Innovation and Intellectual Property among Women Entrepreneurs

A Report on Women's Business Ownership

INSTITUTE FOR WOMEN'S POLICY RESEARCH

About This Report

This report investigates differences in women- and men-owned firms' intellectual property holdings (including patents), their research and development activities, product innovations, and the relationships between innovative activities and business outcomes such as revenues and access to capital and start-up funding. The report also presents analysis of the characteristics of female and male- owned employer firms, including their size and industry locations.

Analysis presented in the report rely on data from the Annual Survey of Entrepreneurs, a relatively new dataset available through the U.S. Census Bureau, that includes data on businesses' innovation activities disaggregated by gender, and by race and ethnicity.

This report is part of a series of IWPR reports on women and innovation, including *Closing the Gender Gap in Patenting, Innovation, and Commercialization: Programs Promoting Equity and Inclusion,* which profiles programs working to increase gender diversity in patenting, innovation, and entrepreneurship. Both were produced with support from Qualcomm, Inc.

About the Institute for Women's Policy Research

The Institute for Women's Policy Research (IWPR) conducts and communicates research to inspire public dialogue, shape policy, and improve the lives and opportunities of women of diverse backgrounds, circumstances, and experiences. The Institute's research strives to give voice to the needs of women from diverse ethnic and racial backgrounds across the income spectrum and to ensure that their perspectives enter the public debate on ending discrimination and inequality, improving opportunity, and increasing economic security for women and families. The Institute works with policymakers, scholars, and public interest groups to design, execute, and disseminate research and to build a diverse network of individuals and organizations that conduct and use women-oriented policy research. IWPR's work is supported by foundation grants, government grants and contracts, donations from individuals, and contributions from organizations and corporations. IWPR is a 501(c)(3) tax-exempt organization that also works in affiliation with the Program on Gender Analysis in Economics at American University.

Acknowledgements

The authors thank IWPR Senior Research Associate Elyse Shaw, who reviewed an early draft. Annie Rorem, former Director of Research at the National Women's Business Council, and Elisabeth Jacobs, Ph.D., Senior Director at the Washington Center for Equitable Growth, reviewed the report and provided helpful feedback. IWPR Mariam K. Chamberlain Fellow Erika Jauregui fact-checked the report. Jennifer Clark, Director of Communications at IWPR, and Nicolas Martinez, Communications Associate, oversaw the dissemination of the report.

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July 19, 2018

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Introduction

Intellectual property rights recognize unique "creations of the mind" and give inventors the exclusive right to use creations for a specific period of time. At the most fundamental level, intellectual property rights are intended to help foster innovation—they are founded on the assertion that individuals are more likely to develop and disclose inventions if they can be sure their hard work will yield competitive advantage. Yet the benefits of intellectual property are not always equally shared across U.S. society and are often less accessible to women and communities of color.

Women make up growing share of U.S. entrepreneurs, with much of that growth driven by women of color (American Express Open 2017). Women are far less likely than men, however, to hold patents (Milli et al. 2016), which has important implications for their business success, particularly for those in STEM industries, where patents are more common. Similarly, Bell et al. (2016) show that children from minority racial and ethnic groups, apart from Asian children, are much less likely to grow up to be inventors: White children are three times as likely as Black children, and eight times as likely as Hispanic children, to become inventors as adults.

Previous research has found that intellectual property rights, including patents, can play an important role in business success. Many lenders consider patent ownership, or at least having a patent application filed, an important factor in making their funding decisions: patent holders are more likely to receive private equity financing from venture capitalists and typically receive funding more quickly than entrepreneurs who do not hold patents (Häussler, Harhoff, and Mueller 2012; Graham et al. 2009). Patents have also been linked to greater market value among established businesses (Hall, Jaffe, and Trajtenberg 2005). Higher rates of patenting or other intellectual property holdings among women business owners could improve their access to financing and help them achieve their growth aspirations and maximize revenues.

Progress toward gender and racial/ethnic equity in innovation would also benefit society. Diverse contributions are essential to identifying and developing solutions to the pressing problems confronting individual communities and the world more broadly. An array of unique standpoints offer invaluable perspectives for innovation. By integrating more women and people of color into the innovation ecosystem, we will benefit from the contributions of more talented inventors and the ideas, products, and solutions they can develop if provided the opportunity.

Until recently, data on the intellectual property (IP) holdings and other research and development (R&D) activities among entrepreneurs were limited. New data from the Annual Survey of Entrepreneurs, a new survey on employer firms gathered by the Census Bureau, however, provide an unprecedented opportunity to examine a broad array of IP holdings, patenting activity, and R&D activities among entrepreneurs by gender, and by race and ethnicity. This report documents participation in these activities among women- and men-owned employer firms and explores how these activities relate to business outcomes, such as funding, revenue,

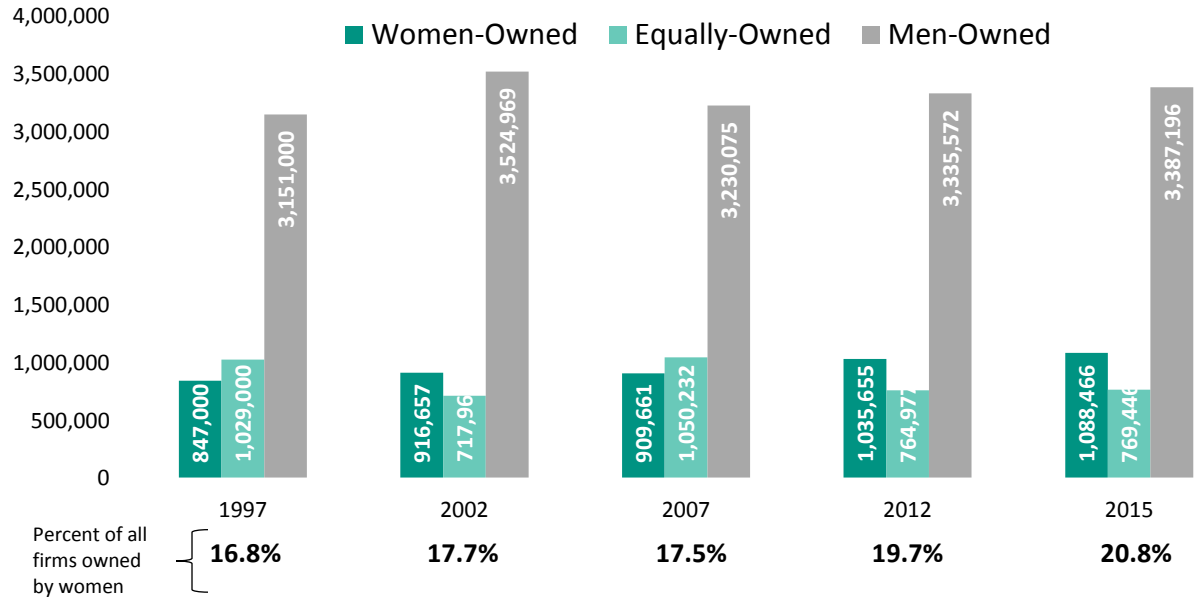
and survival.[1] The report also uses data from the 1997-2010 waves of the Survey of Business Owners to discuss women's representation as entrepreneurs over time.

This report begins with an overview of trends in women's business ownership and women business owners' demographic characteristics and the types of businesses they own. It then explores differences in women's and men's IP holdings and R&D activities. Finally, it examines their business outcomes, linking them to innovative activities where possible.

[1] The Annual Survey of Entrepreneurs surveys only employer firms in the United States. The data presented in this report, gathered in 2014 and 2015, are for the population of nonfarm businesses with paid employees other than the owner and receipts of at least $1,000. Business ownership is defined as owning at least 51 percent of the stock or equity in the business. The report alternates between using the terms "women-owned business," "women-owned firms," and "women-owned employer firms/businesses," and in all cases means those firms that meet the requirements set out here, unless otherwise specified. See Appendix 2 at the end of this report for more information.

Women-owned businesses grew at nearly four times the rate of men-owned businesses between 1997 and 2015, but constituted only 21 percent of employer firms in 2015.

Figure 1. Number and Share of Firms by Gender of Ownership, 1997-2015



Note: Data for each year include nonfarm businesses with paid employees other than the owner and receipts of at least $1,000. Business ownership is defined as owning at least 51 percent of the stock or equity in the business.
Source: IWPR analysis of the 1997-2012 Survey of Business Owners and 2015 Annual Survey of Entrepreneurs.

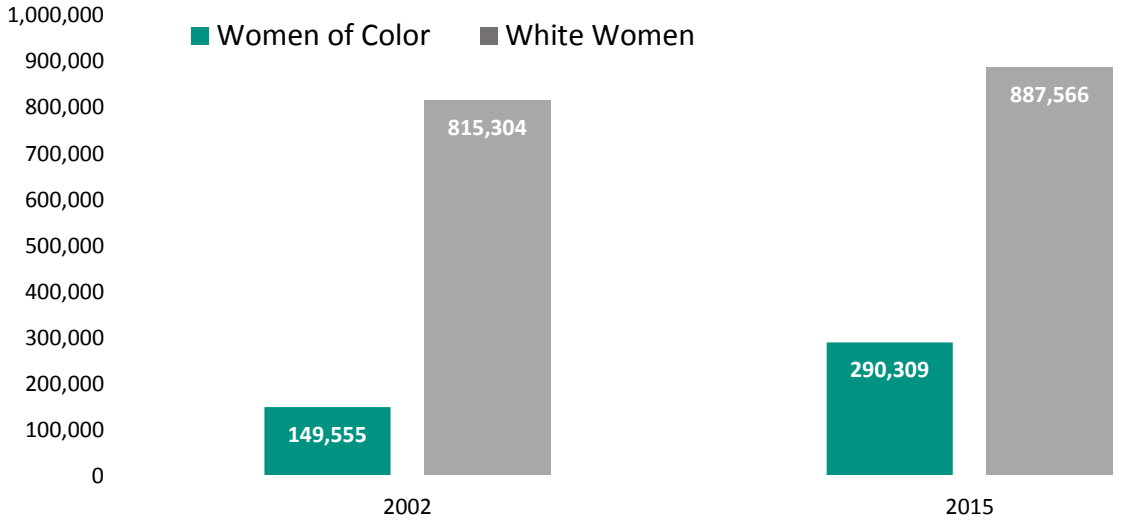
Women are increasingly likely to own businesses. In 1997, women owned 847,000 employer firms in the United States, and by 2015 this number had increased to 1.1 million, compared with an increase from 3.1 million firms owned by men in 1997 to 3.4 million in 2015 (Figure 1). In the nearly two decades between 1997 and 2015, women-owned businesses grew faster than men-owned businesses in both absolute and relative terms, with the number of employer firms owned by women increasing at nearly four times the rate of men-owned firms (28.5 percent compared with 7.5 percent; calculations based on data in Figure 1).

The share of employer firms owned by women has also increased, though women are still dramatically underrepresented among employers. In 1997, just 16.8 percent of all employer firms were owned by women, but by 2015, that share had increased to 20.8 percent (Figure 1). While the focus of this report is on employer-owned firms (businesses with paid employees other than the owner), when considering all firms, including non-employer firms (those in which the owner

is the sole employee), women-owned firms make up about 36 percent of all firms (Institute for Women's Policy Research 2018a).

Firms owned by women of color are driving most of the growth in women-owned businesses, growing nearly 13 times as quickly as businesses owned by White women.

Figure 2. Number and Share of Women-Owned Firms by Minority-Ownership Status, 2002 and 2015



Note: Firm totals may not sum to the overall total because firms may be double-counted. For example, Hispanics or Latinos may be of any race, including White, and firms are double-counted if they report they are majority-owned by multiple race or ethnic groups. The publically-available data do not allow for separating groups into non-overlapping categories. Women of color include those who self-identify as Hispanic or Latina, Black or African American, Asian, Native Hawaiian or Other Pacific Islander, or Other (in the 2015 data, but not an available category in the 2002 data). Respondents could report multiple race or ethnic groups. Data for each year include nonfarm women-owned businesses with paid employees other than the owner and receipts of at least $1,000. Business ownership is defined as owning at least 51 percent of the stock or equity in the business.
Source: IWPR analysis of the 2002 Survey of Business Owners and 2015 Annual Survey of Entrepreneurs.

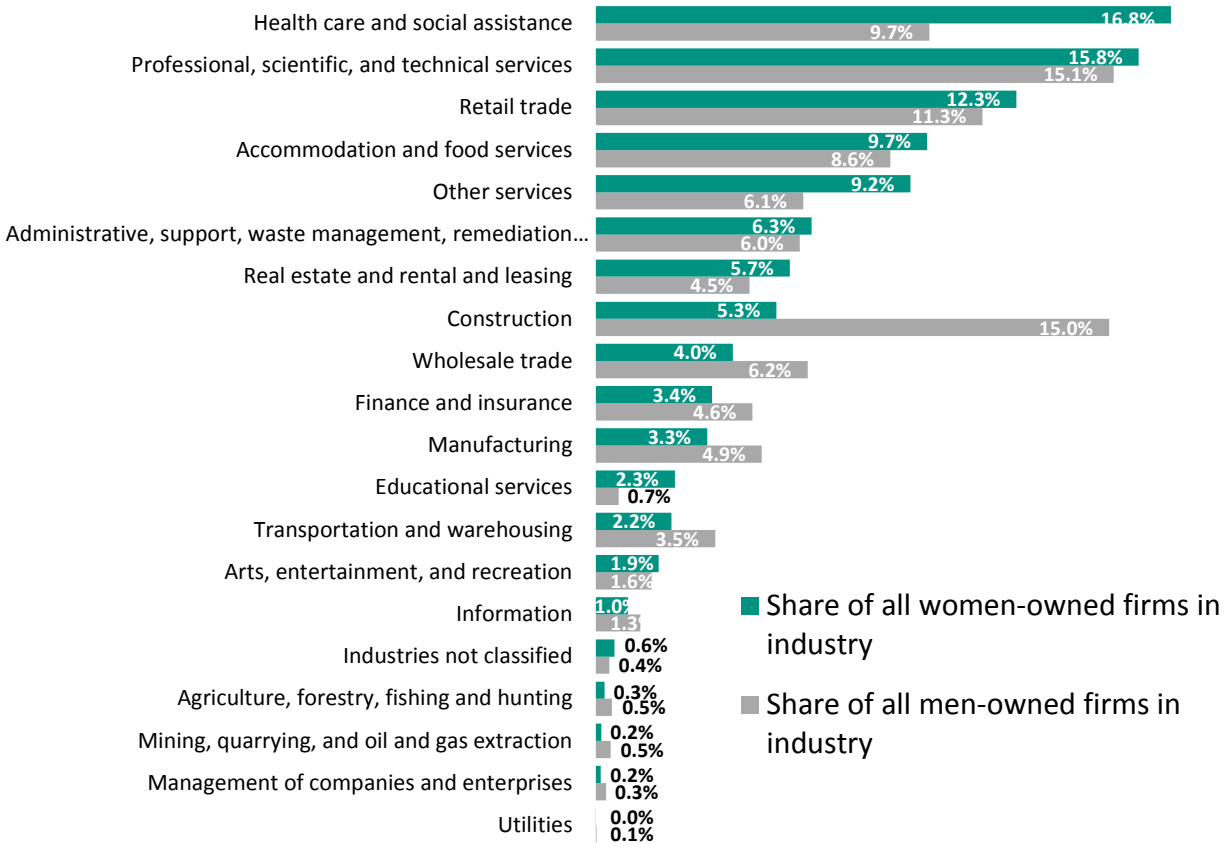
The growth in women-owned businesses has been highest among firms owned by women of color. In 2002, women of color owned 150,000 employer firms, and by 2015 they owned 290,000, an increase of 94.1 percent. In contrast, the number of firms owned by White women increased by only about 72,000 over that same time period (an 8.9 percent increase from 815,304 to 887,566). The growth rate was highest for Asian women business owners, a 105.3 percent increase from 71,177 firms in 2002 to 146,101 in 2015, and for Hispanic women, who saw a 77.1 percent increase in business ownership from 43,142 to 76,383 firms over the period (data not shown). Native Hawaiian and Other Pacific Islander and Black women's ownership also grew substantially, by 66.2 percent and 42.4 percent, respectively, to 554 firms owned by Native Hawaiian and Other Pacific Islander women in 2015, and to 38,478 firms owned by Black women. The growth rate was slowest for American Indian and Alaska Native women, at 6.7

percent (an increase to 7,865 firms in 2015 from 7,372 in 2002), lower than the rate for White women. Finally, as the Survey of Business Owners did not collect data for women of "another race" in 2002, the rate at which they grew to 20,091 firms in 2015 from 2002 is unknown.

In all, increases in the number of businesses owned by women of color accounted for about two-thirds of the overall growth in the number of women-owned businesses over that time period. The share of all women-owned firms owned by women of color grew from 15.5 percent to 24.7 percent between 2002 and 2015 (Figure 2).

While the five most common industries of operation are nearly the same for women- and men-owned firms, women-owned firms are far more likely to operate in health care and men-owned firms are more likely to operate in construction.

