and Dr. Michael Andrews of the National Bureau of Economic Research presented their work on inventor-patentee demographics at the USPTO's Visiting Speaker Series, and consulted with USPTO staff. The USPTO also initiated contact with other federal agencies, such as the U.S. Department of Treasury and the Department of the Army, to explore supplementary sources of data and findings.

In addition to the outreach strategy, the USPTO completed a comprehensive survey of peer-reviewed academic studies, government reports, and other academic literature on the demographics of inventor-patentees. This survey identified about 50 studies cited in this report.[7]

U.S. Patent No. 4,838,644

Ellen Ochoa

Optical systems for performing information processing

Ellen Ochoa, a veteran of three NASA Space Shuttle flight missions and the first Hispanic-American woman in space, is a co-inventor on three patents for an optical inspection system, an optical object recognition method, and a method for noise removal in images. Her inventions significantly increased the ability to capture and analyze finely detailed imagery. She was the 11th director of the Johnson Space Flight Center.

Learn more at www.nasa.gov
Photo courtesy NASA

4 The Federal Register Notice is available at www.federalregister.gov/documents/2019/04/26/2019-08437/request-for-comments-and-notice-of-public-hearings-on-the-report-required-by-the-study-of.

5 The public hearing events took place at the USPTO headquarters in Alexandria, Virginia, USPTO Midwest Regional office in Detroit, Michigan, and the USPTO Silicon Valley Regional Office in San Jose, California.

6 www.uspto.gov/successact

7 Appendix B provides a description of the literature review procedure undertaken to identify the studies that make up the main body of this report.

Section 1: Diversity among U.S. inventor-patentees

The SUCCESS Act asks the Director of the USPTO to identify publicly available data that show the number of patents annually applied for and eventually granted to women, minorities, and veterans. This section addresses this request in three subsections. The first subsection clarifies the scope and meaning of the terms used in the Act, such as "data" and "minority." The second subsection describes the sources of public data on the demographic characteristics of inventors named on patents. The final subsection summarizes the current evidence on the participation of women, minorities, and veterans as inventors named on patent applications or grants.

Scope and meaning of terms

While patenting takes place in many jurisdictions around the world, the focus of this report is on patents applied for and obtained from the USPTO. The USPTO receives patent applications and grants U.S. patents to inventors who reside in the United States, its territories, and to inventors who reside in foreign nations. Consistent with the Sense of Congress described in Section 2 of the SUCCESS Act, this report will focus on women, minority, and veteran inventor-patentees who reside in the United States or one of its territories.

The SUCCESS Act requests "publicly available data" as the relevant sources of information. For the purposes of this report, data are defined as a collection of quantitative or qualitative values. This definition is consistent with the glossary from www.data.gov, which is an online repository for federal data managed by the U.S. General Services Administration.[8] Data.gov also helps to clarify the meaning of the qualifier "publicly available" as data available without any restrictions or conditions. The interpretation of publicly available data applied here excludes datasets that are proprietary as well as datasets that require a fee to access and/or use.

The focus of the SUCCESS Act is on "women, minorities, and veterans." In the literature, minority groups are not well defined. Some authors use the mandated U.S. Federal statistical reporting categories for race and ethnicity and others do not.[9] When reporting findings, this report follows the minority group designations used by the authors of the particular study reviewed.

Publicly available data from the USPTO

As part of its operations, the USPTO collects and publicly disseminates large volumes of data and information on patent applications, examination practices, granted patents, as well as post-grant events and outcomes. However, the USPTO does not collect or use demographic data on inventor-patentees during its examination processes or post-grant proceedings. Typically, the USPTO requires only the legal name, residence, and mailing address of the inventor-patentee or each joint inventor-patentee (see 35 U.S.C. § 115 and 37 C.F.R. §§ 1.63 and 1.64).

Without paying any fee, the public can access and download a variety of datasets on patents and trademarks from three USPTO-sponsored sources. First, the Office of the Chief Economist provides freely downloadable "research ready" datasets with accompanying working papers that provide extensive descriptions and guidance to assist users.[10] Second, the USPTO's "Open Data Portal" webpage offers a wide variety of links to patent and trademark data that can be accessed through an application programming interface (API) catalog or as bulk downloads.[11] The Open Data Portal provides an open platform of visualizations composed of multiple data sources, such as economic data, and Open Analytics functionality. Third, the Office of the Chief Economist supports PatentsView, a public-private partnership offering a

8 www.data.gov/glossary

9 The 1997 standards for statistical reporting issued by the U.S. Office of Management and Budget, Office of Information and Regulatory Affairs, can be found at obamawhitehouse.archives.gov/omb/fedreg_1997standards

10 www.uspto.gov/learning-and-resources/ip-policy/economic-research/research-datasets

11 developer.uspto.gov

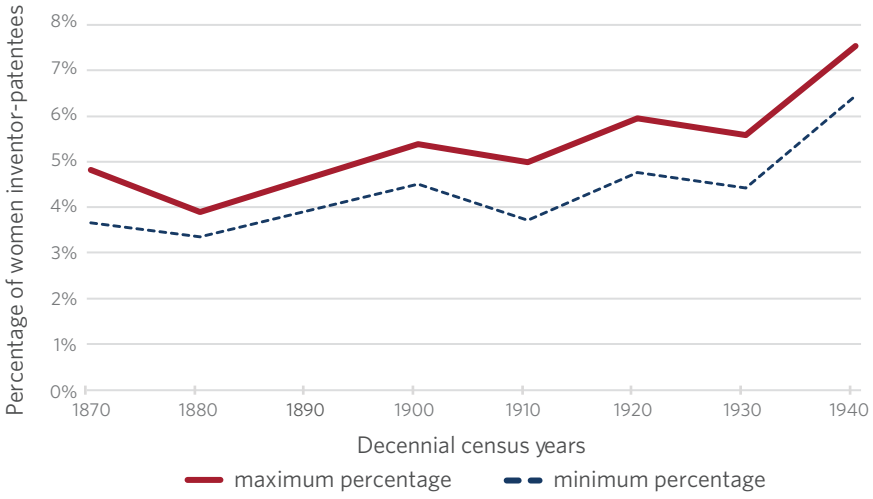
web-enabled data visualization and analytics platform for granted patents.[12] PatentsView uses a sophisticated computer algorithm to assign unique identifiers to individual inventor-patentees, assignees at grant, and locations.[13] Along with other information, these data can be obtained through a query tool, an API, or as bulk downloads. PatentsView is the only source of free, easy-to-access, publicly available data containing some demographic information on inventor-patentees. Following the publication of the USPTO report "Progress and potential: A profile of women inventors on U.S. patents," the Office of the Chief Economist released the data that inferred an inventor-patentee's gender using a name-based algorithm on PatentsView. Those data can be downloaded without a fee.[14]

Evidence on diversity among U.S. inventor-patentees

To characterize the demographic diversity of U.S. inventor-patentees using the administrative records from the USPTO, one must combine the information on inventor-patentee name and location with other data sources. Researchers and analysts have used four approaches to collect or infer demographic information about inventor-patentees: (1) linking USPTO data to other data sources that contain demographic information; (2) using specialized data sources to infer an inventor-patentee's gender from USPTO data; (3) directly surveying inventor-patentees; and (4) collecting information from historical narratives.

There is only limited publicly available evidence on the participation of women, minorities, and veterans as inventors named on patents. The existing evidence is based on one or more of the above methods. As described below, the largest body of available evidence relates to women inventor-patentees. For minorities, only a handful of studies are available that discuss African American inventor-patentees, with some other minority groups mentioned occasionally. Similarly, our literature search did not find any studies describing the number or characteristics of veterans who have applied for or obtained a patent from the USPTO.

Figure 1: Share of women inventors on U.S. granted patents (1870-1940)



(Source: Sarada et al. 2019)

12 www.patentsview.org/web/#viz/relationships
13 An "assignee at grant" is the entity listed as the owner of the patent at the time the patent was issued.
14 The data are available for bulk download at www.patentsview.org/download/.

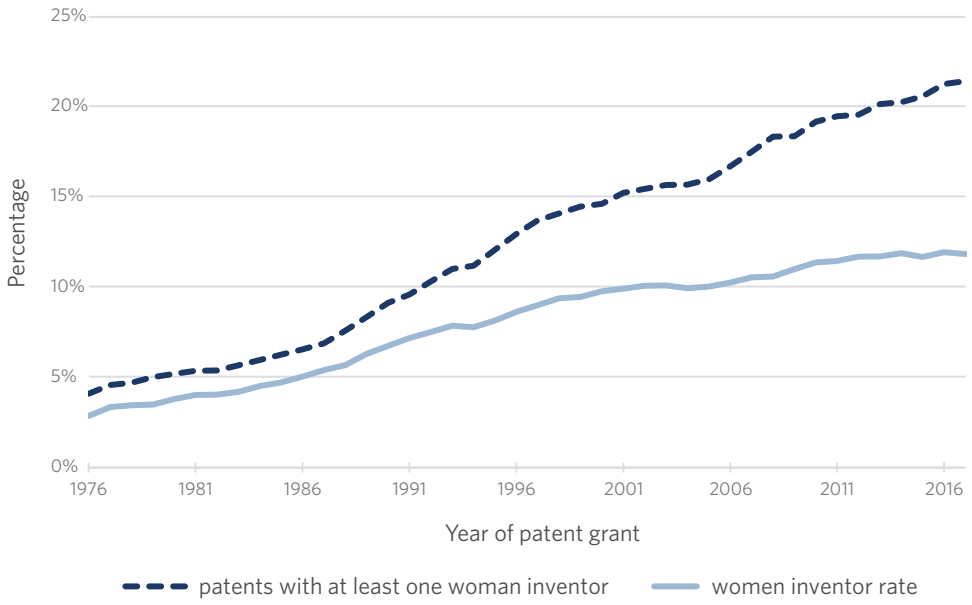
Women inventor-patentees

Information on the trends in patenting among women is available for two distinct periods. For the historical period of 1870–1940, Sarada et al. (2019) match the names of inventors listed on the *Annual Report of the Commissioner of Patents* to demographic information on individuals who participated in the U.S. Decennial Census. Due to measurement inaccuracies, the percentage of women inventor-patentees in this period should be seen as falling in a range from "minimum" to "maximum." Using this range, Figure 1 shows that women comprised between 4 and 5% of the inventor-patentees in 1870 and that participation increased to between 6 and 8% by 1940.

Building on prior work, the USPTO's Progress and Potential report uses specialized databases to infer an inventor-patentee's gender from the individual's name. For the 40-year period from 1976 through 2016, Figure 2 shows two trend lines, each representing an alternative metric for gauging the participation of women as inventors named on U.S.-granted patents. The light blue lower trend shows the annual percentage of women among all USPTO inventor-patentees, called the "women inventor rate." The women inventor rate reveals that the participation of women increased over this 40-year period, rising from just over 3% in 1976 to about 12% by 2016.

