Educating Our Workforce

4 Educating Our Workforce

"If we want to win the future—if we want innovation to produce jobs in America and not overseas—then we also have to win the race to educate our kids."

—President Barack Obama, State of the Union Address, January 25, 2011

Education is a key element for promoting economic growth and increasing the innovative capacity of a firm or a country. Economic growth "closely depends on the synergies between new knowledge and human capital, which is why large increases in education and training have accompanied major advances in technological knowledge in all countries that have achieved significant economic growth."[1] Our nation's education system underpins the United States' rise to the position of richest nation on the planet in the last century.[2] However, we must recognize and address cracks in this building block of American innovation, lest we fall behind countries that have placed a higher priority on developing a skilled workforce.

It is not sufficient in today's global economy for a nation to have a generally skilled and educated workforce. Increasingly, the specific skills embodied in science, technology, engineering, and mathematics (STEM) education fuel the innovative processes that are especially valuable to our economy. These skills are sought by companies across the economy as they look to expand their workforces. These STEM skills are not only important for those working towards advanced degrees. All levels of the education system should incorporate the critical thinking and other skills that are the hallmark of STEM education.[3]

This chapter compares the United States to other nations on the dimensions of access to education and training and academic outcomes, with a particular focus on STEM. Furthermore, it outlines the diverse and critical role of the Federal government in building a skilled and competitive workforce. Areas to be addressed are summarized below:

- The United States must sustain the quality of its post-secondary education system, which is the top destination for students from abroad, while also removing barriers that have limited the post-secondary participation and performance of U.S. students. It is essential that the United States equip future and current workers with the skills needed to compete in a global labor market.

- Given the importance of the role played by technological progress and innovation in promoting economic growth, investment in STEM education is especially important. Yet the United States is falling behind in this area at all education levels, and addressing this shortcoming is needed if we are to continue to produce not only a workforce with the technical skills needed to fill current job openings, but persons with the unique blend of technical expertise and entrepreneurial spirit who will create the products and industries of the future.

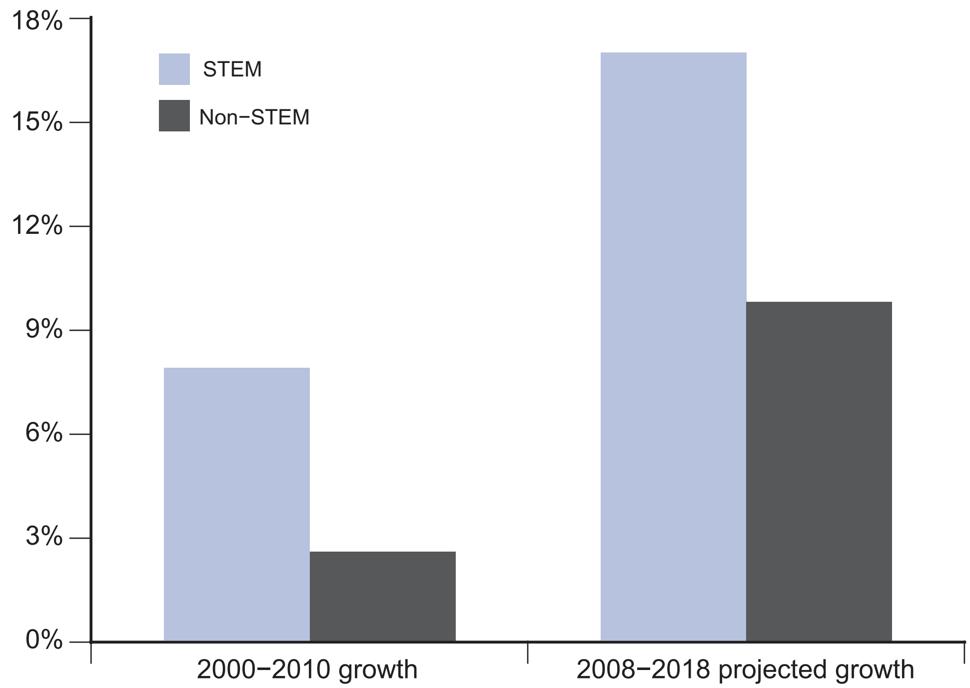
Education is a complex and multifaceted process that spans pre-school through life-long learning and involves policy issues ranging from affordability and technology, to questions of support for higher education, classroom size, equal access, and teacher compensation. This chapter primarily and narrowly focuses its attention to STEM because of the strong link between STEM skills, STEM occupations, and innovation. However, our narrow attention to STEM in no way implies that other aspects of education policy are not important in making our country more innovative and competitive. Indeed, our attention to STEM should be viewed as only one example of an area where concern has been raised about the nation's performance relative to other countries in the world.

The STEM Workforce Is Expanding

The STEM workforce is typically defined as the set of professional and technical support occupations in the fields of computer science and mathematics, engineering, and life and physical sciences. In 2010, there were 7.6 million STEM workers in the United States, representing about 1 in 18 workers. Computer and math occupations account for close to half of STEM employment, followed by engineering with 32 percent of STEM jobs, physical and life sciences with 13 percent, and STEM management jobs with 9 percent. Over the past 10 years, growth in STEM jobs (7.9 percent) was three times as fast as growth in non-STEM jobs (2.6 percent). Looking ahead over the coming years, STEM employment is expected to continue to grow at a faster rate (see figure 4.1).

Figure 4.1

Recent and Projected Growth in STEM and Non-STEM Employment



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

STEM workers fill our nation's research and development facilities and drive our nation's innovation and competitiveness by generating new ideas, new companies, and new industries. Not surprisingly, more than three-fourths of the most celebrated inventors and entrepreneurs since 1800 had degrees in engineering, physics, chemistry, computer science, or medicine.[4]

Commensurate with their importance in driving economic productivity and growth, workers in STEM fields earn more on average than workers in other fields. As a result, providing more students with the skills to work in STEM fields is crucial both to the nation's economic future and to improving the incomes of our workers. STEM workers enjoy large earnings premiums over non-STEM workers. For example, in 2010, the STEM premium earned by workers with a bachelor's degree was 27 percent, and for workers with a graduate degree, it was 12 percent[5] (see table 4.1). STEM workers are also less likely to experience joblessness than their non-STEM counterparts.