Figure 3. Distribution of Women- and Men-Owned Firms, by Industry, 2015

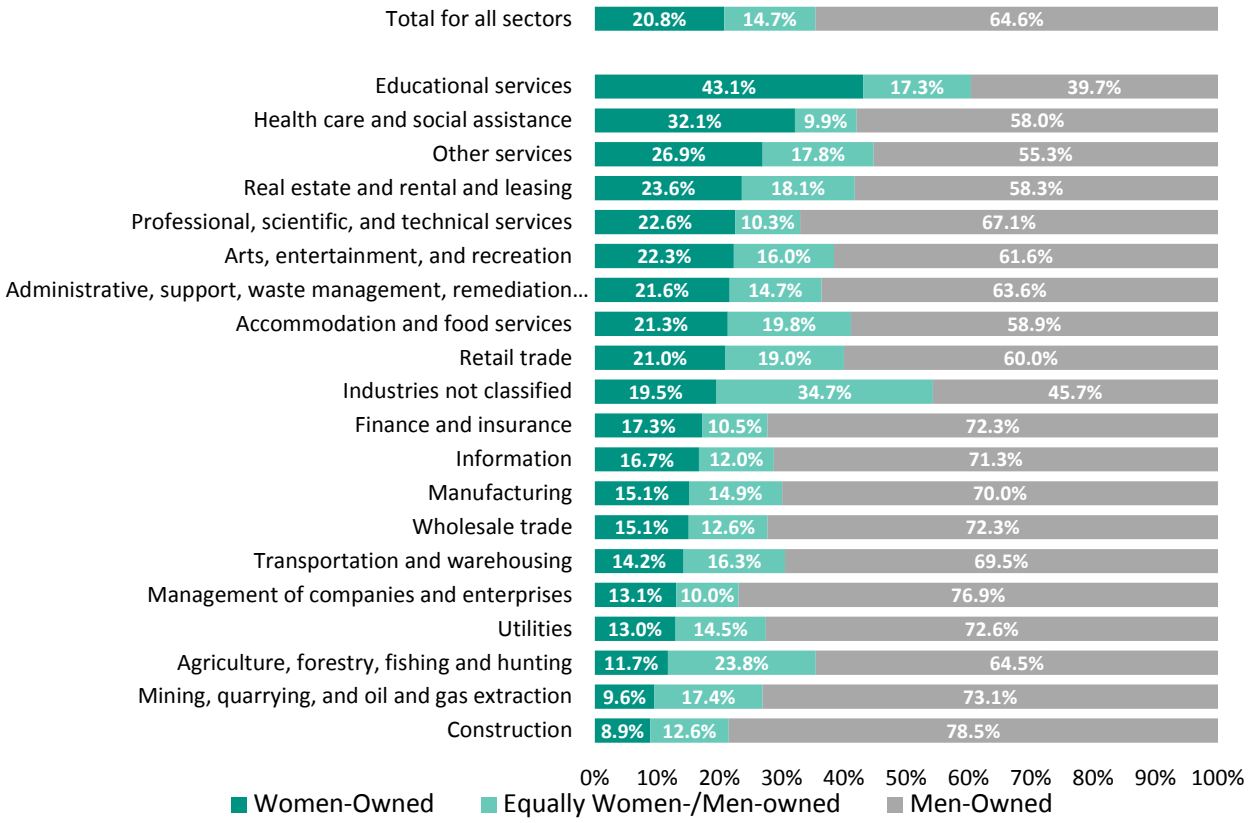


Note: Includes nonfarm businesses with paid employees and receipts of at least $1,000. Business ownership is defined as owning at least 51 percent of the stock or equity in the business.
Source: IWPR analysis of the 2015 Annual Survey of Entrepreneurs.

The top five industries for both women-and men owned businesses are nearly identical: 'Health care and social assistance,' 'Professional, scientific, and technical services,' 'Retail trade,' and 'Accommodation and food services' are all in the top five industries for women- and men-owned businesses. Rounding out the top five for women-owned businesses is the 'other services' industry and for men it is 'Construction.' Though women- and men-owned firms are similarly distributed across industries, there are marked differences in 'Health care and social assistance,' which includes 16.8 percent of women-owned firms but just 9.7 percent of men-owned firms, and 'Construction,' which includes 15.0 percent of men-owned firms and only 5.3 percent of women-owned businesses (Figure 3).

Women business owners are more than a quarter of owners in just three industries: 'Educational services,' 'Health care and social assistance,' and 'Other services.' In no industry do they make up at least half of business owners.

Figure 4. Firms by Gender of Ownership, By Industry, 2015

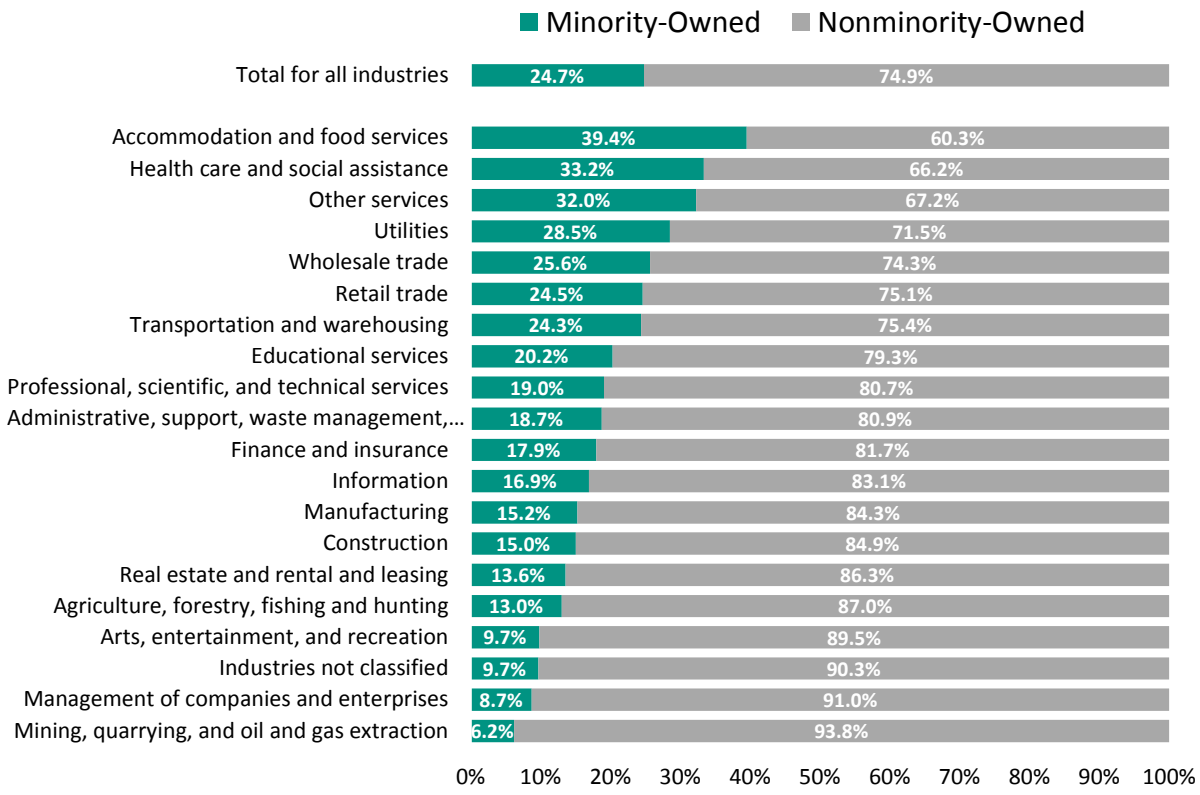


Note: Includes nonfarm businesses with paid employees and receipts of at least $1,000. Business ownership is defined as owning at least 51 percent of the stock or equity in the business.
Source: IWPR analysis of the 2015 Annual Survey of Entrepreneurs.

Women make up less than a quarter of owners in all but three industries, 'Educational services,' 'Health care and social assistance,' and 'Other services.' In contrast, men-owned firms are at least half of businesses in eighteen industries. Women-owned employer firms are just 20.8 percent of employer firms overall, and an additional 14.7 percent of such firms are equally women- and men-owned. In the 'Professional, scientific, and technical services,' 'Information,' and 'Manufacturing' industries (which employ a higher than average share of STEM-related workers; National Women's Business Council 2017), women-owned employer firms are just 20.6 percent of firms, while men-owned employer firms make up 68.0 percent. Men-owned firms are slightly overrepresented in this group, though women-owned firms' share of these fields matches their overall representation in all businesses (Figure 4).

Women of color-owned firms are underrepresented in STEM-related industries, and overrepresented in service industries.

Figure 5. Women-Owned Firms by Minority Ownership Status, by Industry, 2015



Note: Includes women-owned nonfarm businesses with paid employees and receipts of at least $1,000. Business ownership is defined as owning at least 51 percent of the stock or equity in the business. Percentages may not sum to 100% because data for equally minority- and nonminority-owned firms are omitted.
Source: IWPR analysis of the 2015 Annual Survey of Entrepreneurs.

While women of color own 24.7 percent of all women-owned employer firms, they are far more common as businesses owners in health care and service industries. Businesses owned by women of color make up the largest shares of women-owned firms in the 'Accommodation and food services' (39.4 percent), 'Health care and social assistance' (33.2 percent), and 'Other services' (32.0 percent) industries (Figure 5; See Appendix 1 for a glossary with definitions).

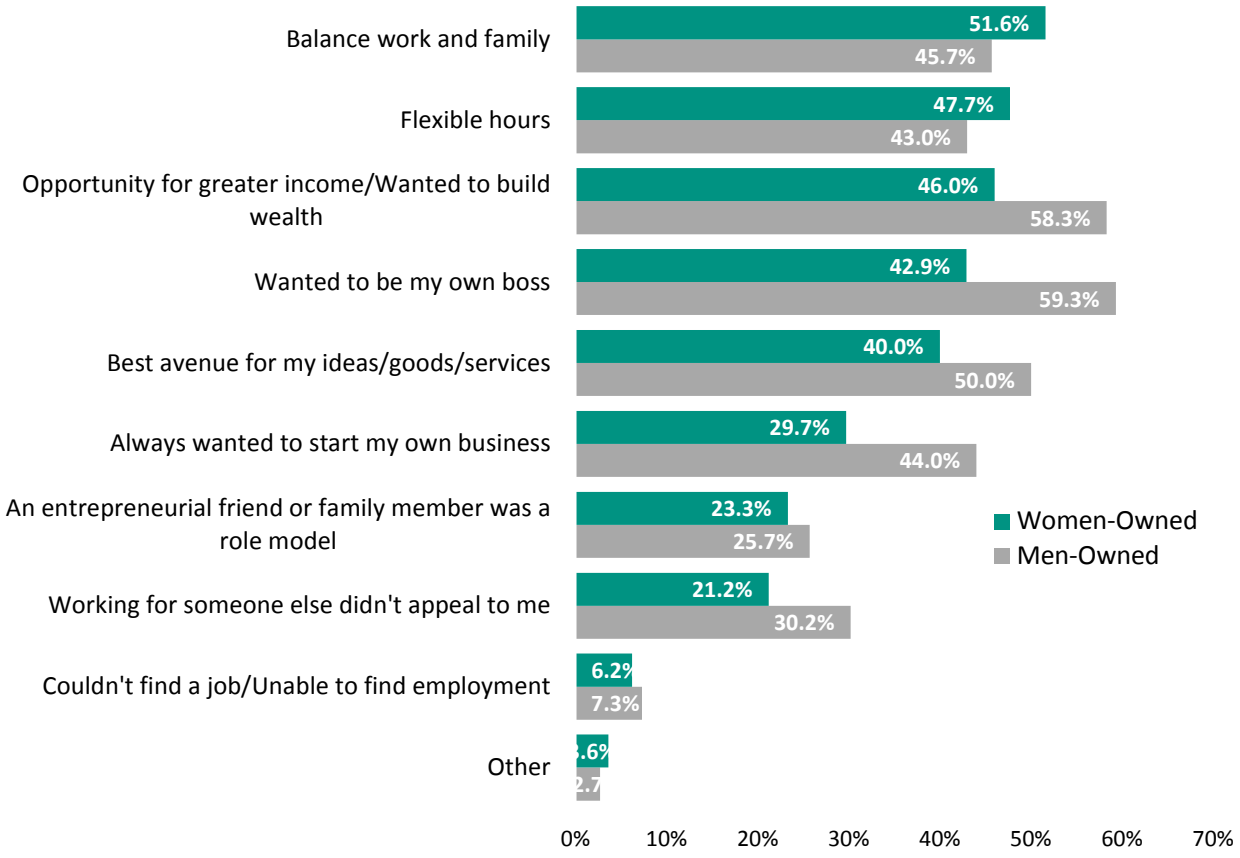
Conversely, the representation of women of color in specific STEM-related industries[2] is lower than their overall representation among business owners. Businesses owned by women of color make up only 19.0 percent of all women-owned businesses in the 'Professional, scientific, and technical services' industry, 16.9 percent of those in 'Information', and 15.2 percent of those in 'Manufacturing' (Figure 5).[3]

[2] Throughout this report, STEM-related industries include 'Information', 'Manufacturing', and 'Professional, Scientific, and Technical Services.' This classification follows National Women's Business Council (2017), and defines STEM-related industries as those with a share of employment in STEM occupations that is above the national average. As the NWBC notes, this definition is limited. Most notably, these industries that are identified as STEM industries employ workers in non-STEM occupations. However, in spite of these limitations, it is still informative to compare businesses and their outcomes in these industries relative to businesses in other industries as a proxy for STEM businesses.

[3] See Appendix 1, for a glossary with definitions of "women of color-owned firms."

Women are more likely to start businesses in a search of better work-life balance, while men want to "be their own boss."

Figure 6. Reasons Entrepreneurs Report as Most Important for Starting Businesses, by Gender, 2015



Note: Includes owners of nonfarm businesses with paid employees and receipts of at least $1,000. Business ownership is defined as owning at least 51 percent of the stock or equity in the business. Data show share of business owners reporting reason to be "very important" in response to the question "How important to [Owner] are each of the following reasons for owning this business?" Business owners could mark more than one reason "very important."
Source: IWPR analysis of the 2015 Annual Survey of Entrepreneurs.

The three most important reasons women report for wanting to own a business are to 'balance work and family' (51.6 percent), work 'flexible hours' (47.7 percent), and the 'opportunity for greater income/wanted to build wealth' (46.0 percent). Among men, the top three reasons are 'wanted to be my own boss' (59.3 percent), the 'opportunity for greater income/wanted to build wealth' (58.3 percent), and feeling that business ownership is the 'best avenue for ideas/goods/services' (50.0 percent). Men were far more likely than women to have simply said that they had the goal of starting their own business (44.0 percent compared with 29.7 percent; Figure 6).

The only two reasons for pursuing business ownership that women are more likely to report than men are better balance between work and family, and flexible hours (Figure 6). These gender

differences suggest that a lack of opportunities and support for work-life balance in traditional wage and salary employment may be an important factor in women's decisions to pursue business ownership.

Female entrepreneurs work fewer hours at their businesses and are less likely to rely on their businesses as their sole source of income.

Table 1. Characteristics of Business Owners by Gender of Ownership, 2014 and 2015

Owner Characteristics	Women-Owned	Men-Owned
Business Acquisition		
Founded or Started	68.4%	70.7%
Inherited	5.0%	3.7%
Purchased	19.3%	21.9%
Transfer of Ownership or Gift	9.6%	6.2%
Age of Owner		
Less than 25	0.5%	0.4%
25 to 34	5.7%	5.3%
35 to 44	17.3%	16.2%
45 to 54	29.2%	27.7%
55 to 64	30.3%	30.7%
65 and over	17.0%	19.6%
Education of Owner		
Less than High School	2.6%	3.6%
High School	18.5%	18.6%
Some College	16.2%	14.3%
Technical, Trade, or Vocational School	5.4%	5.9%
Associate's Degree	7.4%	4.7%
Bachelor's Degree	29.0%	29.2%
Master's, Doctorate, or Professional Degree	20.8%	23.6%
Owner Previously Owned Another Business or Was Self-Employed		
	25.3%	37.0%
Hours Worked at Business per Week		
None	12.4%	8.0%
Less than 20 Hours	20.5%	13.3%
20 to 39 Hours	18.8%	12.7%
40 Hours	14.8%	15.6%
41 to 59 Hours	20.8%	30.7%
60 Hours or More	12.7%	19.7%
Average Number of Employees		
	8	12
Business is Owner's Primary Source of Income		
	62.6%	70.7%
Race of Owner		
White	81.5%	86.9%
Black or African American	3.5%	1.9%
American Indian and Alaska Native	0.7%	0.6%
Asian	13.4%	9.2%
Native Hawaiian and Other Pacific Islander	0.1%	0.1%
Some other race	1.8%	1.9%
Ethnicity of Owner		
Hispanic	7.0%	6.0%
Equally Hispanic/non-Hispanic	0.2%	0.3%
Non-Hispanic	92.8%	93.7%

Note: Includes women- and men-owned nonfarm businesses with paid employees and receipts of at least $1,000. Business ownership is defined as owning at least 51 percent of the stock or equity in the business. Firm totals may not sum to the overall total because firms may be double-counted. For example, Hispanics or Latinos may be of any race, including White, and firms are double-counted if they report they are majority-owned by multiple race or ethnic groups. The publically-available data do not allow for separating groups into non-overlapping categories. Women of color include those who self-identify as Hispanic or Latina, Black or African American, Asian, Native Hawaiian or Other Pacific

Islander, or Other (in the 2015 data, but not an available category in the 2002 data). Respondents could report multiple race or ethnic groups. Source: IWPR analysis of the 2014 and 2015 Annual Survey of Entrepreneurs.