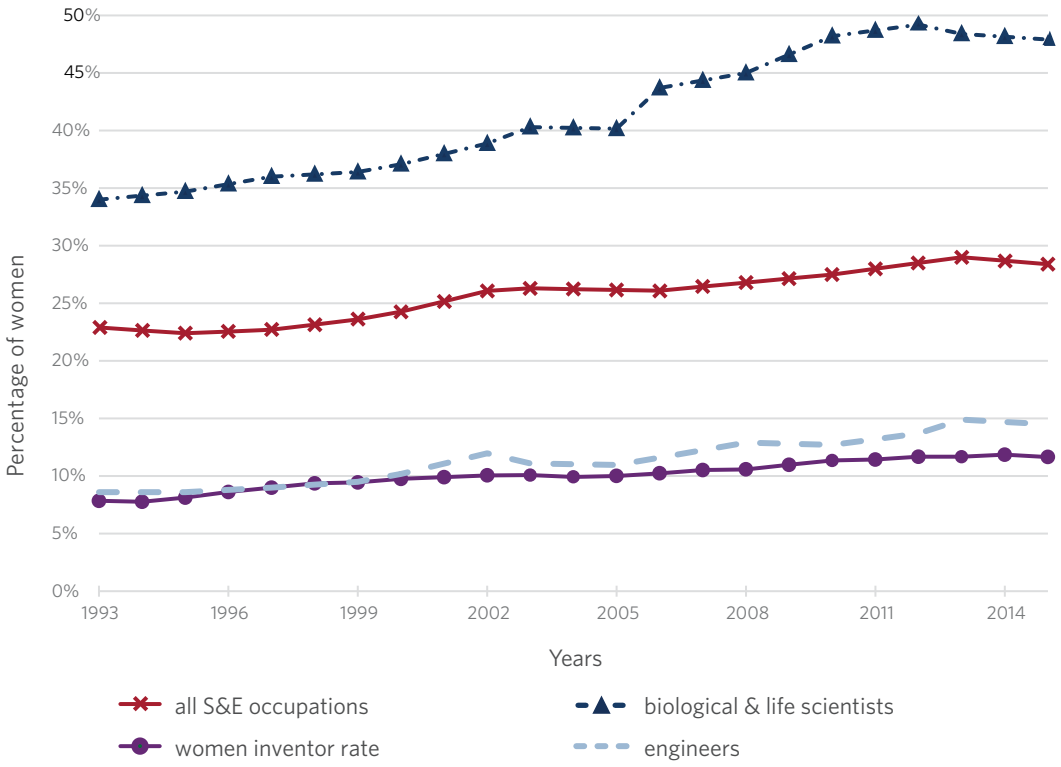
The women inventor rate characterizes participation by counting people, whereas the other metric in Figure 2 characterizes participation by counting the number of granted patent documents with a female inventor. The dark blue dashed line shows the number of patents with at least one woman inventor. Using this metric, women were inventors on about 4% of the patents granted in 1976, with this percentage increasing to 21% by 2016. Further analysis in the USPTO's Progress and Potential report shows that women are entering the patent system predominantly by joining teams of male inventor-patentees. While the trend is positive, it highlights the critical importance of how inventor teams are selected by the organizations involved in patenting, particularly private companies, which are the largest patent-filing entities.

Figure 2: Share of women inventors on U.S. granted patents (1976-2016)



(Source: USPTO 2019)

Figure 3: Women inventor-patentees compared to women in science and engineering occupations



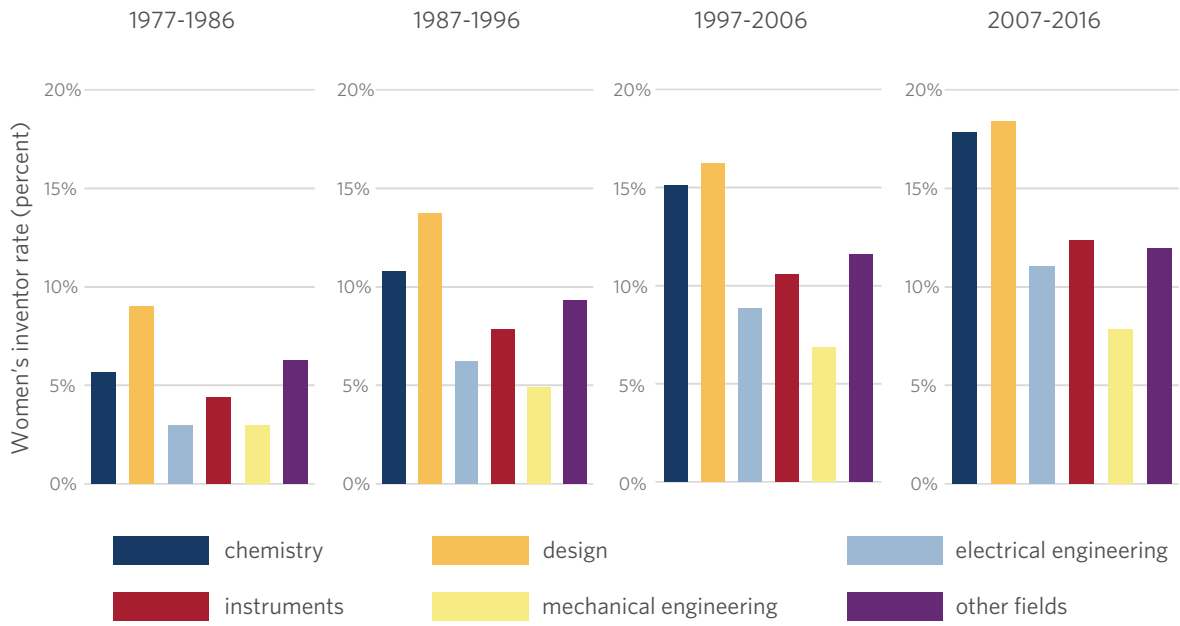
(Source: USPTO 2019)

Historically, science and engineering (S&E) fields produce the most patentable inventions (Marco et al. 2015). Naturally, when fewer women pursue careers in S&E fields, they will make up a smaller share of inventor-patentees. Figure 3 compares the women inventor rate with the percentage of women in S&E occupations based on periodic national surveys. In 2015, women made up about 28% of the total S&E work-force (all S&E occupations shown by the red solid line with "x" tick marks in Figure 3), but only 12% of inventors named on granted patents (women inventor rate as shown by the purple solid line with "circle" tick marks in Figure 3). Across nearly all science occupations, women participate at a much higher rate than they appear as inventor-patentees. It is only in engineering that women's workforce participation rate (the dashed light blue line in Figure 3) resembles the overall women inventor rate.[15]

The participation of women as inventor-patentees is also uneven across technology fields. Figure 4 presents the women inventor rate across broad technology categories for each of the past four decades. Although the female share of inventor-patentees has increased over time in each sector (moving from left to right), there is considerable variation in growth patterns. Women's inventor-patentee participation has improved the most in chemistry and design patents. While women accounted for only 6% of inventors named on chemistry patents issued 1977–1986, they comprised roughly 18% in the last decade (2007–2016). Within chemistry, certain subcategories exhibit even higher women inventor rates. In 2016, for example, women accounted for more than one-fifth of inventors granted patents in biotechnology (25% women inventor rate), pharmaceuticals (23%), and organic fine chemistry (21%).

15 This is consistent with the findings of Hunt et al. (2013), IWPR (2016), and Delgado et al. (2018).

Figure 4: Women inventor rate by technology sector



(Source: USPTO 2019)

Figure 4 also shows that women's participation on patents in instruments and electrical engineering has improved, but to a lesser extent.[16] Women comprised only 12% and 11% of inventors named on patents in instruments and electrical engineering, respectively, in the 2007–2016 decade. Among mechanical engineering patents, where inventor-patentees are the most disproportionately male, there has been the slowest improvement in women's participation. The female share of inventors named on such patents was 3% in the 1977–1986 decade and only reached 8% in the last decade observed.

Ashcraft and Breitzman (2012), who updated an earlier study of patenting in information technologies (IT), find that the share of IT patents with at least one female inventor increased. Their previous article showed a 9% share for the earlier study period covering 1980 to 2005 and a 13% share for the updated study period from 1980 through 2010. Since the overall number of IT patents increased dramatically over the period, the increase in female patenting (total patents) represents a 25-fold increase. The authors also adjusted their counts of patents using "forward citations" to help account for the large variation in economic value across patents.[17] This adjustment suggests diverse teams in IT patenting produce the most valuable inventions.

Bell et al. (2019) find that women are more likely to be inventor-patentees in a particular technology if they grew up in an area where women lived who had patents in that technology. Interestingly, women were not more likely to invent in a technology if raised in an area with more male inventors who patented in the same technology. This result suggests that early exposure to same gender inventor-patentees is important for determining whether an individual becomes an inventor-patentee.

Previous studies found that women are more likely to be inventors on patents granted to public or nonprofit organizations because they offer more opportunities to women than private firms (Sugimoto et al. 2015; Martinez et al. 2016). When a patent is granted, a company, university, or other entity is assigned ownership and is identified as the "assignee" of the patent.

16 Instruments includes technologies related to optics, measurement, analysis of biological material, control, and medical technology. See the USPTO 2019 report Progress and Potential for more detail.

17 Forward citations are future citations by patent applicants and USPTO examiners to the focal patent and have been shown to be positively correlated with indicators of economic value (see Jaffe and de Rassenfosse 2017 for a review).

The female share of inventor-patentees is trending up across assignee types, but universities and hospitals and public research organizations show the largest and most continued improvement (USPTO 2019).

However, even within public research organizations, there appear to be significant institutional factors that limit the participation of women in patenting and commercialization. Azoulay et al. (2007) find female faculty patent at half the rate of male faculty. Part of this difference may arguably be due to women spending less time on research in academic settings and, in certain fields, more time on teaching (Blume-Kohout 2014). Ding et al. (2006) find that female life science faculty patent at a much lower rate than males, and suggest that reduced exposure to commercialization or the belief that commercialization may hinder their university careers are potential reasons for the patenting gap. Murray and Graham (2007) suggest that lower faculty patenting by women may stem from a lack of opportunity, which further leads to lower socialization and knowledge about commercialization in the academy. Despite this, greater equality in mentoring and institutional resources directed toward female faculty may reduce the gap (Murray and Graham 2007; Delgado and Murray 2019). Finally, children may affect faculty differently. Whittington (2011) finds that patenting rates for women academics with children are lower than men and women faculty without children, while male academics increase patenting with parenthood.

While the women inventor rate on patents granted to businesses is persistently the lowest, it has climbed from only 4% in the 1977–1986 period to 12% in the last decade (USPTO 2019). Overall, women inventor-patentee participation is improving, but most of the growth is in the technologies and organizations where women have historically been more likely to innovate. Such trends suggest that women are specializing in technology fields and sectors where female predecessors have patented before, rather than entering into male-dominated fields or firms. Whittington and Smith Doerr (2008) find that women are more likely to patent in biotechnology organizations, and suggest that organizational structure may drive the difference. Since businesses account for the majority of patenting in the United States, expanding women's participation in innovative activity within businesses is especially important to improving the women inventor rate.

U.S. Patent No. 9,254,234

Rory Cooper

Robotic strong arm

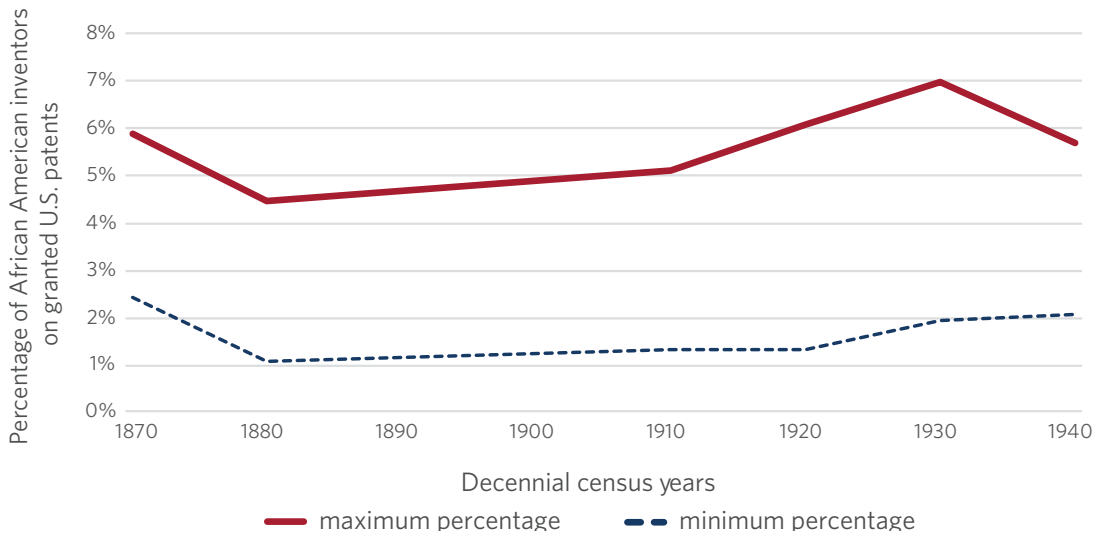
Rory Cooper is a distinguished professor of rehabilitation engineering at the University of Pittsburgh and a senior career scientist for the U.S. Department of Veterans Affairs. His team has developed over 100 inventions and holds 25 patents, ranging from advanced wheelchair design and robotic devices to seat cushions and wearable instruments for people with disabilities and military veterans. He served in the U.S. Army and was paralyzed from the waist down at age 20.

