U.S. Department of Commerce
Economics and Statistics Administration

STEM: Good Jobs Now and for the Future

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

ESA Issue Brief #03-11

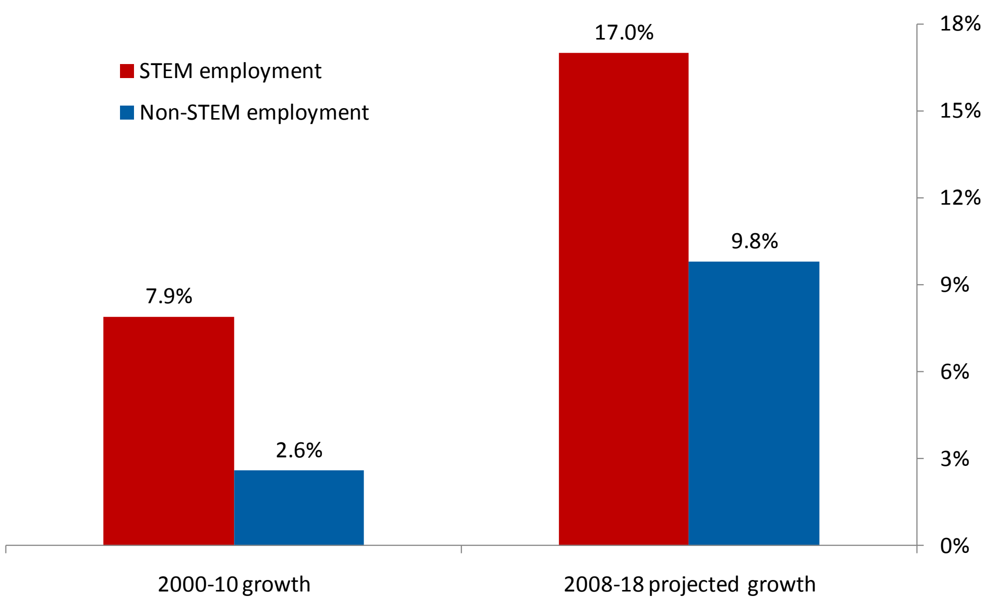
July 2011

Executive Summary

Science, technology, engineering and mathematics (STEM) workers drive our nation's innovation and competitiveness by generating new ideas, new companies and new industries. However, U.S. businesses frequently voice concerns over the supply and availability of STEM workers. Over the past 10 years, growth in STEM jobs was three times as fast as growth in non-STEM jobs. STEM workers are also less likely to experience joblessness than their non-STEM counterparts. Science, technology, engineering and mathematics workers play a key role in the sustained growth and stability of the U.S. economy, and are a critical component to helping the U.S. win the future.

- In 2010, there were 7.6 million STEM workers in the United States, representing about 1 in 18 workers.
- STEM occupations are projected to grow by 17.0 percent from 2008 to 2018, compared to 9.8 percent growth for non-STEM occupations.
- STEM workers command higher wages, earning 26 percent more than their non-STEM counterparts.
- More than two-thirds of STEM workers have at least a college degree, compared to less than one-third of non-STEM workers.
- STEM degree holders enjoy higher earnings, regardless of whether they work in STEM or non-STEM occupations.

Figure 1. Recent and Projected Growth in STEM and Non-STEM Employment



Source: ESA calculations using Current Population Survey public-use microdata and estimates from the Employment Projections Program of the Bureau of Labor Statistics.

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 consensus about whether to include other positions such as educators, managers, technicians, health-care professionals or social scientists. In this report, we define 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] Because of data limitations, education jobs are not included.[2] Further, we elected not to include social scientists.[3]

Our STEM list contains 50 specific occupation codes (see Appendix Table 1), and in 2010, there were 7.6 million workers in these jobs, or 5.5 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 (46 percent) of all STEM employment. Second are engineering and surveying occupations with one-third of all STEM employment, while 13 percent are in the physical and life sciences, and 9 percent in STEM management jobs.

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. Following similar logic to what we used in our occupation selection, we exclude business, healthcare, and social science majors.

