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ON THE COMMERCIALIZATION PATH: ENTREPRENEURSHIP AND INTELLECTUAL PROPERTY OUTPUTS AMONG WOMEN IN STEM

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Introduction

The role of scientific innovation is noted widely in policies targeting economic growth in the United States. Strategies concentrated on innovation are highly focused on science, technology, engineering, and mathematics (STEM) fields, which hold high potential for economic gains and growth from commercialization of innovations.[1] However, the effectiveness of policy to promote scientific innovation and economic growth relies on the broad participation of both men and women in all key steps on the path to commercialization; in STEM, the path begins with education and training in STEM fields and continues through STEM entrepreneurship and the development of intellectual property.

Despite the importance of participation across genders, evidence suggests that a gap exists between men and women in their engagement in STEM activities through their educational and professional careers. A review of the literature reveals that in general, women are underrepresented among students pursuing STEM education.[2, 3] This gender gap persists in relation to entrepreneurial performance, where men-owned businesses outperform those owned by women in terms of firm survival, sales, profit and employment, across sectors.[4, 5] There also exists evidence of a gender gap in successful commercialization of research and development investments; this gap widens for firms operating in STEM fields.[6]

The literature offers two, potentially complementary, frameworks to explain the frequency with which women pursue STEM training and engage in commercialization in STEM firms. The first suggests that internal motivations, driven by personal preferences, prompt women to pursue training and professional work in fields other than STEM. Some studies suggest that women may pursue STEM commercialization activities less frequently than men because these fields are not perceived as contributing to research with socially-meaningful outcomes, a work characteristic that women tend to prioritize in career choice.[7] The second framework suggests

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[1] The White House (2015). A Strategy for American Innovation, Washington, DC: National Research Council and the Office of Science and Technology Policy.

[2] Jarrett, V., & Tchen, C. (2012). Keeping America's women moving forward: The key to an economy built to last. The White House Council On Women And Girls. Available at: https://www.whitehouse.gov/sites/default/files/email-files/womens_report_final_for_print.pdf

[3] Beede, D. N., Julian, T. A., Langdon, D., McKittrick, G., Khan, B., & Doms, M. E. (2011). Women in STEM: A gender gap to innovation. Economics and Statistics Administration Issue Brief, (04-11).

[4] Fairlie, Robert and Alicia Robb (2009). "Gender differences in business performance: Evidence from the characteristics of business owners survey," Small Business Economics, 33(4): 375-395.

[5] Robb, Alicia M. and John Watson (2012). "Gender differences in firm performance: Evidence from new ventures in the United States," Journal of Business Venturing, 27(5): 544-558.

[6] Blume-Kohout, Margaret E. 2014. "Understanding the gender gap in STEM fields entrepreneurship," Final report submitted to the Small Business Administration, Office of Advocacy.

[7] BarNir, A. (2012) Starting Technologically Innovative Ventures: Reasons, Human Capital and Gender. Management Decision, 50(3), 399-419

that external exogenous barriers discourage women's participation in STEM training and entrepreneurship and limit women's commercialization outcomes.[8] External barriers include limitations to accessing financial capital for education or entrepreneurship, gender discrimination, limited access to important networks, or hierarchical and rigid institutional structures, which lack network-oriented features demonstrated to benefit women.[9,10] These obstacles may affect women's educational and career decisions at various stages of their development. In this vein, women's experience in STEM fields' scientific career progression has been likened to a "leaking pipeline", in which the barriers that women face hinder them from moving forward to progressive stages in their career, such as leading the commercialization of discoveries. These frequent "leaks" may limit the number of women working in STEM at senior levels and may additionally hold implications for women's commercialization outcomes over their career cycle.[11]

This report presents an examination of innovation among women in STEM fields by identifying gaps in their entrepreneurial outcomes and highlighting future opportunities for policy improvements. First, it presents results of a descriptive data analysis using data from 2015 American Community Survey (ACS) and U.S. Census Bureau's 2007 and 2012 Survey of Business Owners (SBO). This empirical analysis compares characteristics and outcomes of women and men entrepreneurs in STEM fields; women entrepreneurs in STEM and non-STEM fields; and self-employed women and women in wage/salary employment in STEM fields. The empirical analysis employs two proxies for entrepreneurship based on availability in the data: self-employment in examining ACS data and business ownership in examining SBO data. Furthermore, it focuses on commercialization of scientific innovations in its initial phase: the creation of intellectual property.

Second, the report examines prior research and policy literature related to women's entrepreneurship and commercialization outcomes in STEM fields. Together, the literature review and data analysis identify and explore important themes related to women in STEM, including the prevalence of STEM entrepreneurship among women, the role of STEM education in STEM entrepreneurship, characteristics of owners and firms that are actively engaged in STEM entrepreneurship and their commercialization outcomes. Finally, the report discusses

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[8] Turrentine, A., Well, V. (2015) Career Advancement through Academic Commercialization: Acknowledging and Reducing Barriers for Women Engineering Faculty. 122nd ASEE Annual Conference & Exposition Paper

[9] Turrentine, A., Well, V. (2015) Career Advancement through Academic Commercialization: Acknowledging and Reducing Barriers for Women Engineering Faculty. 122nd ASEE Annual Conference & Exposition Paper

[10] Whittington, K.B., Smith-Doerr, L. (2008) Women Inventors in Context: Disparities in Patenting Across Academia and Industry. Gender and Society, 22(2), 194-218

[11] Polkowska, D. (2013) Women Scientists in the Leaking Pipeline: Barriers to Commercialization of Scientific Knowledge by Women. Journal of Technology and Management Innovation, 8(2), 156-16

policy recommendations related to the women's education, entrepreneurship, and commercialization in STEM, identified through the literature review and policy scan to illustrate policy implications of the analysis findings.

Identifying STEM Entrepreneurs in Empirical Analysis

Identifying STEM Fields

A key methodological decision in the empirical analysis undertaken in this study is the identification of STEM workers and entrepreneurs. As an acronym, STEM covers the fields of science, technology, engineering, and mathematics. The National Science Foundation uses a broader definition of STEM, which also includes social sciences, and STEM education and learning research. Although these definitions clearly link to academic disciplines, how they map to workers and jobs is less well-defined. For the purpose of this study, STEM workers and entrepreneurs were identified based on the STEM occupational classification developed by the Standard Occupational Classification Policy Committee (SOCPC). SOCPC's guidelines identify life and physical science, engineering, mathematics, information technology, and social science occupations as STEM occupations and architecture and health occupations as science- and engineering-related, using 2010 Standard Occupational Classifications (SOC) occupational codes to define occupations.[12]

In this study's treatment of the ACS, STEM workers and entrepreneurs are identified as individuals working in STEM or science- and engineering-related occupations, excluding social science occupations. The decision to exclude social science occupations was driven by the goal to focus on occupations with greater potential for commercialization activity. 2010 SOC codes used in SOCPC's STEM occupation definition were then mapped to Census Bureau occupations using the crosswalk developed by the Census Bureau.[13]

In the analysis of SBO data, STEM fields are identified based on industries with relatively high concentrations of STEM occupations.[14] Specifically, industries, defined at the two-digit North American Industry Classification System (NAICS) code level and in which the share of employment in STEM occupations is above the national average of 5.8% are identified as STEM. This methodology identifies the following three industries as STEM-intensive (percentage of total employment in STEM occupations given in parentheses): *Professional, scientific, management and administrative and waste management services* (17.5%), *Information* (14.2%),

[12] http://www.bls.gov/soc/
[13] http://www.census.gov/people/io/methodology/
[14] STEM occupations are identified based on SOCPC's STEM occupation classification. The concentration of STEM occupation is defined as the share of total employment that is in STEM occupations.

and *Manufacturing* (12.1%). *Public administration* (9.7%) also falls above the national average; however, the SBO is not administered to firms in this industry, given its largely private firm orientation.

The decision to identify STEM fields based on two-digit NAICS codes was driven by the fact that SBO data includes information on industry only based on two-digit NAICS codes and no information on occupation. Furthermore, reliable crosswalk with which to identify STEM-intensive industries by Standard Occupation Classification (SOC), provided by the U.S. Census Bureau, is also only available at the two-digit level.[15] This definition of STEM, however, has certain limitations. In particular, at the aggregate two-digit NAICS code level, industries that are identified as STEM have workers in non-STEM occupations. Yet, the comparative analysis of businesses and business owners in these industries relative to other industries are informative of the trends related to STEM businesses and business owners.

In the analysis of SBO data, only concentrations of STEM occupations *alone*, instead of STEM *and* STEM-related occupations, are used in defining STEM-intensive industries. Considering the broader share of STEM and STEM-related occupations in industry employment yielded *Educational services, and healthcare and social assistance* as an additional STEM-intensive industry. In this industry, there is a large gap between the share of employment in STEM occupations (3%) and the share of employment in STEM and STEM-related occupations (25.7%). Therefore, many working in this industry may not fit a narrow definition of STEM suited to our commercialization focus; rather, they may be employed in supporting or service roles, such as teachers or social workers.

Identifying Entrepreneurs

The empirical analysis uses two proxies for entrepreneurship based on availability in the data. In the analysis of ACS data, entrepreneurs are identified based on self-employment in the job in which they spend the highest number of hours in the last week. This definition covers self-employment in both incorporated and unincorporated businesses. Unincorporated businesses are sole proprietorships and partnerships.[16] Furthermore, this definition includes all self-employed individuals regardless of their ownership share in the business.

In contrast, the SBO data analysis focuses on primary business owners who have a plurality ownership in a business (i.e. more than any other single owner in a business even if it is less

[15] United States Census Bureau, "STEM, STEM-related, and non-STEM Occupation Code List 2010" Methodology: Code Lists and Crosswalks, https://www.census.gov/people/io/files/STEM-Census-2010-occ-code-list.xls

[16] Incorporated businesses, on the other hand, are corporations, such as C and S corporations. Incorporated businesses exist as legally separate from the shareholders, limiting the shareholders' liability for the debts and losses of the business.

than 51% ownership share).[17] If multiple plurality owners exist, primary business owners are identified as those that work the highest number of hours in the business and work in a function that provides a good or service, a function most central to the production of commercial output. The use of both ACS and SBO data sources allows for the juxtaposition of the two classifications for business owners: those who identify as self-employed based on the job at which they work the highest number of hours spent, as identified through use of the ACS, and those that identify as primary business owners with the highest stake in the firm, as identified through use of the SBO.