Learn more at www.herl.pitt.edu
Photo courtesy U.S. Department of Veterans Affairs

Minority inventor-patentees

Despite several impediments, including the lack of financing for development and commercialization of inventions, African Americans have participated as inventor-patentees in nearly every technical field, particularly after the Emancipation Proclamation of 1863 (Baker 1917). However, based on matching names from records of inventors on patents to decennial census records, it is clear that the rate of African American participation as inventor-patentees was low and unchanging in the 70 years from 1870 to 1940. Figure 5 shows that African Americans comprised between 1% and 7% of the inventor-patentees from 1870 to 1940 (Sarada et al. 2019).

Figure 5: Share of African American inventors on granted U.S. patents



(Source: Sarada et al. 2019)

Cook (2011), studying African American inventor-patentees between 1843 and 1930, finds that social capital was important for inventive activity.[18] Yet even the most successful African American inventor-patentees were not able to accumulate large amounts of traditional social capital. Cook (2011) suggests that segregation laws reduced the social capital of African American inventors and depressed economic activity. Conversely during the period from 1870 to 1940, the development of Historically Black Colleges and Universities (HBCUs) increased African American representation in patenting in the locality containing the HBCU, mainly through the channel of drawing African American inventors to the local community (Sarada et al. 2019).

Despite lower inventive activity, Cook and Kongcharoen (2010) find that African Americans are just slightly less likely to commercialize their patented inventions than all U.S. inventor-patentee (77% of inventions commercialized compared to 80% for all U.S. inventor-patentees). Additionally, Cook and Kongcharoen (2010) find that mixed-gender teams are more likely to produce patents that are commercialized.

In other research, Nager et al. (2016) examine the demographic characteristics of inventors who filed "valuable" patent applications as well as innovators listed on *R&D Magazine*'s R&D 100 Award.[19] They surveyed individuals who resided in the United States at the time of patent application filing or R&D award, spanning the years 2011 to 2015. Table 1 shows their survey results on the ethnicity of U.S.-born innovators (column 2) as compared to the overall ethnicity breakouts of U.S.-born Americans (column 3).[20] Their survey shows that Blacks or African Americans and Hispanics born in the U.S. are significantly underrepresented among innovators. For instance, Blacks or African Americans represent 11.3% of U.S.-born Americans and only 0.3% of the innovators who responded to their survey. Asians are slightly underrepresented. On the other hand, White and Native Americans are represented at a rate similar to their overall representation in the U.S.-born population.

18 Social capital is the accumulation of professional and personal networks that facilitate invention, patenting, and commercialization opportunities and outcomes.

19 Valuable patent applications are defined to be "triadic patent applications" — that is, patent applications on the same invention filed in three jurisdictions, specifically patent applications applied for at the USPTO, the European Patent Office, and the Japanese Patent Office.

20 Reproduced from Table 7, page 24 of Nager et al. (2016). Note that the bottom row showing the total percentage of U.S.-born for innovators and for the U.S. population are less than 100%. This occurs because not all innovators or people who reside in the U.S. were born in the U.S.

Table 1: Ethnicity shares for the U.S.-born population and U.S.-born innovators

Ethnicity of U.S.–Born Innovators	Percent of Innovation Sample	Percent of United States Population	Rate of Representation
White	59.6%	59.2%	1.0
Asian	1.5%	1.8%	0.8
Black or African American	0.3%	11.3%	0.0
Hispanic	1.4%	11.5%	0.1
Two or More Races	0.9%	1.9%	0.5
Native American	0.9%	0.9%	1.1
Total U.S.-born	**64.5%**	**86.5%**	**0.7**

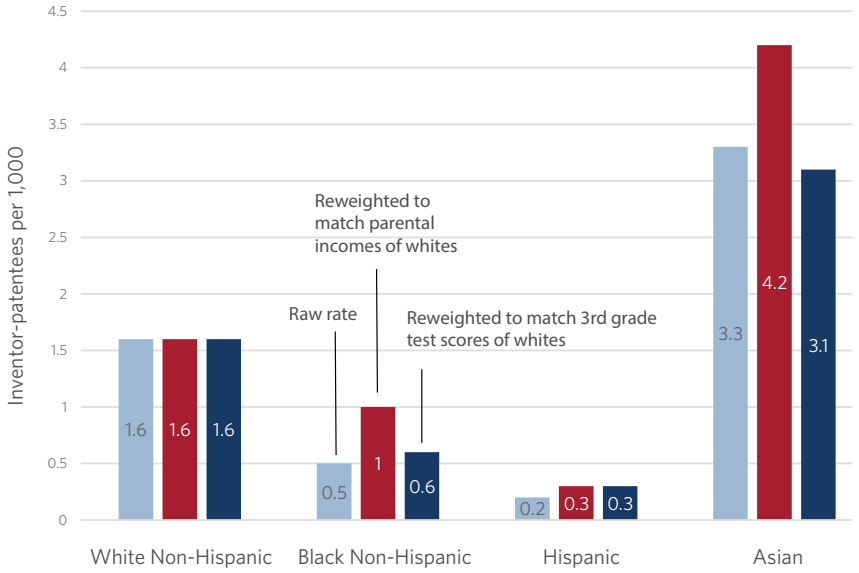
(Source: Nager et al. 2016)

Bell et al. (2019) find that observed gaps in patenting rates between Whites and racial/ethnic minorities cannot be explained by differences in parental income or performance on school tests. As shown in Figure 6, for each group, the first bar is the raw inventor-patentee rate per thousand population in their sample. The second bar is the expected inventor-patentee rate per 1,000 population if the group had the same parent income as the White/non-Hispanic population in their sample. Finally, the third bar is the rate if the group had the same 3rd grade test scores as White/non-Hispanics. From the figure, both parent income and 3rd grade test scores explain only part of the gap for Black/non-Hispanics and Hispanics. Asian Americans have far higher inventor-patentee rates than all groups displayed. The authors suggest that the observed gaps are more likely to reflect differences in exposure to innovation in childhood.[21]

Veteran inventor-patentees

Our literature search did not reveal any studies on the participation of U.S. veterans as inventor-patentees on applications or granted patents.

Figure 6: Patent rates by race and ethnicity



(Source: Bell et al. 2019)

21 The data displayed represent a specialized sample created by linking U.S. inventor-patentees to their U.S. tax records and to their school records. The school records were only available for a subgroup of inventor-patentees who attended New York City schools. See Bell et al. (2019) for details.

Section 2: Benefits from patenting

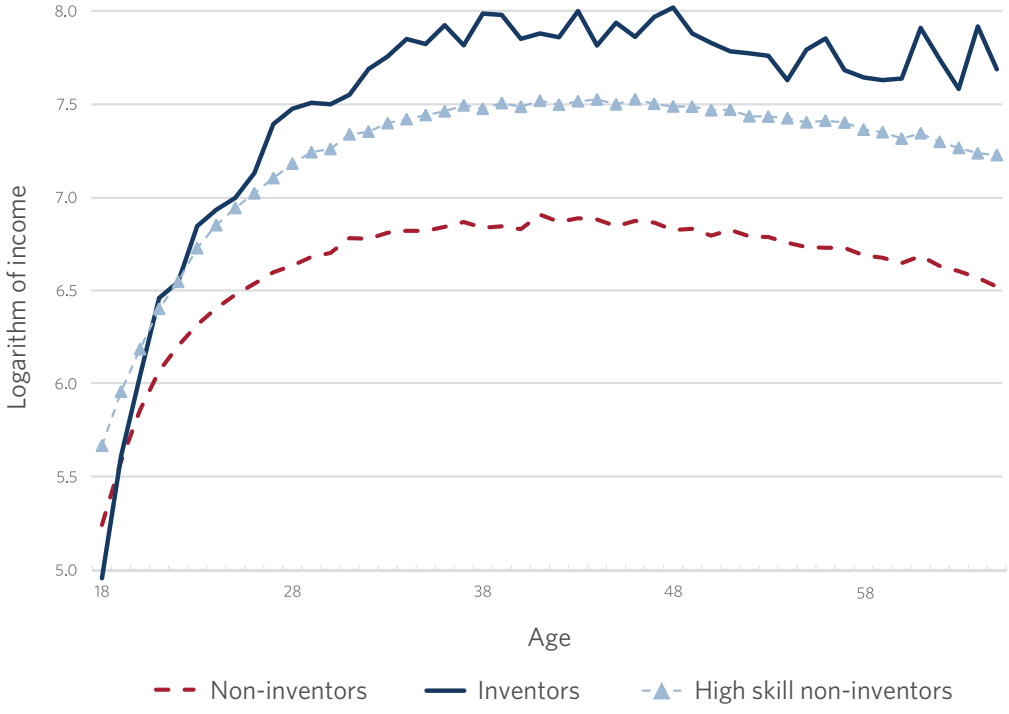
The SUCCESS Act requests the Director of the USPTO to identify publicly available data on the benefits of increasing the number of patents applied for and obtained by women, minorities, and veterans and the benefits to the small businesses owned by women, minorities, and veterans. This section addresses these requests in two subsections. The first subsection focuses on the potential benefits that may accrue to individual inventors from applying for and obtaining a patent. The second subsection focuses on potential benefits that may accrue to the companies owned by women, minorities, and veterans from applying for or obtaining patents.

Potential benefits to individual inventor-patentees

Inventors who apply for and receive a patent may experience a wide range of personal benefits, including heightened prestige, increased income and job promotions, new job opportunities, and increased professional networks. Akcigit et al. (2017) match inventor-patentees to historical Census data to study the relationship between age, patenting, and income. They find that inventor-patentees have higher incomes. Importantly, the relationship persists even after removing the influence of occupation, migrant status, and a variety of other characteristics. Figure 7 plots the lifetime earning profiles for inventor-patentees, high-skill non-inventors, and other non-inventors. Starting after age 25, wages for inventor-patentees (the dark blue line) are always greater.