STEM Employment and Worker Earnings

In 2010, 7.6 million people or 1 in 18 workers held STEM jobs. Although STEM employment currently makes up only a small fraction of total U.S. employment, STEM employment grew rapidly from 2000 to 2010, increasing 7.9 percent. In contrast, employment in non-STEM jobs grew just 2.6 percent over this period (see Figure 1). STEM jobs are projected to grow at a fast pace relative to other occupations. From 2008 to 2018, STEM jobs are expected to grow 17.0 percent compared to just 9.8 percent for non-STEM jobs.[5]

Workers in STEM occupations also earn more on average than their counterparts in other jobs, regardless of their educational attainment. The STEM earnings differential is greatest for those with a high school diploma or less in comparison to their counterparts in a non-STEM field. On average, they earned almost $25 per hour, $9 more per hour than those in other occupations in 2010. It should be noted, however, that only about 1 out of every 10 STEM workers has a high school diploma or less. Those with graduate degrees in a STEM job earned more than $40 per hour, nearly $4.50 more per hour on average than those with non-STEM jobs.

The comparison of wage premiums raises several questions, including to what extent the STEM-earnings premium reflects other characteristics of workers, such as age, and how premiums have evolved over time. A regression analysis – which controls for a variety of demographic, geographic, and other worker characteristics – helps to address these questions. Using Current Population Survey public-use microdata for 1994-2010, we regressed the log of earnings against a standard list of characteristics that have typically been found to be related to earnings including age, marital status, race, ethnicity, region and industry.[6]

After controlling for this set of characteristics, the

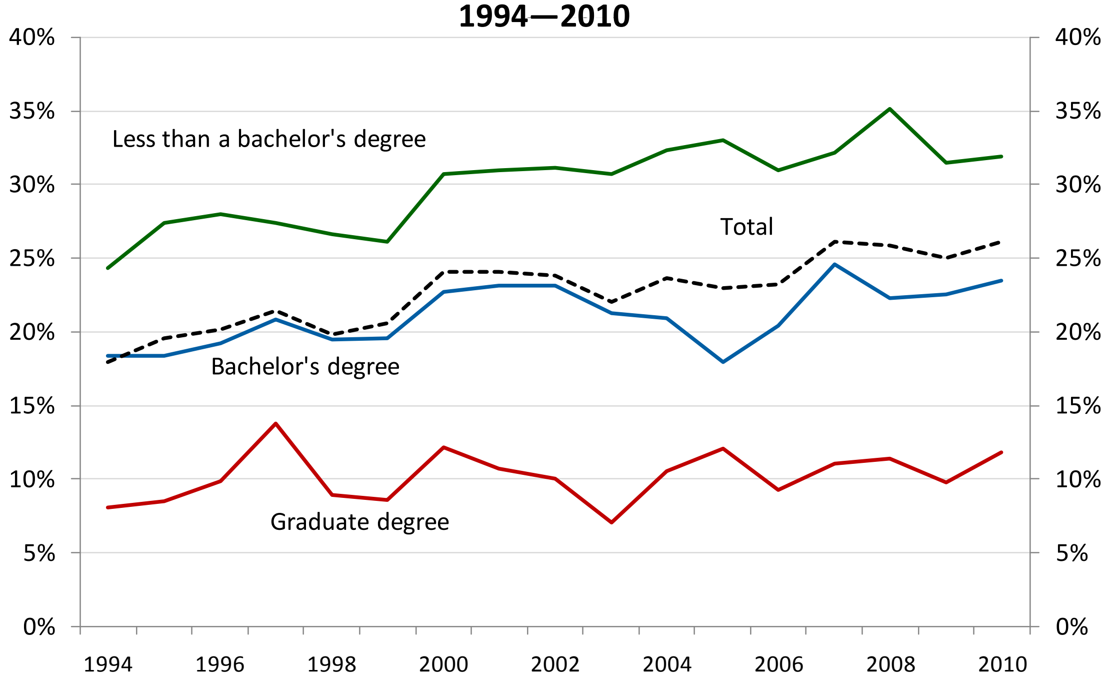
Table 1. Average Hourly Earnings of Full-Time Private Wage and Salary Workers in STEM Occupations by Educational Attainment, 2010

