

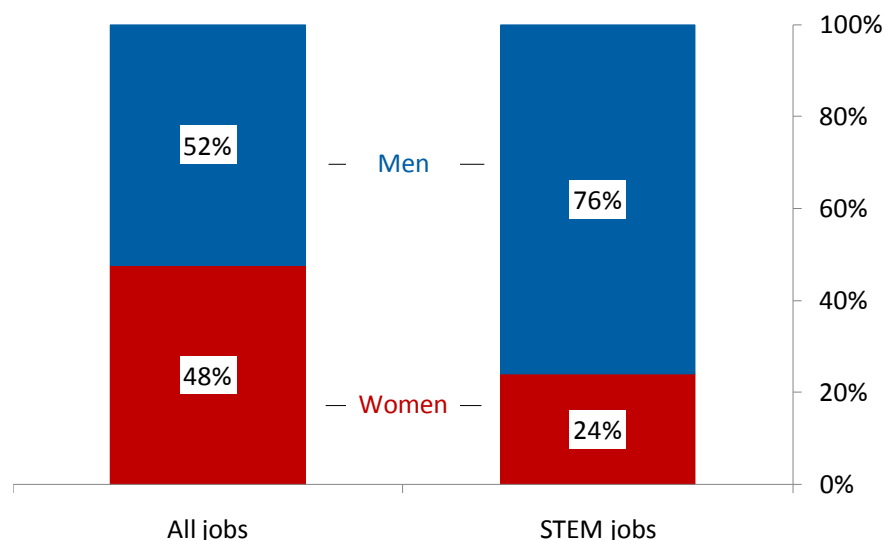
Women in STEM: A Gender Gap to Innovation

Executive Summary

Our science, technology, engineering and math (STEM) workforce is crucial to America's innovative capacity and global competitiveness. Yet women are vastly underrepresented in STEM jobs and among STEM degree holders despite making up nearly half of the U.S. workforce and half of the college-educated workforce. That leaves an untapped opportunity to expand STEM employment in the United States, even as there is wide agreement that the nation must do more to improve its competitiveness.

- Although women fill close to half of all jobs in the U.S. economy, they hold less than 25 percent of STEM jobs. This has been the case throughout the past decade, even as college-educated women have increased their share of the overall workforce.
- Women with STEM jobs earned 33 percent more than comparable women in non-STEM jobs – considerably higher than the STEM premium for men. As a result, the gender wage gap is smaller in STEM jobs than in non-STEM jobs.
- Women hold a disproportionately low share of STEM undergraduate degrees, particularly in engineering.
- Women with a STEM degree are less likely than their male counterparts to work in a STEM occupation; they are more likely to work in education or healthcare.
- There are many possible factors contributing to the discrepancy of women and men in STEM jobs, including: a lack of female role models, gender stereotyping, and less family-friendly flexibility in the STEM fields. Regardless of the causes, the findings of this report provide evidence of a need to encourage and support women in STEM.

Figure 1. Gender Shares of Total and STEM Jobs, 2009



Source: ESA calculations from American Community Survey public-use microdata.
Note: Estimates are for employed persons age 16 and over.

By
David Beede,
Tiffany Julian,
David Langdon,
George
McKittrick,
Beethika Khan,
and
Mark Doms,
Office of the
Chief Economist

ESA
Issue Brief
#04-11

August 2011



What is STEM?

The acronym STEM is fairly specific in nature—referring to science, technology, engineering and math—however, there is no standard definition for what constitutes a STEM job. Science, technology, engineering and math positions consistently make the lists of STEM occupations, but there is less agreement about whether to include other positions such as educators, managers, technicians, healthcare professionals and social scientists. In this report, the Economics and Statistics Administration (ESA) defines STEM jobs to include professional and technical support occupations in the fields of computer science and mathematics, engineering, and life and physical sciences. Three management occupations are also included because of their clear ties to STEM.¹ Education jobs are not included because of the nature of the available data.² In addition, social scientists are not included.³

ESA’s STEM list contains 50 specific occupation codes (see Appendix Table 1), and in 2009, there were 7.4 million workers in these jobs, representing 5.3 percent of the workforce. To better put these jobs into context, we divide STEM occupations into four categories: computer and math, engineering and surveying, physical and life sciences, and STEM managerial occupations.⁴ Across all levels of educational attainment, the largest group of STEM jobs is within the computer and math fields, which account for close to half (47 percent) of all