The vast majority of both female and male business owners are 45 or older (76.5 percent and 78.0 percent respectively). Nearly all business owners have completed at least a high school education, and about half of female and male business owners have completed at least a bachelor's degree (49.8 percent and 52.8 percent respectively). Despite having similar levels of formal education, female business owners were less likely than their male counterparts to have had previous business ownership experience (25.3 percent compared with 37.0 percent).

Female business owners are also less likely to rely on their businesses as their primary source of income and tend to work fewer hours at their businesses than men. One third of female business owners worked fewer than 20 hours at their businesses, compared with 21.3 percent of men.

Black and Hispanic women, along with women who identify as 'some other race' are under-represented among women business owners, whereas White and Asian women are over-represented, in comparison to their distribution among women workers overall. American Indian and Alaska Native women's representation among business owners, on the other hand, is roughly comparable to their representation among working women overall. In order to establish women of color's relative underrepresentation (or overrepresentation) among business owners, we compared their share of all businesses owned by women with their share of all working women aged 16 and older from the 2015 American Community Survey. While data on racial and ethnic groups available through the American Community Survey do not align perfectly with the definitions used in the ASE data, as the ASE racial groups are non-Hispanic, do not overlap (that is, each person is counted under one race or ethnicity alone), and do not include Native Hawaiian and Other Pacific Islanders, disparities in representation are apparent.[4]

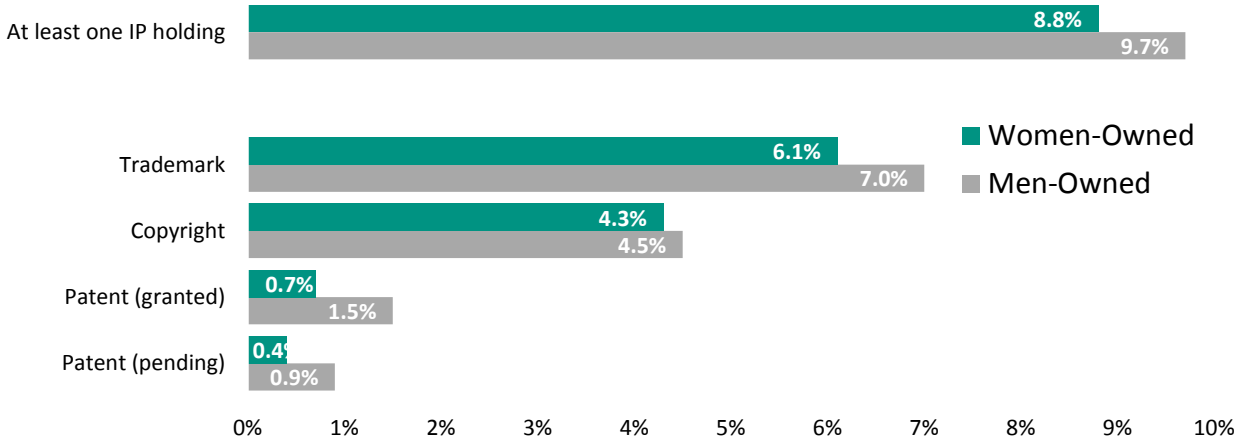
Black women were 13.1 percent of women working nationally in 2015, but just 3.5 percent of women business owners. Hispanic women made up 15.13 percent of the national population of employed women, but 7.0 percent of women business owners in 2015. Conversely, in 2015, 73.7 percent of all employed women aged 16 and over were White, but 81.5 percent of women business owners were White. Interestingly, Asian women are also disproportionately represented among business owners, with 5.9 percent of all working women identifying as Asian or Pacific Islander but 13.5 percent of all business owners identifying as such. Finally, Native American women have roughly the same representation among women business owners and employed women (0.7 percent each; Table 1; (Institute for Women's Policy Research 2018b).

[4] The comparisons between racial and ethnic groups are not exactly comparable and should be interpreted as approximations. Hispanic women in both surveys can also be listed under different racial groups, and may be double counted. While both surveys allow respondents to select multiple races, the ASE does not create a separate category for multi-racial business owners but the American Community Survey does. According to the 2015 American Community Survey, men and women identifying as multi-racial make up only 2.3 percent of the employed population aged 16 and older. Because this population is so small relative to the entire population, it is unlikely that the differences in how this group is defined between the two surveys would significantly influence comparisons.

Intellectual Property Holdings and Research and Development Activities among Women Business Owners

Women-owned businesses are less likely to hold any intellectual property than are men-owned businesses. Men-owned businesses are twice as likely to have a granted patent.

Figure 7. Share of Women- and Men-Owned Businesses with Intellectual Property Holdings, 2015



Note: Includes nonfarm businesses with paid employees and receipts of at least $1,000. Business ownership is defined as owning at least 51 percent of the stock or equity in the business. Percentages may not add to totals because firms may hold more than one type of intellectual property.
Source: IWPR analysis of the 2015 Annual Survey of Entrepreneurs.

Female entrepreneurs are less likely than male entrepreneurs to hold any intellectual property rights (8.8 percent compared with 9.7 percent). Of the different types of intellectual property, trademarks and copyrights are the most common among both women- and men-owned businesses, with only minimal gender differences in copyright holdings (4.3 percent of women employers and 4.5 percent of men-owned businesses held a copyright).

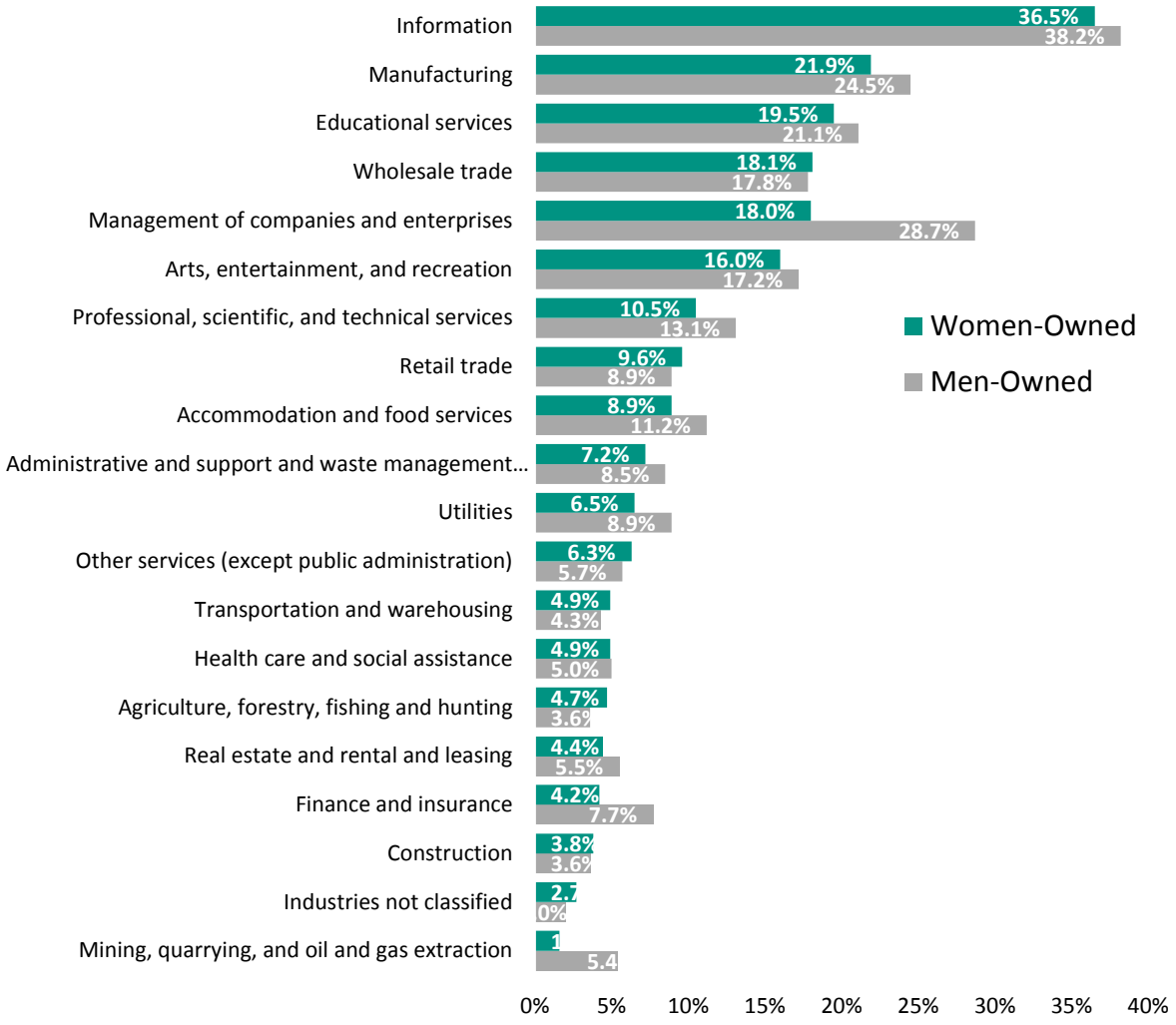
Patents, both granted and pending, are the least common form of intellectual property among business owners, but substantial gender differences in patenting exist. Men-owned businesses are twice as likely as women-owned businesses to have either a granted patent (1.5 percent compared with 0.7 percent) or a pending patent (0.9 percent compared with 0.4 percent).

Though the ASE data are not disaggregated by both gender and race and ethnicity, the data show that people of color are particularly unlikely to hold intellectual property. All but one racial and ethnic group report lower shares of IP holdings than White-owned firms. Shares of firms holding IP range from 7.4 percent of firms owned by people of "some other race" to 9.1 percent of firms owned by Native Hawaiian and Other Pacific Islander people. In contrast, 9.6 percent of businesses owned by White people report any intellectual property holdings. A slightly higher rate, 9.9 percent, of firms owned by American Indian and Alaska Native people report IP

holdings. Given these trends, the share of firms owned by women of color with intellectual property is likely even lower than the shares for all women or all people of color (Appendix 3).

Women-owned businesses are less likely to hold intellectual property rights in 13 out of 20 industries, which include most IP-intensive industries.

Figure 8. Share of Firms with Any Intellectual Property Holdings, by Gender of Ownership, 2015



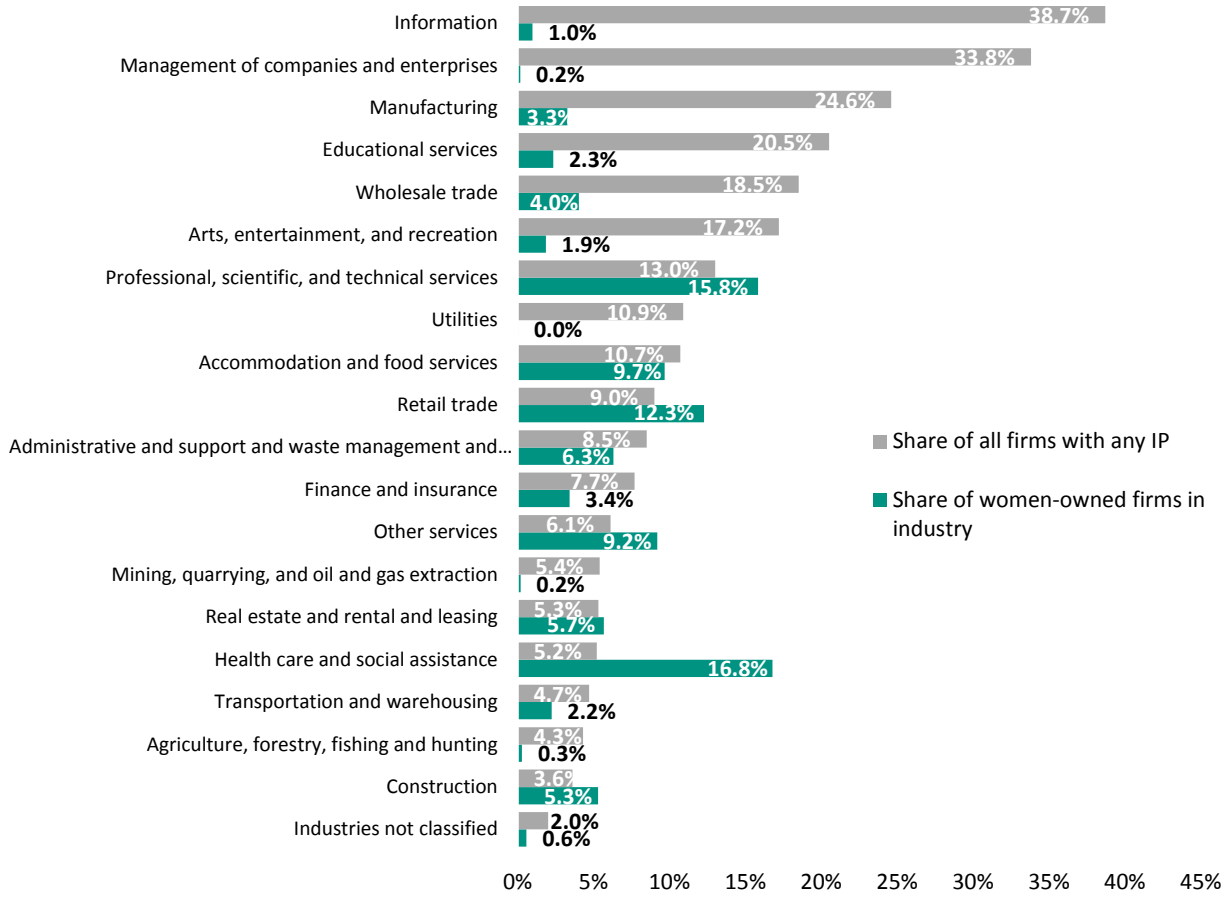
Note: Includes nonfarm businesses with paid employees and receipts of at least $1,000. Business ownership is defined as having at least 51 percent of the stock or equity in the business. Firms may one more than one type of intellectual property holding.
Source: IWPR analysis of the 2015 Annual Survey of Entrepreneurs.

In 13 of 20 industries, women-owned firms are less likely than men-owned firms to hold intellectual property. The largest percentage point difference is in 'Management of companies

and enterprises,' where 28.7 percent of men-owned but just 18.0 percent of women-owned firms hold any type of intellectual property, a gap of 37.3 percent. In contrast, women-owned firms are slightly more likely than men-owned businesses to hold intellectual property in 'Agriculture, forestry, fishing and hunting,' though only 0.3 percent of women-owned firms operate in this industry. While women-owned firms hold larger shares of intellectual property than men-owned firms in seven industries, six of these industries have lower levels of intellectual property holdings than average.

The four industries with the highest shares of intellectual property holdings include 6.7 percent of women-owned businesses, compared with 7.2 percent of men-owned businesses.