	Average hourly earnings		Difference	
	STEM	Non-STEM	Dollars	Percent
High school diploma or less	$24.82	$15.55	$9.27	59.6%
Some college or associate degree	$26.63	$19.02	$7.61	40.0%
Bachelor's degree only	$35.81	$28.27	$7.54	26.7%
Graduate degree	$40.69	$36.22	$4.47	12.3%

Source: ESA calculations using Current Population Survey public-use microdata and estimates from the Employment Projections Program of the Bureau of Labor Statistics.

earning premium diminishes somewhat. However, the fundamental result that STEM workers enjoy large earnings premiums persists, most predominantly for workers with less than a college degree. STEM earnings premiums have also shown persistence over time, and have generally increased since the mid-1990s (see Figure 2). In 2010, workers in STEM jobs with less than a bachelor's degree enjoyed a large premium (more than 30 percent) compared with non-STEM workers with the same education level, even after taking other influences on earnings into account.[7] The regression-based premiums in 2010 were slightly less for workers with a bachelor's (23 percent) or graduate degree (12 percent), and relatively closer to the premiums found in the simple comparison (without a regression adjustment). The overall regression-based STEM premium was 26 percent in 2010, up from 18 percent in 1994.[8]

Figure 2. Regression-based Hourly Earnings Premiums for STEM Workers 1994—2010



Source: ESA calculations using Current Population Survey public-use microdata files of annual merged outgoing rotation groups from the National Bureau of Economic research.

Note: The estimates are for private wage and salary workers age 25 and over.

STEM Jobs and STEM Degrees

The analysis so far has focused on STEM jobs, but conversations about policy most often focus on STEM education. One source of information to analyze the link between STEM jobs and STEM education is the 2009 American Community Survey which collected information on college-educated individuals' undergraduate majors. When examining the relationship between STEM education and STEM jobs, the following patterns emerge.

First, a STEM degree is the typical path to a STEM job, as more than two-thirds of the 4.7 million STEM workers with a college degree has an undergraduate STEM degree.[9] However, this does not necessarily mean that STEM workers' degrees are in the same STEM field as their jobs. For example, only 35 percent of college-educated computer and math workers have a degree in computer science or math while 27 percent majored in the physical or life sciences or engineering.

Second, in addition to STEM jobs, STEM degrees also open the door to many other career opportunities. Almost two-thirds of the 9.3 million workers with a STEM undergraduate degree work in a non-STEM job. Life and physical science majors are the STEM degree holders most likely to work in non-STEM jobs; 81 percent of these graduates work outside the STEM fields. (Note that "non-STEM" occupations include the 28 percent of graduates who work as healthcare practitioners or technicians, and the 12 percent who work in education.) In math, there is a strong pipeline into education jobs, as one-fifth of math majors go on to work in education.

As discussed above, STEM workers earn significantly more than their non-STEM counterparts, but what about the earnings of STEM degree holders who don't necessarily work in STEM jobs? Using the 2009 American Community Survey public-use microdata, calculations of the regression-adjusted earnings premium of college-educated workers with a STEM degree and/or STEM job showed that all STEM degree holders receive an earnings premium relative to other college graduates, whether or not they end up in a STEM job. Likewise, college graduates, regardless of their major, enjoy an earnings premium for having a STEM job. The earnings premium for having a STEM job or a STEM degree is quite similar, at 13 percent and 11 percent, respectively. Still, a much