Table 4.1

Average Hourly Earnings of Workers in STEM Occupations, 2010

Education	STEM	Non-STEM	Difference
High school diploma or less	$24.82	$15.55	59.6%
Some college or associate degree	$26.63	$19.02	40.0%
Bachelor's degree only	$35.81	$28.27	26.7%
Graduate degree	$40.69	$36.22	12.3%

Source: Economics and Statistics Administration calculations using Current Population Survey public-use microdata.
Note: Full-time private wage and salary workers.

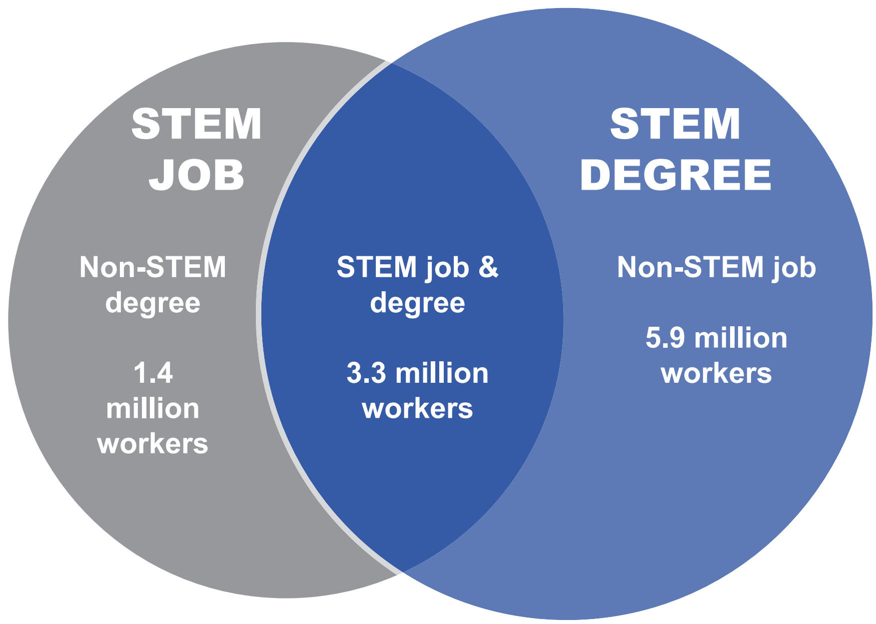
STEM Skills in Demand Throughout the Economy

Just as innovative processes take place both inside and outside the traditional spheres of research and development (R&D), STEM is now often defined both inside and outside the traditional set of science and engineering jobs. Thus, STEM can be defined not just as a group of workers in science and engineering jobs, but also as a set of workers with STEM education or STEM knowledge and skills, whether or not they work in STEM jobs. The human capital embodied in the work that STEM workers perform is valued in other sectors of the economy. This capital includes knowledge of mathematics, computers, and electronics and more general skills, such as critical thinking, troubling shooting, and various forms of reasoning.[6] More generally, a growing number of occupations in the economy have been found to require a greater intensity of non-routine analytical and interactive tasks—that is, ones requiring reasoning and high executive functioning—while a declining number of occupations rely more heavily on manual and routine tasks.[7]

Nearly two-thirds of workers with undergraduate degrees in a STEM field are working in non-STEM occupations, such as healthcare, education, the social sciences, and management[8] (see figure 4.2). These workers are not underperforming, nor are they mismatched in their current jobs. Rather, the same human capital that drives innovative processes through traditional R&D-related employment is needed across our economy, a suggestion that is confirmed in surveys of these workers as well.[9] Furthermore, many STEM-educated workers who choose education jobs are likely teaching STEM skills to others.

Figure 4.2

The Overlap Between STEM Jobs and STEM Degrees



Source: Economics and Statistics Administration calculations from American Community Survey microdata.

The value of STEM human capital is reflected in the earnings premium enjoyed by college-educated workers with a STEM degree. All else equal, workers with a STEM degree earn 11 percent more per hour in full-time non-STEM jobs than workers with other undergraduate degrees. When STEM majors work in STEM jobs, their earnings premium rises to 20 percent, relative to persons with non-STEM degrees working in non-STEM jobs.[10]

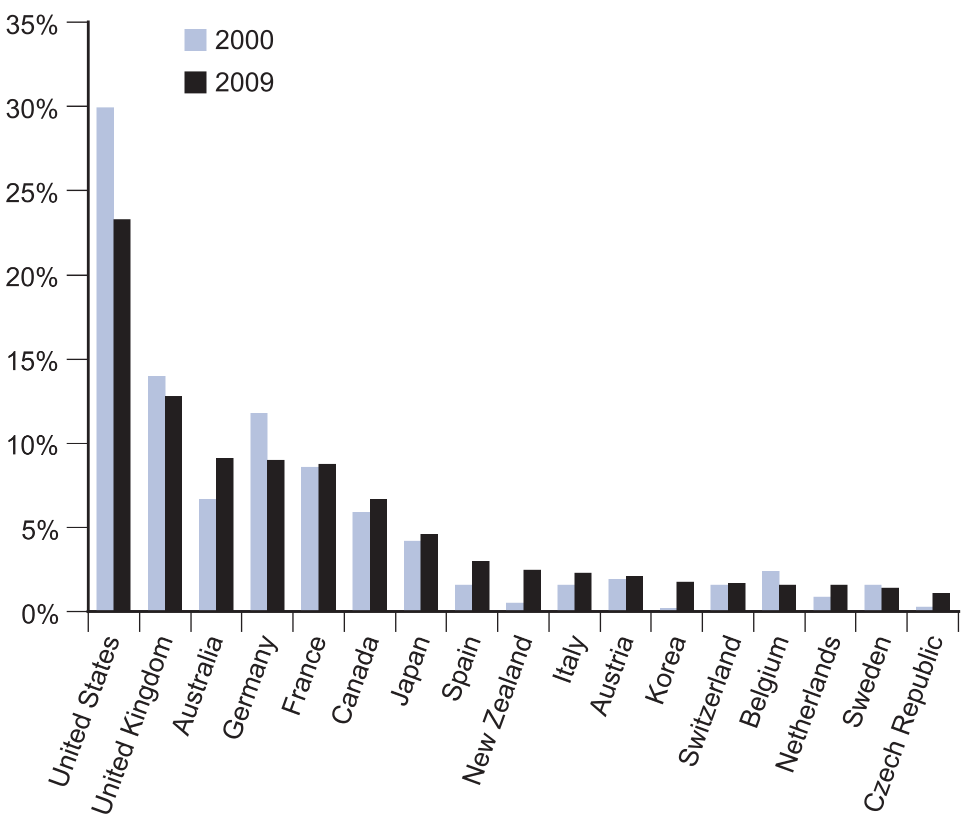
Given that more than two-thirds of STEM workers have at least a college degree and that demand for STEM workers and workers with STEM degrees continues to grow, the U.S. college and university system is a cornerstone of our STEM future. Fortunately, at the college level, the United States continues to set the standard of the quality of the educational system and in the value of obtaining a college degree. However, the United States is losing ground to other countries in important areas of education, specifically in creating opportunities for students to gain expertise in STEM skills. Improvements are required at all education levels, including post-secondary school, if the United States is to remain internationally competitive and for it to continue to excel in preparing its workforce for an increasingly knowledge-intensive economy.