Figure 9. Share of Firms with Any Intellectual Property and Distribution of Women-Owned Firms by Industry, 2015



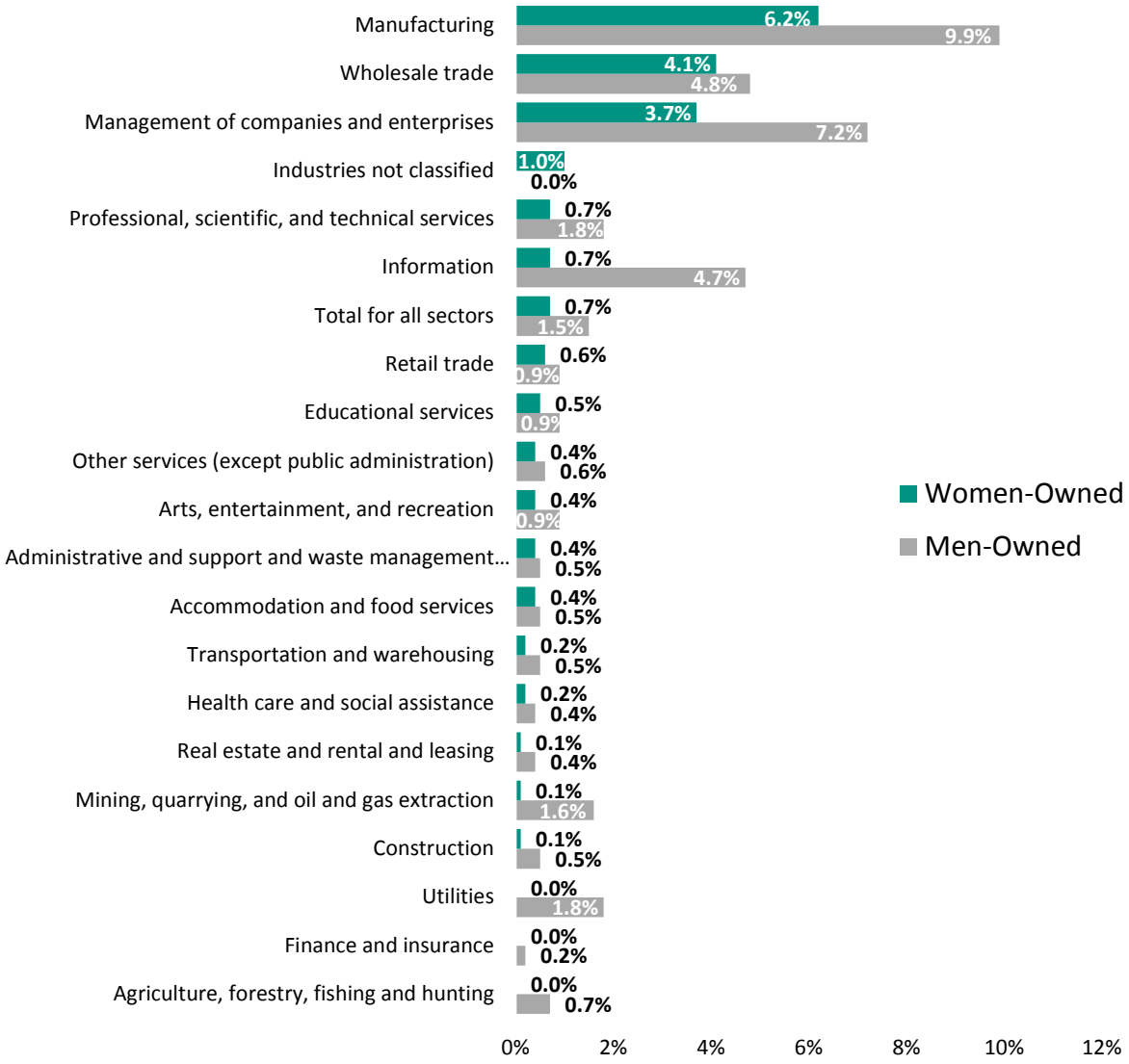
Note: Includes nonfarm businesses with paid employees and receipts of at least $1,000. Business ownership is defined as having at least 51 percent of the stock or equity in the business.
Source: IWPR analysis of the 2015 Annual Survey of Entrepreneurs.

Intellectual property rights are particularly common in the 'Information,' 'Management of Companies and Enterprises,' 'Manufacturing,' and 'Educational Services' industries—38.7 percent, 33.8 percent, 24.6 percent, and 20.5 percent of all firms operating in these industries hold at least one type of intellectual property, respectively. Women entrepreneurs are less common than male entrepreneurs within these industries, with 6.7 percent of all women-owned businesses operating in these industries, compared with 7.2 percent of men-owned businesses. On the other hand, intellectual property rights are less common in the 'Industries not classified,' 'Construction,' 'Agriculture, forestry, fishing, and hunting,' 'Transportation and warehousing,' and 'Health care and social assistance' industries, over a quarter of both women- and men-owned firms operate in these industries (Figure 9; data for men-owned firms not shown).

Previous research has suggested that a lack of women in STEM fields (which tend to be more patent-intensive) may partially explain the relative underrepresentation of women in patenting. To explore the relationship between women's representation as business owners within industries and the share of firms in each industry holding intellectual property, IWPR calculated the correlation coefficient between these two variables. The analysis yielded a correlation coefficient of -0.27, which indicates a statistically significant negative but weak relationship between the two variables. This suggests that factors in addition to women's under-representation in STEM are likely to be contributing to women's lower likelihood of holding intellectual property.

Men-owned businesses are nearly seven times as likely as women-owned firms to hold a patent in the 'Information' industry, and sixteen times as likely to hold a patent in the 'Mining, Quarrying, and Oil and Gas Extraction' industry.

Figure 10. Share of Women and Men-Owned Firms with a Patent Granted, 2015



Note: Includes nonfarm businesses with paid employees and receipts of at least $1,000. Business ownership is defined as owning at least 51 percent of the stock or equity in the business.
Source: IWPR analysis of the 2015 Annual Survey of Entrepreneurs.

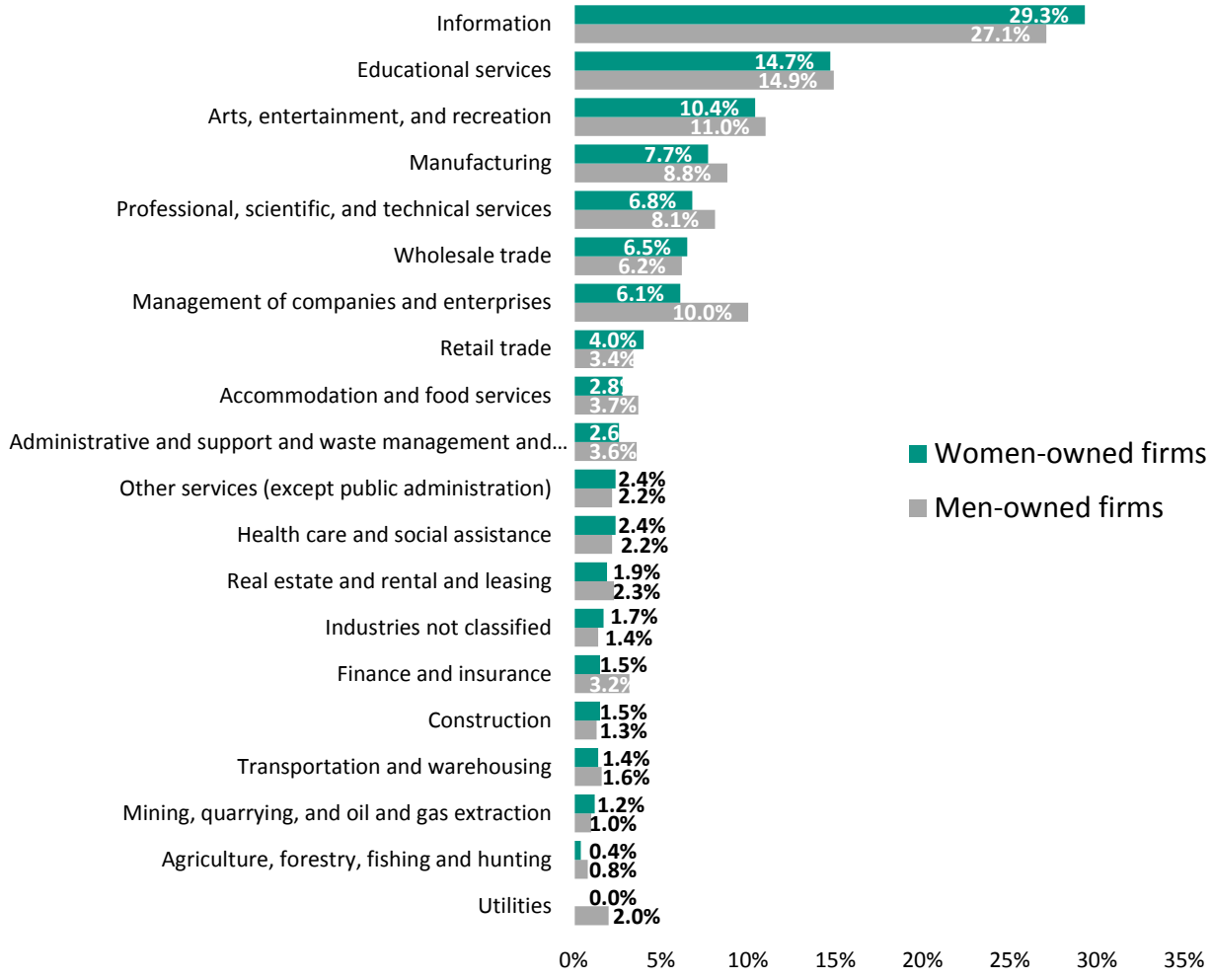
While only 0.7 percent of women-owned businesses have at least one granted patent, patents are more common among those businesses operating in the 'Manufacturing,' 'Wholesale trade,' and 'Management of companies and enterprises' industries—6.2 percent, 4.1 percent, and 3.7 percent of women-owned businesses hold at least one patent in these industries respectively. These

industries are also among the most patent-intensive among men-owned businesses, but men-owned businesses in the ‘Information’ industry also tend to patent at higher rates (4.7 percent of men-owned businesses in this industry hold at least one patent as compared with 0.7 percent of women-owned businesses; Figure 10).

Men-owned businesses are twice as likely as women-owned businesses to hold a patent, though these gender differences are more pronounced in certain industries—especially those that are most patent intensive. In the ‘Information’ industry, men-owned firms are nearly seven times as likely to hold a patent, in ‘Manufacturing’ they are more than one and a half times as likely, and in ‘Management of companies and enterprises’ they are nearly twice as likely. In the ‘Mining, quarrying, and oil and gas extraction’ industry, which is less patent-intensive, men-owned businesses are sixteen times as likely as women-owned businesses to hold a patent (1.6 percent compared with 0.1 percent; Figure 10).

Women- and men-owned businesses are almost equally likely to hold copyrights overall, and in eight industries, women-owned businesses are *more* likely to hold copyrights.

Figure 11. Share of Women- and Men-owned Firms Holding a Copyright, 2015



Note: Includes nonfarm businesses with paid employees and receipts of at least $1,000. Business ownership is defined as owning at least 51 percent of the stock or equity in the business.
Source: IWPR analysis of the 2015 Annual Survey of Entrepreneurs.

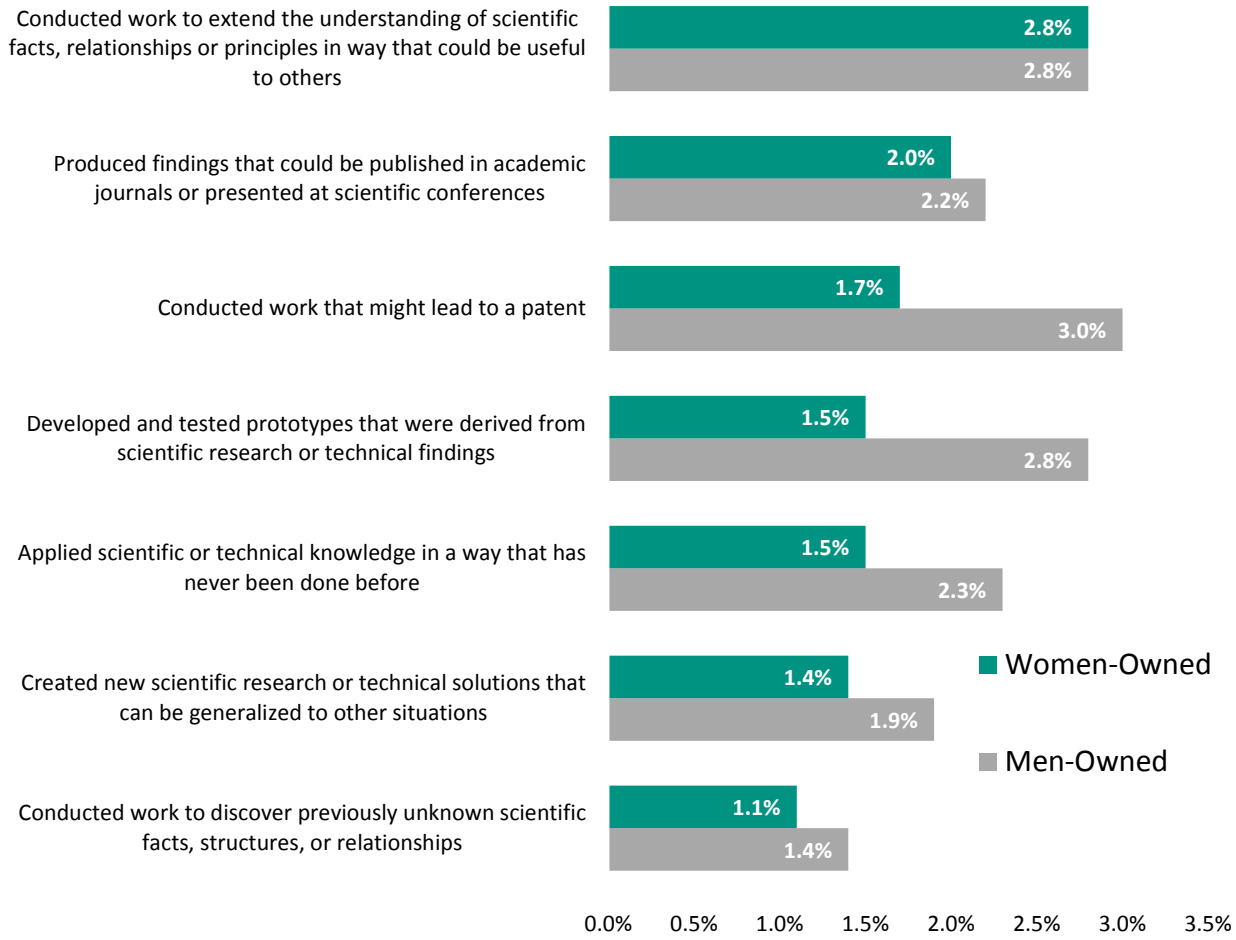
Copyrights are more common among women- and men-owned businesses than patents, and there is virtually no gender difference in the share of copyright holdings by gender—4.3 percent of women-owned firms and 4.5 percent of men-owned firms hold a copyright. In eight industries, women-owned firms are more likely than men-owned firms to hold a copyright, though in some cases the differences are quite small (Figure 11).

Copyrights are far more common in the 'Information' industry than in others—nearly 30 percent of women-owned firms hold a copyright in 'Information' compared with just 4.3 percent of

women-owned businesses overall. Copyrights are also common in the 'Educational Services' and 'Arts, Entertainment, and Recreation' industries, with more than 10 percent of all women-owned businesses holding a copyright (Figure 11).

Women-owned businesses are less likely than men-owned businesses to engage in R&D activities, particularly those involving developing prototypes or that might lead to a patent.

Figure 12. Share of Women- and Men-Owned Businesses Engaging in Research and Development Activities, 2014



Note: Includes nonfarm businesses with paid employees and receipts of at least $1,000. Business ownership is defined as owning at least 51 percent of the stock or equity in the business.
Source: IWPR analysis of the 2014 Annual Survey of Entrepreneurs.

Women-owned businesses are less likely than men-owned businesses to engage in research and development (R&D) activities. These gender differences are particularly pronounced in conducting work that might lead to a patent (1.7 percent of women-owned businesses compared

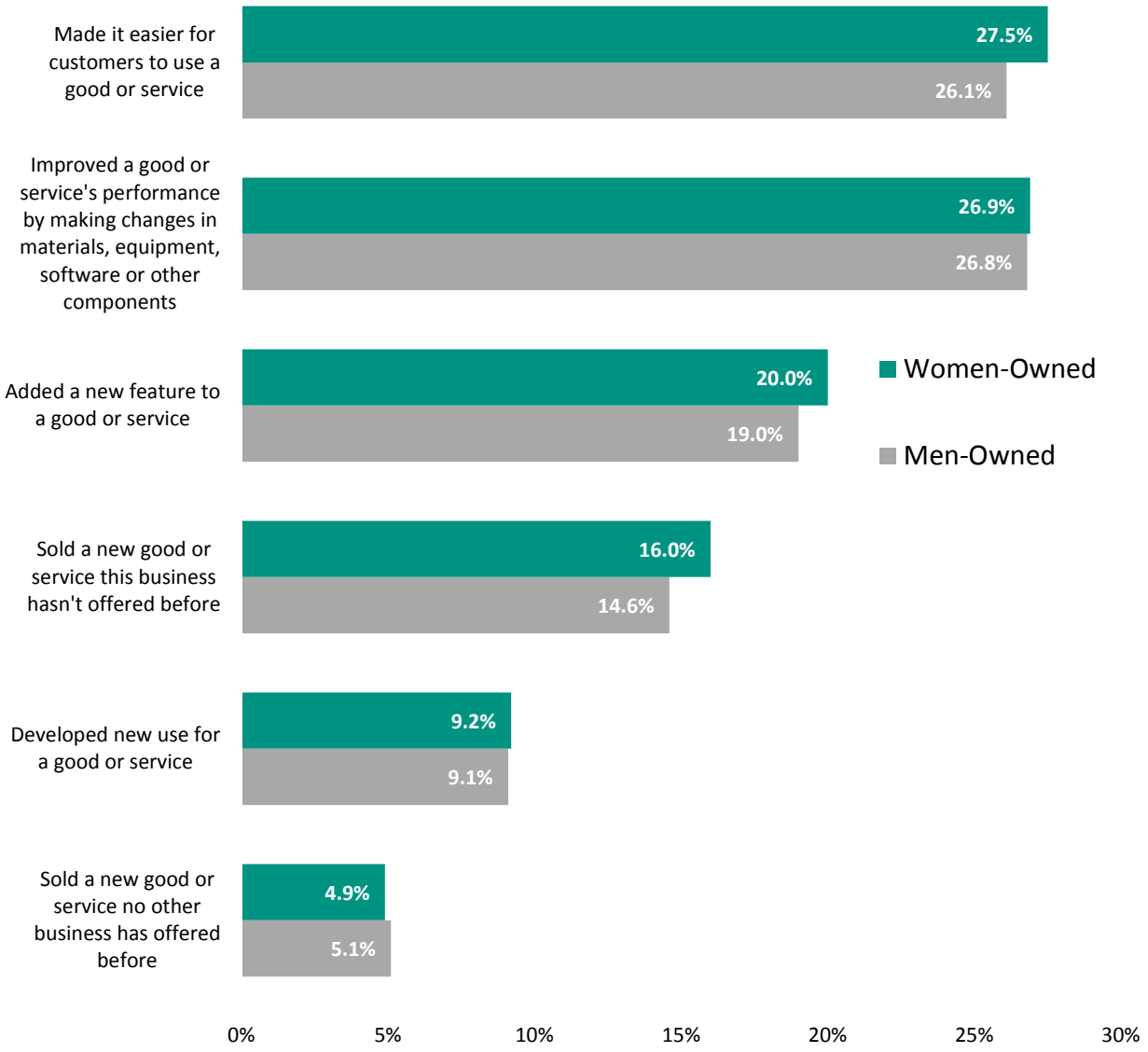
with 3.0 percent of men-owned) and developing and testing prototypes that are derived from scientific research or technical findings (1.5 percent compared with 2.8 percent).[5] Conducting work that might lead to a patent was the most common R&D activity among men-owned businesses (3.0 percent), whereas women-owned businesses were most likely to conduct work to extend the understanding of scientific facts, relationships, or principles in a way that could be useful to others (2.8 percent; Figure 12). Within racial and ethnic groups, the largest share reporting work to develop and test prototypes was among firms owned by Native Hawaiian and Other Pacific Islander people, at 4.8 percent, and the lowest share was among people of "some other race," at 1.5 percent. For work that might lead to a patent, the largest share was 3.6 percent of Asian-owned firms, and the lowest was 1.9 percent of firms owned by people of "some other race"(Appendix 3).