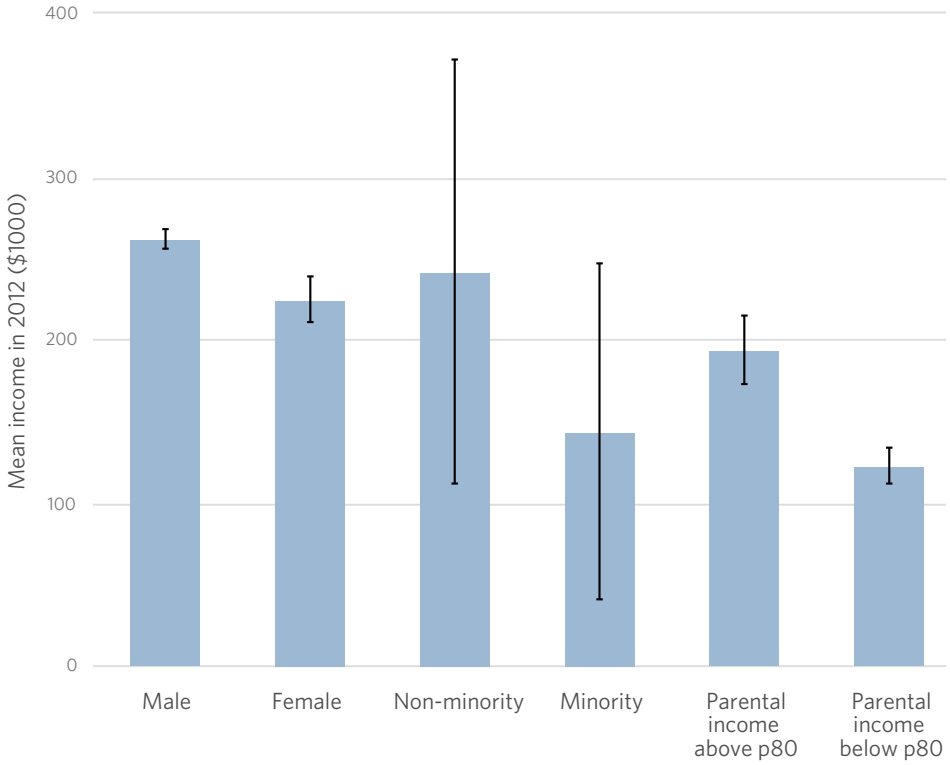
Studying labor income in 1940 using data from the U.S. Census Bureau, Akcigit et al. (2017) find the labor income of inventor-patentees was concentrated at the top, with 58.5% of U.S. inventor-patentees having incomes in the top decile.

Figure 7: Life cycle of earnings



(Source: Akcigit et al. 2017)

Figure 8: Income of inventor-patentees by characteristics at birth



Parental income above p80 are inventor-patentees with parents with income above the 80th percentile of income; Parental income below p80 are inventor-patentees with parent income below that threshold. (Source: Bell et al. 2019)

Matching U.S. tax records to data on U.S. inventor-patentees, Bell et al. (2019) illustrate how average incomes differ among inventor-patentees on granted U.S. patents. The study looks at whether the incomes of these individuals systematically differ based on the inventor-patentees' characteristics at birth. For 2012, Figure 8 shows the mean incomes for inventor-patentees by gender, minority status, and whether the inventor-patentee was born into a high or low income family.[22] The height of the bars represent the mean income while the lines are error ranges. The figure indicates that male inventor-patentees have higher average incomes than female inventor-patentees. Average incomes are also higher for non-minority inventor-patentees (relative to minorities) and inventor-patentees from higher income households (relative to those from lower income households).[23]

Potential benefits to companies

Firms owned by women, minorities, and veterans may enjoy a number of benefits from applying for and obtaining a patent. Although the published literature does not document these benefits specifically for firms owned by women, minorities, or veterans, a number of studies indicate that applying for and obtaining a patent helps companies to gain access to financial capital, find licensees, stimulate innovation, and facilitate firm growth. Spulber (2015), who builds a comprehensive framework describing the economic functions of patents, points out that patents increase transactional efficiencies, provide incentives for efficient investment, and promote financing and innovation. These benefits stem from the various characteristics of patents such as exclusion, transferability, disclosure, certification, and standardization.

22 The Bell et al. (2019) study defines minorities as African Americans and Hispanics.

23 Note that in Figure 8 the difference in mean incomes between non-minority and minority inventor-patentees is not statistically significant as shown by the overlapping error bars.

The remainder of this subsection provides a selective review of published research on firm-level benefits from obtaining patents, which are expected to extend to firms owned by women, minorities, and veterans.

For small firms and entrepreneurs, one of the major benefits from applying for and obtaining a patent is signaling "quality" or "potential." Investors and other resource suppliers are often reluctant to make commitments to new companies. Researchers have found that patents help firms obtain venture capital funding and secure loans, which further allow these companies to attract qualified personnel and other resources. Farre-Mensa et al. (2019), who analyze a sample of U.S. startup companies, find that a company's first USPTO granted patent significantly increases the likelihood the firm will obtain venture capital funding. Analyzing venture capital backed startups, Hochberg et al. (2018) find that more than 25% of the patents awarded to these companies were used to secure loan financing.

By providing a legal right to exclude others from making, using, or selling an invention, a granted patent facilitates bargaining, licensing, and other transactions involving technologies (Arora et al. 2004; Spulber 2015). Without a patent, a firm may be reluctant to reveal their invention to potential licensees or other third parties due to the risk of misappropriation (Arrow 1972). This would limit the number of potential licensors and sellers of technologies. With a patent application or grant, both sellers and buyers gain from search and transactional efficiencies. Buyers are able to find and evaluate potential technologies at lower costs. For instance, patent documents provide a standardized format for communicating an invention's technology, background, novelty, and scope (Spulber 2015).

U.S. Patent No. 6,153,410

Frances Arnold

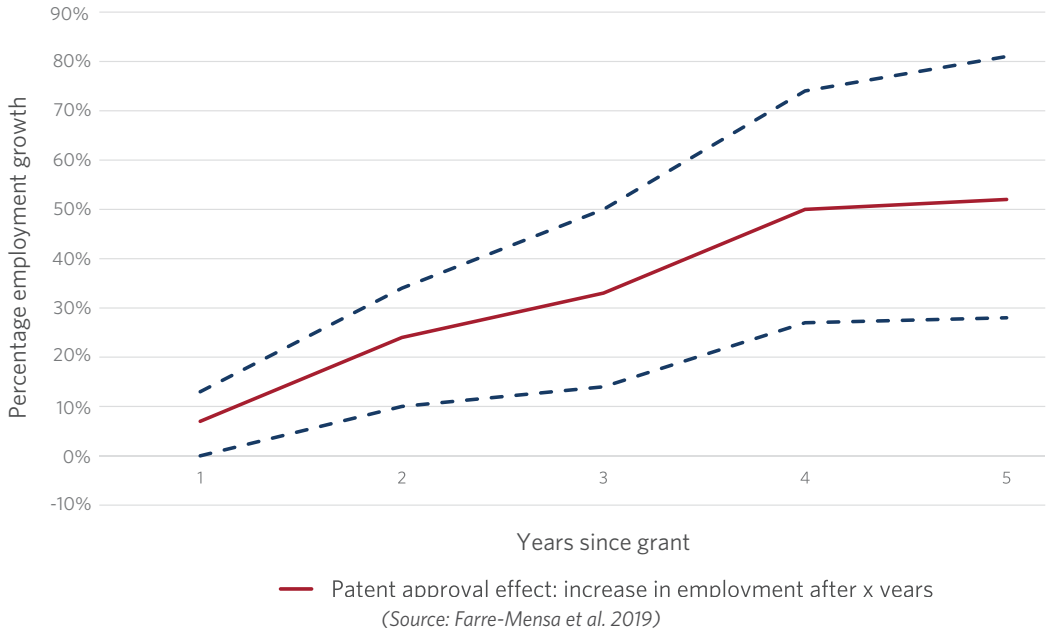
Directed evolution of enzymes

Frances Arnold is a pioneer of directed evolution, a process for "breeding" scientifically interesting or technologically useful proteins by mutating and recombining their DNA sequences and screening for desired properties. Arnold's research has led to practical applications as varied as creating laundry detergents and new drug development, and her methods are now used in hundreds of labs around the world. She received the 2018 Nobel Prize in Chemistry, and holds 60 U.S. patents.

Learn more at www.invent.org
Photo courtesy National Inventors Hall of Fame

Relatedly, approximately 18 months from the date of initial patent filing, most patent applications are publicly disclosed. These pre-grant disclosures allow others to learn about emerging technologies, which facilitates business collaborations and licensing, and encourages follow-on invention and innovation. Drivas et al. (2018), who analyze patenting and licensing data from the University of California, Office of Technology Transfer, find that pre-grant publication accelerates licensing for exclusively licensed inventions and for inventions in the chemical, drug, and medical areas. Although the effect of patent disclosure on follow-on invention is difficult to show empirically, a recent study by Hegde et al. (2019) finds that patent publication has a large and positive effect on follow-on innovation as measured by patents.

Figure 9: Startup employment growth from first granted patent



(Source: Farre-Mensa et al. 2019)

The literature also finds that patents are associated with improvements in firm-level performance indicators such as employment growth, sales growth, and the number of product offerings. Farre-Mensa et al. (2019) find that a startup's first granted patent puts the company on a higher employment growth path, which does not level off until five years later. Figure 9 illustrates this path, with the solid line representing the average effect and the dashed lines showing the upper and lower bound likely to contain the true average (95% confidence interval).

Startups that received a granted patent show a six percentage point increase in employment growth in the first year, with this growth differential increasing to about 55 percentage points by the fifth year. Their analysis finds a similar and substantial sales growth differential starting two years after a startup received its first granted patent.

In another analysis, Balasubramanian and Sivadasan (2011) examine what happens when companies receive patents by linking detailed information on U.S. manufacturing companies to USPTO patent data. They consider a variety of performance indicators for companies in two groups: those that add patents to an existing "stock" of previously obtained patents and those that are first-time patentees. For both groups, they find that obtaining patents is associated with greater skill and capital intensity, improvements in productivity, as well as an increase in the gross number of products produced by the firms. In sum, the authors conclude that their analysis provides "strong evidence that patenting is associated with firm growth through the introduction of new products" (Balasubramanian and Sivadasan 2011, p. 127).

In September 2018, the Institute for Women's Policy Research (IWPR) released a study analyzing various aspects of U.S. women-owned businesses. Their work combined information from the Annual Survey of Entrepreneurs and the Survey of Business Owners, which is conducted by the U.S. Census Bureau every five years. Among the results reported, the authors find that women-owned businesses that hold intellectual property have higher average revenue than women-owned businesses that do not own intellectual property. This difference was especially large for patent ownership.[24] Even though women-owned businesses are less likely to own patents than men-owned businesses, the study finds that women owned businesses are at least as likely to engage in product innovations.

24 The average revenue for women-owned businesses without intellectual property was $1.1 million while those with a patent pending had an average revenue of $18 million and those with a granted patent had an average revenue of $12.7 million (IWPR 2018, p. 28).

Section 3: External factors

Individuals face a complex set of circumstances and factors that influence their choices to become inventor-patentees or business entrepreneurs. These circumstances and factors include tolerance for risk and personal aspirations. They also include broader socio-economic factors such as exposure to role models, integration into professional networks, encouraging social and cultural environments, appropriate educational opportunities, the availability of physical and financial resources, and supportive institutional norms and incentive structures, among others.

Like most inventors, women, minorities, and veterans who are identified from available data as inventor-patentees or as entrepreneurs are not representative of all women, minorities, and veterans. They are a unique group not only because they chose to pursue patentable inventions or entrepreneurship, but also because they were successful enough to be recorded in available databases as an inventor or entrepreneur. Further, even among this select group, their personal journeys and specific challenges are likely to differ in important ways.

External factors can introduce difficulties for potential inventor-patentees and entrepreneurs from all backgrounds. Much of the literature regarding the participation rates of women, minorities, and veterans includes information about potential difficulties faced by these groups in becoming inventor-patentees and entrepreneurs. Three broad areas identified in the literature are: (1) social norms and education, (2) institutional norms and practices, and (3) resource availability and access.