STEM employment. Second are engineering and surveying occupations, representing approximately one-third of all STEM employment, while 12 percent are in the physical and life sciences, and 8 percent in STEM management jobs.⁵

Parallel to our list of STEM occupations, we also identify a set of STEM undergraduate degree fields that span computer science and mathematics, engineering, and life and physical sciences (see Appendix Table 2). We define STEM degree holders as persons whose primary or secondary undergraduate major was in a STEM field. Consistent with the occupations selected for this report, we exclude business, healthcare, and social science majors.⁶

Women in STEM jobs

According to the Census Bureau’s 2009 American Community Survey (ACS), women comprise 48 percent of the U.S. workforce but just 24 percent of STEM workers. In other words, half as many women are working in STEM jobs as one might expect if gender representation in STEM professions mirrored the overall workforce. (See Figure 1.)

This underrepresentation has remained fairly constant over the past decade, even as women’s share of the college-educated workforce has increased. As shown in Table 1, between 2000 and 2009, women’s share of the STEM workforce remained constant at 24 percent, while their share of all college-educated workers increased from 46 to 49 percent. Using data from the Census Bureau’s Cur-

Table 1. Total and STEM Employment by Gender and Educational Attainment, 2000 and 2009
(thousands of workers)

| | Male | | Female | | Percent Female | |
|------------------|--------|--------|--------|--------|----------------|------|
| | 2000 | 2009 | 2000 | 2009 | 2000 | 2009 |
| All workers | 69,098 | 73,580 | 60,619 | 67,058 | 47% | 48% |
| College-educated | 18,995 | 22,167 | 16,415 | 21,433 | 46% | 49% |
| STEM workers | 5,321 | 5,640 | 1,680 | 1,790 | 24% | 24% |
| College-educated | 3,259 | 3,738 | 1,002 | 1,199 | 24% | 24% |

Source: ESA calculations from Census 2000 and 2009 American Community Survey public-use microdata.
Note: Estimates are for employed persons age 16 and over.

Table 2. Employment in STEM Occupations in 2009

(thousands of workers)

| | Male | | Female | | Percent Female | |
|----------------------------|-------|-------|--------|-------|----------------|------|
| | 2000 | 2009 | 2000 | 2009 | 2000 | 2009 |
| STEM total | 5,321 | 5,640 | 1,680 | 1,790 | 24% | 24% |
| Computer science and math | 2,202 | 2,534 | 940 | 929 | 30% | 27% |
| Engineering | 2,185 | 2,079 | 318 | 330 | 13% | 14% |
| Physical and life sciences | 551 | 553 | 310 | 374 | 36% | 40% |
| STEM managers | 382 | 474 | 111 | 157 | 23% | 25% |

Source: ESA calculations from Census 2000 and 2009 American Community Survey public-use microdata.
 Note: Estimates are for employed persons age 16 and over.

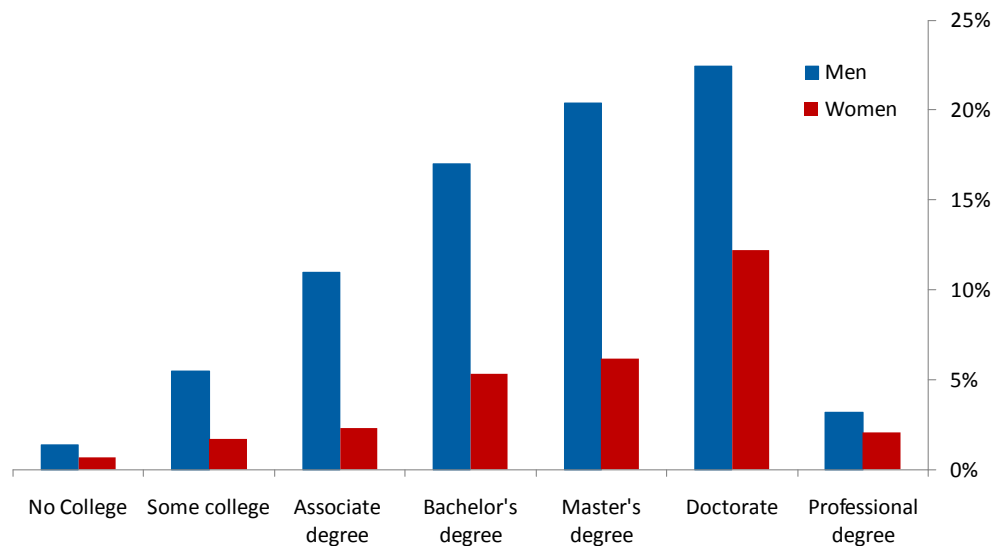
rent Population Survey (CPS) going back to 1994, almost identical trends emerge.