Research and Development activities tend to be more common among businesses operating in intellectual property-intensive industries such as 'Manufacturing,' 'Wholesale Trade,' 'Management of Companies and Enterprises,' 'Professional, Scientific, and Technical Services,' and 'Information' (Institute for Women's Policy Research 2018c). The largest shares of both women- and men-owned firms reporting they conducted work that might lead to a patent are in 'Manufacturing,' at 7.0 percent of women- and 11.3 percent of men-owned firms. The largest disparity between women- and men-owned firms is in the 'Information' industry: just 1.5 percent of women-owned firms, compared with 8.1 percent of men-owned firms reported conducting potentially patentable work. In five industries, virtually no women-owned firms reported this type of work: 'Real estate and rental and leasing;' 'Industries not classified;' 'Agriculture, forestry, fishing, and hunting;' 'Mining, quarrying, and oil and gas extraction;' and 'Utilities' (Figure 12).

[5] As these data on the goals of work conducted in a firm are self-reported by respondents, there may be a gender bias in the patterns. Women scientists may be less likely to identify their work as potentially leading to a patent, even when engaging in similar work as men. Thus, women could be systematically less likely to report, for example, that their work 'might lead to a patent' or 'could be published in academic journals,' even if their work could equally merit those outcomes.

While women are less likely than men to hold intellectual property rights, they are more likely to engage in product innovations more broadly.

Figure 13. Share of Women- and Men-Owned Businesses Engaged in Product Innovation Activities, 2014



Note: Includes nonfarm businesses with paid employees and receipts of at least $1,000. Business ownership is defined as owning at least 51 percent of the stock or equity in the business.
Source: IWPR analysis of the 2014 Annual Survey of Entrepreneurs.

Despite being less likely to hold intellectual property rights than men, women-owned businesses still report actively engaging in innovative activities and generally do so at rates at least as high as men-owned businesses. Such activities include making it easier for customers to use a good or service (27.5 percent of women-owned firms compared with 26.1 percent of men-owned);

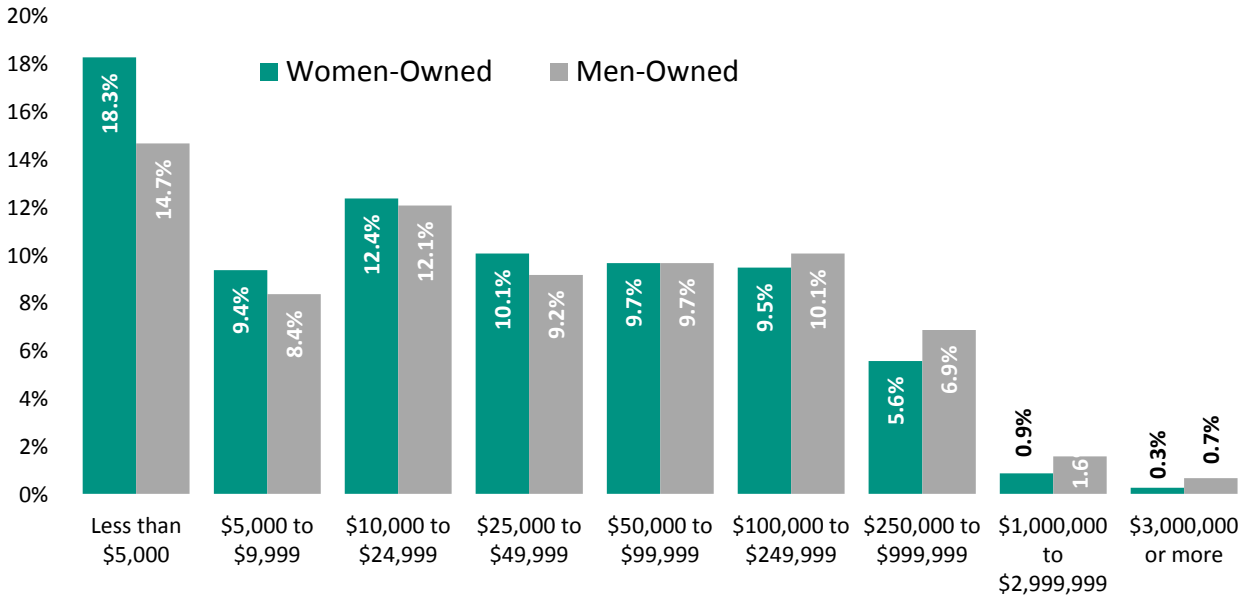
making changes to materials, equipment, software, or other components in order to improve the performance of a good (26.9 percent compared with 26.8 percent); and adding a new feature to a good or service (20.0 percent compared with 19.0 percent; Figure 13). Within specific racial and ethnic groups, the shares of firms reporting they sold a new good or service no other business has offered before range from a low of 4.3 percent of firms owned by Black business owners, to 8.0 percent of firms owned by Native Hawaiian and Other Pacific Islander entrepreneurs. Almost a quarter of firms owned by American Indian and Alaska Native entrepreneurs report adding a new feature to a good or service; the lowest rate on this measure was for White-owned firms and Native Hawaiian and Other Pacific Islander-owned firms, at 18.8 percent (Appendix 3).

Business Outcomes of Women- and Men-Owned Firms across the Lifecycle

This section documents business outcomes among women- and men-owned employer firms, including start-up funding, attempts to establish new funding relationships, average revenues, and business survival, and to the extent possible, makes connections between intellectual property holdings and business outcomes either through analysis of available data or inferences based on existing research literature. The analysis also investigates potential mitigating factors, such as industry of operation, firm size, and revenues. This section is organized around the business lifecycle, beginning with start-up funding, later attempts at attracting financing, moving into average firm revenues, and ending with business survival and closure, for each type of innovative activity. Given data limitations, the authors cannot draw conclusions about causal connections between intellectual property and business outcomes and cannot statistically control for potential mitigating factors predicting relationships between variables. These data should be cautiously understood as identifying potential relationships for more sophisticated analysis in future research, using microdata.

Nearly twice the share of men-owned firms as women-owned firms received at least $1 million in start-up funding.

Figure 14. Women- and Men-Owned Firms by Amount of Start-Up Capital, 2015

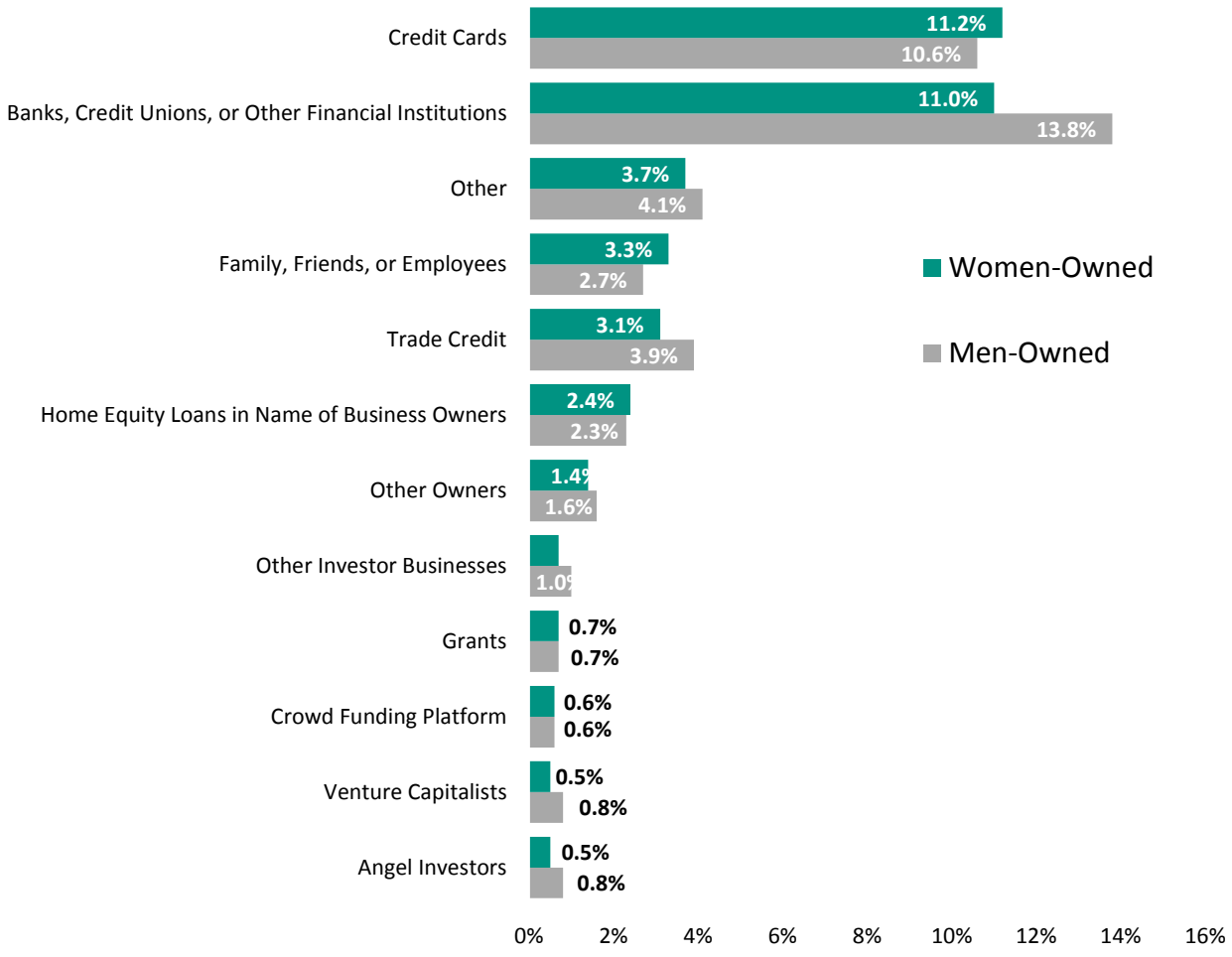


Note: Includes nonfarm businesses with paid employees and receipts of at least $1,000. Business ownership is defined as owning at least 51 percent of the stock or equity in the business.
Source: IWPR analysis of the 2015 Annual Survey of Entrepreneurs.

Women entrepreneurs report lower levels of start-up capital compared with men. Half of women business owners receive less than $50,000 in start-up funding to begin their businesses, while the same is true for 44.4% of men. Almost one in five men-owned firms (19.3 percent) had at least $100,000 in capital, compared with 16.3 percent of women-owned firms. At the highest levels of capital, just 1.2 percent of women, but 2.3 percent of men, receive at least $1 million to start or acquire their firms (Figure 14).

Female entrepreneurs are less likely than their male counterparts to try to establish new funding relationships with venture capitalists, angel investors, and others.

Figure 15. Share of Firms Attempting to Obtain New Funding in the Past Year by Gender of Ownership, 2015.



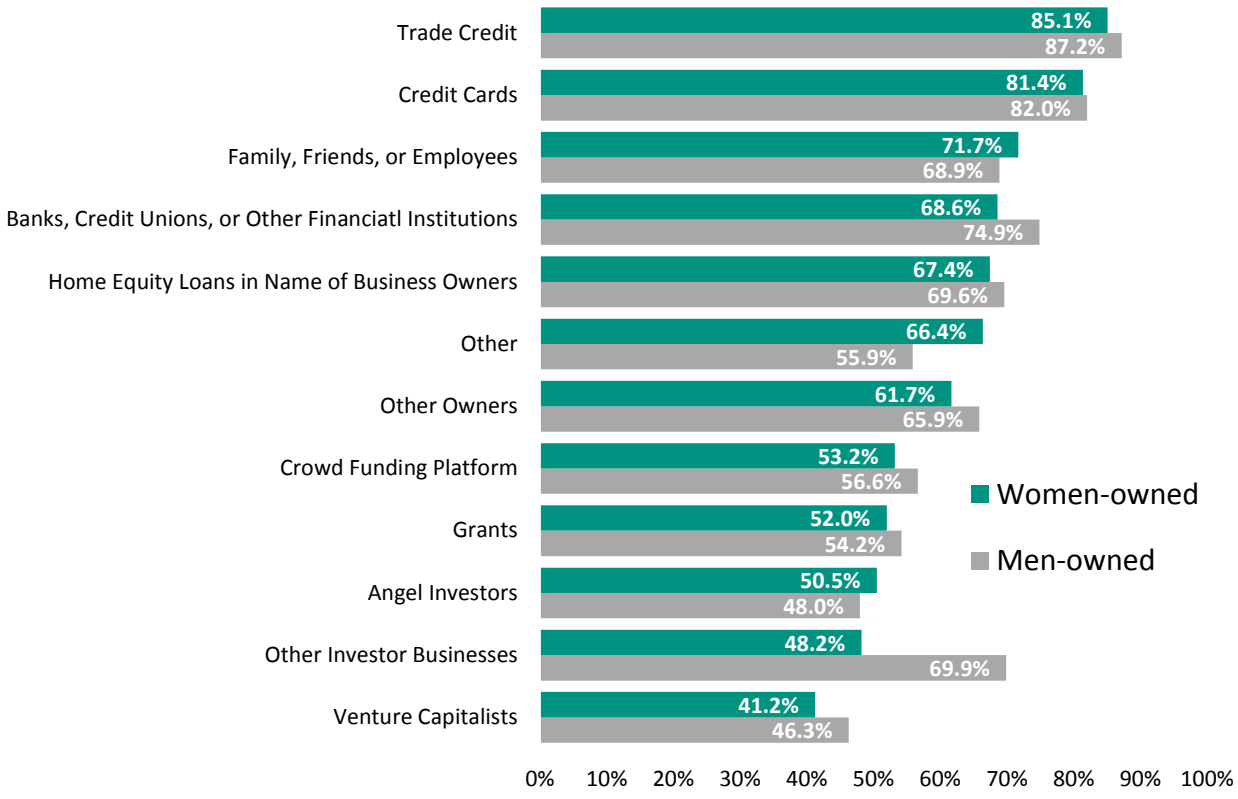
Note: Includes nonfarm businesses with paid employees and receipts of at least $1,000. Business ownership is defined as owning at least 51 percent of the stock or equity in the business.
Source: IWPR analysis of the 2015 Annual Survey of Entrepreneurs.

Women-owned firms are less likely than men-owned firms to report trying to obtain new funding in the past year from banks, credit unions or financial institutions. Women are more likely than men to seek funding from family, friends, or employees, from credit cards, and to apply for home equity loans in their own names (Figure 15).

Few women- and men-owned businesses attempted to establish relationships with venture capitalists in the past year, though men-owned businesses do so at slightly higher rates (0.8 percent of men-owned businesses, compared with 0.5 percent of women-owned businesses).

When they do seek out funds, women-owned businesses are less likely than men-owned businesses to receive the full amount they requested.

Figure 16. Share of Firms Receiving Total Amount of Funding Requested, by Gender of Ownership and Source of Funding, 2015



Note: Includes nonfarm businesses with paid employees and receipts of at least $1,000 that reported they attempted to establish a new funding relationship in the past year. Business ownership is defined as owning at least 51 percent of the stock or equity in the business.
Source: IWPR analysis of the 2015 Annual Survey of Entrepreneurs.