Many U.S. Universities Are Outstanding But Our Production of U.S. STEM Graduates Is Not

Elite institutions within the United States' college and university system typically dominate global rankings of prestigious higher education institutions. In 2011-2012, in a worldwide ranking, 18 out of the top 25 universities and 30 out of the top 50 universities were in the United States. The United Kingdom was next with four in the top 25 and five in the top 50.[11] These rankings make our country a magnet for the best students from around the world. The United States is still the top destination for students studying abroad, although its share has fallen somewhat over time (see figure 4.3).

Figure 4.3

Distribution of Foreign Tertiary Students Across OECD Countries



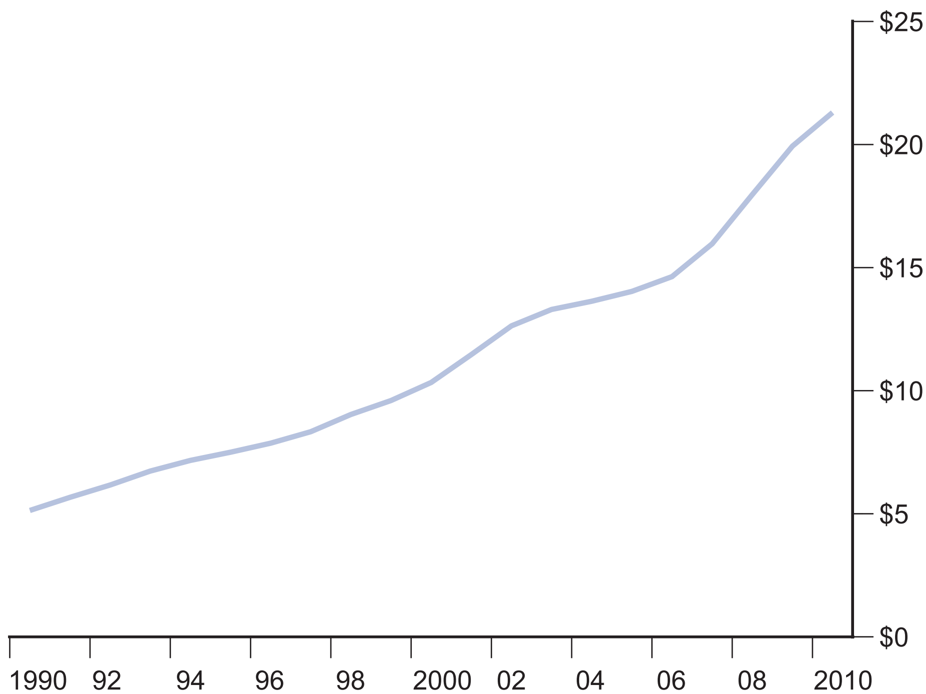
Source: OECD Education at a Glance 2011, Table C3.6.

Note: OECD member countries with fewer than 1% of foreign students are not shown.

Another way to look at the desirability of the United States as a destination for study is in export terms: when students from abroad come to the United States to study, that is an export of educational services (see figure 4.4). In 2010, receipts from education exports exceeded $21 billion, more than doubling over the previous 10 years in keeping with the rising cost of attending U.S. colleges and universities. Close to half of the receipts came from China ($4.0 billion), India ($3.3 billion), and Korea ($2.2 billion) (see figure 4.5). Roughly 40 percent of international students in 2010–2011 were studying in STEM-related fields, such as engineering (18.7 percent), math and computer sciences (8.9 percent), and physical and life sciences (8.8 percent). Business and management ranked the most popular individual field (21.5 percent).[12]