This primary business ownership definition employed in the analysis of SBO data offers advantages over using the standard ownership definition, in which owners must hold a majority stake (51% share of ownership) in the firm. Using this alternative definition of primary ownership captures a greater population of business owners than the one that would be captured under the stricter majority stake ownership definition. It not only includes business owners with the highest ownership share, which may be less than 51%, but it also includes those multiple plurality owners with evidence of significant involvement in the creation of the firm's innovative product. The primary business ownership definition used in the current analysis identified a single primary owner in 71.5% of the firms in the survey. In the remaining 28.5% of the firms, it identified multiple owners as primary owners, where no firm owner held a plurality ownership, worked a majority of hours among other owners, or responded that they provided goods or services, where other owners did not.

Analysis of SBO data draws on data from two rounds, conducted in 2007 and 2012, that offer advantages and limitations for our analysis. 2007 SBO data is available as a micro dataset with individual observations, which allows us to apply our definition of business ownership based on plurality ownership and stake in the business in the analysis. 2012 SBO data offers timelier analysis and is also the first SBO survey to include questions about intellectual property outputs. While examining multiple time periods gives some comparative insight, our analysis is limited by public data availability. Specifically, 2012 SBO data is available only in aggregate form, which requires the analysis to be based on the standard majority ownership definition.

[17] The SBO collects data on up to four owners of a firm and tracks statistics, such as percentage ownership in the firm, which can be used to identify either majority or plurality ownership. In our analysis, we use the SBO 2007 PUMS data to discern plurality ownership among the responding owners.

STEM Entrepreneurship Among Women

An important first step in examining commercialization among women entrepreneurs is to understand women's entrepreneurial decisions, particularly the decision to become an entrepreneur. Using data from the 2015 ACS, this report analyzes women's propensity to become self-employed in STEM fields, and how it compares to (1) men's prevalence in STEM self-employment and (2) women's participation in STEM fields in wage/salary employment.[18] This descriptive analysis not only provides contextual information for examining women's commercialization activities in STEM but may also reveal preliminary patterns and insights related to women's self-employment and commercialization outcomes in STEM fields.

Comparison of self-employment rates in STEM fields based on ACS data reveals that men are roughly twice as likely to be self-employed in STEM fields relative to women (Table 1). Self-employed men in STEM make up 0.8% of the population of employed men whereas self-employed women in STEM constitute 0.4% of the population of employed women. This gender gap widens when the definition of STEM occupations is narrowed to eliminate STEM-related occupations. Self-employed men are *more* than twice as likely to be employed in STEM-only occupations than self-employed women (0.36% vs. 0.14% as shown in Appendix Table A1).

This difference in STEM self-employment rate between men and women is driven by two underlying patterns. First, in general, women are less likely to be self-employed than men. The self-employment rate is 7.3% among women versus 11.3% among men (Table 1). Second, among self-employed individuals, women are less likely to work in STEM fields compared to men. Of the self-employed women, 5.9% participate in a STEM field compared to 7.1% of self-employed men (Table 2).

Table 1. Break-down of the Employed Population (2015 ACS)

	Women		Men	
	Count	**Percentage**	**Count**	**Percentage**
Employed	71,657,044	100%	79,936,236	100%
Wage/Salary Employment	66,456,749	92.7%	70,911,908	88.7%
STEM	9,609,195	13.4%	8,538,726	10.7%
Non-STEM	56,847,554	79.3%	62,373,182	78.0%
Self-Employment	5,200,295	7.3%	9,024,328	11.3%
STEM	307,753	0.4%	644,230	0.8%
Non-STEM	4,892,542	6.8%	8,380,098	10.5%

Source: Authors' analysis of 2015 American Community Survey obtained from the IPUMS-USA database.
Note: STEM fields are defined based on occupation codes and include the following: Computer and Mathematical Occupations, Architecture and Engineering Occupations, Life and Physical Sciences Occupations, Health Occupations.

[18] 2015 ACS data are obtained from the IPUMS-USA database (Ruggles et al., 2015).

The smaller share of STEM entrepreneurship among self-employed women stands in contrast to the share of STEM workers among women in wage/salary employment (Table 2). Among wage/salary workers, women are more likely to be employed in a STEM field (14.5%) compared to men (12%). The observation that relative to men, women in wage/salary employment have greater participation in STEM and self-employed women have lower participation in STEM, may be indicative of the barriers women in STEM face in entering self-employment. Specifically, women in STEM may face different challenges than those faced by women in non-STEM fields in entering entrepreneurship or their entrepreneurial decision may be more sensitive to certain determinants of entrepreneurship compared to women in other fields. Identifying the unique determinants of STEM entrepreneurship among women or factors that disproportionately affect STEM entrepreneurship is an important research goal that would provide key insights for policy-making.

Table 2. Share of STEM in the Employed Population (2015 ACS)

	Women	Men
Self-Employed (Total Count)	5,200,295	9,024,328
STEM	5.9%	7.1%
Non-STEM	94.1%	92.9%
Wage/Salary Workers (Total Count)	66,456,749	70,911,908
STEM	14.5%	12.0%
Non-STEM	85.5%	88.0%

Source: Authors' analysis of 2015 American Community Survey obtained from the IPUMS-USA database.
Note: STEM fields are defined based on occupation codes and include the following: Computer and Mathematical Occupations, Architecture and Engineering Occupations, Life and Physical Sciences Occupations, Health Occupations.

Distribution of entrepreneurship across STEM occupations varies between men and women, suggesting that both internal motivations and external forces may encourage women's entrepreneurship to a greater extent in certain STEM fields (Table 3). Women who choose to be self-employed in STEM occupations work predominantly in health occupations (e.g., physicians, dentists, physical therapists, opticians) (77.8%). The distribution of the self-employed women population across the remaining STEM occupations varies substantially, with 13.1% in computer and mathematical occupations, 6.7% in architecture and engineering, and 2.4% in life and physical sciences occupations.

While these general patterns hold for self-employed men in STEM fields, there are differences in the distribution across fields. Self-employed men in STEM are almost twice as likely to be in computer/mathematical occupations and almost three times as likely to be in architecture/engineering occupations relative to self-employed women in STEM. On the other hand, they have a smaller representation in health occupations (52.6%) relative to women who are self-employed in STEM fields (77.8%).

Table 3. Distribution of STEM Entrepreneurship across STEM Fields (2015 ACS)

	Women	Men
Self-employed in STEM (Total Count)	307,753	644,230
Computer and Mathematical Occupations (e.g., computer programmers, web developers, operations research analysts)	13.1%	26.1%
Architecture and Engineering Occupations	6.7%	18.2%
Life and Physical Sciences Occupations (e.g., physical scientists, chemist and material scientists, biological scientists)	2.4%	3.1%
Health Occupations (e.g., physicians and surgeons, registered nurses, clinical laboratory technologists and technicians)	77.8%	52.6%
TOTAL %	100%	100%

Source: Authors' analysis of 2015 American Community Survey obtained from the IPUMS-USA database.
Note: STEM fields are defined based on occupation codes and include the following: Computer and Mathematical Occupations, Architecture and Engineering Occupations, Life and Physical Sciences Occupations, Health Occupations.

The Role of STEM Education and Training

Central to understanding the gender dynamics of entrepreneurship and commercialization in STEM fields are factors motivating participation, including STEM education and training. To better understand the relationship between STEM education and STEM entrepreneurship, this report presents an examination of fields that people employed in STEM occupations studied during their undergraduate education. The undergraduate degree fields are classified into the following seven groups based on Siebens and Ryan (2012): science and engineering, science- and engineering-related, social sciences, business, education, arts/humanities, and other. Science and engineering fields include computer science, computer and information systems, mathematics, and statistics, biological, agricultural, and environmental sciences, physical and related science, social sciences, engineering among others. Science- and engineering-related fields include, for example, nursing, architecture, and mathematics teacher education.

The analysis findings reveal several key features of the relationship between STEM education and STEM entrepreneurship. First, the majority of self-employed men and women in STEM with at least a bachelor's degree have received a bachelor's degree in science, engineering or related fields (Table 4). However, relative to men, self-employed women in STEM are less likely to have received a bachelor's degree in science, engineering or related field in their undergraduate education (31.5%+31.5%=63% vs. 58.7%+14.3%=73%). Therefore, a larger share of self-employed women in STEM, relative to similar men, consists of individuals with an undergraduate degree that is not related to science or engineering. A similar pattern is also evident among wage/salary workers in STEM; however, the difference between men and women in terms of their undergraduate fields is more pronounced among the self-employed in STEM.

Table 4. Field of Bachelor's Degree among the Self-Employed and Wage/Salary Workers in STEM with at least a Bachelor's Degree (2015 ACS)

Field of Bachelor's Degree	Self-Employed		Wage/Salary Employment	
	Women	Men	Women	Men
STEM Employment (Total Count)	237,856	536,298	5,123,550	5,744,025
Science and engineering	31.5%	58.7%	25.2%	61.5%
Science- and engineering-related	31.5%	14.3%	44.0%	11.0%
Social sciences	12.6%	7.6%	8.5%	6.3%
Business	5.0%	7.6%	7.9%	10.6%
Education	4.0%	1.9%	3.2%	1.4%
Arts and humanities	12.0%	8.4%	7.5%	7.0%
Other	3.5%	1.5%	3.7%	2.2%
TOTAL %	100%	100%	100%	100%

Source: Authors' analysis of 2015 American Community Survey obtained from the IPUMS-USA database.
Note: STEM entrepreneurs are defined as those who are self-employed and have the following occupations: Computer and Mathematical Occupations, Architecture and Engineering Occupations, Life and Physical Sciences Occupations, Health Occupations. Bachelor's degree fields are classified according to the classification in Siebens and Ryan (2012) (https://www.census.gov/prod/2012pubs/acs-18.pdf). Psychology is classified under social sciences.