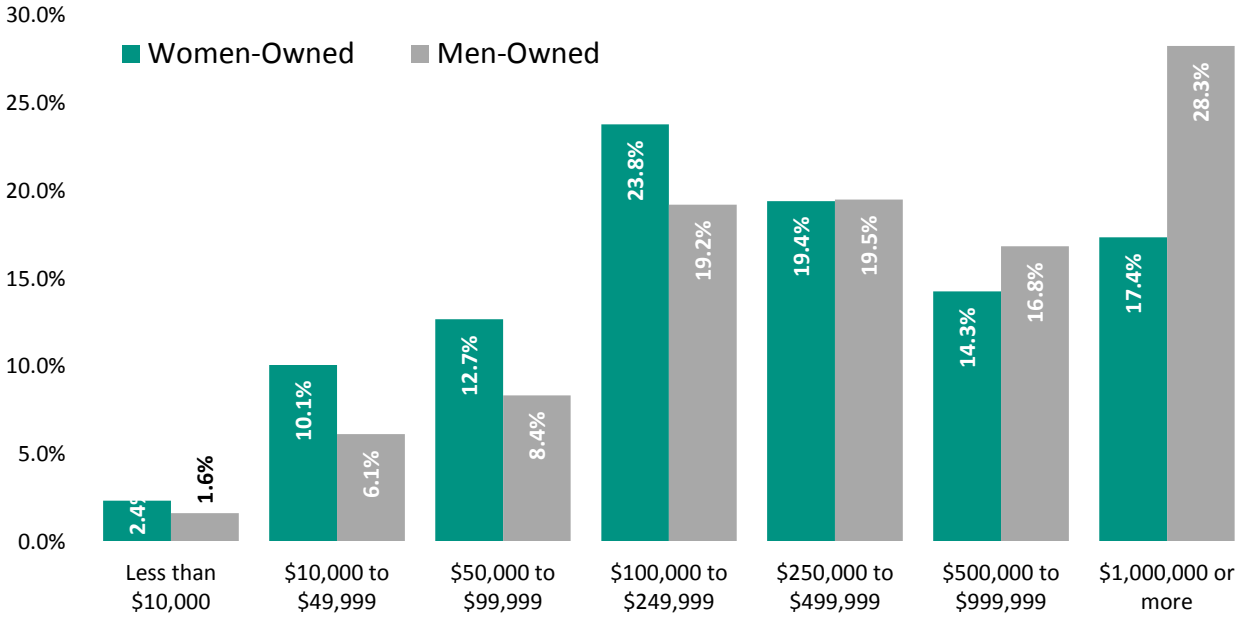
Of those firms that do try to establish new funding relationships, success rates in receiving the total amount of funds requested are fairly gender equitable with men just slightly more likely to

obtain the full requested amounts for most sources of funding. Women-owned businesses are more successful than men-owned firms with only three types of funders: family, friends, or employees, angel investors, and "other sources" (Figure 16). Several previous reports have examined the gender differences in entrepreneurs' success at securing funding: one finds that venture capitalists prefer pitches delivered by men, even compared to the exact same pitch from a woman (Brooks et al. 2014). An analysis of crowdfunding sites finds that men ask for and receive more money than do women, on average: the mean amount raised is $14,490 for men, compared with $8,791 for women (National Women's Business Council 2018).

Previous literature finds that patents, and potentially other intellectual property, can be important factors in investors' decisions, suggesting that women-owned firms' lower likelihood of owning intellectual property may contribute to the lower amounts of start-up capital they receive from early investors compared with men (Graham et al. 2009; Häussler, Harhoff, and Mueller 2012). Further, patenting is an expensive process, and women-owned firms' smaller amounts of start-up capital compared with men could hinder their efforts to produce intellectual property in the early stages of business development. Without the use of microdata to explore these questions, however, we can only speculate about the relationships between start-up funding and intellectual property.

Men-owned employer firms have average sales and receipts that are more than twice as high as women-owned employer firms'--$2.7 million compared with $1.2 million.

Figure 17. Women- and Men-Owned Businesses by Sales and Receipts, 2015



Note: Includes nonfarm businesses with paid employees and receipts of at least $1,000. Business ownership is defined as owning at least 51 percent of the stock or equity in the business.
Source: IWPR analysis of the 2015 Annual Survey of Entrepreneurs.

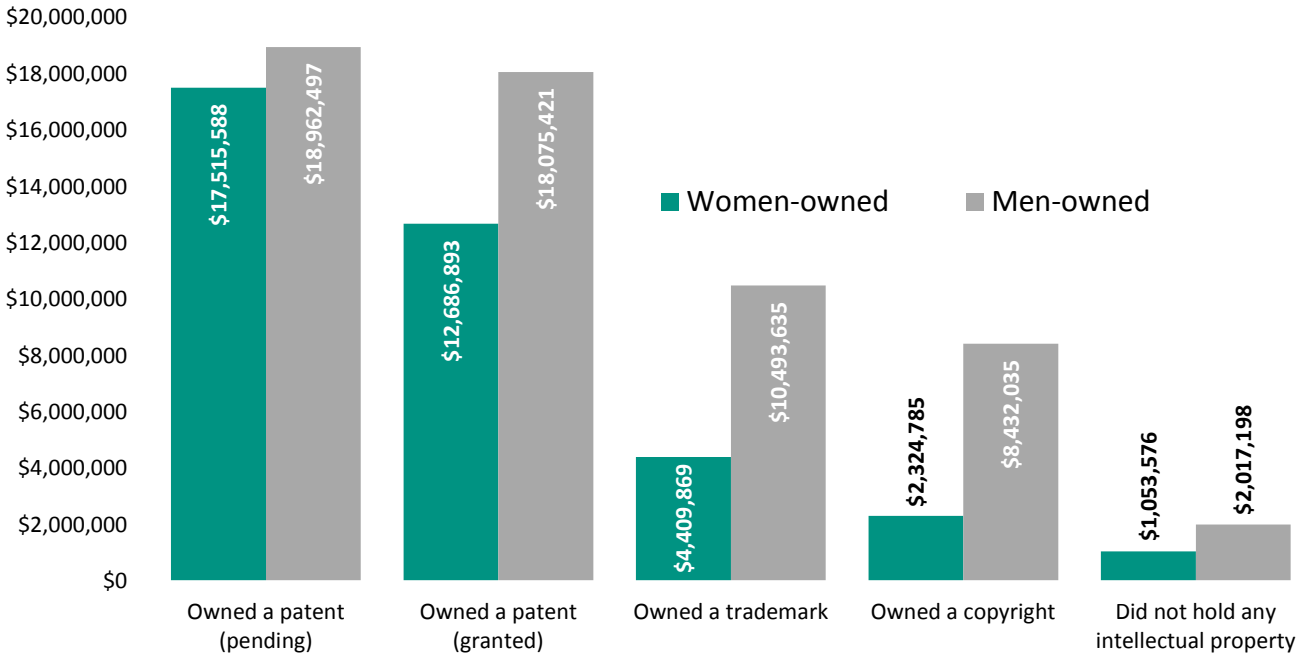
Women-owned firms have lower revenues than men-owned businesses. Nearly half (49.0 percent) of women-owned firms report sales and receipts of less than $250,000, while only about a third (35.3 percent) of men-owned firms report revenues below that level. Conversely, nearly three in ten men-owned firms (28.3 percent) report revenues of $1 million or more, while just 17.4 percent of women-owned firms report the same. Annual sales and receipts for men-owned firms are more than twice as high ($2.7 million per year) as those reported by female-owned firms ($1.2 million per year; Figure 17).

Gender difference in firm revenues could relate to a number of different factors, including differences in firm size, length of operation, or the industry locations of women- and men-owned businesses, with women-owned firms more likely to operate in lower-revenue industries. To explore one of these possibilities, IWPR calculated a correlation coefficient measuring the relationship between women's representation in an industry and industry revenues to see if women-owned firms were more concentrated in low-revenue industries. The analysis finds that the share of women-owned firms in each industry is moderately negatively correlated with the share of all firms within the industry with sales of at least $1 million, with a correlation of -0.28, which is statistically significant. This relationship reflects that women entrepreneurs do tend to operate in lower-revenue industries, though the magnitude of the correlation indicates that there are likely to be other factors at play in predicting gender differences in firm revenues. For example, women-owned businesses employ fewer workers on average, which could also be associated with firms' sales and receipts.[6]

[6] Since IWPR didn't have access to the microdata for the Annual Survey of Entrepreneurs, the authors were unable to test the relative contributions of a range of factors in predicting gender differences in firm outcomes.

Intellectual property holdings are associated with higher revenues. Women-owned businesses that have a patent pending have average revenues more than 16 times higher than those firms without intellectual property holdings.

Figure 18. Average Sales and Receipts per Firm, by Type of Intellectual Property Holding and Gender of Ownership, 2015



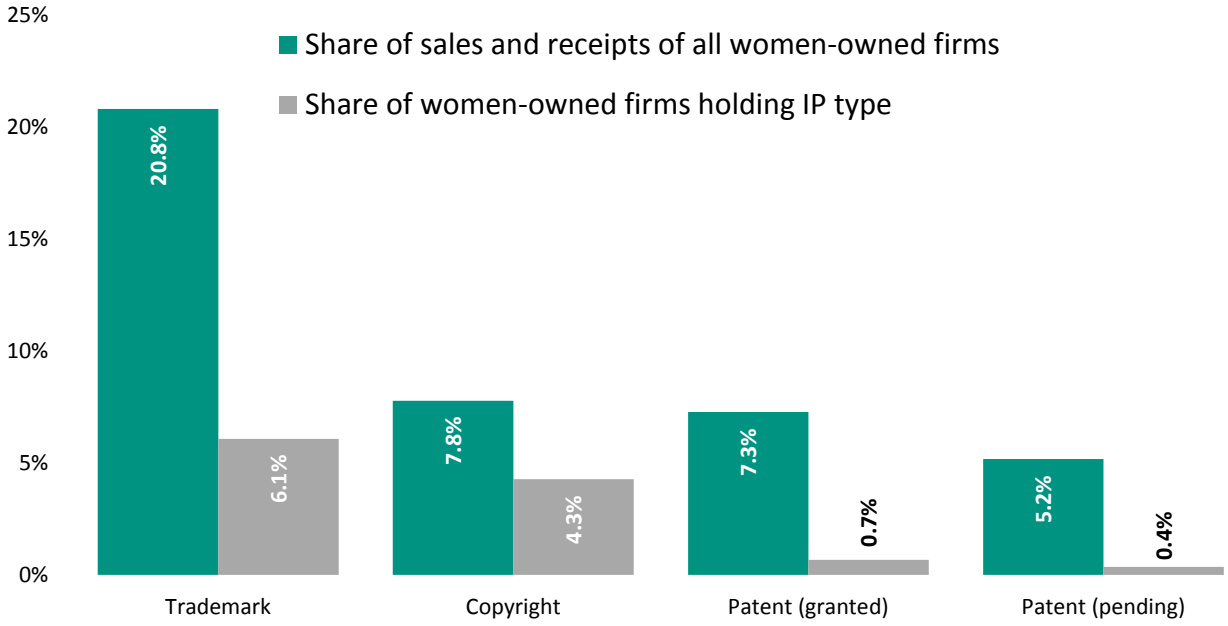
Note: Includes nonfarm businesses with paid employees and receipts of at least $1,000. Business ownership is defined as owning at least 51 percent of the stock or equity in the business. Firms may one more than one type of intellectual property holding.
Source: IWPR analysis of the 2015 Annual Survey of Entrepreneurs.

Both male and female-owned firms that own intellectual property have higher average sales and receipts than those without intellectual property (though as will be discussed later, this pattern could be due to firm characteristics other than, or in addition to, the intellectual property itself). Women-owned firms without any IP reported average revenues of $1.1 million, below the average for all firms ($1.2 million). In contrast, the average revenue of women-owned firms with a patent pending was nearly $18 million and the average for those with a granted patent was $12.7 million; across all types of intellectual property, patenting was associated with the largest revenues. While women-owned firms with a trademark or copyright had lower average revenues than those that held patents, their average revenues were still larger than the average for women-owned firms—at $4.4 and $2.3 million, respectively. Women-owned firms that had either a granted patent or a patent pending also had the smallest average revenue gaps in comparison with men-owned firms—the gap in sales and receipts between women- and men-owned

businesses that had a patent pending was 8.3 percent and for those with a granted patent it was 42.5 percent. For those without any IP holdings, the gap was 91.5 percent (Figure 18).

The few women-owned businesses that own IP control a significant share of firm revenues. The 0.7 percent that have a patent control 7.3 percent of all revenues of women-owned businesses, and the 6.1 percent that own a trademark control 20.8 percent.

Figure 19. Share of Women-Owned Firms with Intellectual Property Holdings and Their Corresponding Share of Sales and Receipts, By Type of Holding, 2015



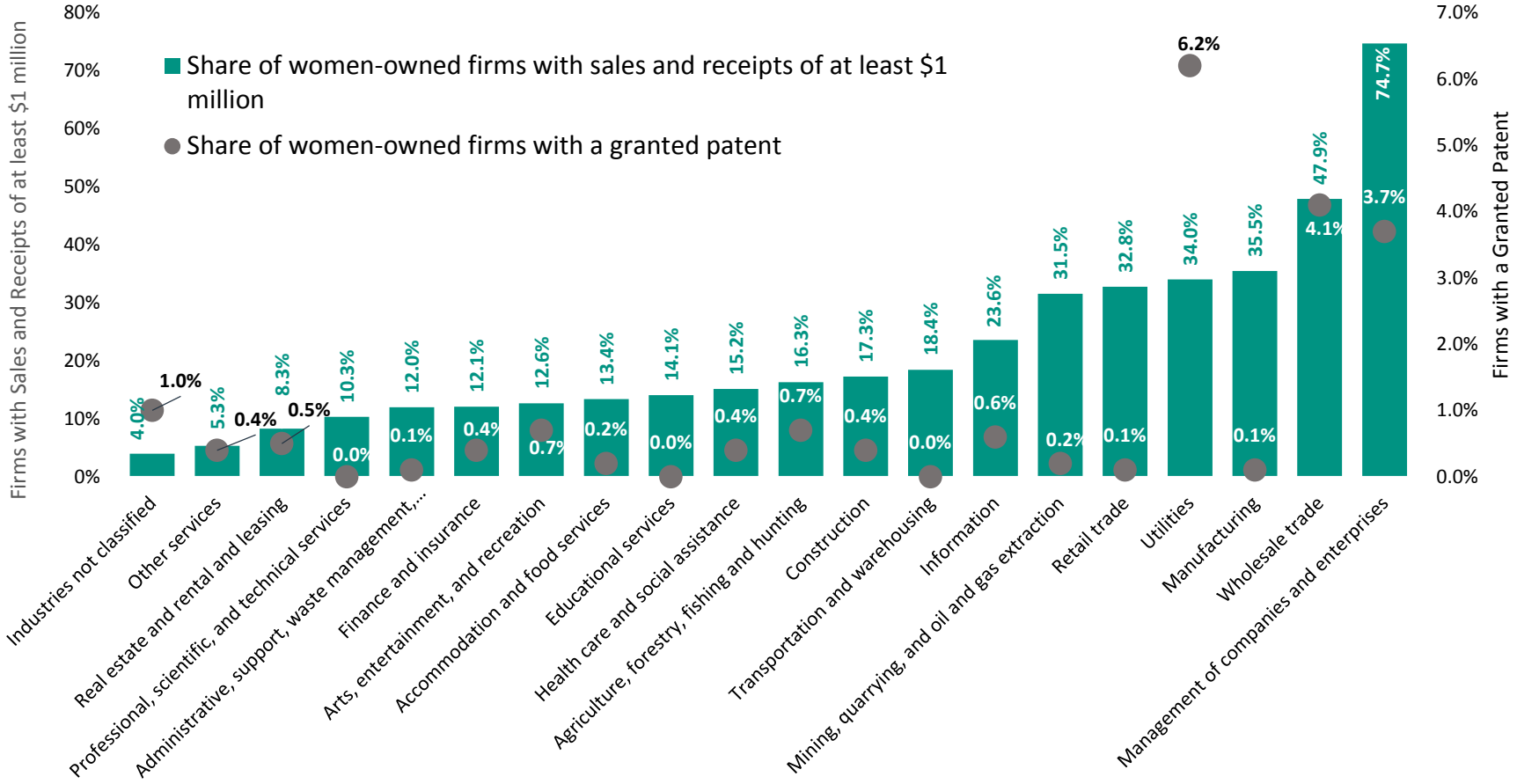
Note: Includes women-owned nonfarm businesses with paid employees and receipts of at least $1,000. Business ownership is defined as owning at least 51 percent of the stock or equity in the business. Firms may one more than one type of intellectual property holding.
Source: IWPR analysis of the 2015 Annual Survey of Entrepreneurs.