Figure 4.4

Exports of Educational Services, 1990–2010

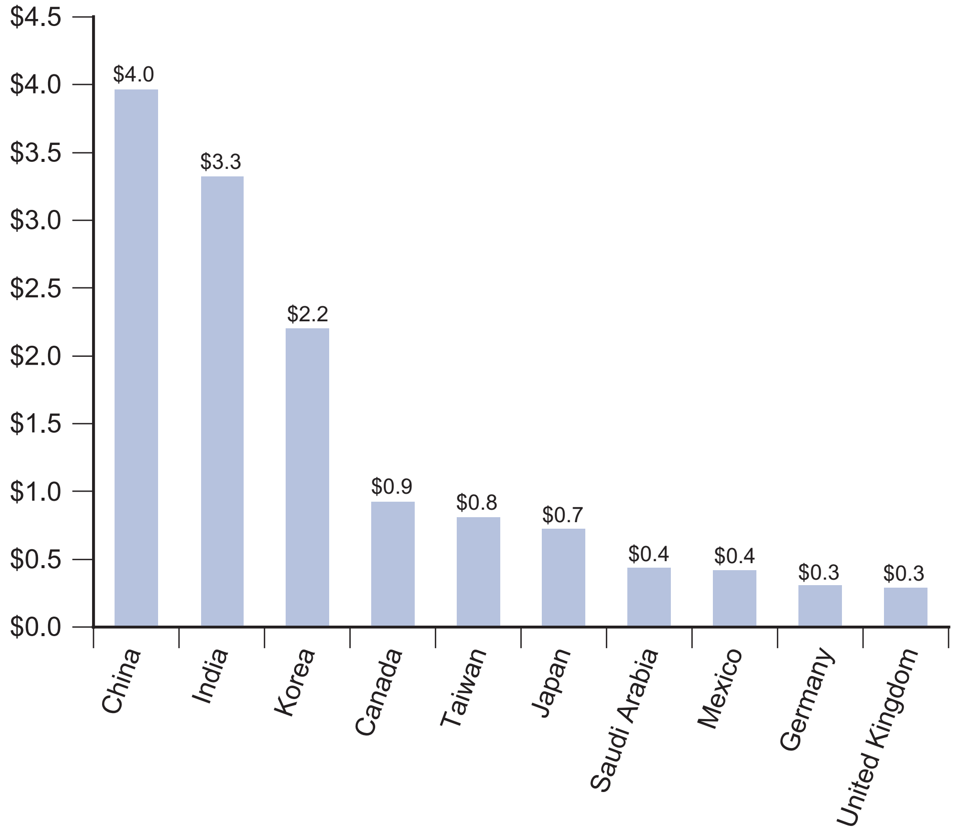


Source: Bureau of Economic Analysis.

Note: Data are in billions of current dollars.

Figure 4.5

Exports of Educational Services to Selected Countries, 2010



Source: Bureau of Economic Analysis.

Note: Data are for 2010 and are in billions of current dollars.

While the United States continues to have top-flight higher education institutions, fundamental problems in the kindergarten through college system threaten our ability to increase the skills of our workforce as rapidly as needed. Among high school graduates who do enroll in college, a remarkably high proportion—20 percent—takes at least one remedial course their freshman year.[13] Students who take remedial coursework often do not fully catch up with their other college-going peers: compared with college students who need no remediation, students who take even a single remedial course are less likely to earn their bachelor's degree than students who did not take any remedial courses.[14] More generally, the United States has slipped behind other countries in terms of college attainment rates over the second half of the 20th century. The cohort born between 1943 and 1952 had the highest share of bachelor degree holders in the world. Since then several other countries have not only caught up but surpassed the United States in the proportion of adults who have completed college. Currently, the share of the U.S. population aged 25–34 that has attained post-secondary education is only slightly above the OECD average.[15]

Of those who graduate from college, the United States produces fewer STEM graduates relative to other developed countries. OECD data show that in 2009 12.8 percent of U.S. graduates with bachelor's degrees were in STEM fields. This places the United States near the bottom of OECD countries in terms of the percentage of STEM graduates produced. Significant economic competitors—such as South Korea (26.3 percent), Germany (24.5 percent), Canada (19.2 percent), and the United Kingdom (18.1 percent)—are on the long list of countries producing a much higher percentage of STEM graduates.[16]

As they advance through the education system, U.S. students choose not to enter STEM fields or, if they do pursue these studies, do not continue. Three out of four high school students who test in the top math quartile don't start with a STEM major in college, and only half of all students who start in a STEM major graduate with a STEM degree.[17] While no single reason can account for the low share of students in STEM fields, students' poor K–12 math and science preparation and their unwillingness to commit the additional study time needed for math and science courses relative to other classes are likely contributing factors.[18] As detailed below, the Department of Education and the National Science Foundation have developed initiatives to improve K–12 and college-level STEM instruction and to reduce the number of students exiting STEM majors for other majors.

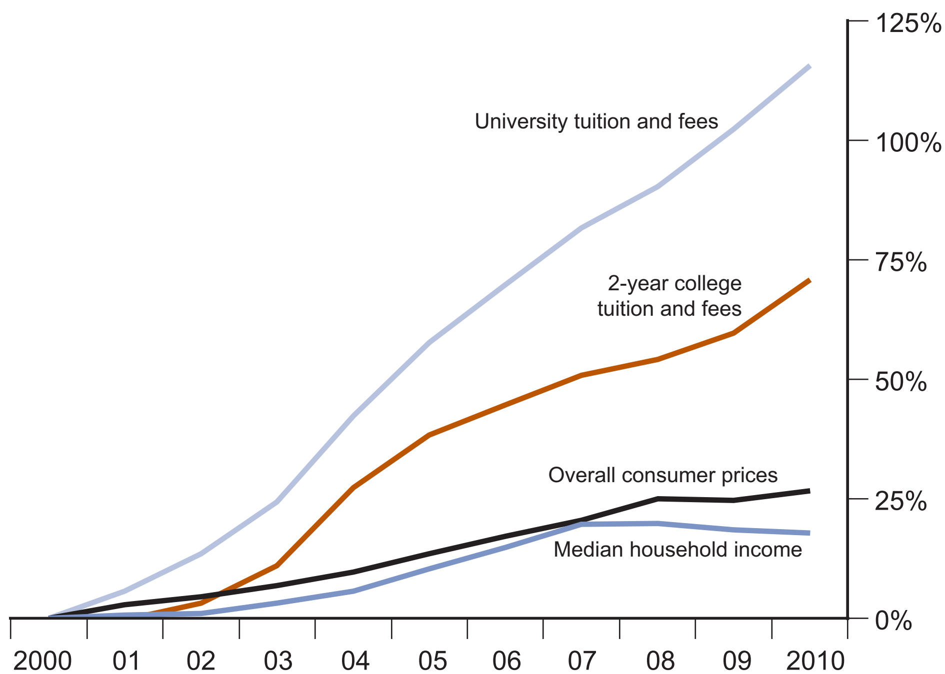
The High Cost of College and Poor Academic Preparation Deter Students

Given the importance of a college education to a worker's productivity and earnings, particularly for STEM-educated workers, it is striking that only 70 percent of high school graduates in 2009 went on to some higher education—a rate lower than that of the highest performing countries, such as Norway and New Zealand.[19]