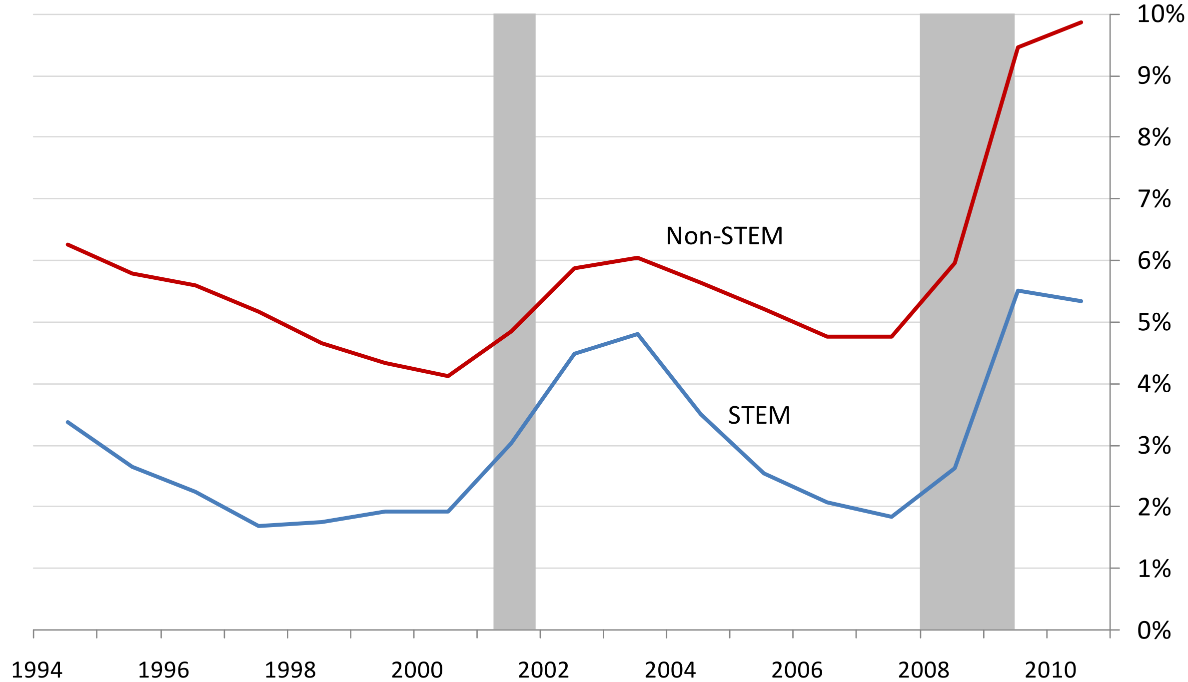
Table 2. Employment of Workers Age 25 and Over with a Bachelor's Degree or Higher, by STEM Occupation and STEM Undergraduate Degree, 2009

Employed persons in thousands

	Total	STEM degree					Non-STEM degree
		Total	Computer	Math	Engineering	Physical and life sciences	
Total	41,530	9,262	1,359	646	3,706	3,551	32,268
STEM employment	4,736	3,327	763	167	1,738	659	1,409
Computer and math	2,167	1,331	637	120	447	128	835
Engineering	1,444	1,225	39	19	1,083	85	219
Physical and life sciences	654	484	8	9	54	413	170
STEM manager	471	287	80	19	155	33	184
Non-STEM employment	6,570	1,354	142	89	677	446	5,217

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

Figure 3. Unemployment Rates in STEM and Non-STEM Occupations, 1994-2010



Source: ESA calculations using Current Population Survey public-use microdata.
Note: The estimates are for the civilian labor force age 16 and over. Shading indicates recession.