The lower prevalence of undergraduate STEM education among self-employed women in STEM relative to men may reflect different pathways that women may take into STEM entrepreneurship. For example, self-employed women in STEM who study a non-STEM-related field in college may be more likely than men to receive graduate degrees in STEM fields. Among examples of moving from a non-STEM undergraduate field to a STEM graduate field are individuals who earn undergraduate degrees in literature or history who go on to medical school or earn other graduate degrees in healthcare. Alternatively, women who do not receive a formal education in STEM may be more likely than men to build their STEM expertise through informal or on-the-job training prior to starting their businesses. Our finding of lower prevalence of undergraduate STEM education among self-employed women in STEM relative to men suggests that these alternative paths may be more prevalent for female entrepreneurs relative to male entrepreneurs. Further empirical research is needed to determine the extent to which these alternative explanations hold.

Second, self-employed women in STEM are less likely to have a science, engineering, or related degree compared to women STEM wage/salary workers (63% vs. 69.2%). This finding underscores the relative importance of graduate degrees or informal STEM training among self-employed women compared to women in wage/salary employment. Furthermore, compared to self-employed women in STEM, women working in STEM wage/salary employment have a lower frequency of receiving a science and engineering degree and a higher frequency of receiving a science- and engineering-related degree.

A review of the literature reveals that in general, women are underrepresented among students pursuing STEM educations. This gender-based gap has been identified consistently in primary and secondary education, documented by programs targeting girls' K-12 involvement.[19] However, this gap is most often identified at the undergraduate level, where data on majors and course selection is collected more systematically, and when students pursue distinct degrees by subject.[20] Furthermore, women who pursue STEM educations do not, on average, attain equally high degrees as men. For example, men receive more STEM or STEM-related doctoral degrees than women.[21] Women that complete STEM degrees are also less likely than men to work in careers or sectors that draw on STEM-relevant skillsets.[22]

Among students of color, lower prevalence of women pursuing STEM education is even more marked and may represent a critical area of underutilized human capital. Ong et al. (2011) argue that the extant underrepresentation of women of color in STEM too often relies on the false notion that minority women are not interested in STEM educations and careers.[23] An examination of undergraduate women of color in STEM fields argues that minority women students are more likely to complete STEM majors when external assurances are present; degree completion increases when minority women students are engaged with a supportive collegiate environment, with strong academic peer relationships and research program involvement.[24] Examining female African-American students specifically, programs that promote the psychological readiness of students, or preparedness to work in a field in which individuals of similar backgrounds are few, to conduct research in non-minority-dominated fields have been demonstrated to be effective.[25]

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[19] Jarrett, V., & Tchen, C. (2012). Keeping America's women moving forward: The key to an economy built to last. The White House Council On Women And Girls. Available at: https://www.whitehouse.gov/sites/default/files/email-files/womens_report_final_for_print.pdf

[20] Choi, J., Jeong, S., and Kehoe, C. (2012) Women in Entrepreneurship Education in US Higher Education. Journal of Business Diversity, 12(2), 11-26

[21] Hunt, J., Garant, J. P., Herman, H., and Munroe, D. J. (2013) Why are Women Underrepresented Amongst Patentees? Research Policy, 42, 831-843

[22] Beede, D. N., Julian, T. A., Langdon, D., McKittrick, G., Khan, B., & Doms, M. E. (2011). Women in STEM: A gender gap to innovation. Economics and Statistics Administration Issue Brief, (04-11).

[23] Ong, M., Wright, C., Espinosa, L. and Orfield, G.(2011) Inside the Double Bind: A Synthesis of Empirical Research on Undergraduate and Graduate Women of Color in STEM. Harvard Education Review, 81(2), 172-208

[24] Espinosa, L. (2011) Women of Color in Undergrad STEM Majors. Harvard Education Review, 81(2), 209-240

[25] Perna et al. (2009) The Contribution of HBCUs to the Preparation of African American Women for STEM Careers: A Case Study. Research in Higher Education, 50, pp. 1-23

Owner Characteristics of Women-Owned STEM Businesses

This section presents results from the analysis of 2015 ACS and 2007 SBO data to examine the characteristics of business owners across genders and STEM and non-STEM fields. The analysis is aimed to provide insight into the potential factors associated with STEM entrepreneurship among women.

American Community Survey Analysis Results

The analysis of 2015 ACS data reveals differences between self-employed men and women in STEM as well as between self-employed women in STEM and non-STEM fields. First, the results show that self-employed women in STEM are slightly younger than self-employed men in STEM (49 vs. 52). Second, they are less likely to be married compared to self-employed men in STEM (67% vs. 76%).

While the frequency of graduate degree holders is similar between self-employed men and women in STEM (57.0% vs. 58.8%), it varies across different graduate degrees (Table 5). Women who are self-employed in STEM are more likely to hold a master's degree relative to self-employed men in STEM. However, they are less likely to hold a professional or doctoral degree compared to self-employed men in STEM. Furthermore, bachelor's degrees are less prevalent and high school and associate's degrees are more prevalent among self-employed women relative to self-employed men in STEM.

Table 5. Educational Attainment of the Self-Employed in STEM Fields, by Gender (2015 ACS)

	Women	Men
Self-employed in STEM (Total Count)	307,753	644,230
Education (%)		
High School or Less	5.2%	3.9%
Some College	9.3%	8.4%
Associate's Degree	8.3%	4.4%
Bachelor's Degree	20.3%	24.4%
Master's Degree	18.7%	11.6%
Professional Degree	28.3%	35.8%
Doctorate Degree	10.0%	11.4%

Source: Authors' analysis of 2015 American Community Survey obtained from the IPUMS-USA database.
Note: STEM fields are defined based on occupation codes and include the following: Computer and Mathematical Occupations, Architecture and Engineering Occupations, Life and Physical Sciences Occupations, Health Occupations.

The results also show that self-employed women in STEM are more likely to be non-white compared to men who are self-employed in STEM (20.9% vs. 16.8%) (Table 6). Asians make up the largest non-white group among both women and men who are self-employed in STEM (11.9% and 10.7%). Women who are self-employed in STEM fields are also more likely to be black or African American (5.2% vs. 3.2%) or other race (3.8% vs. 3.0%) relative to men. Furthermore, a greater percentage of self-employed women in STEM are Hispanic relative to men (6.5% vs. 5.5%).

Table 6. Race and Ethnicity of the Self-Employed in STEM Fields, by Gender (2015 ACS)

	Women	Men
Self-employed in STEM (Total Count)	307,753	644,230
Race (%)		
White	79.1%	83.2%
Black or African American	5.2%	3.2%
Asian	11.9%	10.7%
Other	3.8%	3.0%
Hispanic (%)	6.5%	5.5%

Source: Authors' analysis of 2015 American Community Survey obtained from the IPUMS-USA database.
Note: STEM fields are defined based on occupation codes and include the following: Computer and Mathematical Occupations, Architecture and Engineering Occupations, Life and Physical Sciences Occupations, Health Occupations. Other races include American Indian/Alaska Native, other race not elsewhere classified, and individuals with two or more major races.

Compared to self-employed women in non-STEM fields, self-employed women in STEM fields are older (49 vs. 48) and more likely to be married (67% vs. 61%). As explained above, however, the average age and likelihood to be married among self-employed women in STEM is lower than that for self-employed men in STEM. The analysis results reveal large differences between STEM and non-STEM women entrepreneurs in terms of educational attainment (Table 7). The majority of self-employed women in STEM fields (57%) have a graduate degree while 13% of self-employed women in non-STEM fields have a similar degree. In contrast, more than half of self-employed women in non-STEM fields have at most a high school degree (including some college) (55.6%) while only 14.45% of self-employed women in STEM fields have similar educational attainment. These findings underscore the important role that higher education plays in STEM entrepreneurship.

Table 7. Educational Attainment of Self-Employed Women, by Field (2015 ACS)

	STEM	Non-STEM
Self-Employed Women (Total Count)	307,753	4,892,542
Education (%)		
High School or Less	5.2%	32.2%
Some College	9.3%	23.4%
Associate's Degree	8.3%	8.7%
Bachelor's Degree	20.3%	22.7%
Master's Degree	18.7%	9.0%
Professional Degree	28.3%	2.5%
Doctorate Degree	10.0%	1.5%

Source: Authors' analysis of 2015 American Community Survey obtained from the IPUMS-USA database.
Note: STEM fields are defined based on occupation codes and include the following: Computer and Mathematical Occupations, Architecture and Engineering Occupations, Life and Physical Sciences Occupations, Health Occupations.

Racial distribution of self-employed women in STEM and non-STEM fields reveals that the prevalence of minority entrepreneurship is similar in both groups (Table 8). Among self-employed women in STEM, 20.9% are likely to be non-white compared to 19.8% among self-employed women in non-STEM fields. However, the racial break-up within minority entrepreneurs differs between the two groups. In particular, self-employed women in STEM are almost twice as likely to be Asian compared to self-employed women in non-STEM fields (11.9% vs. 6.3%). On the other hand, women who are self-employed in non-STEM fields are almost twice as likely to be of other race compared to self-employed women in STEM (7.3% vs. 3.8%). Furthermore, self-employed women in STEM are less likely to be Hispanic compared to self-employed women in non-STEM fields (6.5% vs. 15.5%).

Table 8. Race and Ethnicity of Self-Employed Women, by Field (2015 ACS)

	STEM	Non-STEM
Self-Employed Women (Total Count)	307,753	4,892,542
Race (%)		
White	79.1%	80.2%
Black	5.2%	6.2%
Asian	11.9%	6.3%
Other	3.8%	7.3%
Hispanic (%)	6.5%	15.5%

Source: Authors' analysis of 2015 American Community Survey obtained from the IPUMS-USA database.
Note: STEM fields are defined based on occupation codes and include the following: Computer and Mathematical Occupations, Architecture and Engineering Occupations, Life and Physical Sciences Occupations, Health Occupations.

Survey of Business Owners Analysis Results

Tables 9 through12 summarize the characteristics of firm owners and firms based on SBO data of single-owner firms using the adapted, plurality business owner definition described above. The Appendix includes results of additional analysis that examines joint-ownership firms (e.g. firms with multiple plurality owners that work the same hours and both provide goods and services), as well as results of analysis that use the standard business owner definition of 51% ownership. Table 13 uses the standard majority owner definition, based on 51% ownership, to explore commercialization outputs.