One barrier to college attendance is the high price of tuition and fees. Whether for a 2-year or 4-year degree, tuition has climbed much faster than consumer prices and household incomes. Over the past decade, in-state public university tuition and fees more than doubled while tuition and fees for 2-year schools rose 71 percent. During the same period, overall consumer prices increased 27 percent and nominal median household income rose 18 percent (see figure 4.6). In other words, household income over the period was not able to keep up with the overall increase in consumer prices, let alone the soaring sticker price of a college education. The cost of room and board (not included in tuition and fees) was no more forgiving. Between the 1999–2000 and 2009–2010 school years, the cost of staying in a college dormitory rose 80 percent while board increased 55 percent. Grant aid from public and private sources, including Federal Pell Grants and Federal education tax credits and deductions, however, have helped soften the financial blow to families. As a result, the net price of a college education—that is, the published price of tuition and fees minus all forms of financial aid—has not increased as fast as the sticker prices.[20] In fact, in constant dollars the net price for full-time students attending public, four-year institutions in 2011–2012 increased just $60 relative to 2007–2008, while the net price for public, two-year schools and private schools in 2011–2012 was lower than in 2007–2008.[21]

Figure 4.6

Percentage Growth Since 2000 in College Tuition, Consumer Prices, and Median Household Income

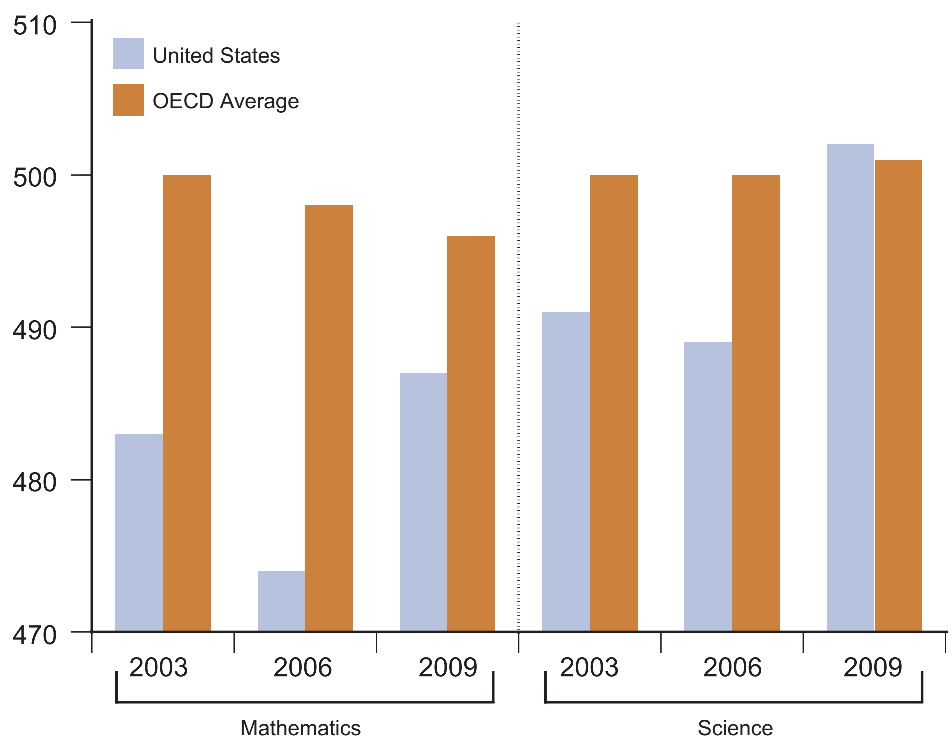


Source: National Center for Education Statistics, Census Bureau, and Bureau of Labor Statistics.

Another barrier to attending college (and an explanation for the high rate of remedial education in college) is inadequate K–12 preparation. The primary and secondary education system in the United States must prepare students who wish to go to college and specialize in a STEM field with the skills to do so. Similarly, those students who choose to enter the workforce directly after high school and not attend college must be equipped with the skills necessary to be trained for STEM jobs that do not require a college education. Yet pre-college preparation in the skills that will allow students to specialize in STEM coursework in college or to enter STEM jobs right out of high school is lagging. The Program for International Student Assessment (PISA) test scores reveal that U.S. students consistently scored below the OECD average in math in 2003, 2006, and 2009 (the past three testing cycles). In science, while U.S. students scored lower than the OECD average in science literacy in 2006, the average score of U.S. students in 2009 was not measurably different from the 2009 OECD average (see figure 4.7). Further, U.S. students scored lower than the students in 12 OECD countries, and not significantly different from students in 12 other countries. These conclusions

Figure 4.7

Math and Science Test Scores in the U.S. and OECD



Source: OECD, PISA 2003, 2006, and 2009 databases.

about the world ranking of U.S. students is supported by the results of the most recent National Assessment for Educational Progress study, which shows that although U.S. students have improved in math over the past 30 years, only 26 percent of 12th graders are "proficient" or better in math. In reading, 38 percent of students scored at the proficient level or higher in 2009. While overall math and reading scores for 12th graders have improved between 2005 and 2009 (the latest two reports available), there remain notable and persistent disparities by race, ethnicity and gender.[22] The latest science scores may also give reason for pause as only 21 percent of 12th graders were found to be "proficient" or better.[23] Overall these scores suggest that while we need to boost student achievement in all dimensions, we are particularly poor right now in skills that prepare students for post-secondary STEM education and training.

Although post-secondary education is the principal path into a STEM job, a 4-year degree is just one option for future or current workers who want to gain STEM-related knowledge and skills. With relatively low tuition, wide dispersion through the United States, convenient class times, and course offerings aimed at students from diverse high school backgrounds, our nation's community colleges lower the barriers to post-secondary education. A recent study of Florida community colleges highlights their dual role in increasing economic mobility by enabling students (particularly low-income students with good grades in high school) to transfer to 4-year colleges and in teaching work-enhancing skills (which particularly benefit low-income students who were less successful in high school).[24] As the Florida study and others highlight, the payoff of choosing more technically oriented fields is considerable. This becomes particularly clear when examining training programs aimed at dislocated workers, for whom 1 year of technical training can increase workers' re-employment earnings by $1,600, compared with $800 for other types of training.[25] Note that these results related to just 1 year of study, as opposed to a 2-year degree.