Social norms and education

The literature finds that women and minorities have historically faced certain increased social and/or legal impediments to patenting. For instance, between 1870 and 1940, Cook (2014) finds that segregation laws and hate-related violence reduced patenting among African Americans. Similarly, Khan (1996) and Kahler (2011) note that female inventor-patentees faced increased restrictions on property rights, fewer educational activities, fewer economic opportunities, bias, and stereotyping. Starting in the 1830s, state-level legal reforms allowed married women the right to own patents, as opposed to their husbands. These reforms increased patenting by women as well as commercial activity related to the inventions (Khan 1996).

Recent research by Bell et al. (2019) highlights the important role of socialization through exposure to inventor role models, particularly during childhood, for becoming inventor-patentees. Their work suggests that children who gained greater exposure to patenting by moving from a low-patent

U.S. Patent No. 7,103,511

T. David Petite

Wireless communication networks

T. David Petite is one of the early inventors of the wireless ad hoc network or Wireless Mesh Technology that enables all mobile phones to work today. He is a member of the Fond du Lac Band of Lake Superior Chippewa tribe and founder of the Native American Intellectual Property Enterprise Council, a non-profit organization helping Native American inventors and communities around the country. Petite has over 50 U.S. patents.

Learn more at www.nativeamericaninventors.org
Photo courtesy T. David Petite

producing neighborhood (e.g. New Orleans, LA, which is in the 25th percentile in inventors per capita) to a highly innovative neighborhood (e.g. Austin, TX, which is in the 75th percentile) would increase the chance of patenting by 37%. The authors emphasize that it is not the outward aspects of a neighborhood, such as school programs or residential segregation, that direct a young inventor to a particular field. Instead, it is the lack of transmission of specific know-how through mentoring, networks, and internships where female and minority children currently face barriers. Other work (Murray and Graham 2007; IWPR 2016; Delgado and Murray 2019) supports the claim that the gender gap in patenting, entrepreneurial activities, and commercialization of inventions could be mitigated by the intervention of mentors and role models.

According to Hunt et al. (2013), education is another factor explaining the differences in patenting between men and women. They estimate that science and engineering (S&E) degrees account for about 7% of the gender difference observed for patents that get commercialized. They further find that 78% of this patent commercialization gap is accounted for by differences among those holding an S&E degree. Specifically, among those having an S&E education, women are underrepresented in the most patent-intensive disciplines, especially electrical and mechanical engineering, and in patent-intensive job tasks, specifically development and design. Cook and Kongcharoen (2010) find that advanced engineering degrees predict increases in commercialization for both women and African Americans.

Institutional norms and practices

Institutional norms and practices is a second broad area where the literature finds that women and other underrepresented groups may face difficulties to becoming inventor-patentees or entrepreneurs. Most of the existing evidence focuses almost exclusively on women inventor-patentees. A 2019 USPTO report found significant differences in the fraction of women inventor-patentees across institutional groups such as business firms, public research organizations, universities and hospitals. Over the full period of analysis, 1977–2016, patents granted to business firms had the lowest percentage of women inventors, although the percentage increased from 4% in the 1977–1986 period to 12% in the last decade. Whittington and Smith-Doerr (2008) suggest the gender gap in industry is particularly prevalent in hierarchical settings, where women may disproportionately hold corporate positions with limited opportunities to patent.

Some studies find that, historically, women have experienced implicit barriers such as bias that limited promotion to high-level positions as they advanced in their careers (Meyerson and Fletcher 1999; Cotter et al. 2001). Hunt (2016) finds that women disproportionately leave engineering fields rather than science fields and attributes this trend to dissatisfaction over promotional opportunities and pay. Hunt suggests the "lack of mentoring and networks, or discrimination by managers and co-workers are the more promising" explanations for the exits rather than family-related issues or the nature of engineering work. Murray and Graham (2007), who study the role of exposure and career advancement on commercialization opportunities among women academic life scientists, find a significant positive relationship between reaching high-profile positions of status and the subsequent number of commercial opportunities.

Some research suggests that the academic institutional environment may be more conducive to women patenting than private industry (Sugimoto et al. 2015). Although, in a study of patenting among women scientists holding doctoral degrees, women academic scientists who become mothers were less likely to patent even after accounting for factors such as rank, salary, and prestige (Whittington 2011). Additionally, technology transfer offices (TTOs) tend to be of greater significance to female academics for the purposes of patenting than these offices are to male academics. Ding et al. (2006) find that female academics use more TTO services such as commercialization advice, industry contacts, and commercialization assistance.

The literature also details the effects of networks on the opportunity for academics to commercialize their inventions (Abreau and Grinevich 2013; Ding et al. 2006; Gicheva and Link 2013; Hunt et al. 2013; Meng 2016; Sugimoto et al. 2015; Whittington and Smith-Doerr 2008). Ding et al. (2006) find that female

academics tend to lack the broad, loose networks that male colleagues leverage to build businesses and that female academics tend to rely on male associates to begin the patenting process. Delgado and Murray (2019), who analyze factors related to female patenting inclusivity in 25 U.S. universities, argue that a university's most prolific inventors are the key people for determining who participates and who gets exposed to opportunities to patent. Regardless of gender, they find top inventors are more inclusive, but they identify female top inventors as having a 6% higher level of female inclusivity. They argue that an important role for female top inventors is to act as catalysts for greater female participation as inventor-patentees.

Separately, veterans may face difficulties related to military service. For instance, in 1928 and 1950 Congress took action to help veterans by passing laws to allow patent term extensions for veterans of World War I and World War II.[25]

Resource availability and access

The availability and access to resources is the third broad area where the literature finds that women and other underrepresented groups face some different conditions to becoming inventor-patentees or entrepreneurs. Resources can take a variety of forms including physical resources, such as equipment or tools, information resources about patenting or entrepreneurial strategies, and financial resources to support patent applications or other company expenses.

The existing literature focuses mainly on financial resource disparities for women and minorities, which may or may not extend to veterans.[26] Research has found that female and minority entrepreneurs are less likely to receive venture and start-up capital (Brush et al. 2014, U.S. Census Bureau 2016, IWPR 2016, Bewaji et al. 2015). According to IWPR (2016) only 3% of venture capital funding between 2010 and 2013 went to businesses with a female CEO even though 36.3% of all businesses in the United States are women owned. As a signal of potential firm quality, patent applications and grants are important determinants of venture capital funding (Haeussler et al. 2009). Groups that are underrepresented in patenting, therefore, may not have the same opportunity to signal the quality of their entrepreneurial ventures to the providers of financial risk capital (IWPR 2016).

Another strand of literature explores the factors that limit access to financial capital for minority entrepreneurs (Coleman 2005; Ekanem and Wyer 2007; Fairlie and Robb 2009; Bewaji et al. 2015). Bewaji et al. (2015) find two separate impediments to financing for minorities: (a) social networks and (b) the "liability of newness." Bewaji et al. (2015) also find that the share of minority-owned businesses has increased over time and that minority-owned businesses are disproportionately newer than those of White-owned businesses. The authors argue that financial institutions are less likely to lend to newer businesses because of the high failure rate of all new businesses. Coleman (2005) finds that African Americans were more likely to secure financing through non-bank sources than White business owners and that Black or African American men were also more likely to be turned down for loans than their White contemporaries. In another study, Bogan and Darity (2008) suggest that African Americans have access to fewer resources (land, education, etc.), leading to adverse entrepreneurial outcomes.

25 The May 31, 1928, legislation can be accessed through www.loc.gov/law/help/statutes-at-large/70th-congress/session-1/c70s1ch992.pdf. The June 30, 1950, legislation can be accessed through www.loc.gov/law/help/statutes-at-large/81st-congress/session-2/c81s2ch444.pdf.

26 Sankaran and Battisto (2018) find the number of veteran-owned businesses are declining relative to non-veteran-owned businesses. They suggest barriers restricting access to financial capital and weak social capital may explain part of the observed decline.

Section 4: USPTO and SBA programs

This section provides an overview of current and planned USPTO and SBA programs and initiatives to help address the external factors faced by women, minority, and veteran inventor-patentees.

USPTO programs and initiatives

The USPTO has a robust array of programs and initiatives to encourage and increase the participation of women, minorities, and veterans as inventor-patentees in the intellectual property (IP) system and as entrepreneurs. These programs and initiatives vary in scope and purpose, but specifically address identified needs within and across the three broad areas discussed in Section 3.

- Addressing financial resource constraints by first-time inventors including those in underrepresented groups, the USPTO has designed its patent fee structure with discounts to encourage patent applications from small businesses, universities, nonprofit organizations, and individual inventors. Patent filing and maintenance fees for "small entities" are reduced by 50% relative to "large entity" fees. For "micro entities," fees are reduced by 75%. Further information on definitions and the criteria used to meet the entity status requirements is available from the USPTO's *Manual of Patent Examining Procedure* (MPEP) (https://mpep.uspto.gov/RDMS/MPEP/current#/current/ch500_d1ff69_210b3_1ca.html).
- To promote and encourage greater participation in the intellectual property system by small businesses and underrepresented groups, the USPTO has a strong regional presence with dedicated resources stationed in Dallas, Texas; Denver, Colorado; San Jose, California; Detroit, Michigan; and Alexandria, Virginia. These offices provide valuable educational programming and guidance on how to navigate successfully through the patent and trademark systems. USPTO employees in these regions work regularly with their SBA counterparts to provide IP information, one-on-one consultations, speaking engagements, and collaborative marketing. The regional offices also provide information and participate in events aimed at helping emerging small businesses and inventors from underrepresented groups to navigate the IP systems.
- The USPTO also supports individual inventors and small businesses through the Patent Pro Bono Program, the Law School Clinic Program and the Pro Se Assistance Program. The Patent Pro Bono Program is a

U.S. Patent No. 7,715,368

Marian Rogers Croak

Text-to-donate technology

Marian Rogers Croak is a pioneer in the advancement of Voice over Internet Protocol (VoIP) with inventions that made phone calls more reliably and securely transmittable over the internet. Croak also invented a text-to-donate technology after Hurricane Katrina that revolutionized how people donate to charitable organizations. She holds more than 200 patents and has spent more than three decades developing advanced technologies for voice and data networks, and the internet.

Learn more at www.witi.com
Photo courtesy Marian Rogers Croak

nationwide network of independently operated regional programs that match volunteer patent professionals with financially underresourced inventors and small businesses for the purpose of securing patent protection. Efforts are underway to increase awareness and participation in the Pro Bono Program by securing additional attorney volunteers and inventor applicants for the regional programs. Like the Pro Bono Program, the Law School Clinic Program provides legal assistance for financially under-resourced individuals. Participating law schools match students, supervised by a Law School Faculty Clinic Supervisor, with inventors or entrepreneurs for the purpose of securing patent or trademark protection. The Pro Se Assistance Program is a comprehensive pilot to expand outreach to inventors who file patent applications without the assistance of a registered patent attorney or agent (also known as "pro se" filing).