The analysis of SBO data reveals significant differences in educational attainment and previous entrepreneurial experience between men and women in STEM fields, echoing themes found in the education and training literature (Table 9). Male owners of single-owner businesses more often hold advanced degrees than women in all industries, a disparity that increases in graduate degrees (i.e. Master's, Doctorate) among STEM fields, in particular. Across genders, entrepreneurs in STEM fields attain higher educational degrees than owners in non-STEM fields, highlighting the importance of education and training in STEM entrepreneurship. Further, men owners are also more likely, across STEM and non-STEM businesses, to have previously been self-employed or owned their own business than women owners. In STEM and non-STEM fields, previous entrepreneurial experience is less common among female business owners than male business owners.

Table 9. Education of Business Owners, by Gender and Field (2007 SBO)

	Women-owned STEM	Men-owned STEM	Women-owned non-STEM	Men-owned non-STEM
N	1,819,021	3,454,597	9,541,546	15,841,195
Owner education				
High school diploma or less	8.9%	8.9%	19.1%	24.3%
Tech school	2.5%	3.0%	6.1%	5.3%
Some college	11.6%	10.5%	13.4%	13.7%
Associate	5.0%	3.7%	5.1%	4.0%
Bachelor	25.4%	27.0%	15.9%	18.4%
Masters, Doctorate, or Professional Degree	20.5%	27.8%	10.6%	12.4%
Not reported	26.1%	19.1%	29.8%	22.0%
Owner previously self-employed	20.3%	30.5%	20.6%	32.6%

Source: Authors' own analysis of 2007 Survey of Business Owners (U.S. Census Bureau)

Examining racial and ethnic background among owners of single-owner businesses identifies more white business owners, in STEM and non-STEM fields, than minority business owners (Table 10). Interestingly, Black, Asian, and Hispanic women own a greater proportion of STEM firms than men STEM business owners of the same race. Men and women business owners of non-STEM firms more often identify as racial or ethnic minorities than owners in STEM fields, a trend that is particularly pronounced among black women. Further, trends in owner age reveal a slight gender gap; at later ages (age 55 and above), men-owned businesses are more prevalent than women-owned businesses in both STEM and non-STEM fields. However, at younger ages (age 25-44), STEM *and* non-STEM business owners are somewhat more likely to be women than men.

Table 10. Race/Ethnicity and Age of Business Owners, by Gender and Field (2007 SBO)

	Women-owned STEM	Men-owned STEM	Women-owned non-STEM	Men-owned non-STEM
N	1,819,021	3,454,597	9,541,546	15,841,195
Race/Ethnicity*				
White	86.9%	90.0%	81.2%	87.0%
Black	5.1%	3.5%	9.8%	5.7%
Asian	5.9%	5.0%	6.5%	5.4%
Other	2.2%	1.5%	2.5%	2.0%
Hispanic	6.7%	5.2%	10.3%	9.2%
Owner age**				
Under 25	1.4%	1.3%	1.9%	1.6%
25 to 34	8.6%	7.2%	8.6%	7.8%
35 to 44	17.2%	15.5%	15.4%	16.1%
45 to 54	23.0%	22.3%	20.6%	23.2%
55 to 64	16.2%	22.2%	16.3%	19.1%
65 or over	6.6%	12.6%	7.5%	10.5%
Not reported	26.0%	18.9%	29.6%	21.7%

Source: Authors' own analysis of 2007 Survey of Business Owners (U.S. Census Bureau)
*Respondents able to select one or more race/ethnicity with which they identify
** Age categories reflect those presented to respondents in the SBO questionnaire (2007)

Business Characteristics and Performance of Women-Owned STEM Businesses

Business characteristics drawn from the 2007 SBO data suggest that on key firm performance indicators, such as number of employees, payroll and receipts, men-owned businesses show significantly higher figures than do women-owned businesses (Table 11). In both STEM and non-STEM fields, men-owned businesses, on average, employ nearly three times as many employees than women-owned businesses. Using number of employees as a proxy for firm size, other firm-level performance indicators, such as payroll and receipts, follow a similar trend. While men- and women-owned STEM businesses have a higher average payroll than non-STEM businesses, men-owned businesses, regardless of STEM status, have higher payroll and receipts than women-owned businesses in similar fields.

Women-owned businesses are more likely to have been established for a shorter period of time than men-owned businesses, in both STEM and non-STEM fields. In particular, this variation is greatest among businesses operating for 18 years or more. The sharp disparity in years of firm ownership by gender suggests that several dynamics may be at play. First, women business owners may face fewer barriers to firm start-up and entry in recent years compared to 15 or 20 years ago. Second, women starting businesses 15 or 20 years ago may have faced greater barriers to survival than those starting more recently, and did not continue to operate into 2007.

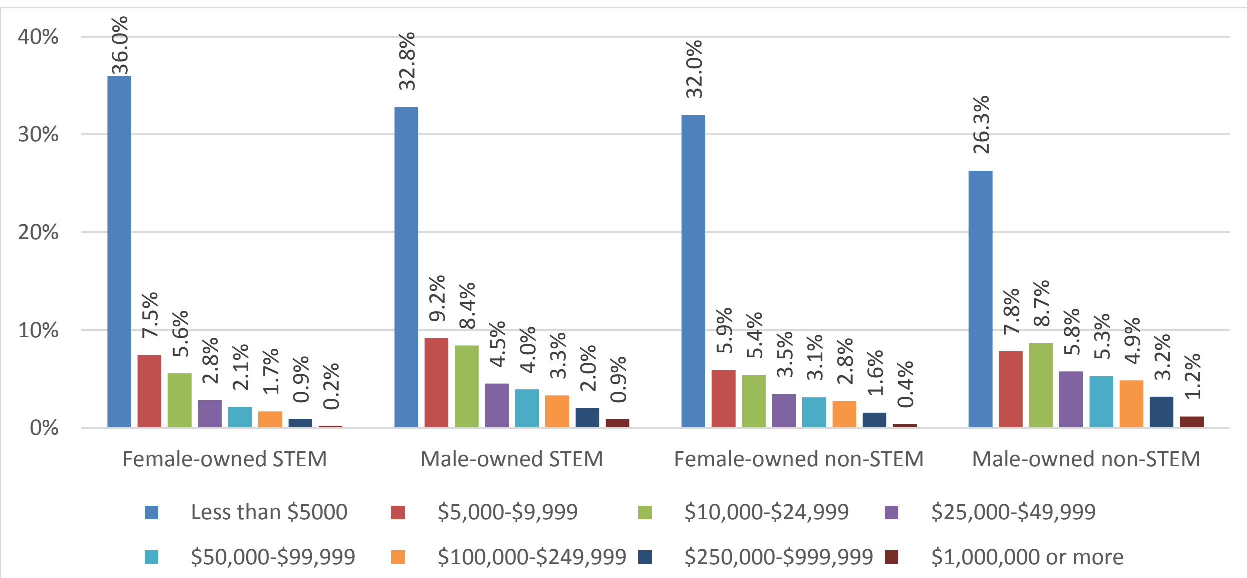
Table 11. Characteristics of Businesses: Business Performance, by Owner Gender and STEM Status (2007 SBO)

	Female-owned STEM	Male-owned STEM	Female-owned non-STEM	Male-owned non-STEM
N	1,360,550	2,761,549	6,681,528	11,708,507
No. employee (average)	1.1	3.1	1.0	2.7
Payroll ($1000, average)	40.5	135.0	24.7	86.1
Receipts ($1000, average)	176.3	574.3	144.4	536.5
Number of years in operation				
Not reported	4.5%	3.4%	6.3%	5.0%
Less than 1	13.6%	10.3%	12.7%	9.3%
1	8.8%	6.9%	8.4%	6.5%
2 to 4	17.6%	15.4%	17.3%	15.1%
5 to 17	32.3%	32.8%	28.6%	30.2%
More than 18	15.0%	25.1%	16.0%	25.9%

Source: Authors' own analysis of 2007 Survey of Business Owners (U.S. Census Bureau)
Note: Firms operating in STEM fields are identified using two digit NAICS codes representing industries in which STEM occupations make up 5.8% (national average) of total employment.

A widely cited barrier to business entry and survival is access to start-up and expansion financing. The analysis of 2007 SBO data suggests that the role of financing in motivating successful entrepreneurship and commercialization may further explain existing gender gaps, as the disparity is quite marked, particularly among women-owned firms in STEM. The majority of all respondent businesses rely on less than $5000 in start-up capital, the lowest funding category included in the survey questionnaire; however, women-owned single-owner businesses in STEM are most likely to rely on this funding category (Figure 1). Men-owned firms are more likely to use higher levels of start-up funding slightly more often than women-owned firms, in both STEM and non-STEM firms. At start-up funding levels above $5000, the disparity in funding by gender becomes apparent. Among STEM and non-STEM men-owned firms, non-STEM firms are more likely to receive start-up funding at all higher levels of funding than STEM firms. Among female owners, STEM firms see the gap in likelihood to receive start-up funding most markedly from all other firm owners beginning at the $100,000 - $249,999 level, while the gap emerges prominently for women-owned non-STEM businesses at the $250,000 - $999,999 funding level.

Figure 1. Amount of Start-up Capital by Owner Gender and STEM Status (2007 SBO)*



Source: Authors' own analysis of 2007 Survey of Business Owners (U.S. Census Bureau)

* Total amount of capital used to start or acquire the business, 2007 dollars

Note: Firms operating in STEM fields are identified using two digit NAICS codes representing industries in which STEM occupations make up 5.8% (national average) of total employment.

Start-up funding sources, to some degree, also highlight disparities between men- and women-owned businesses. Men-owned businesses, in STEM and non-STEM fields, are consistently more likely to rely on or gain access to a bank loan to fund start-up than women-owned businesses (Table 12). This is notable, as bank loans typically give advantages over other personal funding sources, such as credit cards or personas loans, in that they are associated with lower interest rates and lower personal financial risk. Expansion capital sources further highlight the gender disparity in access to bank loans, as men-owned firms, in STEM and non-STEM fields use bank loans to finance expansion at more than twice the rate of women-owned firms. Men-owned firms in both STEM and non-STEM fields are additionally more likely to use business profits to fund expansion than women-owned firms; however, STEM firms, broadly, are more likely to use business profits to expand than non-STEM firms.