Among STEM jobs, women’s representation has varied over time. While the female share has declined in computer and math jobs, their share has risen in other occupations. In 2009, women comprised 27 percent of the computer and math workforce (the largest of the four STEM components), a drop of 3 percentage points since 2000. (See Table 2.) Engineers are the second largest STEM occupational group, but only about one out of every seven engineers is female. Interestingly, the number of female engineers edged up by 12,000 over nine

years, while the number of male engineers declined by 106,000. In physical and life sciences jobs, however, women made up about 40 percent of the workforce in 2009, up from 36 percent in 2000. STEM managers is another area that has shown growth, with women’s share of the workforce increasing to 25 percent.

Men are much more likely than women to have a STEM job regardless of educational attainment. Figure 2 demonstrates that higher education levels generally correspond to an increased likelihood of having a STEM job for both men and women. The gap lessens somewhat at the doctoral level, but

Figure 2. Share of Workers in STEM Jobs by Gender and Educational Attainment, 2009



Source: ESA calculations from American Community Survey public-use microdata.
 Note: Professional degrees include medical, dental, veterinary, and law degrees. Estimates are for employed persons age 16 and over.

women still lag far behind men in STEM employment.⁷

STEM worker earnings and gender

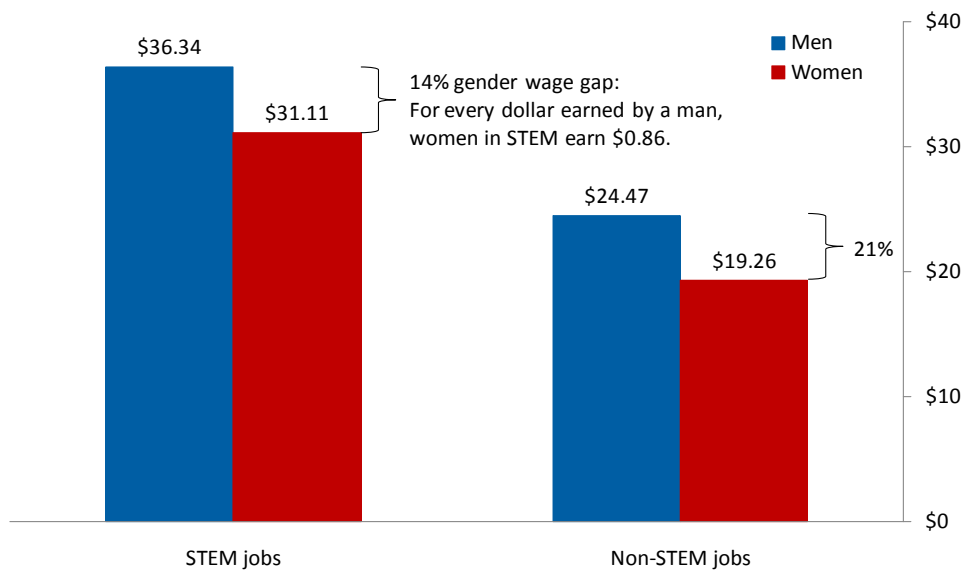
There are two notable findings in examining the relationship between STEM, gender and earnings. First, as is clearly documented in our previous report “*STEM: Good Jobs Now and for the Future*,” STEM workers earn considerably more than their non-STEM counterparts (what we call in this report the “STEM earnings premium”). Second is the gender wage gap – a robust finding that women earn considerably less than men, even after controlling for a wide set of characteristics such as education and age. Figure 3 highlights how these two findings intersect by showing the average hourly earnings of full-time, year-round workers in private sector STEM and non-STEM jobs. On average, men and women earn \$36.34 and \$31.11 per hour, respectively, in STEM jobs – higher than the \$24.47 that men earn and \$19.26 that women earn, on average, in other occupations. For every dollar earned by a man in STEM, a woman earns 14 cents (or 14

percent) less, smaller than the 21 percent gender wage gap in non-STEM occupations, but a clear gender disparity nonetheless.