Demographics Create Challenges and Opportunities for Growth

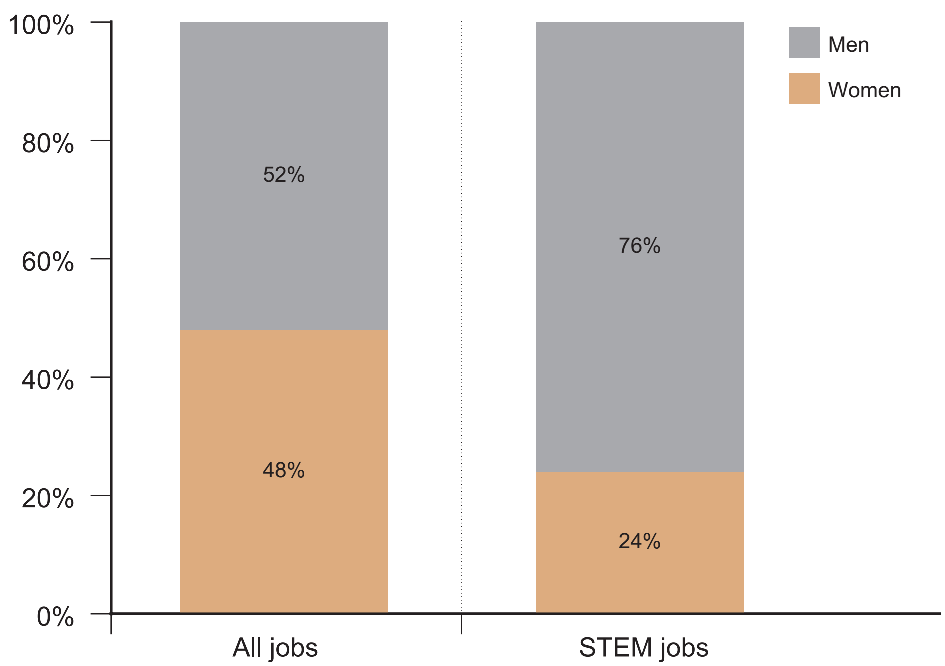
Given the advantages of working in a STEM occupation and having an educational background in STEM, there are disturbing demographic disparities in STEM education and in the composition of workers in STEM occupations. Women are vastly underrepresented among STEM workers. Despite making up nearly half of the

U.S. workforce, women hold less than 25 percent of STEM jobs, and this disparity has persisted throughout the past decade, even as college-educated women have increased their share of the overall workforce (see figure 4.8). Though this varies by field of study, overall women hold a disproportionately low share of STEM undergraduate degrees. For example, this is particularly true in engineering, though women receive the majority of degrees in biology. Also, women with a STEM degree are less likely than their male counterparts to work in a STEM occupation and more likely to work in education or healthcare. This has real consequences, as women with STEM jobs earned 33 percent more than comparable women in non-STEM jobs—considerably higher than the STEM premium for men—so the gender wage gap is smaller in STEM jobs than in non-STEM jobs.[26]

Like women, most racial and ethnic minorities are underrepresented among STEM workers. A noticeable exception is non-Hispanic Asians. Fifteen percent of all non-Hispanic Asians work in STEM jobs, almost 3 times the overall share of STEM workers in the economy. This reflects non-Hispanic Asian's greater likelihood of graduating from college, majoring in a STEM discipline, and working in a STEM job given a degree in a STEM major. For example, non-Hispanic Asians are

Figure 4.8

Gender Distribution Between STEM and All Employment, 2009



Source: Economics and Statistics Administration calculations from American Community Survey microdata.

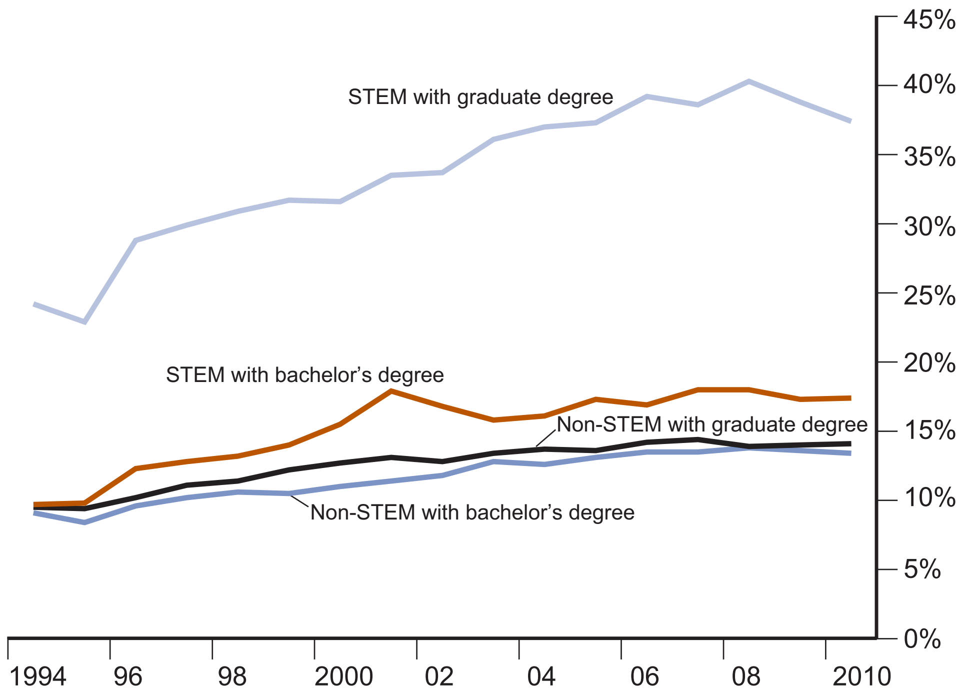
most likely (42 percent) to graduate from college with a STEM degree, while the propensities of other groups are all fairly similar (17–22 percent). Half of all non-Hispanic Asian workers with STEM degrees have STEM jobs, compared to 30 percent of Hispanics, non-Hispanic black, and American Indian and Alaska Native workers. Interestingly, on average, all minority groups have higher wage premiums from having a STEM job than do non-Hispanic whites (31 to 39 percent versus 22 percent). With greater equality in educational attainment, demographic disparities within the STEM workforce can be diminished, helping to boost STEM employment and U.S. leadership in technology and innovation.[27]