Table 12. Characteristics of Businesses: Financial Access, by Owner Gender and STEM Status (2007 SBO)

	Female-owned STEM	Male-owned STEM	Female-owned non-STEM	Male-owned non-STEM
Start-up capital source*ᵻ				
Personal savings	54.0%	62.1%	49.0%	56.2%
Credit cards	10.5%	10.1%	9.9%	9.6%
Bank loan	3.4%	6.3%	5.4%	11.1%
Government loan	0.3%	0.4%	0.4%	0.6%
Venture capital	0.2%	0.4%	0.1%	0.3%
Expansion capital source*ᵻ				
Personal savings	24.6%	28.8%	23.7%	28.0%
Credit cards	11.0%	11.8%	10.1%	11.7%
Bank loan	3.1%	7.1%	3.5%	9.3%
Business profits	7.6%	12.2%	5.6%	9.6%
Government loan	0.2%	0.4%	0.3%	0.4%
Venture capital	0.1%	0.2%	0.1%	0.1%

*"Not applicable" responses not reported
ᵻ Respondents able to select none, one or more than one capital source
Source: Authors' own analysis of 2007 Survey of Business Owners (U.S. Census Bureau)
Note: Firms operating in STEM fields are identified using two digit NAICS codes representing industries in which STEM occupations make up 5.8% (national average) of total employment.

The analyses presented here, while descriptive, yield insights that support findings from the literature which identify a significant gender gap among factors influencing participation in STEM education and entrepreneurship and experience-based precursors, as well as critical outputs of commercialization behaviors. The findings are additionally robust to changes in the definition of primary business ownership. A comparison of the findings to results under traditional definitions of majority ownership applied to 2007 and 2012 SBO data (presented in

Appendix) demonstrates that, across the plurality and majority owner definitions and survey rounds, characteristics of business owners and businesses are broadly similar. While variation in owner definition and survey round introduce some minor changes in the size of gender and sector disparities along certain indicators, trends remain very similar.

Commercialization Among Women-Owned STEM Businesses

Using data from the 2012 Survey of Business Owners, the report also examines a firm's intellectual property ownership as an important indicator of commercialization behavior. The analysis takes into account the behavior of filing and receiving intellectual property as the first critical step in the commercialization process, which is followed by the licensing of proprietary innovations. Thus, the analysis results presented below characterize the role of gender in a key initial phase of commercialization.

The commercialization-focused analysis draws on 2012 SBO data and the same approach to identifying STEM fields by two-digit NAICS codes as the one used in analyzing 2007 SBO data. However, to define the gender of firm owner, a Census Bureau classification which identifies the owner as an individual holding at least 51% of the firm is adopted. In firms where no individual majority owner is identifiable, firms are classified as equal-ownership. SBO data further identifies firms that hold at least one piece of a type of intellectual property (e.g. trademark, patent), but does not provide information on the intensity of intellectual property production (e.g., number of patents held by a single firm.) Table 13 summarizes the trends in intellectual property outputs of STEM and non-STEM firms.

In all measures of commercial licensing (e.g. patenting, trademarking, copyrighting) a distinct gender gap exists within STEM firms. Accordingly, men-owned firms are significantly more likely to hold at least one piece of intellectual property than women-owned firms (Figure 2). This stands in stark contrast to men- and women-owned non-STEM businesses, which show virtually no gap between firm ownership of intellectual property.

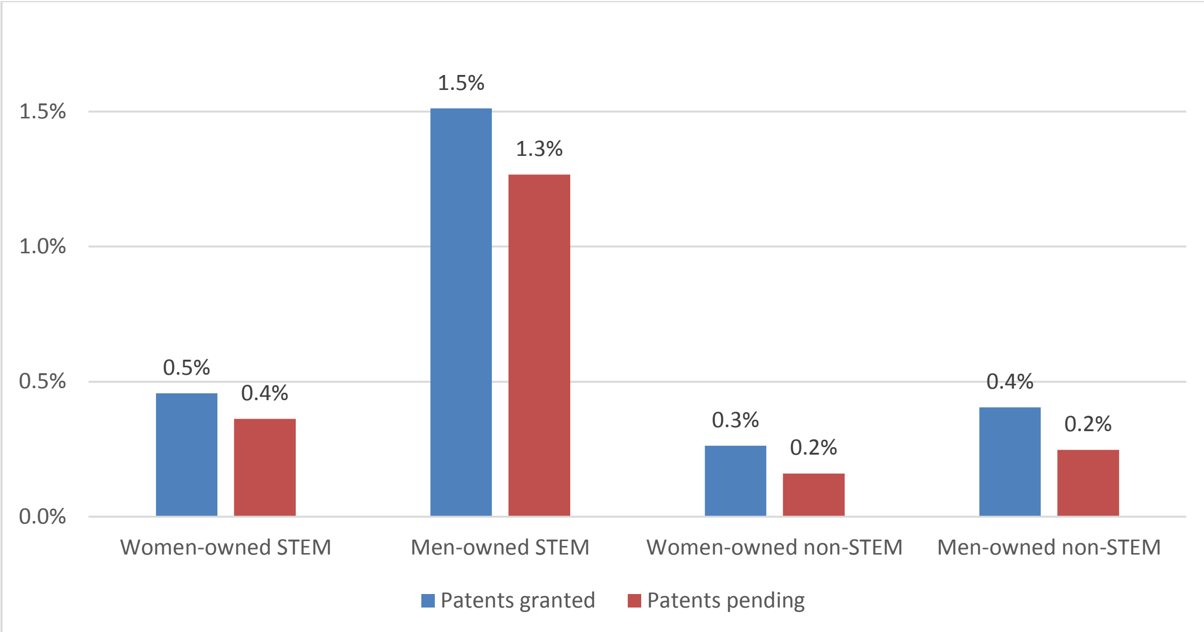
Table 13. Characteristics of Businesses: Intellectual Property Outputs, by Owner Gender and STEM Status (2012 SBO)

	Women-owned STEM	Men-owned STEM	Equally-owned STEM	Women-owned non-STEM	Men-owned non-STEM	Equally-owned non-STEM
Firms with:						
Patents granted	5,085	32,030	4,183	11,973	29,769	5,504
	0.5%	1.5%	1.3%	0.3%	0.4%	0.4%
Patents pending	4,030	26,836	3,426	7,296	18,175	3,606
	0.4%	1.3%	1.1%	0.2%	0.2%	0.2%
Trademark owned	30,990	94,148	17,810	80,567	175,833	39,697
	2.8%	4.4%	5.7%	1.8%	2.4%	2.6%
Copyright owned	58,998	144,672	27,724	104,508	172,439	38,800
	5.3%	6.8%	8.9%	2.3%	2.3%	2.5%
Total reporting*	1,113,988	2,118,272	311,136	4,557,680	7,346,623	1,556,328
Not reported	9,278	14,284	1,567	68,771	95,648	8,836

Source: U.S. Census estimates from 2012 Survey of Business Owners.
*Including "None of the above" response
Note: Firms operating in STEM fields are identified using two digit NAICS codes representing industries in which STEM occupations make up 5.8% (national average) of total employment.

Further, examining intellectual property ownership additionally favors STEM industries. STEM businesses are more likely to hold intellectual property, generally, than non-STEM businesses. STEM businesses are also more likely to own copyrights, followed by trademarks and patents granted. Within STEM businesses, fewer men- and women-owned businesses own at least one patent or have a patent pending than other forms of intellectual property.

Figure 2. Proportion of Firms with At Least One Patent, by Owner Gender and STEM Status (2012 SBO)



Source: U.S. Census estimates from 2012 Survey of Business Owners.
Note: Firms operating in STEM fields are identified using two digit NAICS codes representing industries in which STEM occupations make up 5.8% (national average) of total employment.

While studies related to commercialization are more limited than those focused solely on entrepreneurship, they identify a clear trend that women are less likely than men to commercialize or patent innovations. Worldwide, men continually patent more frequently than women, a gap which has decreased only slightly since the 1970s.[26] As the descriptive analysis suggests, this trend may have important implications for the economic outcomes of women, and particularly women entrepreneurs in STEM fields and their firms. Future analyses of commercialization among women in STEM would benefit from improved data collection on commercialization outcomes and their inclusion in publicly available, nationally-representative microdata, two factors which limited this paper's data analysis.

While many analyses, including this report's, evidence this gender disparity in commercialization, systematic comparative studies of the commercialization gap in different disciplines have not been conducted and several studies point to heterogeneity in outcomes across some fields. In the medical sciences, one study suggests little evidence of a gender gap persists, as women may simply be less likely to report patenting and commercialization activity

[26] Sugimoto, C.R., Ni, C., West, J.D., Larivière, V. (2015) The Academic Advantage: Gender Disparities in Patenting. PLOS ONE, 10(5)

in the same volume as men.[27] Studies of patenting in the academic life sciences find that while women produce fewer patents, this may be a generational trend, most prevalent among senior faculty.[28]

Demonstrating the size and existence of the gender gap in commercialization outcomes is important to motivating applied research, but understanding the potential causes of the gap may further aid in developing exact policy solutions to target the disparity. The literature cites both individual and external influences as critical in defining the commercialization gap. These draw on gender differences in education and training, work preferences, and discrimination faced professionally.

Most often, studies identify the most influential predictor of this gap as lower levels of prior experience with commercialization among women than men. [29,30] Blume-Kohout (2014) shows that this may begin early in a woman's STEM career. She finds that female engineering PhD students are less likely to enroll in programs with and gain access to industry-funded R & D opportunities as men, which significantly influences their future patenting behaviors.[31]

Studies examining women-owned firms' performance, often measured in revenue or firm size, similarly link this gender gap to a disparity in exposure to commercialization behaviors. Specifically, findings link women's firm performance to a lack of previous experience in and with the commercial sector, less common training in engineering-specific disciplines, and fewer women in "patent-intensive" jobs.[32,33] However, most widely studied is the role of limited financial access on women-owned firms' entrepreneurial performance, which identifies discrimination and limitations in access to funding networks and high cost of capital. [34,35,36]

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[27] Colyvas, J. A., Snellman, K., Bercovitz, J. and Feldman, M. (2012) Disentangling Effort and Performance: A Renewed Look at Gender Differences in Commercializing Medical School Research. Journal of Technological Transfer, 37, 478-489

[28] Ding, W. W., Murray, F., and Stuart, T. E.(2006) Gender Patenting Differences in the Academic Life Sciences. Science, 313(5787), 665-667

[29] Goel, G. K., Göktepe-Hultén, D., and Ram, R. (2015) Academics' Entrepreneurship Propensities and Gender Differences. Journal of Technological Transfer, 40, 161, 177

[30] Blume-Kohout, Margaret E. 2014. "Understanding the gender gap in STEM fields entrepreneurship," Final report submitted to the Small Business Administration, Office of Advocacy.