While illustrative, these simple comparisons do not take into account the many factors that can help explain why STEM workers tend to earn more than non-STEM workers, or why women earn less than men. Following the methodology of our earlier STEM report, we use regression analyses to control for many of these factors, including workers’ age, educational attainment, and region of residence. The results of these analyses underscore both the STEM earnings premium and the gender earnings gap.

In our previous report on this issue, we found that STEM workers earn significantly more than their non-STEM counterparts in the private sector. So, one way to compare men and women in STEM is to see to what extent their STEM earnings premium varies. Our analysis shows that, all else being equal, women in STEM jobs earn 33 percent more than their female peers in other jobs, while the STEM premium for men is 25 percent.

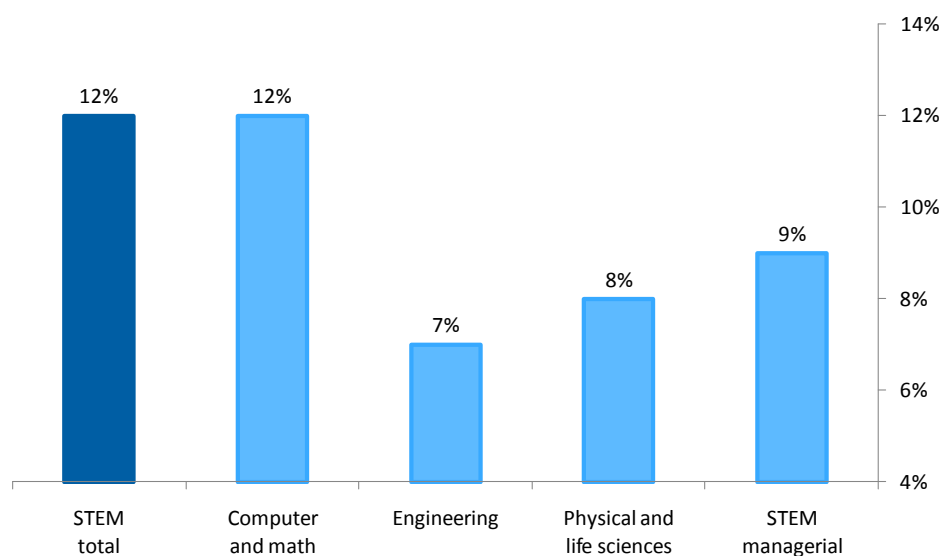
Figure 3. Average Hourly Earnings by Gender and Occupation, 2009



Source: ESA calculations from American Community Survey public-use microdata.

Note: Estimates are for full-time year-round private wage and salary workers age 16 and over.

Figure 4. Regression-adjusted Gender Wage Gap of College-educated STEM Workers by Occupation, 2009



Source: ESA calculations from American Community Survey public-use microdata.

Note: Estimates are for full-time year-round private wage and salary workers age 25 and over.

Given that the STEM premium for women is higher than for men, we would expect women in STEM to face a smaller gender earnings gap than women in other occupations. Not surprisingly, we find that the gap shrinks but does not disappear for women in STEM. Furthermore, as we look at more specific groups of STEM workers (which allows us to make better “apples-to-apples” comparisons of male and female wages), we find an even smaller gender wage difference. Figure 4 shows the regression-adjusted gender wage gap for college-educated STEM workers in each of the four major occupational groups. Interestingly, the most male-dominated STEM occupational group—engineers—is also the one with the smallest regression-adjusted wage gap; female engineers earned 7 percent less per hour than male counterparts. Physical and life sciences occupations, the most gender-balanced STEM group, have an 8 percent wage gap, and STEM managers a 9 percent gap. Notably higher was the 12 percent gender wage gap in computer and math occupations.