The Foreign-Born Are Key Members of the STEM Workforce

Many innovations that were born in America have been developed by persons who were not born in America. One in five STEM workers is foreign born, with 63 percent coming from Asia. The foreign-born share of STEM workers with graduate degrees (44 percent) is about twice the foreign-born share of STEM workers for all education levels and has nearly doubled over the past 17 years, as has the foreign-born share of STEM workers with just a bachelor's degree also has posted strong gains[28] (see figure 4.9). The growth in the foreign-born STEM workforce

Figure 4.9

Foreign-Born Share of STEM and Non-STEM Employment, by Education



Source: Economics and Statistics Administration calculations using Current Population Survey public-use microdata.

reflects multiple factors affecting the supply of and demand for STEM workers. One factor is the difficulty that employers often report in finding applicants with the right technical skills to fill their job openings. Even as we emerge from a historically deep recession, employers report shortages of skilled workers including engineers and software developers.[29]

In a global economy, the payoff to attracting the brightest minds to the United States has been considerable. Consider, for example, that nearly 20 percent of the *Fortune 500* firms founded between 1985 and 2010 were started by an immigrant to the United States.[30]

Many of the foreign-born students educated in STEM disciplines in the United States want to remain here lawfully—starting their own firms or contributing to the growth of existing firms. The United States must develop immigration policies to ensure that this country is welcoming to the world's best and brightest.

The Administration Is Lowering the Barriers to a College Education

States and localities, like American families, face difficult budget situations following the recent deep recession. This has led to difficult choices regarding education. The Obama Administration recognizes these difficulties and has worked on several fronts to make critical investments in our education system—investments that make college affordable and increase the quality and payoff of the education investment that American families are making. These initiatives will strengthen our future and current workforce and more fundamentally build our overall innovative capacity.

Making College More Affordable

Since its origin in 1972, the Federal Pell Grant program has become the most significant source of Federal grant aid to college students and the largest single source of aid at public colleges and universities. The Obama Administration has worked to raise both the maximum Pell Grant amount and expand the number of grants awarded. Through amendments to Higher Education Act of 1965 (HEA) by the American Recovery and Reinvestment Act (ARRA) and the Student Aid and Fiscal Responsibility Act (SAFRA), the maximum Pell Grant award was raised from $4,731 in 2008 to $5,550 in 2010. Beginning in 2013, the maximum Pell grant will increase with the Consumer Price Index. SAFRA also made Federal loans available directly to students, ending wasteful subsidies once paid to lenders and other state guaranty agencies. Overall, the Administration has maintained extraordinary commitment to the Pell program, with total aid to students increasing from $18 billion in 2008 to more than $30 billion in 2011.[31]

These initiatives have succeeded in holding down the growth in the out-of-pocket costs students and their families are paying for college. Over 9 million college students received an average of $3,700 in Pell Grant awards in the most recent academic year, as compared to 5.5 million college students who received an average Pell Grant award of $2,650 in the year before President Obama took office.[32]

In addition to expanding and increasing Pell Grant availability and awards, ARRA established the American Opportunity Tax Credit (AOTC), which provides up to $2,500 a year for college tuition and related expenses for American families. This tax credit improves notably upon the Hope Scholarship credit that it replaced. AOTC has a higher maximum benefit, and it can be claimed for up to four years rather than only two years of undergraduate education. Furthermore, AOTC has a higher income eligibility cutoff, thus making it available to more middle-class families, and it is partially refundable, making it more beneficial to lower-income families. This credit was expected to benefit 9.4 million students and their families in 2011. In December 2010, the President signed an extension of the AOTC through the end of 2012.

The SAFRA Act also greatly improved the terms of an income-based repayment program established in 2007 for student loans. Under these improvements, borrowers will have their student loan payments capped at 10 percent rather than 15 percent of their discretionary income. This new cap was originally going to be available only to new borrowers after July 1, 2014, but President Obama recently announced the availability of a similar "pay-as-you-earn" plan two years earlier. Borrowers who keep up their payments for 20 years will see their remaining debts forgiven—or 10 years for persons with public service jobs.[33]

Addressing STEM Shortcomings

To address the poor STEM participation and performance in our nation's schools, the Administration has launched multiple initiatives (see box 4.1 for a discussion on the efforts mandated by COMPETES to develop an inventory of all STEM educational initiatives). "Educate to Innovate" establishes five major public-private partnerships to harness the power of media, interactive games, hands-on learning, and community volunteers to reach millions of students and expand STEM education and opportunities to all students, particularly those of underrepresented groups.

A necessary step to improving our students' understanding of STEM fields, which should, in turn, lead to more college graduates with STEM training and more STEM workers, is to train additional STEM teachers. Of course, having more teachers is only effective if it does, in fact, lead to an increase in college graduation rates in STEM fields. The Widening Implementation and Demonstration of Evidence based Reforms (WIDER) program at NSF will help improve undergraduate STEM instruction and outcomes at universities.

Finally, STEM education and career opportunities for underrepresented groups, including minorities and women and girls, need to be expanded. To this end, the "NSF Career-Life Balance Initiative," has been announced. This is a 10-year plan designed to give flexibility to women and men who pursue research careers. For example, NSF will expand a program that will allow researchers to delay or suspend their grants for up to one year in order to care for a newborn or newly adopted child or fulfill other family obligations.