- The USPTO's Patent and Trademark Resource Centers (PTRCs) are a nationwide network of public, state and academic libraries that disseminate patent and trademark information and support the diverse intellectual property needs of individuals who are not familiar with the patent and trademark processes. PTRC library staff are information experts trained on how to use search tools to access patent and trademark information. They provide a human touch that no webpage or legal book can provide in helping inventors and small businesses find the information they need to protect their intellectual property. There are over 80 PTRCs throughout the country.
- The USPTO conducts outreach to independent inventors, small business owners, and university-affiliated innovators, including Historically Black Colleges and Universities. It works with independent inventor groups, government agencies and institutions, and universities and schools, to sponsor programs throughout the year and hosts both an annual inventor's conference (Invention-Con) and an annual Women's Entrepreneurship Symposium. In addition, the USPTO produces an interactive webinar and inventor info chat to provide USPTO stakeholders with educational opportunities on intellectual property, tips on navigating the patent system, and instructions on how to locate and use available resources during the application process. Outreach programming is conducted via webinars, conferences, and roadshows.
- The USPTO also works to build and expand partnerships with other federal agencies, non-profit organizations, school districts and universities to reach K-12 students and educators. The annual National Summer Teacher Institute has trained over 200 educators on how to promote student engagement in the areas of STEM and entrepreneurship.
- Through its signature partnership with the nonprofit National Inventors Hall of Fame (NIHF), the USPTO supports a menu of education and outreach programs reaching students and teachers. In partnership with the NIHF, the USPTO runs a series of STEM and IP-based summer camps and after-school programs that reach more than 150,000 students each year from pre-kindergarten through high school, in 1,300 school districts across all 50 states, plus Washington, D.C., and Puerto Rico.
- The Patents Ombudsman is available to provide assistance to applicants and attorneys throughout the application process including initial filing, patent examination and post examination. This program assists applicants when their normal processing has stalled, helping to get applications back on track.
- The USPTO's Inventors Assistance Center (IAC) and Trademark Assistance Center (TAC) provide direct assistance to inventors and entrepreneurs. The IAC provides patent information and services to the public. The IAC is staffed by former supervisory patent examiners and primary examiners who answer general questions concerning patent examining policy and procedure. The Trademark Assistance Center (TAC) is the main support center for all trademark customers, from first-time filers to legal professionals and experienced trademark applicants.
- Earlier in 2019, the USPTO updated its website to better serve new inventors and entrepreneurs.

Now, with one click, visitors are directed to a U.S. map, where they can find a multitude of free resources in their area to better help them navigate the patent and trademark system and protect their intellectual property.

- Beyond USPTO programs and initiatives, the USPTO also works with other federal agencies, such as the SBA, the Minority Business Development Agency, and non-federal organizations such as AUTM (formally the Association of University Technology Managers). These collaborative efforts result in educational programs delivered both in-person and through the internet. The educational content and approaches are often tailored to the various needs and challenges of small businesses, including those owned by women, minorities, and veterans.

The USPTO also plans to launch a new set of initiatives that will enhance and expand upon its existing programs and services in at least the following ways:

1. **Collaborative IP program**
   While corporations are the largest patent filers, available evidence shows these organizations have some of the lowest participation rates for women inventor-patentees. To address this issue, the USPTO plans to create an IP toolkit for corporate employee inventors to help demystify the patent process and encourage greater participation.
2. **Award program**
   To encourage and recognize individuals and/or organizations that are undertaking efforts and/or accelerating diversity among entrepreneurs, the USPTO plans to help develop an award and accompanying award criteria to recognize significant efforts and actions.
3. **Creation of a council for innovation inclusiveness**
   The USPTO plans to establish a council consisting of representatives from the general public, private corporations, academia, nonprofit organizations, and the U.S. government to develop a national strategy for promoting and increasing the participation of underrepresented groups as inventor-patentees, entrepreneurs, and innovation leaders.
4. **Expansion of USPTO educational outreach programs for youth and teachers**
   The USPTO has successfully worked to build and expand strategic partnerships with other federal agencies, universities, and non -profit organizations to reach a diverse range of students and educators. The USPTO will continue and expand its programs and partnerships to promote entrepreneurship and innovation in STEM fields through resources, activities, or other mechanisms for engagement with youth such as after-school programs, partnerships with libraries or other community-based organizations.
5. **Workforce development**
   The USPTO plans to work with other relevant agencies to help develop workforce training materials with information on how to obtain a patent, and the importance of invention and IP protections, for inclusion in the administration's

U.S. Patent No. 5,906,540

Temple Grandin

Animal-stunning system

Temple Grandin is a professor of animal science at Colorado State University. Her work on equipment design, animal behavior, and animal welfare auditing has greatly improved conditions in the livestock industry. In addition to being a U.S. patent holder, Dr. Grandin is also an acclaimed speaker, a best-selling author, and an advocate for people with autism.

Learn more at
www.uspto.gov/dwcstories/grandin.html
Photo courtesy USPTO

workforce development training initiative. These materials support the Trump Administration's efforts through the National Council for the American Worker to equip America's students and workers to compete and win in the global economy.

6. Increase professional development of IP training for educators
   The USPTO will work with appropriate federal agencies to partner in developing training materials to help elementary, middle, and high school teachers incorporate the concepts of invention and IP creation and protection into classroom instruction.Similar training materials could be developed for educators at trade schools and community colleges. Materials from the USPTO's National Summer Teacher Institute on Innovation, STEM, and IP could serve as a model for the training materials.

SBA programs and initiatives

The SBA has a number of programs and initiatives to encourage and increase the participation of women, minorities, and veterans as entrepreneurs and facilitate their use of patent protection. These programs and initiatives (examples listed below) vary in scope and purpose, but broadly address the external factors described in Section 3.

- Federal and State Technology (FAST) Partnership Program. The objective of the FAST program is to improve outcomes for underrepresented entrepreneurs in the SBA's Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) Programs and to increase participation for women-owned, rural-based, and socially and economically disadvantaged firms. Through FAST, the SBA provides grant funding to organizations that provide specialized training, outreach, mentoring, and technical assistance for these R&D focused businesses.
- SBIR and STTR: The SBA is responsible for oversight, providing policy direction, marketing, and congressional reporting on these two programs. SBIR enables small businesses to explore their technological potential and provides the incentive to profit from its commercialization. Each of the 11 participating agencies administers its own individual program. STTR is another program that expands funding opportunities in the federal innovation research and development (R&D) arena. Central to the program is expansion of public/private sector partnerships to include joint venture opportunities for small businesses and nonprofit research institutions. STTR's most important role is to bridge the gap between performance of basic science and commercialization of resulting innovations. Currently, five federal agencies participate in the STTR program.
- The SBA has a vast network of resource partners throughout the country—Small Business Development Centers (SBDCs), Women's Business Centers (WBCs), Service Corps of Retired Executives (SCORE), Veteran Business Outreach Centers (VBOCs)—that provides counseling and training (including access to USPTO resources and outside IP professionals) to all types of small businesses, many with a particular focus on women, minority, and veteran entrepreneurs.
- Women-owned Small Businesses (WOSB): To help provide a level playing field for women business owners and achieve the goal of awarding at least 5% of all federal contracting dollars to WOSBs each year, the federal government limits competition for certain contracts to businesses that participate in the SBA's WOSB program. These contracts are for industries where WOSBs are underrepresented. Some contracts are restricted further to economically disadvantaged women-owned small businesses (EDWOSBs). The SBA maintains a list of those eligible industries and their North American Industry Classification codes.
- Boots to Business (B2B): Boots to Business is an entrepreneurial education and training program offered by the SBA as part of the Department of Defense's (DOD) Transition Assistance Program

(TAP). The program, involving the SBA's close collaboration with its resource partners, DOD, other federal agencies, and local military installations, provides participants with introductory training for starting a business (e.g., understanding business concepts and markets, where to go for start-up capital, technical assistance, and contracting opportunities). B2B is open to transitioning service members (including National Guard and Reserve) and their spouses.

- **Community Advantage Pilot Program:** This program is delivered as an SBA 7(a)-guaranteed loan through a network of approved mission-based lenders, such as non-federally regulated Community Development Financial Institutions (CDFIs), Certified Development Companies, and Microloan Intermediaries. Through this pilot, lenders provide entrepreneurs with loans of up to $250,000. These lenders specialize in providing capital to small businesses in underserved markets, which include low-to-moderate income communities and veteran-owned businesses.

Section 5: Legislative recommendations

The SUCCESS Act asks the USPTO for legislative recommendations to encourage and increase the participation of women, minorities, and veterans as inventor-patentees in the intellectual property system and as entrepreneurs. Accordingly, the USPTO submits the following legislative recommendations:

Recommendation 1

Enhance USPTO authority to gather information

Currently the USPTO collects only the full name, residence, and mailing address of each inventor-patentee; it does not collect demographic information. To help address the dearth of information on the participation of women, minorities, and veterans as inventor-patentees, Congress could authorize a streamlined mechanism for the USPTO to undertake a voluntary, confidential, biennial survey of individuals named in patent applications that have been filed with the USPTO.

In so doing, care must be exercised to avoid the perception that demographic or other personal information might be used in the examination of patent applications, which could discourage underrepresented groups from filing and obtaining patents in the first place.

Recommendation 2

Enhance authority for federal interagency data sharing and cooperation

To address the lack of information on the participation of women, minorities, and veterans as inventor-patentees, Congress could encourage the sharing of federal data and support enhanced cooperation among the USPTO and other federal agencies.

Recommendation 3

Expand the purposes/scopes of relevant federal grant programs

To encourage more participation by women, minorities, and veterans, Congress could expand the authorized uses of grants and funds in appropriate federal programs to include activities that promote invention and entrepreneurship, as well as the protection of inventions and innovations using intellectual property among underrepresented groups.

Recommendation 4

Create a commemorative series of quarters and postage stamps to be placed in circulation

The U.S. Mint has authorized and undertaken a commemorative set of American Innovation $1 coins, which are available for purchase from the U.S. Mint. In 1983, the U.S. Postal Service released four stamps to honor the contributions of American inventors. To further increase the nation's awareness of invention, Congress could authorize the creation of a set of innovation quarters and postage stamps to be released into circulation that feature a spectrum of American inventors from a variety of backgrounds, including those from underrepresented groups.

Recommendation 5

Support exhibits at national museums featuring inventors/entrepreneurs

Congress could encourage national museums to feature exhibits that highlight the contributions to U.S. invention and entrepreneurship by individuals from underrepresented groups.

Legislative recommendations 1, 2, and 3 address the SUCCESS Act Section 3(a)(2)(A), which asks for ways to promote the participation of women, minorities, and veterans in entrepreneurship activities. For Section 3(a)(2)(B) of the SUCCESS Act, all of the USPTO legislative recommendations will help increase the number of women, minorities, and veterans who apply for and obtain patents.

References

Abreau, M., & Grinevich, V., 2013. The nature of academic entrepreneurship in the UK: Widening the focus on entrepreneurial activities. Research Policy, 42, pp. 408–422.

Akcigit, U., Grigsby, J. and Nicholas, T., 2017. The Rise of American Ingenuity: Innovation and Inventors of the Golden Age. National Bureau of Economic Research, Working Paper no. 23407.

Arora, A., Fosfuri, A. and Gambardella, A., 2004. Markets for technology: The economics of innovation and corporate strategy. MIT Press.

Arrow, K.J., 1972. Economic welfare and the allocation of resources for invention. In Readings in Industrial Economics (pp. 219-236). Palgrave, London.

Ashcraft, C., Breitzman, Sr, A., 2012. Who Invents It? Women's Participation in Information Technology Patenting, 2012 Update. Faculty Scholarship for the College of Science & Mathematics. 6. http://rdw.rowan.edu/csm_facpub/6.

Azoulay, P., Ding, W. and Stuart, T., 2007. The determinants of faculty patenting behavior: Demographics or opportunities?. Journal of Economic Behavior & Organization, 63(4), pp. 599-623.

Baker, H.E., 1917. The Negro in the field of invention. The Journal of Negro History, 2(1), pp. 21-36.

Balasubramanian, N., and Sivadasan, J. 2011. What happens when firms patent? New evidence from U.S. economic census data. The Review of Economics and Statistics, 93(1), pp 126-146.

Bell, A., Chetty, R., Jaravel, X., Petkova, N. and Van Reenen, J., 2019. Who becomes an inventor in America? The importance of exposure to innovation. The Quarterly Journal of Economics, 134(2), pp. 647-713.