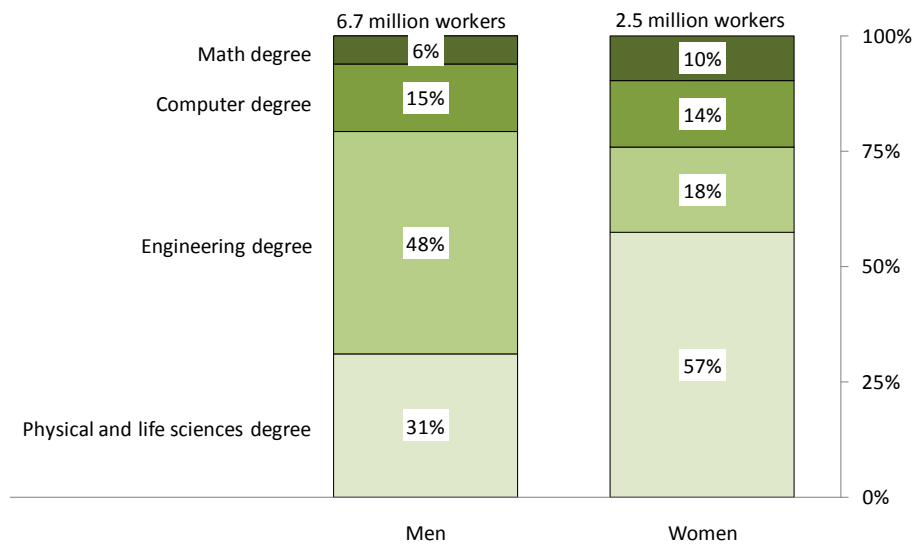
STEM degrees and fields of study by gender

Since the gateway to many high-paying STEM jobs is a STEM degree, it is useful to examine the extent to which college-educated workers had STEM degrees. The 2009 ACS provides a rich new data source for analyzing the link between undergraduate studies and subsequent employment. The ACS data on undergraduate fields of study show that women account for nearly half of employed college graduates age 25 and over, but only about 25 percent of employed STEM degree holders and an even smaller share – just about 20 percent – of STEM degree holders working in STEM jobs.

There were 2.5 million college-educated working women with STEM degrees in 2009 compared with 6.7 million men. What makes this disparity even more alarming is that, in the overall labor force, there are 21.4 million women (49 percent of the total) and 22.2 million men who are employed and have bachelor’s degrees.

Among STEM majors, the distribution of men and

Figure 5. College-educated Workers with a STEM Degree by Gender and STEM Degree Field, 2009



Source: ESA calculations from American Community Survey public-use microdata.
 Note: Estimates are for employed persons age 25 and over. The shares for men and women do not add up to 100% due to rounding.

women differs significantly. As shown in Figure 5, well over half (57 percent) of female STEM majors study physical and life sciences, while fewer than one-third (31 percent) of men choose these fields. The share of women choosing math majors is also higher than men: 10 versus 6 percent. The bulk of men with STEM majors (48 percent) choose engineering degrees, two-and-a-half times the share of women who choose engineering. Equal shares of male and female STEM majors enter computer science. In terms of raw numbers, however, men in the workforce with STEM degrees outnumber women across all four fields of study.⁸

STEM degrees and careers by gender

As noted in the previous section, college-educated women are much less likely than men to major in STEM fields. But even when women choose STEM degrees, their typical career paths diverge substantially from their male counterparts. About 40 percent (2.7 million) of men with STEM college degrees work in STEM jobs, whereas only 26 percent (0.6 million) of women with STEM degrees work in

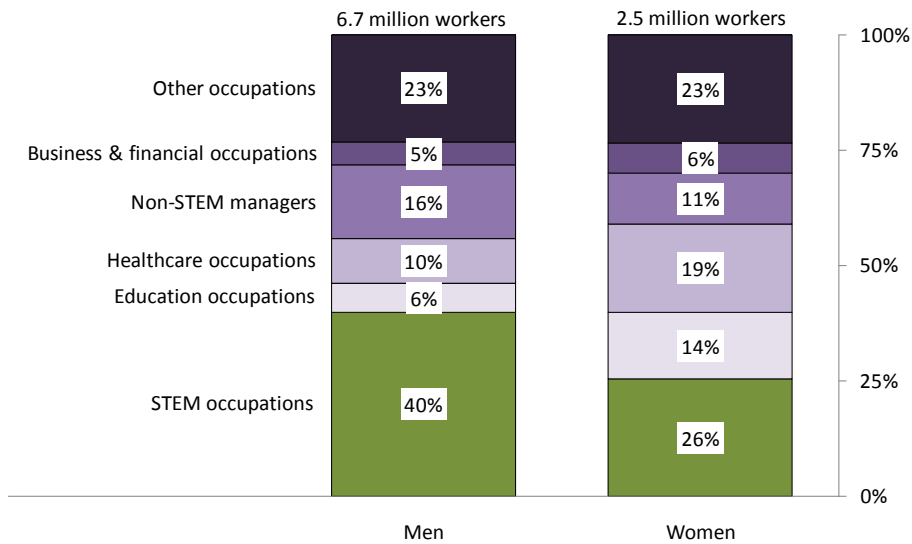
STEM jobs. (See Figure 6.)