Box 4.1

Inventory of Federal STEM Educational Programs

Section 101 of COMPETES requires the White House Office of Science and Technology Policy (OSTP) to prepare an annual report to Congress describing STEM educational programs and activities by Federal agency in the prior and current fiscal years as well as in the President's budget.[1] The report will also list the programs' funding levels, evaluate their duplication and fragmentation, and describe how participating Federal agencies will disseminate information about federally supported resources to STEM educators. In partial fulfillment of this requirement, OSTP has developed a detailed inventory covering all 13 Federal agencies that sponsor such programs. The inventory tallied 252 specific programs with a total Federal investment of $3.5 billion. About $1 billion of that is being spent to train individuals for activities specific to the mission of those funding agencies, including National Institutes of Health training programs to help develop the next generation of biomedical researchers and US Department of Agriculture programs to train agricultural scientists.

1. Office of Science and Technology Policy Press Release, "Federal Science, Technology, Engineering, and Math Education Inventory Highlighted," September 19, 2011; www.whitehouse.gov/sites/default/files/microsites/ostp/ostp-stem-inventory_9-19-11.pdf, and America COMPETES Reauthorization Act of 2010, Pub L. No. 115–358, January 4, 2011; www.gpo.gov/fdsys/pkg/PLAW-111publ358/pdf/PLAW-111publ358.pdf.

Helping Community Colleges Assist Workers and Businesses

The Health Care and Education Reconciliation Act (HCRA) includes a $2 billion investment in our nation's community colleges, enabling eligible institutions of higher education to expand their capacity to provide quality education and training services to Trade Adjustment Assistance (TAA) eligible workers as well as other individuals to improve their knowledge and skills and enable them to obtain high-quality employment. Already $500 million in grants have been awarded to community colleges around the country to expand and improve their ability to deliver education and career training programs that can be completed in two years or less. These grants support partnerships between community colleges, community organizations, and employers to develop programs that provide pathways to good jobs, including building instructional programs that meet specific industry needs.

Further serving displaced workers, the Skills for America's Future initiative, an industry-led initiative announced in October 2010, will build and improve partnerships between businesses and educational institutions to train American workers for 21st century jobs. The initiative was created to foster collaborative efforts between the private sector, community colleges, labor unions, and other institutions, with a commitment to scaling up meaningful and measurable solutions. The goal is to build a nationwide network of stakeholders who will work to maximize workforce development strategies, job training programs, and job placement. The Skills for America's Future Task Force has been created and co-chaired by top-level Administration policymakers, to coordinate Federal efforts.[34]

The Race to the Top Initiative Rewards Statewide Reform

The Race to the Top Fund uses competitive grants to encourage comprehensive state and local reform that result in increased student achievement, narrowed achievement gaps, and improved high school graduation and college enrollment rates.[35] As part of Race to the Top, the Department of Education has awarded $4 billion in competitive grants to 11 states and the District of Columbia over two phases that will directly impact 13.6 million students and 980,000 teachers in 25,000 schools.[36] An additional $700 million was made available in 2011, $200 million of which was used to make additional awards to enable states to carry out meaningful portions of their ambitious reform plans. The remaining $500 million was awarded to nine states through for the new Race to the Top Early Learning Challenge, a competition to support the states with the most ambitious plans to ensure that high-need children from birth to age five enter kindergarten ready to succeed.[37]

Enhancing Our Nation's Educational Infrastructure

As the United States emerges from the Great Recession, states and localities still face reduced revenues and are continuing to reduce budgets. Local schools, for example, cut nearly 235,000 jobs from May 2009 to November 2011. At the same time, budgets to maintain our nation's more than 100,000 public schools have been pared back, which has led to a $270 billion backlog of deferred maintenance and repair. The cost of heating and cooling antiquated and inefficient buildings lead districts to spend more each year on their energy bills than on computers and textbooks combined. Increasing class sizes combined with aging buildings result in overcrowded schools that have crumbling ceilings and inadequate wiring to support today's information technology infrastructure. More funds are needed to enhance our public schools, with a priority placed on high-need and rural schools, Bureau of Indian Education schools and community colleges (including tribal colleges).

Endnotes

1. Becker 2008.
2. Goldin and Katz 2008.
3. These include skills such as mathematics, science, critical thinking, active learning, complex problem solving, operations analysis, systems analysis, and problem solving. See Carnevale, Smith, and Melton 2011, 7–10.
4. Baumol, Schilling, and Wolff 2009, 723–724.
5. Langdon et al. 2011, 3.
6. Carnevale, Smith, and Melton 2011, 7–10 and 10–60.
7. Council of Economic Advisers 2009, 9-10.
8. Langdon et al. 2011, 4.
9. National Science Foundation 2010, 3.17–3.20.
10. Langdon et al. 2011, 4–5.
11. Times Higher Education 2011.
12. Institute of International Education 2011.
13. National Center for Education Statistics 2010a, Table 241.
14. Adelman 1998.
15. Council of Economic Advisers 2010, 223–225.
16. Organisation of Economic Co-operation and Development (OECD) 2011b.
17. Carnevale, Smith, and Melton 2011, 46–47.
18. Silverman and Light 2011. In addition, many research papers have found that the quality of undergraduate teaching is a factor that influences the number of STEM students. See for example: www4.ncsu.edu/unity/lockers/users/f/felder/public/Papers/long5.html.
19. OECD 2011a, Chart C2.1. Entry into postsecondary education is of course not the only obstacle to obtaining more STEM workers. Attention must also be paid to ensuring students complete their postsecondary education.
20. College Board 2011, Table 7.
21. Council of Economic Advisers 2011b, 1.
22. National Center for Education Statistics 2010b, Figure 13 and Figure 3, 26 and 9.
23. National Center for Education Statistics 2011, Figure 37, 46.
24. Furchtgott-Roth, Joacobson, and Mokher 2009, 6.
25. The Hamilton Project 2010, 3.
26. Beede et al. 2011b, 4–5.
27. Beede et al. 2011a, 3–5 and 7–8.
28. Beede et al. 2011a, 5–6.
29. See, for example, summary reports from Federal Reserve Board *Beige Book.*
30. Partnership for a New American Economy 2011, 9.
31. U.S. Department of Education 2011b.
32. U.S. Department of Education 2011b.
33. White House 2010.
34. Council of Economic Advisers 2011a, 79.
35. U.S. Department of Education, *Race to the Top Fund.*
36. U.S. Department of Education 2011a.
37. U.S. Department of Education 2011c.

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