[31] Blume-Kohout, Margaret E. 2014. "Understanding the gender gap in STEM fields entrepreneurship," Final report submitted to the Small Business Administration, Office of Advocacy.

[32] Hunt, J., Garant, J. P., Herman, H., and Munroe, D. J. (2013) Why are Women Underrepresented Amongst Patentees? Research Policy, 42, 831-843

[33] Cook, Lisa D. and Chaleampong Kongcharoen (2010). "The idea gap in pink and black," NBER working paper 16331.

[34] Turrentine, A., Well, V. (2015) Career Advancement through Academic Commercialization: Acknowledging and Reducing Barriers for Women Engineering Faculty. 122nd ASEE Annual Conference & Exposition Paper

Further, organizational dynamics and associated incentive structures may also play an important role in influencing women's commercialization efforts. Overall, scientists working in industry see a smaller gender gap in patenting and commercialization than in academia. Studies suggest that this gap decreases in industry due to organizational incentives and resources, such as bonus structures and promotions that reward commercialization activities.[37] Academia stands in contrast to industry in that little incentive is given to commercialization and in the academic tenure process, in particular.[38]

Institutional dynamics between academia and industry may also affect women's patenting outputs uniquely, affecting women who have children. A study of patenting among women scientists with and without children in academia and in industry suggests that patenting outputs of women in industry were not affected by their decision to have children, while, in academia, women with children were less likely to patent at the rate of women without children. [39] The authors suggest that this "motherhood gap", the disparity in commercialization output once a woman has children, further underscores the significant role of organizational incentives and dynamics.

Findings suggest that network-oriented, non-hierarchical organizational structures – in academia or in industry – may also decrease the disparity across genders in patenting.[40] Smith-Doerr (2004) finds that regardless of academic or industrial setting, gender equality in the workplace may be easier to achieve in smaller work environments with network-oriented structures, as compared to hierarchical institutions. Hierarchical organizational dynamics may provide structures that hide existing gender bias.[41]

Further, some suggest that that identifying a gender disparity in commercialization measured by the volume of patents may fundamentally favor men. Whittington et al. (2005) examine

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[35] Coleman, S., Robb, A,. (2012) Unlocking Innovation in Women-Owned Firms: Strategies for Educating the Next Generation of Women Entrepreneurs. Journal of Women's Entrepreneurship and Education, 1(2), 99-125

[36] Robb, A. (2012) Access to Capital among Young Firms, Minority-owned Firms, Women-owned Firms, and High-tech Firms. Small Business Association

[37] Whittington, K.B., Smith-Doerr, L. (2008) Women Inventors in Context: Disparities in Patenting Across Academia and Industry. Gender and Society, 22(2), 194-218

[38] Cadwaler, E. (2013) Policy Analysis: Identification of Barriers to Participation for Women in University Technology Transfer Activities. Association for Women in Science

[39] Whittington, K. B. (2011) Mothers of Invention? Gender, Motherhood, and New Dimensions of Productivity in the Science Profession. Work and Occupations, 38(3), 417-456

[40] Whittington, K.B., Smith-Doerr, L. (2008) Women Inventors in Context: Disparities in Patenting Across Academia and Industry. Gender and Society, 22(2), 194-218

[41] Smith-Doerr, L. (2004). Flexibility and fairness: Effects of the network form of organization on gender equity in life science careers. *Sociological Perspectives*, *47*(1), 25-54.

women and men in the life sciences in both industry and academia and find that while male scientists may produce more commercial output than their female counterparts, women may produce patents of higher quality and impact.[42] Patent quality and impact is measured by the number of other patents that cite the innovation, a metric shown to be highly correlated with the value of an innovation. The authors suggest that looking beyond a simple count of patents and looking more closely at its societal and scientific value may better distinguish the value of women in commercialization.

Policy Recommendations Identified in Literature Review and Policy Scan

The significance of the gender gap in STEM is salient in the discussions of practical solutions to decrease it, from educational participation in K-12 to patenting activities of women scientists. Through a review of scientific literature and policy discussions, we summarize these proposed solutions on a variety of levels, including recommendations for legislative action and programmatic best practices. The majority of these recommendations are organized around central objectives of increasing women and girls' participation in STEM educations, supporting women's inclusion in STEM commercial activity, boosting commercial outputs among women academics in STEM, and improving opportunities for further research in this field.

Increasing Women and Girls' Participation in STEM Education

Concentrated policy efforts targeting women and girls' STEM education center on participation and target future gains in the STEM gender gap. At a policy level, recommendations include legislative allocation of funds for programs targeting STEM pathways for female and minority students and targeting higher education preparation for these groups, increasing industry participation in STEM-support programs for women, and increasing collaborative resources for multiple agencies involved in crafting early STEM curricula. [43,44] The Institute for Women's Policy Research suggests encouraging state-level education agencies to monitor the access and outcomes of women in technical education programs, in particular those that are high-skill, high-wage, and not traditionally pursued by women, as is mandated in the Perkins Act.[45] Additionally, enforcing gender equity regulations in STEM in college environments, such as Title IX, a law which prohibits discrimination on the basis of sex in education, might increase

[42] Whittington, K.B., Smith-Doerr, L.(2005) Gender and Commercial Science: Women's Patenting in the Life Sciences. Journal of Technology Transfer, 30, 355-370

[43] The White House (2013). Federal STEM Education 5-year Strategic Plan, Washington, DC.

[44] Ganapathy, B., Olson, C., Davis, I., Frase, E., Kantor, J. S., Fimbres, L., Robinson, Y., Babb, G., and Gerstain, A.(2014) Women in STEM: Realizing the Potential. STEMconnector.

[45] Institute for Women's Policy Research. (2016) "Where are the Women Patent Holders?" Institute for Women's Policy Research Resource Paper.

participation.[46,47] Resources examining the application of Title IX in STEM suggest targeting university Title IX coordinators to include STEM disciplines in compliance reviews.

In the classroom and on campus, policy recommendations center on practical offerings for underrepresented students in STEM. Suggestions specifically focus on reducing known barriers to women and minority students, including creating inclusive networks through mentorship, a challenge that many minority women face in developing careers in STEM. On the institutional side, for minority and non-minority women, policy recommendations focus on developing curricula that emphasize real-world problems and the applied nature of STEM careers, boosting paid internship programs to increase professional experience of women in STEM, and increasing visibility of women and minority role-models working in STEM fields.[48]

Improving Women's Role in Commercialization and Entrepreneurship

Policies targeting the commercialization and entrepreneurship in STEM fields aim to also reduce some of the obstacles identified in the literature. Several sources suggest that increasing the visibility of federal programs that serve to accelerate innovation may attract women to resources already flagged to promote STEM innovators.[49] Two such programs, the Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) programs, encourage commercialization and technology transfer from federally-funded agencies' investments in research through competitive rounds of funding. A participant in a SBIR/STTR workshop on diversity and innovation suggested launching a "Phase Zero" program for women and minority entrepreneurs that would serve as a precursor to the highly competitive Phase I and II SBIR/STTR funding.[50]

Additional recommendations focus on strategies to communicate and improve access to resources beyond established networks. To facilitate access to resources, some suggest that hotlines to communicate commercialization opportunities or resources to women entrepreneurs may ease the intellectual property filing process.[51] Additionally, informal

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[46] United States Department of Justice. (1972) "Overview of Title IX and the Educational Amendments of 1972". Available at: https://www.justice.gov/crt/overview-title-ix-education-amendments-1972-20-usc-1681-et-seq

[47] Hill, C., Corbett, C., and St. Rose, A.(2010) Why so Few? Women in STEM. American Association of University Women

[48] The White House (2013). Federal STEM Education 5-year Strategic Plan, Washington, DC.

[49] Delixus, Inc. (2012) Intellectual Property and Women Entrepreneurs. National Women's Business Council

[50] National Academies of Sciences, Engineering, and Medicine. (2015) Innovation, Diversity, and the SBIR/STTR Programs. Summary of a Workshop. Washington, DC: The National Academies Press.

[51] Ganapathy, B., Olson, C., Davis, I., Frase, E., Kantor, J. S., Fimbres, L., Robinson, Y., Babb, G., and Gerstain, A.(2014) Women in STEM: Realizing the Potential. STEMconnector.

educational and networking opportunities for women entrepreneurs may increase commercialization behaviors.[52]

Improvements to Commercial Outputs Among STEM Women in Academia

Policy recommendations specific to women who work in academia, distinct from industry-employed counterparts, focus on tenure award decisions. Specifically, recommendations advocate that tenure decision criteria include commercialization-oriented criteria. If tenure criteria prioritized commercialization activities, it follows that women academics may be more likely to pursue commercialization behaviors and outputs. The focus on tenure decisions targets individual researchers' commercialization incentives and differs from historical policies, such as the Bayh-Dole Act of 1980. The Bayh-Dole Act took a broad stance on engaging academia in commercialization, by allowing universities to patent research from federally-funded programs, but its impact remains unclear.[53]

Other policy recommendations focused on academia involve the use of university technology transfer offices as a powerful mechanism to reduce gender discrimination. Specifically, a white paper produced by the Association for Women in Science suggests that implicit bias training and increased outreach to women-dominated fields may be important in supporting academic commercialization efforts from a psychological perspective.[54] Additional policy recommendations include reducing the emphasis on hierarchical work relations in science, in favor of more egalitarian practices among academicians, in order to better accommodate junior and mid-level women scientists in commercially-oriented work distributions.[55]

Enabling Future Research on Women in STEM

Significant attention in existing scientific and policy resources further notes the scarcity of appropriate data to understand the commercialization and entrepreneurial outcomes of women in STEM. Specifically, improvements in data collected may better detail the factors that contribute to the gender gap in commercialization and track progress towards equity.[56] To date, the United States Patent and Trademark Office does not publicly share demographic information on patent applicants and granted patents, a practice that is also common among

[52] Delixus, Inc. (2012) Intellectual Property and Women Entrepreneurs. National Women's Business Council

[53] Whittington, K.B., Smith-Doerr, L.(2005) Gender and Commercial Science: Women's Patenting in the Life Sciences. Journal of Technology Transfer, 30, 355-370

[54] Cadwaler, E. (2013) Policy Analysis: Identification of Barriers to Participation for Women in University Technology Transfer Activities. Association for Women in Science

[55] Whittington, K.B., Smith-Doerr, L. (2008) Women Inventors in Context: Disparities in Patenting Across Academia and Industry. Gender and Society, 22(2), 194-218

[56] Institute for Women's Policy Research. (2016) "Where are the Women Patent Holders?" Institute for Women's Policy Research Resource Paper.

university technology transfer offices.[57] Furthermore, microdata that has detailed information on not only outputs related to intellectual property (e.g. patents, trademarks, etc.) but also information on the extent to which underlying technology enters the market would lead to research that can provide more direct evidence on commercial activity and better inform policy.