Men are more likely to have non-STEM management jobs than women, 16 percent and 11 percent, respectively. In contrast, female STEM majors are twice as likely as men to work in education or healthcare. Nearly one in five STEM college-educated women works in healthcare occupations, compared with about one in ten men. Likewise, approximately 14 percent of female STEM majors end up in education occupations, compared with approximately 6 percent of men. Similar shares of men and women with STEM degrees worked in business and financial occupations or other fields.

STEM premiums and gender

As highlighted in our earlier STEM report, receiving a STEM degree tends to result in higher earnings later in life. Figure 7 illustrates the considerable extent to which the earnings premium from having a STEM job or STEM degree varies by gender. Women enjoy a much bigger STEM job premium than men, but a slightly smaller premium for having earned a STEM bachelor's degree. Specifically, when we control for whether or not women have

Figure 6. College-educated Workers with a STEM Degree by Gender and STEM Occupation, 2009

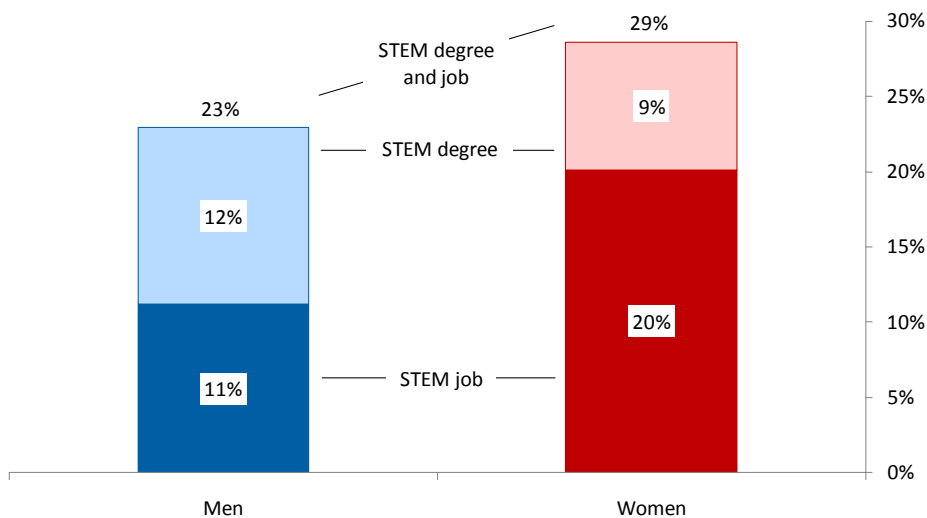


Source: ESA calculations from American Community Survey public-use microdata.
 Note: Estimates are for employed persons age 25 and over. The shares for men and women do not add up to 100% due to rounding.

STEM degrees, we find that college-educated women (regardless of choice of undergraduate major) earn 20 percent more in STEM jobs than elsewhere. This is nearly double the 11 percent premium that college-educated men realize working in STEM. On the other hand, female STEM degree holders earn 9 percent more than women with other degrees, regardless of their job. The STEM degree premium for men is somewhat higher at

nearly 12 percent. The biggest STEM-related wage premiums go to men and women who both major in a STEM field and choose a STEM job. This career path nets women 29 percent higher hourly earnings, on average, than their peers who have neither a STEM degree nor a STEM job. The corresponding premium for men is smaller, but also sizeable, at 23 percent.

Figure 7. Wage Premium from Having a STEM Job and/or Degree



Source: ESA calculations from American Community Survey public-use microdata.
 Note: Estimates are for full-time year-round private wage and salary workers who have at least a bachelor's degree and are age 25 and over.

Conclusion

This report finds that women are underrepresented both in STEM jobs and STEM undergraduate degrees and have been consistently over the last decade. The relatively few women who receive STEM degrees are concentrated in physical and life sciences, in contrast to men, who are concentrated primarily in engineering. Women who do receive STEM degrees are less likely to work in STEM jobs than their male counterparts. And while women working in STEM jobs earn less than their male counterparts, they experience a smaller gender wage gap compared to others in non-STEM occupations.