Bewaji, T., Yang, Q. and Han, Y., 2015. Funding accessibility for minority entrepreneurs: An empirical analysis. Journal of Small Business and Enterprise Development, Vol. 22 No. 4, pp. 716-733.

Blume-Kohout, M., 2014. Understanding the gender gap in STEM fields entrepreneurship. U.S. Small Business Administration Office of Advocacy Report, (424).

Bogan, V. and Darity, W., 2008. Culture and entrepreneurship? African American and immigrant self-employment in the United States. Journal of Socio-Economics, 37, pp. 1999-2019.

Brush, C., Greene, P., Balachandra, L., and Davis, A., 2014. Women entrepreneurs 2014: Bridging the gender gap in venture capital (Diana Report). Babson.

Coleman, S. 2005. Is there a liquidity crisis for small, black-owned firms?. Journal of Developmental Entrepreneurship, 10(1), pp. 29-47.

Cook, L.D. and Kongcharoen, C., 2010. The idea gap in pink and black. National Bureau of Economic Research Working paper no. 16331.

Cook, L.D., 2011. Inventing social capital: Evidence from African American inventors, 1843–1930. Explorations in Economic History, 48(4), pp. 507-518.

Cook, L.D., 2014. Violence and economic activity: evidence from African American patents, 1870–1940. Journal of Economic Growth, 19(2), pp. 221-257.

Cotter, D.A., Hermsen, J.M., Ovadia, S. and Vanneman, R., 2001. The glass ceiling effect. Social Forces, 80(2), pp. 655-681.

Delgado, M., M. Mariani, and F. Murray, 2018, "The Role of Location on the Inventor Gender Gap," Presentation to GEOINNO2018, 4th Geography of Innovation Conference.

Delgado, M. and F. Murray, 2019, Catalysts for Gender Inclusion in Innovation: The Role of Universities and their Top Inventors. Working Paper, MIT.

Ding, W.W., Murray, F. and Stuart, T.E., 2006. Gender differences in patenting in the academic life sciences. Science, 313(5787), pp. 665-667.

Drivas, K., Lei, Z., and Wright, B. 2018. Application publication or confirmation of grant: which matters more for academic technology transfer? International journal of industrial organization 56, pp. 204-228.

Ekanem, I., and Wyer, P., 2007. A fresh start and the learning experience of ethnic minority entrepreneurs. International Journal of Consumer Studies, 312, pp. 144-151.

Fairlie, R., and Robb, A., 2009. Gender differences in business performance: Evidence from the characteristics of business owners survey. Small Business Economics, 33(4), pp. 375-395.

Farre-Mensa, J., Hegde, D. and Ljungqvist, A., 2019. What is a patent worth? Evidence from the U.S. patent "lottery." Journal of Finance, forthcoming.

Gicheva, D., and Link, A., 2013. Leveraging entrepreneurship through private investments: Does gender matter? Small Business Economics, 40, pp. 199–210.

Haeussler, C., Harhoff, D., and Müller, E., 2009, To Be Financed or Not… – The Role of Patents for Venture Capital Financing. ZEW Discussion Paper No. 09-003, Mannheim, published in: Frontiers of Entrepreneurship Research.

Hegde, D., Herkenhoff, K. and Zhu, C., 2018. Patent disclosure and innovation. Available at SSRN 3158031.

Hochberg, Y., Serrano, C., and Ziedonis, R. 2018. Patent collateral, investor commitment and the market for venture lending. Journal of Financial Economics 130(1), pp. 74-94.

Hunt, J., 2016. Why do women leave science and engineering?. ILR Review, 69(1), pp. 199-226.

Hunt, J., Garant, J.P., Herman, H. and Munroe, D.J., 2013. Why are women underrepresented amongst patentees?. Research Policy, 42(4), pp. 831-843.

Institute for Women's Policy Research (IWPR), 2016. Equity in innovation: Women inventors and patents. Institute for Women's Policy Research.

Institute for Women's Policy Research (IWPR), 2018. Innovation and intellectual property among women entrepreneurs. Institute for Women's Policy Research.

Jaffe, A.B., and de Rassenfosse, G., (2017). Patent citation data in social science research: Overview and best practices. Journal of the Association for Information Science and Technology, 68(6), pp. 1360–1374.

Kahler, A.I., 2011. Examining exclusion in woman-inventor patenting: a comparison of educational trends and patent data in the era of computer engineer Barbie. American University Journal of Gender Social Policy and Law, 19(3), pp. 773-798.

Khan, B.Z., 1996. Married women's property laws and female commercial activity: Evidence from United States patent records, 1790–1895. The Journal of Economic History, 56(2), pp. 356-388.

Marco, A.C., Carley, M., Jackson, S., and Myers, A. 2015. The USPTO historical patent data files: Two centuries of innovation. USPTO economic working paper 2015-1.

Martinez, G.L., Raffo, J. and Saito, K., 2016. Identifying the gender of PCT inventors (No. 33). World Intellectual Property Organization. Economic Research Working Paper no. 33.

Meng, Y., 2016. Collaboration patterns and patenting: Exploring gender distinctions. Research Policy, 45(1), pp. 56-67.

Meyerson, D.E. and Fletcher, J.K., 1999. A modest manifesto for shattering the glass ceiling. Harvard Business Review, 78(1), pp. 126-136.

Murray, F. and Graham, L., 2007. Buying science and selling science: gender differences in the market for commercial science. Industrial and Corporate Change, 16(4), pp. 657-689.

Nager, A., Hart, D., Ezell, S., and Atkinson, R. 2016. The demographics of innovation in the United States. The Information Technology and Innovation Foundation (ITIF).

Sankaran, S., and Battisto, J., 2018. Financing their future: veteran entrepreneurs and capital access. Small Business Administration.

Sarada, S., Andrews, M.J. and Ziebarth, N.L., 2019. Changes in the demographics of American inventors, 1870–1940. Explorations in Economic History, pp. 101275.

Spulber, D. , 2015. How patents provide the foundation of the market for inventions. Journal of Competition Law and Economics, 11(2), pp. 271-316.

Sugimoto, C.R., Ni, C., West, J.D. and Lariviére, V., 2015. The academic advantage: Gender disparities in patenting. PloS one, 10(5), p.e0128000.

U.S. Census Bureau. 2016. 2012 Survey of Business Owners: Table SB1200CSCB16: Statistics for All U.S. Firms by Total Amount of Capital Used to Start or Acquire the Business by Industry, Gender, Ethnicity, Race, and Veteran Status for the U.S.: 2012. American FactFinder.

U.S. Patent and Trademark Office, 2019. Progress and potential: A profile of women inventors on U.S. patents. Office of the Chief Economist, USPTO.

Whittington, K.B. and Smith-Doerr, L., 2008. Women inventors in context: Disparities in patenting across academia and industry. Gender & Society, 22(2), pp. 194-218.

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.

Appendix A: Summary of public hearings and written comments

Review of the oral comments from the three USPTO nationwide public hearings and the written comments submitted in response to the USPTO Federal Register Notice on the SUCCESS Act shows that respondents hold a wide variety of viewpoints and a diverse range of opinions on how to promote and encourage greater participation by women, minorities, and veterans as inventor-patentees and entrepreneurs. Nevertheless, several themes emerged and the substance of the oral and written comments are summarized below under five themes. Reference codes to the underlying oral and written comments are also provided in the discussion of each theme. Codes such as "WT3" or "OT1" correspond to written comment #3 and oral comment #1. Tables A.1 and A.2 provide the crosswalk between the codes and the comments to provide easy reference. The written comments and transcripts of the public hearings are available at: www.uspto.gov/successact. The five themes are:

1. Data collection
2. Programs and education
3. Increased funding and reduced patent fees
4. USPTO rules and regulation reform
5. Legislative reform

Data collection

Submissions on data collection discussed the potential for the USPTO to collect demographic information, with over 60% of written answers regarding data collection in favor of USPTO collection of this information (WT3, 14, 21, 36, 37, 38, 46, 49, 50; OT1, 2, 3, 4, 5, 18). Other responses suggested a third party undertake the data collection and analysis to address privacy concerns (WT1 and 42). It was also suggested that all demographic data be collected on a voluntary basis and be held as business confidential information (WT6, 33).

Programs and education

Many oral and written comments called for programs to promote and encourage invention and innovation by underrepresented groups. For example, the written comment of Senator Dianne Feinstein quotes a Brookings Institution report, "there is a clear need for the expansion of access to skills development opportunities, networks and capital for underrepresented groups" (WT9). Multiple respondents support the idea of targeting and collaborating with private firms to help address the issues (WT1, 14, 25, 46, 47, 49). Diverse ideas for implementation include targeting programs to minority youth (e.g., K–12) who show early aptitude in math and science (WT21, 24, 44). Ideas also include tailoring programming to participant background (WT3, 24). Another recommendation was to increase participation of women in STEM fields (WT49). Multiple respondents also support the expansion of the USPTO's micro entity and pro bono programs (WT1, 9, 54; OT3, 11). Another common recommendation was to collaborate with organizations that already work in the areas of enabling and encouraging inventors, such as those in academia or the private sector (WT1, 6, 19, 25, 38, 49; OT6, 13).

There was also support for programs that increase understanding and education about the patent system, with submissions suggesting ideas such as the creation of a union of inventors where people can get advice and encouraging intellectual property organizations to provide more resources for outreach and training (WT14, 27, 33).

Within STEM organizations, it was recommended that stories of successful women and minority inventors be shared to encourage greater interest in patenting, mentoring be increased, and training be provided to reduce the influence of unconscious biases within organizations (OT19).

Increased funding and reduced patent fees

Respondents called for increased funding for educational and other programs (described in the previous section), and fee reductions in several areas of the patent process

(OT3, 14, 15, 16, 17). In addition to funding new and existing programs, several comments suggested research into program best practices to maximize benefits (WT3, 44, 49). Another suggestion included providing fee reductions for minorities, individuals 21 years and younger, veterans, and women (WT15, 21, 27, 44; OT1). There were a number of references to the high cost of defending a patent at the Patent Trial and Appeals Board (PTAB). One commenter suggested that costs could be reduced by making the process more like the European Patent Office's opposition proceeding (OT16).

In terms of increased funding for underrepresented inventors, testifiers also suggested reducing non-USPTO costs, particularly those related to legal representation. Suggestions included greater cooperation across federal agencies to increase funding for inventors from underrepresented groups, with lower USPTO fees and greater technical assistance used to offset patent attorney fees (WT28, 43, 53; OT11). A repeated theme from the oral comments was that women and minorities receive much less funding from venture capital funds. There was no consensus as to how to increase the rate at which venture capitalists invest in women and minority owned firms (OT5, 8). The oral comments included requests for women and minorities to receive financial assistance at critical times, such as childbirth and unemployment, to minimize exiting from patenting (OT9). There was a request to create a government supported world-class research facility for inventors focused on issues related to patent procurement and enforcement (OT10, 11, 3).

USPTO rules and regulations reform

There were many recommendations that targeted current USPTO regulations. These fall into four categories:

a. The Patent Trial and Appeal Board (PTAB)

b. Disadvantaged and minority groups

c. Improvements for independent inventors

d. Other recommendations

U.S. Patent No. 4,034,197 & 4,213,187

Victor B. Lawrence

Signal processing in telecommunications

Victor Lawrence has improved transmission for the modern Internet, made high-speed connections more available, and stimulated the growth of the global Internet. Born in Ghana, Lawrence spent much of his career at Bell Laboratories where he manipulated data for faster and more reliable travel over telephone lines. He also developed methods of including more information in a signal, facilitating the introduction of digital video and radio, and the development of high-definition and digital television.