Conclusions

This report presents an examination of women's entrepreneurship and commercialization in STEM through descriptive data analysis and literature review. Its findings highlight differences between men and women entrepreneurs in STEM fields as well as differences between women entrepreneurs in STEM and non-STEM fields in terms of owner and business characteristics. These differences suggest that women entrepreneurs in STEM fields may face unique challenges or may experience the effects of certain challenges disproportionately relative to men. Further, minority women may face steeper and somewhat different challenges to pursuing careers and commercial success in STEM fields than other women.

Prior research has identified external factors in each career stage, starting with STEM education and on-the-job training through business formation and operation, that affect commercialization among women. Individually, each stage represents a critical opportunity for leveraging the potential of women and girls in STEM. Taken together, this pipeline demonstrates the considerable breadth of the challenge of decreasing the commercialization gap.

There is still a need for further research to better understand the determinants of commercialization and why they may have differential effects on women and minority entrepreneurs in STEM. An immediate limitation in this research effort is the lack of data sources that allow researchers to simultaneously identify entrepreneur and business characteristics and measure the quality and quantity of their commercialization outcomes. Therefore, enhancing data sources to permit rigorous empirical analyses of commercialization outcomes is an important step for future research that is needed to inform policy-making.

Future research, empowered by improved data for analysis, should investigate the relative roles that various internal and external factors play in explaining commercialization outcomes among women entrepreneurs. A better understanding of the determinants influencing women's entrepreneurial choice and commercialization outcomes is key for the development of effective and targeted policies that will allow the U.S. economy to reach the full potential of STEM fields.

[57] Cadwaler, E. (2013) Policy Analysis: Identification of Barriers to Participation for Women in University Technology Transfer Activities. Association for Women in Science

References

BarNir, A. (2012) Starting Technologically Innovative Ventures: Reasons, Human Capital and Gender. *Management Decision*, 50(3), 399-419.

Beede, D. N., Julian, T. A., Langdon, D., McKittrick, G., Khan, B., & Doms, M. E. (2011). Women in STEM: A gender gap to innovation. Economics and Statistics Administration Issue Brief, (04-11).

Blume-Kohout, Margaret E. 2014. "Understanding the gender gap in STEM fields entrepreneurship," Final report submitted to the Small Business Administration, Office of Advocacy.

Cadwaler, E. (2013) Policy Analysis: Identification of Barriers to Participation for Women in University Technology Transfer Activities. Association for Women in Science.

Choi, J., Jeong, S., and Kehoe, C. (2012) Women in Entrepreneurship Education in US Higher Education. *Journal of Business Diversity*, 12(2), 11-26.

Coleman, S., Robb, A,. (2012) Unlocking Innovation in Women-Owned Firms: Strategies for Educating the Next Generation of Women Entrepreneurs. *Journal of Women's Entrepreneurship and Education*, 1(2), 99-125.

Colyvas, J. A., Snellman, K., Bercovitz, J. and Feldman, M. (2012) Disentangling Effort and Performance: A Renewed Look at Gender Differences in Commercializing Medical School Research. *Journal of Technological Transfer*, 37, 478-489.

Cook, Lisa D. and Chaleampong Kongcharoen (2010). "The idea gap in pink and black," NBER working paper 16331.

Delixus, Inc. (2012) Intellectual Property and Women Entrepreneurs. National Women's Business Council.

Ding, W. W., Murray, F., and Stuart, T. E.(2006) Gender Patenting Differences in the Academic Life Sciences. *Science*, 313(5787), 665-667.

Espinosa, L. (2011) Women of Color in Undergrad STEM Majors. *Harvard Education Review*, 81(2), 209-240.

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

Ganapathy, B., Olson, C., Davis, I., Frase, E., Kantor, J. S., Fimbres, L., Robinson, Y., Babb, G., and Gerstain, A.(2014) Women in STEM: Realizing the Potential. STEMconnector.

Goel, G. K., Göktepe-Hultén, D., and Ram, R. (2015) Academics' Entrepreneurship Propensities and Gender Differences. *Journal of Technological Transfer*, 40, 161, 177.

Hill, C., Corbett, C., and St. Rose, A.(2010) Why so Few? Women in STEM. American Association of University Women.

Hunt, J., Garant, J. P., Herman, H., and Munroe, D. J. (2013) Why are Women Underrepresented Amongst Patentees? Research Policy, 42, 831-843.

Institute for Women's Policy Research. (2016) "Where are the Women Patent Holders?" Institute for Women's Policy Research Resource Paper.

Jarrett, V., & Tchen, C. (2012). Keeping America's women moving forward: The key to an economy built to last. The White House Council On Women And Girls. Available at: https://www.whitehouse.gov/sites/default/files/email-files/womens_report_final_for_print.pdf

National Academies of Sciences, Engineering, and Medicine. (2015) Innovation, Diversity, and the SBIR/STTR Programs. Summary of a Workshop. Washington, DC: The National Academies Press.

Ong, M, Wright, C., Espinosa, L. and Orfield, G.(2011) Inside the Double Bind: A Synthesis of Empirical Research on Undergraduate and Graduate Women of Color in STEM. *Harvard Education Review*, 81(2), 172-208.

Perna et al. (2009) The Contribution of HBCUs to the Preparation of African American Women for STEM Careers: A Case Study. *Research in Higher Education*, 50, pp. 1-23.

Polkowska, D. (2013) Women Scientists in the Leaking Pipeline: Barriers to Commercialization of Scientific Knowledge by Women. *Journal of Technology and Management Innovation*, 8(2), 156-165.

Robb, A. (2012) Access to Capital among Young Firms, Minority-owned Firms, Women-owned Firms, and High-tech Firms. Small Business Association.

Robb, Alicia M. and John Watson (2012). "Gender differences in firm performance: Evidence from new ventures in the United States," Journal of Business Venturing, 27(5): 544-558.

Ruggles S., Katie Genadek, Ronald Goeken, Josiah Grover, and Matthew Sobek (2015). Integrated Public Use Microdata Series: Version 6.0 [Machine-readable database]. Minneapolis: University of Minnesota.

Siebens J. and C. Ryan (2012). "Field of Bachelor's Degree in the United States: 2009," American Community Survey Reports. U.S. Census Bureau.

Smith-Doerr, L. (2004). Flexibility and fairness: Effects of the network form of organization on gender equity in life science careers. *Sociological Perspectives*, *47*(1), 25-54.

Sugimoto, C.R., Ni, C., West, J.D., Larivière, V. (2015). The Academic Advantage: Gender Disparities in Patenting. PLOS ONE, 10(5).

The White House (2013). Federal STEM Education 5-year Strategic Plan, Washington, DC.

The White House (2015). A Strategy for American Innovation, Washington, DC: National Research Council and the Office of Science and Technology Policy.

Turrentine, A., Well, V. (2015) Career Advancement through Academic Commercialization: Acknowledging and Reducing Barriers for Women Engineering Faculty. 122nd ASEE Annual Conference & Exposition Paper.

United States Department of Justice. (1972) "Overview of Title IX and the Educational Amendments of 1972". Available at: https://www.justice.gov/crt/overview-title-ix-education-amendments-1972-20-usc-1681-et-seq

Whittington, K.B., Smith-Doerr, L.(2005) Gender and Commercial Science: Women's Patenting in the Life Sciences. *Journal of Technology Transfer*, 30, 355-370.

Whittington, K.B., Smith-Doerr, L. (2008) Women Inventors in Context: Disparities in Patenting Across Academia and Industry. *Gender and Society*, 22(2), 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), 417-456.

APPENDIX

Participation in STEM and STEM-Related Occupations

Table A1. Break-down of the Employed Population in STEM and STEM-Related Occupations(2015 ACS)

	STEM and STEM-Related Occupations		STEM Occupations Only	
	Women	**Men**	**Women**	**Men**
Employed	100%	100%	100%	100%
Wage/Salary Employment	92.7%	88.7%	92.7%	88.7%
STEM	13.4%	10.7%	8.8%	8.7%
Non-STEM	79.3%	78.0%	84.0%	80.1%
Self-Employment	7.3%	11.3%	7.3%	11.3%
STEM	0.43%	0.81%	0.14%	0.36%
Non-STEM	6.8%	10.5%	7.1%	10.9%

Comparison Tables Using Majority Owner Definition, 51% Ownership of Firm (Census Bureau Estimates Based on Survey of Business Owners)

Table A2. Characteristics of Business Owners (2012 SBO) – Majority Owner Definition

	Female-owned STEM	Male-owned STEM	Female-owned non-STEM	Male-owned non-STEM
N	1,588,487	2,854,943	8,293,919	12,018,866
Owner age				
Not reported				
Under 25	2.5%	2.3%	2.6%	2.7%
25 to 34	12.4%	11.4%	11.1%	9.9%
35 to 44	20.1%	18.6%	18.1%	17.5%
45 to 54	27.1%	25.7%	26.1%	25.9%
55 to 64	24.3%	24.6%	25.4%	25.8%
65 or over	13.7%	17.4%	16.7%	18.1%
Owner education				
Not reported				
Highschool diploma or less	15.2%	19.5%	25.1%	26.1%
Tech school	4.6%	6.1%	5.0%	4.8%
Some college	17.0%	16.9%	19.4%	16.9%
Associate	7.6%	5.4%	8.4%	5.3%
Bachelor	34.9%	36.3%	29.6%	32.8%
Masters, Doctorate, or Professional Degree	15.9%	15.8%	12.5%	14.2%
Owner previously self-employed	26.4%	37.4%	26.7%	40.5%