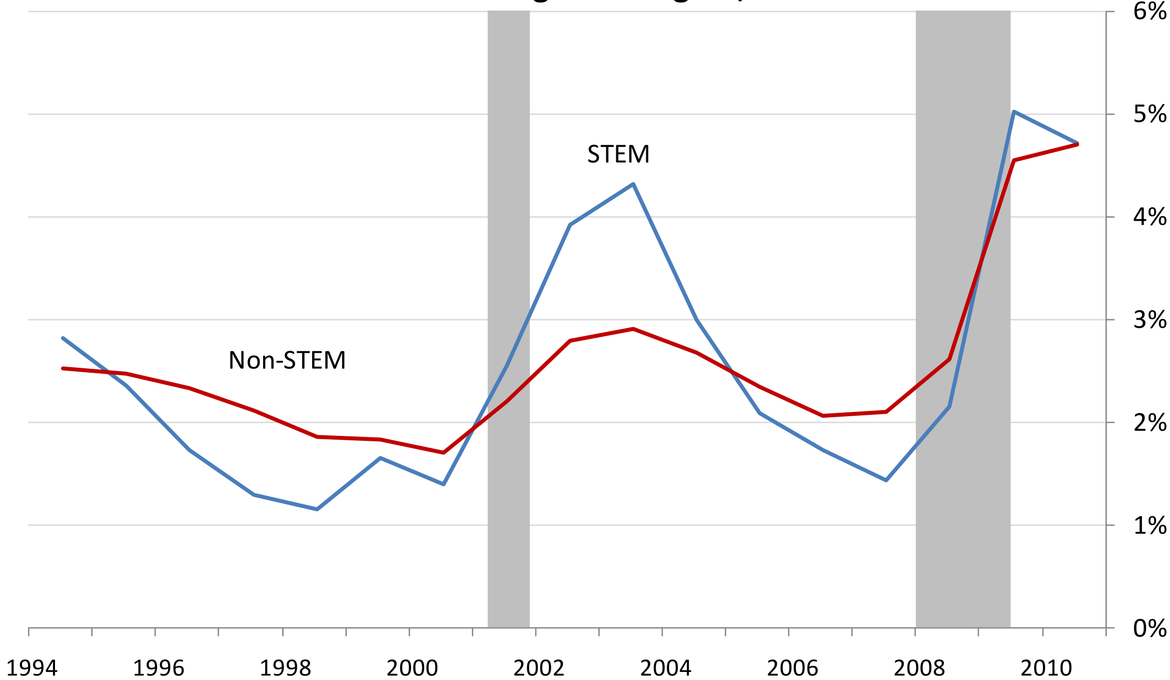
larger payoff tends to come when a STEM major goes on to work in a STEM job, as their earnings (all else equal) are about 20 percent higher than those of non-STEM majors working in non-STEM jobs.

STEM Joblessness

In addition to higher earnings, workers in STEM occupations on average experience lower unemployment rates than workers in other fields (see Figure 3).[10] The unemployment rate for STEM workers rose from 1.8 percent in 2007 to 5.5 percent in 2009 before easing to 5.3 percent in 2010. The unemployment rate for non-STEM workers rose from 4.8 percent in 2007 to 9.5 percent in 2009 and then continued to increase to almost 10 percent in 2010. STEM workers, however, are not totally immune to economic downturns, as STEM joblessness did increase during the last two recessions.

Some of the difference in unemployment rates between STEM and non-STEM workers reflects differences in educational attainment. On balance, workers with a higher educational level tend to experience lower unemployment, and STEM workers tend to be better educated. Looking at workers with a bachelor's degree or graduate degree, one finds less of a difference in unemployment rates between STEM and non-STEM workers than for those with less education. During the latest recession, the unemployment rate for college-educated STEM workers edged above the non-STEM rate in 2009, but the rate for both groups converged to 4.7 percent in 2010 (see Figure 4). While college-educated STEM workers were less likely to be jobless than other workers during the latter part of the last two economic expansions, they were more likely to be jobless during and after the 2001 recession. The decrease in the demand for information technology workers following the Y2K efforts and the crash of the Internet dot-com bubble likely played a role.

Figure 4. Unemployment Rates in STEM and Non-STEM Occupations, Workers with a Bachelor's Degree or Higher, 1994-2010



Source: ESA calculations using Current Population Survey public-use microdata.
Note: The estimates are for the civilian labor force age 25 and over with a bachelor's degree or higher. Shading indicates recession.