Women-owned firms with patents pending hold shares of sales and receipts that are 13 times higher than their share of the population of business owners. In other words, women-owned businesses with patents pending make up 0.4 percent of all women-owned employer businesses, but those businesses bring in 5.2 percent of all revenue. For granted patents, they control a share of sales and receipts that is 10.4 times larger than their share of all women-owned employer firms (7.3 percent compared with 0.7 percent). Women-owned businesses that hold a trademark also control a substantial share of the sales and receipts among women-owned businesses. Though only 6.1 percent of women-owned businesses hold a trademark, they control 20.8 percent of all sales and receipts of women-owned businesses (Figure 19). These data indicate

that intellectual property rights may be connected to higher average revenues among both women- and men-owned firms.

Part of the perceived "revenue advantage" of intellectual property may be because IP is more common in some higher revenue industries.

Figure 20. Share of Women-Owned Firms that Hold a Patent and Share with Sales and Receipts of $1 Million or More, by Industry, 2015



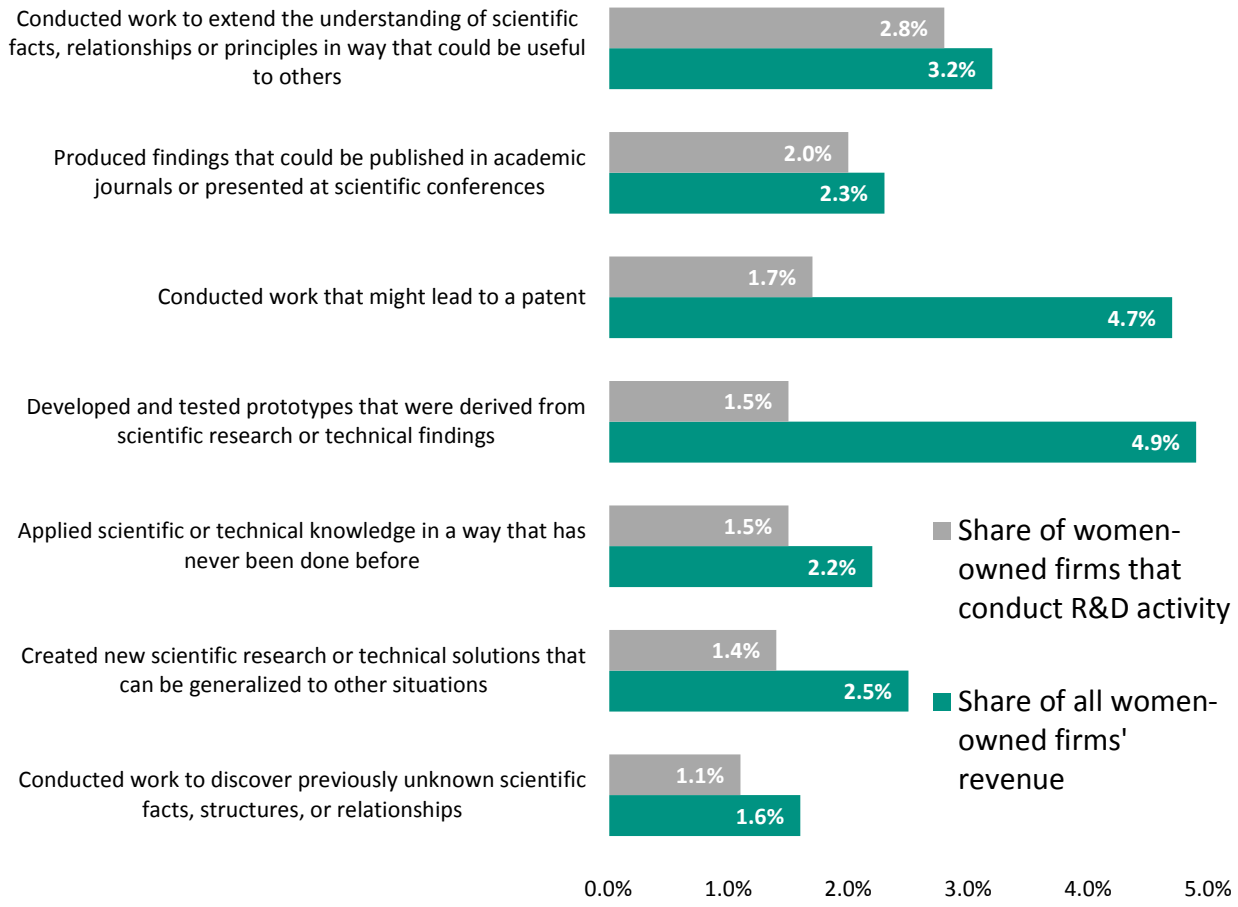
Note: Includes women-owned nonfarm businesses with paid employees and receipts of at least $1,000. Business ownership is defined as owning at least 51 percent of the stock or equity in the business.
Source: IWPR analysis of the 2015 Annual Survey of Entrepreneurs.

IWPR calculated the correlation between firm revenues and intellectual property holdings illustrated in Figure 18. Among women-owned firms, for example, there is a relatively strong correlation between the share of firms within an industry holding a patent and the share of firms reporting at least $1 million in revenue (a statistically significant correlation of 0.61). This correlation is even stronger for men-owned firms, at 0.72. The strength of the relationship between IP rates and high revenues by industry is highest when examining patenting specifically, though the correlation is still relatively strong when including all types of intellectual property (a statistically significant correlation of 0.58 for all firms). It is important to note, however, that these correlations only show an association between IP holdings and revenue rather than demonstrating a causal relationship between the two. Many other factors could be at play, such as the fact that firms holding intellectual property tend to be larger or operate in high-revenue industries overall that have more funds to invest in developing intellectual property—in other words, those firms may have higher revenues regardless of whether they held IP.

Firms that own intellectual property are many times larger, on average, than firms without IP: women-owned firms without IP holdings have seven employees, on average, while those with a granted patent have 27. For men-owned firms, those without IP have an average of ten employees, while those with a granted patent have 51. And larger firms tend to have higher average revenues: for example, firms with fewer than 5 employees have average sales and receipts of $401,517 while firms with 50-99 employees have average sales of $14.8 million (data not shown; Institute for Women's Policy Research 2018b). Thus it is unclear whether holding intellectual property is actually *causing* firms to have higher revenues or that they simply have higher revenues by virtue of their size or other unmeasured characteristics.

Conducting R&D activities is associated with higher revenues: the 1.7 percent of women-owned businesses that "conducted work that could lead to a patent" generated 4.7 percent of the sales and receipts of all women-owned businesses.

Figure 21. Share of Women-Owned Firms Engaged in Research and Development Activities, and Share of All Women-Owned Firms' Revenue, 2014



Note: Includes women-owned nonfarm businesses with paid employees and receipts of at least $1,000. Business ownership is defined as owning at least 51 percent of the stock or equity in the business.
Source: IWPR analysis of the 2014 Annual Survey of Entrepreneurs.

For all forms of research and development activities, the share of sales and receipts generated by firms outpaced their share of the population of women-owned firms overall.

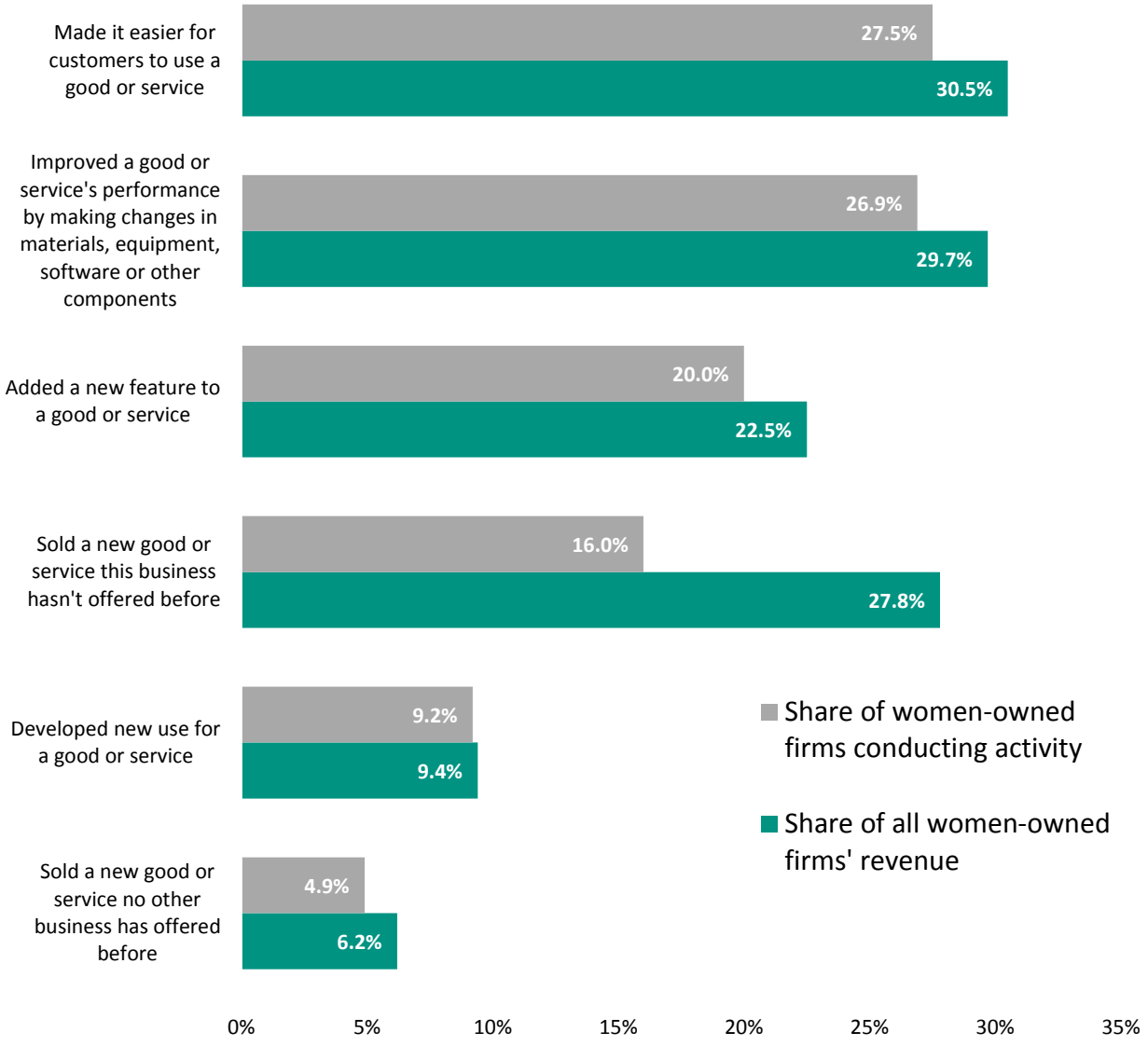
The 1.5 percent of women-owned firms that developed and tested prototypes that were derived from scientific research or technical findings controlled 4.9 percent of women-owned firms' sales and receipts, a share 3.3 times greater than their share of firms overall. The 1.7 percent of women-owned firms reporting they conducted work that might lead to a patent generated 4.7 percent of the sales and receipts of all women-owned firms. And the 1.4 percent that created new

scientific research or technical solutions that can be generalized to other situations controlled 2.5 percent of all women-owned firms' sales and receipts. If there were no relationships between R&D activities and revenue, we would expect to see that the firms conducting these activities would have about a roughly similar share of revenue as their share of the population. For example, if there were no relationship, we would estimate that the 1.5 percent of women-owned firms that developed and tested prototypes would have about 1.5 percent of women-owned firms' revenues. Thus, the fact that these firms' share of revenues is several times larger than their share of the population implies that a relationship likely exists between these R&D activities and firm revenue (Figure 21).

As with the relationship between intellectual property holdings and revenues, however, data limitations prevent the authors from causally linking R&D activities and firm revenues. For example, it may well be the case that firms pursue R&D when they have the money to afford it, rather than the R&D leading to the increased revenues. These findings do point to the importance of further research on the relationship between R&D activities and firm revenues among women and men owned firms, using multivariate methods to explore a number of potential predictive factors using adequate controls (such analysis would be possible with the Annual Survey of Entrepreneurs microdata).

Several product innovations are positively associated with business outcomes—the 16 percent of women-owned businesses that "sold a new good or service their business hadn't offered before" earned nearly 30 percent of all revenues among women-owned businesses.

Figure 22. Share of Women-Owned Firms Engaged in Product Innovation Activities, and Share of All Women-Owned Firms' Revenue, by Type of Product Innovation, 2014



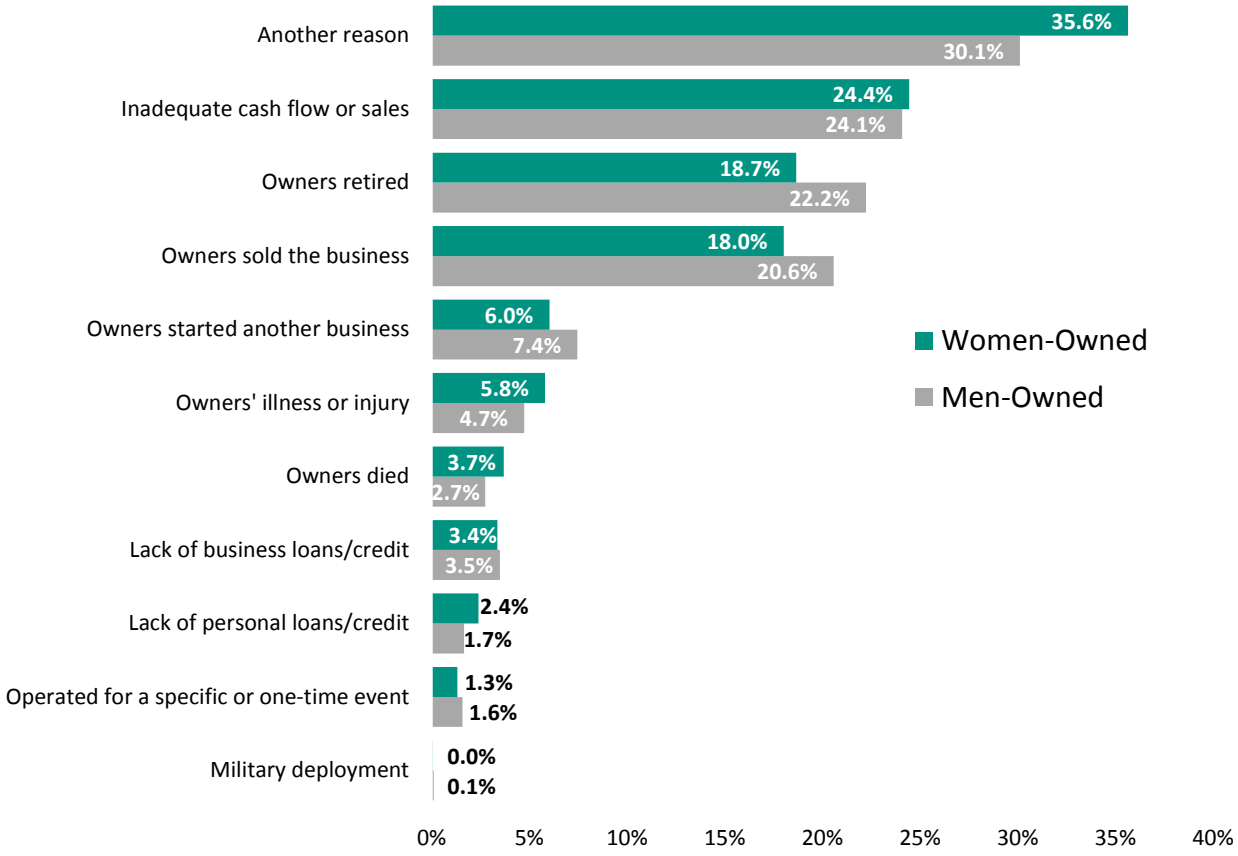
Note: Includes women-owned nonfarm businesses with paid employees and receipts of at least $1,000. Business ownership is defined as having at least 51 percent of the stock or equity in the business.
Source: IWPR analysis of the 2014 Annual Survey of Entrepreneurs.

Firms with any type of product innovation or process improvements report slightly larger shares of sales and receipts than their share of the population. The 16 percent who sold a new good or service that their business hasn't offered before generated 27.8 percent of sales and receipts. Other product innovations had a more modest relationship with the share of revenues controlled. The 27.5 percent of women-owned businesses that made it easier for customers to use a good or service saw 30.5 percent of sales and receipts. The 26.9 percent that improved a good or service's performance by making changes in materials, equipment, software, or other components generated 29.7 percent of revenues. The 20.0 percent reporting that they added a new feature to a good or service produced 22.5 percent of sales and receipts of all women-owned firms. Nearly equal shares of women-owned businesses said they developed new use for a good or service, at 9.2 percent, as the share of all women-owned firms' revenues, at 9.4 percent. And finally, while 4.9 percent reported that they sold a new good or service no other business had offered before, this group controlled 6.2 percent of sales and receipts (Figure 22).

As in the prior discussions of intellectual property holdings and research and development activities, however, we must take care not to assume a direct causal relationship between product innovation activity and business outcomes. The relationship between product innovation and share of revenue may be connected to unmeasured variables, such as the size of firms and industry, and/or the relationship may be such that higher revenues lead to more product innovations, many of which are expensive to conduct, rather than vice versa.