Table A3. Characteristics of Businesses (2012 SBO) – Majority Owner Definition

	Female-owned STEM	Male-owned STEM	Female-owned non-STEM	Male-owned non-STEM
N	1,588,487	2,854,943	8,293,919	12,018,866
Number of years in business				
Not reported	1.7%	1.9%	2.1%	0.2%
Less than 1	13.0%	9.6%	12.6%	9.9%
1	8.3%	6.5%	7.4%	6.1%
2	6.9%	5.5%	5.8%	4.4%
3	5.0%	4.4%	4.1%	3.8%
4	4.1%	3.9%	3.4%	3.3%
5 to 12	20.7%	20.9%	18.4%	19.2%
13 to 22	11.2%	13.5%	10.3%	11.7%
23 to 32	5.5%	8.2%	5.6%	8.3%
More than 32	4.1%	7.9%	5.2%	7.9%

Table A4. Financing Sources for Businesses (2012 SBO) - Majority Owner Definition

	Female-owned STEM	Male-owned STEM	Female-owned non-STEM	Male-owned non-STEM
N	1,588,487	2,854,943	8,293,919	12,018,866
Amount of start-up capital				
Not reported				
Less than $5000	37.1%	32.5%	30.2%	23.9%
$5000-$9999	7.7%	9.1%	6.0%	7.7%
$10000-$24999	5.5%	8.3%	5.3%	8.0%
$25000-$49999	3.0%	4.7%	3.5%	5.3%
$50000-$99999	2.2%	4.1%	3.4%	4.8%
$100000-$249999	1.9%	3.5%	3.3%	4.9%
$250000-$999999	1.0%	2.3%	1.6%	3.9%
$1000000 or more	0.4%	1.1%	1.0%	2.1%
Don't know	8.7%	13.3%	15.4%	18.1%
Start-up capital source				
Personal savings	54.9%	62.4%	49.9%	56.0%
Credit cards	8.0%	9.0%	7.0%	6.1%
Bank loan	3.5%	6.4%	4.8%	10.6%
Government loan	0.2%	0.2%	0.2%	0.2%
Venture capital	0.2%	0.6%	0.3%	0.5%
Expansion capital source				
Personal savings	20.4%	23.8%	18.5%	22.0%
Credit cards	5.0%	5.7%	4.4%	4.4%
Bank loan	2.9%	6.1%	3.7%	7.7%
Business profits	5.2%	9.1%	5.1%	7.4%
Government loan	0.3%	0.3%	0.1%	0.2%
Venture capital	0.1%	0.4%	0.1%	0.3%

Table A5. Characteristics of Business Owners (2007 SBO) – Majority Owner Definition

	Female-owned STEM	Male-owned STEM	Female-owned non-STEM	Male-owned non-STEM
N	1,959,094	3,969,161	9,968,521	18,140,420
Race/Ethnicity				
White	87.4%	90.3%	82.1%	87.4%
Black	4.8%	3.3%	9.4%	5.2%
Asian	5.7%	5.0%	6.2%	5.5%
Other	0.5%	0.3%	0.6%	0.5%
Hispanic	6.4%	5.0%	9.9%	8.7%
Owner age				
Under 25	1.4%	1.4%	1.9%	1.7%
25 to 34	8.6%	7.5%	8.7%	8.0%
35 to 44	17.7%	16.3%	16.4%	16.6%
45 to 54	24.2%	22.9%	22.4%	23.6%
55 to 64	18.6%	22.0%	17.4%	19.2%
65 or over	7.5%	12.4%	7.9%	10.8%
Not reported	22.1%	17.6%	25.4%	20.1%
Owner education				
Highschool diploma or less	10.6%	9.3%	21.0%	23.9%
Tech school	2.9%	3.0%	6.1%	5.1%
Some college	12.6%	10.4%	14.2%	13.5%
Associate	5.4%	3.7%	5.6%	4.0%
Bachelor	26.4%	28.1%	16.9%	20.0%
Masters, Doctorate, or Professional Degree	20.0%	27.8%	10.6%	13.0%
Not reported	22.1%	17.8%	25.6%	20.5%
Owner previously self-employed	22.8%	34.6%	23.2%	37.9%

Table A6. Characteristics of Businesses (2007 SBO) – Majority Ownership Definition

	Female-owned STEM	Male-owned STEM	Female-owned non-STEM	Male-owned non-STEM
N	1,296,211	2,790,044	6,403,121	12,271,688
Number of employees	0.9	3.4	0.9	2.9
Payroll ($1000s)	37.5	153.3	22.3	93.0
Receipts ($1000s)	164.8	652.1	130.1	571.1
Number of years in operation				
Not reported	3.9%	2.7%	5.9%	3.9%
Less than 1	10.9%	6.4%	11.0%	6.2%
1	8.0%	5.2%	7.9%	5.3%
2	6.7%	4.9%	6.7%	5.1%
3	5.6%	4.5%	5.5%	4.8%
4	4.4%	3.7%	4.3%	3.6%
5 to 17	33.9%	32.5%	29.5%	30.4%
More than 18	20.0%	36.4%	20.0%	35.7%

Table A7. Financing Sources for Businesses (2007 SBO) – Majority Ownership Definition

	Female-owned STEM	Male-owned STEM	Female-owned non-STEM	Male-owned non-STEM
N	1,296,211	2,790,044	6,403,121	12,271,688
Amount of start-up capital*				
Not reported	4.7%	3.7%	6.8%	5.5%
Less than $5000	5.3%	12.0%	6.4%	12.5%
$5000-$9999	9.3%	12.4%	8.8%	12.2%
$10000-$24999	20.1%	20.7%	17.5%	19.3%
$25000-$49999	11.7%	11.6%	10.6%	10.4%
$50000-$99999	4.4%	4.2%	4.3%	3.9%
$100000-$249999	5.7%	5.1%	5.7%	5.4%
$250000-$999999	7.3%	6.2%	7.1%	6.1%
$1000000 or more	8.9%	7.1%	8.5%	6.7%
Don't know	13.9%	10.5%	13.0%	9.6%
Start-up capital source				
Personal savings	52.7%	61.0%	47.4%	54.9%
Credit cards	10.3%	9.8%	9.6%	9.2%
Bank loan	3.1%	6.2%	4.6%	10.8%
Government loan	0.3%	0.4%	0.4%	0.6%
Venture capital	0.1%	0.5%	0.1%	0.3%
Expansion capital source				
Personal savings	23.6%	27.6%	22.6%	26.9%
Credit cards	10.5%	11.4%	9.6%	10.9%
Bank loan	2.8%	7.2%	3.0%	9.0%
Business profits	7.3%	12.2%	5.2%	9.3%
Government loan	0.2%	0.4%	0.2%	0.4%
Venture capital	0.1%	0.3%	0.1%	0.1%

Additional Analysis of 2007 SBO Microdata: Businesses with Joint Ownership

Table A8. Characteristics of Businesses and Performance (2007 SBO) - Joint Ownership

	Female-owned STEM	Male-owned STEM	Female-Male-owned STEM	Female-owned non-STEM	Male-owned non-STEM	Female-Male-owned non-STEM
N	23,933	132,832	399,155	179,742	764,012	2,380,426
No. employee	2.8	9.6	1.5	2.1	5.7	1.6
Payroll	115.4	444.0	55.3	49.1	208.8	37.0
Receipts	513.4	1852.6	255.3	244.9	1179.4	239.6
No. years in operation						
Not reported	6.1%	3.5%	6.4%	8.5%	5.3%	7.9%
Less than 1	13.9%	8.1%	10.5%	9.9%	7.9%	9.0%
1	12.4%	7.0%	7.0%	8.8%	7.0%	6.7%
2 to 4	18.2%	15.6%	15.5%	18.0%	16.8%	15.4%
5 to 17	26.2%	31.8%	30.7%	27.6%	29.5%	29.4%
More than 18	14.9%	30.2%	20.6%	15.6%	26.7%	21.3%

Table A9. Characteristics of Businesses and Financial Access (2007 SBO) - Joint Ownership

	Female-owned STEM	Male-owned STEM	Female-Male-owned STEM	Female-owned non-STEM	Male-owned non-STEM	Female-Male-owned non-STEM
N	23,933	132,832	399,155	179,742	764,012	2,380,426
Start-up capital amount						
Not reported	7.6%	5.6%	8.3%	10.5%	7.7%	10.5%
Less than $5000	32.9%	20.6%	31.9%	21.9%	15.8%	25.1%
$5000-$9999	9.6%	7.9%	7.4%	7.9%	6.5%	6.4%
$10000-$24999	8.7%	10.9%	8.1%	8.8%	8.9%	7.5%
$25000-$49999	5.3%	7.3%	4.1%	6.6%	6.5%	5.6%
$50000-$99999	5.4%	7.4%	3.7%	6.2%	8.0%	5.3%
$100000-$249999	4.1%	7.4%	3.4%	5.2%	9.3%	5.7%
$250000-$999999	1.4%	4.9%	2.1%	3.8%	8.1%	3.9%
$1000000 or more	0.8%	2.3%	0.6%	1.0%	3.3%	1.1%
Don't know	8.5%	12.6%	7.1%	11.1%	14.2%	9.9%
Start-up capital source						
Personal savings	64.0%	64.3%	58.8%	50.9%	56.0%	54.0%
Credit cards	12.9%	8.3%	10.2%	9.7%	6.8%	9.4%
Bank loan	7.6%	13.5%	5.9%	11.5%	20.3%	11.0%
Government loan	0.5%	0.8%	0.4%	1.0%	1.0%	0.7%
Venture capital	0.2%	0.8%	0.2%	0.3%	0.6%	0.2%
Expansion capital source						
Personal savings	25.0%	21.9%	29.2%	22.1%	22.8%	28.4%
Credit cards	11.4%	9.6%	11.6%	10.6%	8.1%	10.7%
Bank loan	7.3%	17.5%	5.3%	7.2%	17.4%	7.5%
Business profits	13.0%	20.7%	9.4%	7.5%	13.3%	7.8%
Government loan	0.1%	0.7%	0.4%	0.7%	0.6%	0.4%
Venture capital	0.1%	0.4%	0.1%	0.3%	0.3%	0.1%