Learn more at www.invent.org
Photo courtesy IEEE

The Patent Trial and Appeal Board

Various respondents had recommendations regarding changes to the PTAB. One frequently cited recommendation was to reduce invalidation rates, mentioned in 20% of the written recommendations discussing USPTO rules and regulations (WT2, 4, 5, 16, 17, 18, 29, 31; OT20). Other recommendations included standardizing patent claim construction and greater consistency in the sense that the USPTO should not change its pre-grant or post-grant claim construction in post grant procedures (WT8). Additionally, the USPTO should not reconsider prior art after it was given consideration and was dismissed (WT8). Other recommendations were in support of overhauling PTAB (WT30 and 32) and eliminating the inter partes review process for all patents initially filed by a small/micro entity, such as an individual inventor (WT23).

Disadvantaged and minority groups

Recommendations in this category include increased reliability of granted patents, as well as the development of an alternative pathway to apply for patents for underrepresented populations. Suggestions also included modifying the SBA's Small Business Investment Company program[27] to incentivize underrepresented class participation (WT40, 44, 48; OT11). Suggestions that are more general include investigating bias, including disabled people as a minority group (WT12), and generally creating a more encouraging environment for minorities to invent (WT35).

Improvements for independent inventors

Some respondents provided suggestions regarding modifications to operational aspects of the USPTO that would make the patent process easier for independent inventors (OT12). These included increasing the clarity of the USPTO website via the inclusion of an online chat feature, increasing the oversight of examiners, reviewing the process of approving patents to benefit small entities, the creation of a political arm of the USPTO to defend inventors, and streamlining the patent process in general (WT11, 12, 13, 27).

Other recommendations

Some comments noted that patent rights could be expanded to include not just the right to exclude but total control over inventions, including the ability to decide and execute punishments for infringement (WT2, 5, 29, 31; OT20).

Legislative reform

Frequently mentioned points were to remedy uncertainty regarding 35 USC 101, and expand patent eligibility (WT17, 30 and 44). Another recommendation was the development of a standard legal procedure for compelling large technology companies to respond to licensing requests from small vendors or independent inventors (OT20). Other recommendations included overturning the Supreme Court's eBay decision (reinstating the power of injunctions in courts), a tax break for people with "off the wall" ideas, barring states from having tort law covering patent infringement letters, allowing immigrants who get a patent to have no wait time to receive residency, and creating tax incentives for investing in companies with founders from underrepresented classes (WT4, 17, 27, 28, 30, 40, 44).

Table A.1:
Index of oral comments from USPTO public hearings

ID	Name (Location)
OT1	Dr. Danny Briere (Detroit)
OT2	Dr. Lisa Cook (Detroit)
OT3	Holly Fechner (Detroit)
OT4	Carrie Hafeman (Detroit)
OT5	Cecilia Corral (San Jose)
OT6	Dr. Kelly Sexton (Detroit)
OT8	Robin Feldman (San Jose)
OT9	Maria McKendrick (Detroit)
OT10	Kimberly Wesley (San Jose)
OT11	Dr. Rory Cooper (Detroit)
OT12	Marjorie Weir (Detroit)
OT13	Dr. Nichole Mercier (Detroit)
OT14	William Coughlin (Detroit)
OT15	Paul Morinville (Detroit)
OT16	Kelly Burris (Detroit)
OT17	Nicholas Ripplinger (Detroit)
OT18	Darcy Bisker (Alexandria)
OT19	Dr. Leslie Flynn (Alexandria)
OT20	Ted Tsao (San Jose)

27 www.sba.gov/document/support--sbic-program-overview

Table A.2: Index of written comments submitted to the USPTO

ID	Name
WT1	AIPLA
WT2	Pete Antros
WT3	Alex Bell
WT4	Bob Zeidman
WT5	Deja Castro
WT6	Valerie Carbone
WT7	Elizabeth Crouch
WT8	John D'Agostino
WT9	Sen. Dianne Feinstein
WT10	Curt Flowers
WT11	Rachel Fox
WT12	Clinton Gallagher
WT13	Laura Hayes
WT14	IBM
WT15	Chauntel Jackson
WT16	Laura Myers
WT17	NEIP
WT18	Martin Nguyen
WT19	Brian Aumiller
WT21	Danny Briere
WT23	Tesia Thomas
WT24	Dr. Stephanie Couch
WT25	Facebook
WT26	Robin Feldman
WT27	Alberto Ratmiroff

ID	Name
WT28	David Clark
WT29	Thomas Riederer
WT30	Britten Sessions
WT31	AJ Beal
WT32	Dr. Keir Finlow-Bates
WT33	AAMC AAU APLU AUTM COGR
WT35	Ronald Zhang
WT36	ABA IPL
WT37	Susan Armstrong
WT38	Dr. Dedric Carter
WT39	Braxton Davis
WT40	Dr. Chris Ford
WT41	Miers Goldman
WT42	Justin Hughes
WT43	Rowland Martin
WT44	Jeff Hardin and Patricia Duran
WT45	Paul Morinville
WT46	Colleen Chien
WT47	Brian Pomper
WT48	US Inventor
WT49	Saurabh Vishnubhakat et al.
WT50	Dr. Kevin Walters
WT51	Kimberley Wesley
WT54	Pat Brown

*Note: Only written comments are cited when duplication in content occurred between oral and written comments by the same respondent.

Appendix B: Literature search strategy

To identify the literature for this report, the USPTO queried multiple databases, including those available through the USPTO's Scientific & Technical Information Center and the Internet. Purposely, the queries were broad in order to be as inclusive as possible. The literature identified through the queries was narrowed to focus on peer-reviewed academic literature, government reports, and other academic literature in an effort to identify the most credible sources. In addition, several sources were added to the study directly from the oral and written comments, as well as congressional hearings on the topic of underrepresentation in patenting. Finally, web pages and curricula vitae from the identified authors in the previous searches were used to identify additional literature on the demographics of inventor-patentees and their small businesses. These approaches yielded two hundred studies for further examination.

The papers and sources were then classified into several groups based upon the nature of the study. In particular, the USPTO focused on literature studying the demographics of individual U.S. inventor-patentees and small business owners. The focus was on U.S. inventor-patentees based on the description provided in the SUCCESS Act.

The USPTO also visited the webpages of many nonprofit organizations for information relevant to the SUCCESS Act, including: The 50K coalition, National Society of Black Engineers, Society of Hispanic Professional Engineers, Society of Women Engineers, American Indian Science and Engineering Society, Coalition of Hispanic, African and Native Americans for the Next Generation of Engineers and Scientists, Institute for Broadening Participation, National Action Council for Minorities in Engineering, Society for Advancement of Chicanos and Native Americans in Science, National Society of Black Physicists, National Organization for the Professional Advancement of Black Chemists and Chemical Engineers, Latinos in Science and Engineering (MAES), National Technical Association, American Association of Blacks in Energy, Black Women in Science and Engineering, American Association of University Women, Association for Women in Science, Veterans of Foreign Wars, Veterans Association of America, Veterans in Society, American Legion, Girl Scouts (the Girl Scouts have an inventor and R&D merit badge), National League of Families of POW/MIA, Rolling Thunder, Women in Technology and Science, Women in Technology, Women in Technology International, and the National Biotechnology and Pharmaceutical Association.

Finally, in addition to the literature and non-profit organization search, the Office of the Chief Economist at the USPTO hosted several authors from the studies identified in the literature review for their Visiting Speaker Series. The purpose was to learn more from scholars in the area of inventor demographics about publicly available data, and other useful resources on the demographics of inventors.[28]

U.S. Patent No. 4,472,728

George Alcorn

X-ray spectrometer

George Alcorn is a pioneering physicist and engineer noted for his aerospace and semiconductor inventions. His x-ray imaging spectrometer, patented during his career at NASA, allowed for the detection of radio signatures at a more distant and accurate rate than previously possible. Alcorn's devices and their descendants have been used to conduct planetary mapping, search for new planets, create star charts to reveal motions of systems, and examine deep space phenomena.

Learn more at www.invent.org
Photo courtesy NASA/Goddard

28 In particular, the USPTO's Office of the Chief Economist hosted Professor Lisa Cook from Michigan State University and Dr. Michael Andrews from the National Bureau of Economic Research.

Appendix C: Public Law 115-273—Oct. 31, 2018

Public Law 115–273
115th Congress

An Act

To direct the Under Secretary of Commerce for Intellectual Property and Director of the United States Patent and Trademark Office, in consultation with the Administrator of the Small Business Administration, to study and provide recommendations to promote the participation of women, minorities, and veterans in entrepreneurship activities and the patent system, to extend by 8 years the Patent and Trademark Office's authority to set the amounts for the fees it charges, and for other purposes.

Oct. 31, 2018
[H.R. 6758]

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

Study of Underrepresented Classes Chasing Engineering and Science Success Act of 2018.
15 USC 1 note.

SECTION 1. SHORT TITLE.

This Act may be cited as the "Study of Underrepresented Classes Chasing Engineering and Science Success Act of 2018" or the "SUCCESS Act".

SEC. 2. FINDINGS; SENSE OF CONGRESS.

(a) FINDINGS.—Congress finds the following:

(1) Patents and other forms of intellectual property are important engines of innovation, invention, and economic growth.

(2) Many innovative small businesses, which create over 20 percent of the total number of new jobs created in the United States each year, depend on patent protections to commercialize new technologies.

(3) Universities and their industry partners also rely on patent protections to transfer innovative new technologies from the laboratory or classroom to commercial use.

(4) Recent studies have shown that there is a significant gap in the number of patents applied for and obtained by women and minorities.

(b) SENSE OF CONGRESS.—It is the sense of Congress that the United States has the responsibility to work with the private sector to close the gap in the number of patents applied for and obtained by women and minorities to harness the maximum innovative potential and continue to promote United States leadership in the global economy.

SEC. 3. REPORT.

(a) STUDY.—The Director, in consultation with the Administrator and any other head of an appropriate agency, shall conduct a study that—

(1) identifies publicly available data on the number of patents annually applied for and obtained by, and the benefits of increasing the number of patents applied for and obtained

by women, minorities, and veterans and small businesses owned by women, minorities, and veterans; and

(2) provides legislative recommendations for how to—

(A) promote the participation of women, minorities, and veterans in entrepreneurship activities; and

(B) increase the number of women, minorities, and veterans who apply for and obtain patents.

(b) REPORT.—Not later than 1 year after the date of the enactment of this Act, the Director shall submit to the Committees on the Judiciary and Small Business of the House of Representatives and the Committees on the Judiciary and Small Business and Entrepreneurship of the Senate a report on the results of the study conducted under subsection (a).

SEC. 4. EXTENSION OF FEE-SETTING AUTHORITY.

Section 10(i)(2) of the Leahy-Smith America Invents Act (Public Law 112–29; 125 Stat. 319; 35 U.S.C. 41 note) is amended by striking "7-year" and inserting "15-year".

SEC. 5. DEFINITIONS.

In this Act:

(1) ADMINISTRATOR.—The term "Administrator" means the Administrator of the Small Business Administration.

(2) AGENCY.—The term "agency" means a department, agency, or instrumentality of the United States Government.

(3) DIRECTOR.—The term "Director" means the Under Secretary of Commerce for Intellectual Property and Director of the United States Patent and Trademark Office.

Approved October 31, 2018.

LEGISLATIVE HISTORY—H.R. 6758:

HOUSE REPORTS: No. 115–966 (Comm. on the Judiciary).
CONGRESSIONAL RECORD, Vol. 164 (2018):
Sept. 25, considered and passed House.
Oct. 11, considered and passed Senate.
DAILY COMPILATION OF PRESIDENTIAL DOCUMENTS (2018):
Oct. 31, Presidential statement.

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