Women-owned firms were slightly more likely to have closed in the past year due to inadequate cash flow, lack of business loans, or lack of personal loans, though the reasons for closure are fairly gender-equitable.

Figure 23. Reasons Firms Ceased Operation in Past Year, by Gender of Business Ownership, 2015



Note: Includes nonfarm businesses with paid employees and receipts of at least $1,000. Business ownership is defined as owning at least 51 percent of the stock or equity in the business.
Source: IWPR analysis of the 2015 Annual Survey of Entrepreneurs.

Women-owned firms were nearly equally likely to have ceased operation in the past year compared with men-owned firms, at 7.2 percent compared with 6.2 percent, respectively. The most common reason for business closure was inadequate cash flow or sales, affecting women- and men-owned firms nearly equally. Of those firms that closed, 24.4 percent of women-owned firms and 24.1 percent of men-owned reported that inadequate cash flow or sales were in part to blame. The second most common reason for closure was retirement, though men-owned firms were more likely to report this reason: 22.2 percent of men-owned firms that closed, compared with 18.7 percent for women-owned businesses that closed, say they closed because the owner retired. The third most common reason for business closure was owners selling the business:

18.0 percent of women-owned firms that closed, and 20.6 percent of men-owned firms, cited this as the reason (Figure 23).

Recommendations and Conclusion

Women-owned businesses, while growing as a share of all businesses, make up only 20.8 percent of employer firms in the nation as of 2015, and African American and Hispanic women are especially underrepresented. Black women were just 3.5 percent of women business owners and Hispanic women were only 7.0 percent of all women business owners. Women-owned businesses face a number of challenges throughout their lifecycles—they often have less start-up capital, seek out new funding relationships less often, are less likely to receive the full amount requested from funders, and earn lower revenues than men-owned businesses. Though the publicly available data from the Annual Survey of Entrepreneurs does not allow researchers to directly study these challenges among women of color, previous research has indicated that even though women of color are the primary driving force behind the growth in the number of women-owned businesses, their outcomes tend to be poorer (see American Express Open (2017), for example).

While women-owned businesses engage in research and development activities and produce innovative products at rates nearing or surpassing those of men-owned firms, they are less likely to hold intellectual property (as are women and men of color; Bell et al. 2016), suggesting that their innovative power could be better marshalled to benefit their businesses and promote economic and social progress more broadly. Prior research has shown that patents can motivate early business investors, (Häussler, Harhoff, and Mueller 2012; Graham et al. 2009; Hall, Jaffe, and Trajtenberg 2005), suggesting that women's underrepresentation among IP holders may put them at a disadvantage throughout the business lifecycle.

Previous research has explored some of the challenges that women face in participating in the patenting process, such as the high cost of research involved in developing prototypes and ultimately applying for a patent, the nature of women's networks, gender role socialization and bias, and women's underrepresentation in more patent-intensive STEM fields (for a review of this literature, see Milli et al. 2016).

Unconscious bias can influence funders' decision-making; for example, research finds that venture capitalists prefer pitches delivered by men, compared with a woman, even when the content of the pitch is exactly the same (Brooks et al. 2014). Research also finds that investors ask women and men different kinds of questions, that reflect different levels of confidence in their ability to succeed: investors tend to ask male entrepreneurs questions about how they will scale up their firms, while asking women how they will manage risk, and these questions correspond with sex-based funding disparities (Kanze et al. 2018). Investors themselves should consider strategies to prevent bias in their interactions and decision-making processes. Efforts to address these challenges could contribute to increasing the share of women who develop and commercialize inventions, and improve outcomes for women-owned businesses.

Increase women and girls' access to programs that support innovation activities and entrepreneurship in highly profitable industries.

Programs that encourage women's business ownership can present data on industry segments most likely to provide strong business returns, along with information on how to enter those fields. In addition, communities, universities, and the public sector can implement programs likely to encourage and increase women's participation in intellectual property development activities. IWPR's report *Closing the Gender Gap in Patenting, Innovation, and Commercialization: Programs Promoting Equity and Inclusion* profiles seven programs working to increase gender and racial/ethnic diversity in innovation and entrepreneurship, and identifies common program elements and promising practices, including promoting relationships between women inventors and investors and providing coaching on the patent application process and other research and development activities. In addition, introducing girls and young women to inventing and intellectual property development through science and math classes, after-school programs, and summer camps could highlight the benefits of developing intellectual property later in life.

Programs designed to promote innovation among women and girls should be independently evaluated to allow an evidence-based approach to replicating and scaling effective strategies. While some of these programs have already been independently evaluated, future research should evaluate other such programs for their impact and scalability.

Implement and test strategies to overcome implicit bias on the part of funders and investors.

Women business owners' lower levels of funding can restrict the types of innovation firms can pursue, and difficulties receiving funds are one of the primary reasons why women-owned businesses close. Venture capitalists and other investors have a major role to play in enabling women-owned firms to pursue intellectual property and research and development, and in helping women-owned businesses thrive more broadly. Investors should pursue intentional strategies to minimize the influence of bias in their investment decisions. For example, following formal or informal guidelines or quotas for investing across gender or racial/ethnic lines could help investors ensure they make equitable investment decisions. Additional research is needed to assess promising strategies for minimizing gender and racial/ethnic bias, unconscious or otherwise, in investment decisions.

Maintain and strengthen targeted funding for women entrepreneurs.

Funds that target businesses owned by women and women of color can help mitigate bias and increase access to capital. A number of corporations and a handful of venture funds around the country target women entrepreneurs with promising product innovations. Although data on underrepresented women of color entrepreneurs is scarce, research on their experiences in STEM

fields suggests that programs and initiatives encouraging women's innovation should take steps to actively encourage participation of Hispanic, African American, and other underrepresented women.

Increase women's representation in patent-intensive STEM fields.

Women' disparate participation in patenting has been linked to their underrepresentation in patent-intensive STEM fields such as engineering (Hunt et al. 2013). By pursuing strategies to increase women's participation in these fields, from early childhood exposure to science, to recruiting and retaining young women in patent-intensive college majors, women entrepreneurs will be more likely to patent themselves and to encourage and support other women's intellectual property development.

Improve data availability on women entrepreneurs, especially to allow disaggregation by gender, race and ethnicity.

Currently, American Survey of Entrepreneurs data that is available to the public provides information on innovative activities by gender or race/ethnicity separately, but not concurrently. Understanding these intersections is important for targeting available resources and quantifying the business contributions across an array of demographic groups. In addition, making the complete ASE microdata set more readily available for public use would allow researchers to rigorously explore the relationships between innovation and business outcomes while considering the relative contributions of an array of potential predictive factors, such as firm size, industry of operation, and owner experience, and to investigate potential causal relationships between innovation and business outcomes.

In addition, the U.S. Patent and Trademark Office should consider collecting data on the gender and race/ethnicity of patent applicants (to be kept confidential during the patent examination process), so researchers and policy makers can more easily track progress toward gender and racial/ethnic equity in intellectual property holdings.

Finally, targeted federally sponsored surveys, such as the Survey of Earned Doctorates and the National Survey of College Graduates, should include regular modules on intellectual property holdings and business ownership, to allow researchers to better understand the characteristics associated with commercialization of invention.

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Appendix 1: Glossary

Women-owned firms

Employer firms (those with at least one employee; excludes the self-employed) of which women own at least 51 percent of stock or equity in the business. Excludes firms that are not classifiable by gender, ethnicity, and race of ownership, and firms that are publicly held, foreign-owned, or not for profits.

Men-owned firms

Employer firms (those with at least one employee; excludes the self-employed) of which men own at least 51 percent of stock or equity in the business. Excludes firms that are not classifiable by gender, ethnicity, and race of ownership, and firms that are publicly held, foreign-owned, or not for profits.

Equally women- and men-owned firms

Employer firms (those with at least one employee; excludes the self-employed) of which women and men own equal amounts of stock or equity in the business. Excludes firms that are not classifiable by gender, ethnicity, and race of ownership, and firms that are publicly held, foreign-owned, or not for profits.

Minority-owned firms

Employer firms (those with at least one employee; excludes the self-employed) of which people who self-identify as Hispanic or Latino; Black or African American; American Indian or Alaska Native; Asian; Native Hawaiian or Other Pacific Islander; or some other race (but not White) own at least 51 percent of stock or equity in the business. Business owners may report more than one race or ethnicity. Excludes firms that are not classifiable by gender, ethnicity, and race, and firms that are publicly held, foreign-owned, or not for profit.

Nonminority-owned firms/White-owned firms

Employer firms (those with at least one employee; excludes the self-employed) of which people who self-identify as White and not as any other race, though they may identify as Hispanic or non-Hispanic, own at least 51 percent of stock or equity in the business. Business owners may report more than one race or ethnicity. Excludes firms that are not classifiable by gender, ethnicity, and race, and firms that are publicly held, foreign-owned, or not for profit.

Intellectual property

Includes patents pending, granted patents, trademarks, and copyrights held by the business.

Patents

As described by the U.S. Patent and Trademark Office (2015), a "patent for an invention is the grant of a property right to the inventor, issued by the United States Patent and Trademark Office. The right conferred by the patent grant is, 'the right to exclude others from making, using, offering for sale, or selling' the invention in the United States or 'importing' the invention into the United States. What is granted is not the right to make, use, offer for sale, sell or import, but the right to exclude others from making, using, offering for sale, selling or importing the invention. Once a patent is issued, the patentee must enforce the patent without aid of the USPTO. There are three types of patents: 1) Utility patents may be granted to anyone who invents or discovers any new and useful process, machine, article of manufacture, or composition of matter, or any new and useful improvement thereof; 2) Design patents may be granted to anyone who invents a new, original, and ornamental design for an article of manufacture; and 3) Plant patents may be granted to anyone who invents or discovers and asexually reproduces any distinct and new variety of plant."

Trademarks

As described by the U.S. Patent and Trademark Office (2015), a "trademark is a word, name, symbol, or device that is used in trade with goods to indicate the source of the goods and to distinguish them from the goods of others."

Copyrights

As described by the U.S. Patent and Trademark Office (2015), a "copyright is a form of protection provided to the authors of 'original works of authorship' including literary, dramatic, musical, artistic, and certain other intellectual works, both published and unpublished."

Research and development activities

Includes work that might lead to a patent; developing and testing prototypes that were derived from scientific research or technical findings; producing findings that could be published in academic journals or presented at scientific conferences; applying scientific or technical knowledge in a way that has never been done before; creating new scientific research or technical solutions that can be generalized to other situations; conducting work to discover previously unknown scientific facts, structures, or relationships; and conducting work to extend the understanding of scientific facts, relationships or principles in way that could be useful to others.

Revenues/Sales and receipts

The total sales, shipments, receipts, revenue, or business done by domestic establishments (excludes foreign subsidiaries) within the scope of the ASE.

Industry

The ASE covers 20 industries defined by the 2012 North American Industry Classification System (NAICS), excluding 'Crop and animal production,' 'Rail transportation,' 'Postal service,' 'Monetary authorities-central bank,' 'Funds, trusts, and other financial vehicles,' 'Religious, grantmaking, civic, professional, and similar organizations,' 'Private households,' and 'Public administration.'

Appendix 2: About the Data Used in This Report

Annual Survey of Entrepreneurs

Background

The Annual Survey of Entrepreneurs (ASE) dataset, provides annual data on economic and demographic characteristics of employer businesses and their owners. The ASE was created as a public-private partnership between the U.S. Census Bureau, the Kauffman Foundation, and the Minority Business Development Agency. The mandatory survey asks a standard set of questions each year, but also includes modules on specific topics each year that are rotated. The 2014 ASE, for example, asked businesses about their innovative and research and development activities. At the time this analysis was conducted, only two waves of the ASE were available: 2014 and 2015. Both years of data are used throughout this report, since the two survey years include different sets of questions. As microdata is restricted, this report uses the publicly-available tables available online at https://www.census.gov/programs-surveys/ase.html. The use of these tables limits the types of analyses and statistical tests that may be performed, including prohibiting the analysis of data by both gender and race/ethnicity.

Sample

The ASE sample includes nonfarm businesses filing IRS tax forms as individual proprietorships, partnerships, or corporations, with receipts of at least $1,000, and with paid employees. Data are for the company or firm basis, not the establishment basis. The sample includes approximately 290,000 businesses in operation at any time during the survey year. Data are available at the national and state levels, and for the 50 most populous metropolitan statistical areas, though data for employer demographic characteristics are available at only the national level.

Demographic data are recorded for up to four business owners. For the sake of classifying businesses by the gender or race/ethnicity of their owners, business ownership is defined as one group owning at least 51 percent of the stock or equity in the business. For example, if three of four owners of a company were female (and they all owned an equal share of the company) the company would be 75 percent female-owned, and would be classified as a woman-owned business.

Survey of Business Owners

Background

Like the ASE, the Survey of Business Owners (SBO) dataset provides data on the economic and demographic characteristics of businesses and their owners. The SBO has been fielded by the U.S. Census Bureau every five years since 1972. Since its inception, definitions of women-owned and men-owned businesses have been altered, with 1997 being the first year of data available under the most recent definition. This report utilizes data from the 1997, 2002, 2007, and 2012 SBO in order to illustrate trends in women's and men's business ownership, as the

ASE data are only available from 2014 onward. Data were drawn from publicly-available tables available online at https://www.census.gov/programs-surveys/sbo/data/tables.html.

Sample

The primary difference between the SBO and the ASE data is that the SBO data include information on non-employer firms (firms in which the owner is the only employee) whereas the ASE only surveys employer firms. The questions asked in the SBO and ASE overlap substantially, but the ASE does contain modules each year for special topics not covered in the SBO. In order to make older data from the SBO comparable to the ASE data, the SBO data were limited to firms with paid employees.

Appendix 3: Data on Innovative Activities by Owner's Race/Ethnicity

	White	Black or African American	American Indian and Alaska Native	Asian	Native Hawaiian and Other Pacific Islander	Hispanic	Some other race	Total, All Races
Intellectual Property Holdings								
At least one IP holding	9.6%	8.8%	9.9%	8.4%	9.1%	7.9%	7.4%	9.8%
Trademark	6.8%	5.9%	6.0%	6.0%	4.6%	5.5%	4.5%	7.0%
Copyright	4.5%	4.3%	4.9%	3.5%	3.9%	3.5%	3.5%	4.5%
Patent (granted)	1.3%	0.7%	1.1%	1.3%	2.5%	0.8%	1.2%	1.4%
Patent (pending)	0.8%	0.5%	1.3%	0.9%	0.1%	0.5%	0.3%	0.9%
Research and Development Activities								
Conducted work to extend the understanding of scientific facts, relationships or principles in a way that could be useful to others	2.6%	4.1%	3.5%	3.9%	3.8%	2.7%	2.3%	2.7%
Produced findings that could be published in academic journals or presented at scientific conferences	2.0%	2.7%	2.2%	2.6%	4.1%	1.8%	1.2%	2.1%
Conducted work that might lead to a patent	2.5%	2.9%	2.9%	3.6%	3.2%	2.2%	1.9%	2.7%
Developed and tested prototypes that were derived from scientific research or technical findings	2.3%	2.2%	2.4%	3.0%	4.8%	1.8%	1.5%	2.5%
Applied scientific or technical knowledge in a way that has never been done before	1.9%	2.3%	2.8%	3.3%	2.9%	1.9%	1.4%	2.1%
Created new scientific research or technical solutions that can be generalized to other situations	1.6%	2.1%	2.1%	2.8%	2.8%	1.9%	1.5%	1.8%

Conducted work to discover previously unknown scientific facts, structures, or relationships	1.1%	1.8%	1.0%	2.4%	2.3%	1.6%	1.5%	1.3%
Product Innovations								
Made it easier for customers to use a good or service	25.7%	31.6%	31.8%	31.4%	27.6%	30.7%	31.1%	26.4%
Improved a good or service's performance by making changes in materials, equipment, software or other components	26.6%	27.8%	28.9%	28.2%	30.9%	29.7%	32.2%	26.8%
Added a new feature to a good or service	18.8%	20.9%	24.0%	23.2%	18.8%	20.8%	21.1%	19.4%
Sold a new good or service this business hasn't offered before	15.4%	11.2%	17.1%	13.2%	18.0%	13.7%	11.8%	15.2%
Developed new use for a good or service	8.2%	10.8%	10.9%	15.7%	9.0%	13.7%	15.5%	9.0%
Sold a new good or service no other business has offered before	4.8%	4.3%	4.9%	7.0%	8.0%	6.3%	6.9%	5.1%

Note: Includes women- and men-owned nonfarm businesses with paid employees and receipts of at least $1,000. Business ownership is defined as owning at least 51 percent of the stock or equity in the business. Respondents could report multiple race or ethnic groups, thus firms may be double-counted. For example, Hispanics or Latinos may be of any race, including White, and firms are double-counted if they report they are majority-owned by multiple race or ethnic groups. The publically-available data do not allow for separating groups into non-overlapping categories. Respondents could report multiple race or ethnic groups.

Source: Data on intellectual property holdings come from IWPR analysis of the 2015 Annual Survey of Entrepreneurs. Data on research and development activities and product innovations come from IWPR analysis of the 2014 Annual Survey of Entrepreneurs.