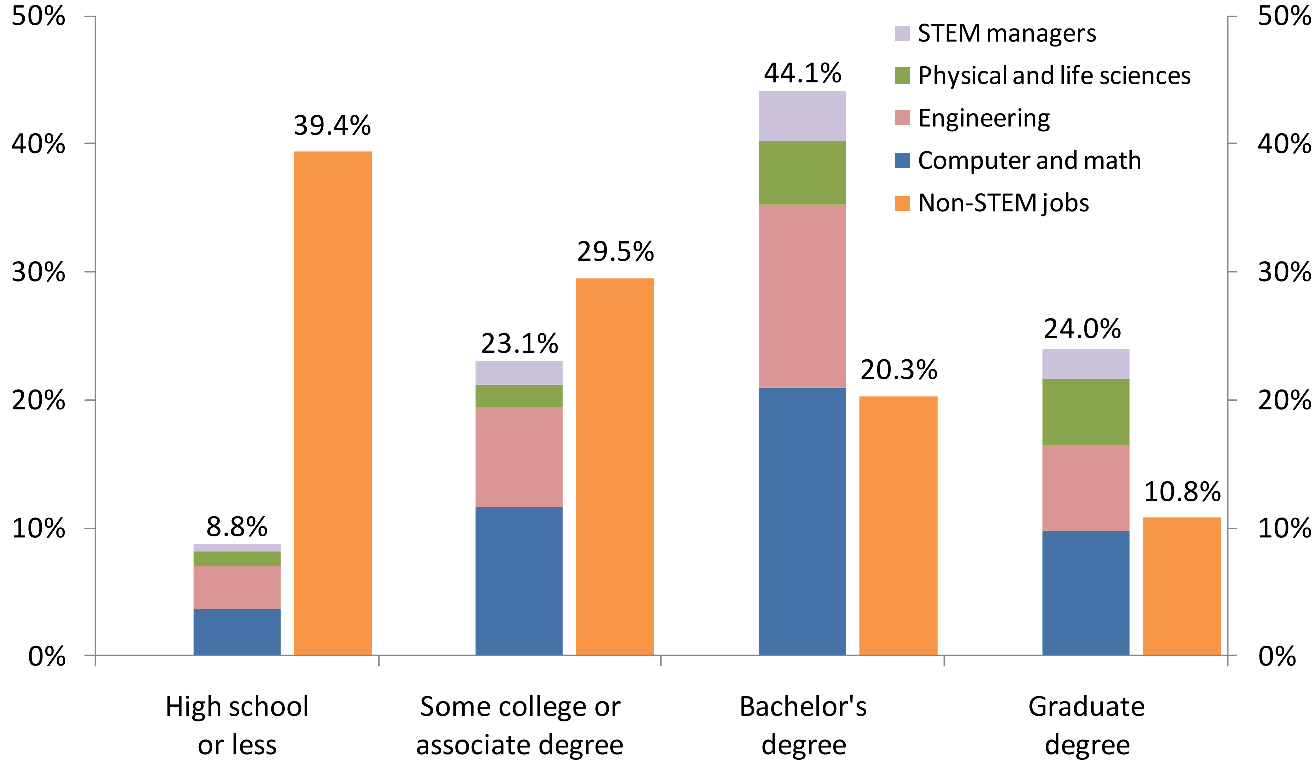
Educational Attainment of STEM Workers

One of the more distinguishing characteristics of STEM workers is their educational attainment. More than two-thirds (68 percent) of STEM workers have a bachelor's degree or higher, compared to just under one-third (31 percent) of other workers age 16 and over (see Figure 5). Among the four STEM occupational groups, the physical and life sciences have the highest-educated workforce, with nearly 40 percent holding a graduate degree – about double the share for computer, math and engineering jobs. Nonetheless, because STEM includes professionals as well as first-tier support jobs, we find that a number of STEM workers have less than a four-year college degree; nearly one-quarter (23 percent) have completed an associate degree or at least some college, and 9 percent have a high school diploma or less. So while it is certainly true that the majority of STEM workers tend to have at least a bachelor's degree, opportunities also exist for STEM workers with lower education levels.

Conclusions

The greatest advancements in our society from medicine to mechanics have come from the minds of those interested in or studied in the areas of STEM. Although still relatively small in number, the STEM workforce has an outsized impact on a nation's competitiveness, economic growth, and overall standard of living. Analysis of data from the U.S. Census Bureau's American Community Survey and Current Population Survey provide new insights into the growing STEM workforce that is central to our economic vitality. STEM jobs are the jobs of the future. They are essential for developing our technological innovation and global competitiveness.

Figure 5. Percent Distribution of STEM and Non-STEM Employment by Educational Attainment, 2010



Source: ESA calculations using Current Population Survey public-use microdata.
Note: The estimates are for all employed persons age 16 and over.