The underrepresentation of women in STEM majors and jobs may be attributable to a variety of factors. These may include different choices men and women typically make in response to incentives in STEM education and STEM employment – for example, STEM career paths may be less accommodating to people cycling in and out of the workforce to raise a family – or it may be because there are relatively few female STEM role models. Perhaps strong gender stereotypes discourage women from pursuing STEM education and STEM jobs.

While this report does not – and cannot – explain why gender differences in STEM exist, it does aim to provide data and insight that will enable more informed policymaking. The findings provide definitive evidence of a need to encourage and support women in STEM with a goal of gender parity. Given the high-quality, well-paying jobs in the fields of science, technology, engineering and math, there is great opportunity for growth in STEM in support of American competitiveness, innovation and jobs of the future.

Appendix Table 1. Detailed STEM occupations and Standard Occupational Classification (SOC)

| Occupation | SOC Code | Occupation | SOC code |
|---|----------|--|----------|
| <i>Computer and math occupations</i> | | | |
| Computer scientists and systems analysts | 15-10XX | Network systems and data communications analysts | 15-1081 |
| Computer programmers | 15-1021 | Mathematicians | 15-2021 |
| Computer software engineers | 15-1030 | Operations research analysts | 15-2031 |
| Computer support specialists | 15-1041 | Statisticians | 15-2041 |
| Database administrators | 15-1061 | Miscellaneous mathematical science occupations | 15-2090 |
| Network and computer systems administrators | 15-1071 | | |
| <i>Engineering and surveying occupations</i> | | | |
| Surveyors, cartographers, and photogrammetrists | 17-1020 | Materials engineers | 17-2131 |
| Aerospace engineers | 17-2011 | Mechanical engineers | 17-2141 |
| | | Mining and geological engineers, including mining safety engineers | 17-2151 |
| Agricultural engineers | 17-2021 | | |
| Biomedical engineers | 17-2031 | Nuclear engineers | 17-2161 |
| Chemical engineers | 17-2041 | Petroleum engineers | 17-2171 |
| Civil engineers | 17-2051 | Engineers, all other | 17-2199 |
| Computer hardware engineers | 17-2061 | Drafters | 17-3010 |
| Electrical and electronic engineers | 17-2070 | Engineering technicians, except drafters | 17-3020 |
| Environmental engineers | 17-2081 | Surveying and mapping technicians | 17-3031 |
| Industrial engineers, including health and safety | 17-2110 | Sales engineers | 41-9031 |
| Marine engineers and naval architects | 17-2121 | | |
| <i>Physical and life sciences occupations</i> | | | |
| Agricultural and food scientists | 19-1010 | Physical scientists, all other | 19-2099 |
| Biological scientists | 19-1020 | Agricultural and food science technicians | 19-4011 |
| Conservation scientists and foresters | 19-1030 | Biological technicians | 19-4021 |
| Medical scientists | 19-1040 | Chemical technicians | 19-4031 |
| Astronomers and physicists | 19-2010 | Geological and petroleum technicians | 19-4041 |
| Atmospheric and space scientists | 19-2021 | Nuclear technicians | 19-4051 |
| | | Other life, physical, and social science technicians | 19-40XX |
| Chemists and materials scientists | 19-2030 | | |
| Environmental scientists and geoscientists | 19-2040 | | |
| <i>STEM managerial occupations</i> | | | |
| Computer and information systems managers | 11-3021 | Natural sciences managers | 11-9121 |
| Engineering managers | 11-9041 | | |