These factors make STEM workers highly desirable to companies developing or operating on the technological forefront and extremely important to the U.S. economy, as competitive businesses are the foundation of a competitive economy. As this analysis highlights, STEM jobs should also be highly desirable to American workers. Regardless of educational attainment, entering a STEM profession is associated with higher earnings and reduced joblessness. For college graduates, there is a payoff in choosing to pursue a STEM degree, and for America's workers, an even greater payoff in choosing a STEM career.

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

Occupation	SOC code	Occupation	SOC code
		Computer and math occupations	
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		
		Engineering and surveying occupations	
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		
		Physical and life sciences occupations	
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
Chemists and materials scientists	19-2030	Other life, physical, and social science technicians	19-40XX
Environmental scientists and geoscientists	19-2040		
		STEM managerial occupations	
Computer and information systems managers	11-3021	Natural sciences managers	11-9121
Engineering managers	11-9041		

Appendix Table 2. Detailed STEM undergraduate majors

Computer majors

- Computer and information systems
- Computer programming and data processing
- Computer science
- Information sciences
- Computer administration management and security
- Computer networking and telecommunications

Math majors

- Mathematics
- Applied mathematics
- Statistics and decision science
- Mathematics and computer science

Engineering majors

- General engineering
- Aerospace engineering
- Biological engineering
- Architectural engineering
- Biomedical engineering
- Chemical engineering
- Civil engineering
- Computer engineering
- Electrical engineering
- Engineering mechanics physics and science
- 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
- 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

Physical and life sciences majors

- Animal sciences
- Food science
- Plant science and agronomy
- Soil science
- Environmental science
- Biology
- Biochemical sciences
- Botany
- Molecular biology
- Ecology
- Genetics
- Microbiology
- Pharmacology
- Physiology
- Zoology
- Miscellaneous biology
- Nutrition sciences
- Neuroscience
- Cognitive science and biopsychology
- Physical sciences
- Astronomy and astrophysics
- Atmospheric sciences and meteorology
- Chemistry
- Geology and earth science
- Geosciences
- Oceanography
- Physics
- Nuclear, industrial radiology, and biological technologies

Endnotes

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

[2] Although our principal data sources, the monthly Current Population Survey (CPS) and the 2009 American Community Survey (ACS), collect detailed information on workers' occupations, they do 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 postsecondary 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."

[4] The distinction between "scientists" rather than "science occupations" is more than just semantic as "science occupations" covers 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] Using 2008-18 employment projections from the Bureau of Labor Statistics (BLS), ESA calculated the projected employment growth of STEM occupations. BLS's Employment Projections Program's homepage is http://www.bls.gov/emp and detailed occupational projections are available at http://www.bls.gov/emp/ep_table_106.htm

[6] More specifically, the earnings regressions control for age (up to a fourth degree polynomial of age), gender, marital status, race and Hispanic origin, nativity and citizenship, educational attainment, metropolitan area, region, union representation, major industry, STEM occupation, time, and STEM occupation interacted with time.

[7] For the regression analysis, we combined workers that had completed some college, high school, or less into a single "less than a bachelor's degree" category because of small sample concerns.

[8] One caveat with these results is that the STEM premium may also capture other unidentified factors that systematically distinguish STEM workers from other workers. STEM workers may have more in common than just their career fields, such as a similar work ethic or affinity, and the STEM premium could reflect the net impact of those unidentified common characteristics as well as the pure premium from working in a STEM job.

[9] As mentioned earlier, a person whose primary or secondary major was in a STEM field is counted as having a STEM undergraduate degree.

[10] In the Current Population Survey, occupations are assigned to persons based on their most recent work experience. As a result, unemployment rates by occupation are sometimes referred to as the "experienced unemployment rate." Thus, if we define U_{STEM} as the number of unemployed persons whose most recent job was in a STEM occupation and E_{STEM} as the number of persons currently employed in a STEM occupation, then the STEM unemployment rate is calculated as U_{STEM} / (E_{STEM} + U_{STEM}).

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