Appendix Table 2. Detailed STEM undergraduate majors

| | | |
|---|---|--|
| | <i>Computer majors</i> | |
| <ul style="list-style-type: none"> • Computer and information systems • Computer programming and data processing | <ul style="list-style-type: none"> • Computer science • Information sciences | <ul style="list-style-type: none"> • Computer administration management and security • Computer networking and telecommunications |
| | <i>Math majors</i> | |
| <ul style="list-style-type: none"> • Mathematics • Applied mathematics | <ul style="list-style-type: none"> • Statistics and decision science | <ul style="list-style-type: none"> • Mathematics and computer science |
| | <i>Engineering majors</i> | |
| <ul style="list-style-type: none"> • General engineering • Aerospace engineering • Biological engineering • Architectural engineering • Biomedical engineering • Chemical engineering • Civil engineering • Computer engineering • Electrical engineering • Engineering mechanics physics and science | <ul style="list-style-type: none"> • Environmental engineering • Geological and geophysical engineering • Industrial and manufacturing engineering • Materials engineering and materials science • Mechanical engineering • Metallurgical engineering • Mining and mineral engineering • Naval architecture and marine engineering • Nuclear engineering | <ul style="list-style-type: none"> • Petroleum engineering • Miscellaneous engineering • Engineering technologies • Engineering and industrial management • Electrical engineering technology • Industrial production technologies • Mechanical engineering related technologies • Miscellaneous engineering technologies • Military technologies |
| | <i>Physical and life sciences majors</i> | |
| <ul style="list-style-type: none"> • Animal sciences • Food science • Plant science and agronomy • Soil science • Environmental science • Biology • Biochemical sciences • Botany • Molecular biology • Ecology | <ul style="list-style-type: none"> • Genetics • Microbiology • Pharmacology • Physiology • Zoology • Miscellaneous biology • Nutrition sciences • Neuroscience • Cognitive science and biopsychology | <ul style="list-style-type: none"> • Physical sciences • Astronomy and astrophysics • Atmospheric sciences and meteorology • Chemistry • Geology and earth science • Geosciences • Oceanography • Physics • Nuclear, industrial radiology, and biological technologies |

The Commerce Department’s Economics and Statistics Administration has released two other reports detailing the roles of women in American society. The first, *Women-Owned Businesses in the 21st Century*, was released in October 2010. The second, *Women in America: Indicators of Social and Economic Well-Being*, was released in March 2011. Both reports can be found at <http://www.esa.doc.gov/reports>

Endnotes

¹These occupations are computer and information systems managers, engineering managers, and natural sciences managers.

²Although our principal data source, the 2009 American Community Survey (ACS), collects detailed information on workers’ occupations, it does not break out educators by their specific field. As a result, it is not possible to distinguish math and science professors from other professors. Data from the Bureau of Labor Statistics’ Occupational Employment Statistics program show that there are roughly 200,000 post-secondary teachers in STEM fields, and so their exclusion is unlikely to materially affect our results.

³ The National Science Foundation does count social scientists among “science and engineering jobs” in keeping with the agency’s mission supporting “all fields of fundamental science and engineering, except for medical sciences.” This report, however, follows a different approach.

⁴ Note that persons in science occupations include not just scientists but also science technicians. Likewise, engineering and surveying occupations include engineering technicians and drafters, and computer occupations range from computer support specialists to computer software engineers.

⁵ The estimates reported in this paragraph are based on 2009 data from the American Community Survey (ACS). The estimates are very similar to those cited in *STEM: Good Jobs Now and For the Future* (<http://www.esa.doc.gov/Reports/stem-good-jobs-now-and-future>), p. 2, which were based on 2010 data from the Current Population Survey. The estimates are very similar but not exactly the same because they were drawn from different samples of workers in two different years.

⁶ In the few cases where both the primary and secondary undergraduate majors were in STEM fields, we used the primary major as the STEM major.

⁷ Few persons with professional degrees (e.g., MBA’s, law, and medicine) work in STEM jobs because such

persons typically have jobs that we do not characterize as STEM.

⁸ Using data from a different source, the number of bachelor’s degrees conferred annually in STEM fields in the United States increased about 20 percent between 1998 and 2008 (from 200,000 to 240,000). But women’s share has not risen and remains far below parity with men (35 percent in both years), despite the fact that a majority of all bachelor degrees are conferred on women (56 percent in 1998 and 57 percent in 2008). About one-quarter of bachelor’s degrees awarded to men are in STEM fields, compared with one-tenth conferred on women; these shares have remained about the same between 1998 and 2008. About two-thirds of STEM degrees awarded to men were in engineering and computer science, compared with one-quarter awarded to women. Over half of STEM degrees awarded to women were in biological sciences compared with 20 percent for men. See U.S. Department of Commerce, Economics and Statistics Administration and Executive Office of the President, Office of Management and Budget (2011) *Women in America: Indicators of Social and Economic Well-Being* (<http://www.esa.doc.gov/sites/default/files/reports/documents/womeninamerica.pdf>), p. 23.

The authors are economists in the Office of the Chief Economist of the U.S. Department of Commerce’s Economics and Statistics Administration.

Technical inquiries:
Office of the Chief Economist
(202) 482-3523

Media inquiries:
Office of Communications
(202) 482-3331

U.S. Department of Commerce
Economics and Statistics Administration
1401 Constitution Ave., NW
Washington, DC 20230
www.esa.doc.gov