Chapter 2.

Higher Education in Science and Engineering

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Highlights

Characteristics of the U.S. Higher Education System

Doctorate-granting institutions with very high research activity, although few, are the leading producers of S&E degrees at the bachelor's, master's, and doctoral levels, but other types of institutions are also important in educating S&E graduates.

- In 2013, doctorate-granting institutions with very high research activity awarded 73% of doctoral degrees, 41% of master's degrees, and 37% of bachelor's degrees in S&E fields.
- Master's colleges and universities awarded 29% of all S&E bachelor's degrees and 26% of all S&E master's degrees in 2013.
- About 30% of Hispanic S&E doctorate recipients who earned their doctorates between 2009 and 2013 had obtained their baccalaureate credential at a high Hispanic enrollment institution, and 25% of black S&E doctorate recipients who received their doctorates in the same period had obtained their baccalaureate degree at a historically black college or university.
- Nearly one in five U.S. citizens or permanent residents who received an S&E doctoral degree from 2009 to 2013 had earned some college credit from a community or 2-year college.

Higher education spending and revenue patterns and trends underwent substantial changes over the last two decades.

- Between 1987 and 2012, average revenue per full-time equivalent (FTE) student from net tuition at public very high research universities nearly tripled, whereas state and local appropriations fell by nearly 40%.
- Although tuition remained lower at public very high research universities than at their private counterparts, average revenue from student tuition increased more rapidly at public institutions.
- In public very high research universities, revenues from federal appropriations, grants, and contracts per FTE student grew by nearly 80% between 1987 and 2012, and research expenditures per FTE student grew by 75% in the same period. In private very high research universities, revenues from federal appropriations, grants, and contracts per FTE student grew by 60%, and research expenditures per FTE increased by 90%.
- Between 2008 and 2010, expanding enrollment in community colleges, coupled with reductions in state and local appropriations, contributed to a 10% reduction in instructional spending per FTE student. Instructional spending per FTE student continued to decline in 2011 but increased in 2012, with a larger drop in enrollment as the U.S. economy improved.

Between 2009–10 and 2014–15, estimated average net tuition and fees paid by full-time undergraduate students in public 4-year colleges increased by about 50% after adjusting for inflation.

- Undergraduate debt varies by type of institution and state. Among recent recipients of S&E bachelor's degrees, the level of undergraduate debt is somewhat higher for degree holders in the life sciences and in the social and related sciences, but overall it does not vary much by major.
- Levels of debt of doctorate recipients vary by field. In S&E fields, high levels of graduate debt were most common among doctorate recipients in the social sciences, psychology, and the medical and other health sciences.

- At the time of doctoral degree conferral, 45% of 2013 S&E doctorate recipients had debt related to their undergraduate or graduate education.

Undergraduate Education, Enrollment, and Degrees

Undergraduate enrollment in U.S. higher education rose from 13.3 million in 2000 to 17.7 million in 2013. The largest increases coincided with the two economic downturns in 2000–02 and 2008–10, continuing a well-established pattern seen in earlier economic downturns. Enrollment peaked at 18.3 million in 2010 but has since declined.

- Associate's colleges enroll the largest number of students, followed by master's colleges and universities and doctorate-granting institutions with very high research activity.
- Increased enrollment in higher education is projected to come mainly from minority groups, particularly Hispanics.

The number of S&E bachelor's degrees has risen steadily over the past 13 years, reaching a new peak of more than 615,000 in 2013. The proportion of all bachelor's degrees awarded in S&E relative to degrees in all fields has remained stable at about 32% during this period.

- All S&E fields experienced increases in the numbers of bachelor's degrees awarded in 2013, including computer sciences, which had declined sharply in the mid-2000s and had remained flat through 2009.
- Women have earned about 57% of all bachelor's degrees and about half of all S&E bachelor's degrees since the late 1990s. Men earn the majority of bachelor's degrees in engineering, computer sciences, mathematics and statistics, and physics, and women earn the majority in the biological, agricultural, and social sciences and in psychology.
- Between 2000 and 2013, the proportion of S&E bachelor's degrees relative to degrees in all fields awarded to women remained flat. During this period, it declined in computer sciences, mathematics, physics, engineering, and economics.

The racial and ethnic composition of those earning S&E bachelor's degrees is changing, reflecting both population changes and increases in college attendance by members of minority groups.

- For all racial and ethnic groups, the total number of bachelor's degrees earned, the number of S&E bachelor's degrees earned, and the number of bachelor's degrees in most broad S&E fields have increased since 2000.
- Between 2000 and 2013, the share of bachelor's degrees awarded to Hispanics among U.S. citizens and permanent residents increased from 7% to 11%, both in S&E and in all fields combined, and remained steady at about 1% for American Indians and Alaska Natives. In the same period, the share of bachelor's degrees awarded to blacks remained stable at 9% in S&E fields but increased from 9% to 10% in all fields.

The number of international undergraduate students in the United States increased by more than 50% between fall 2008 and fall 2014.

- The number of international undergraduate students grew considerably between fall 2011 and fall 2012. Between fall 2012 and fall 2014, the numbers continued to increase but at a somewhat slower rate.
- Between fall 2013 and fall 2014, the largest increases in international students enrolled in S&E fields were in computer sciences, mathematics, engineering, and the physical sciences.

- In fall 2014, China, Saudi Arabia, and South Korea were the top countries sending undergraduates to the United States, both in S&E and in non-S&E fields.

At the bachelor's level, attrition from science, technology, engineering, and mathematics (STEM) majors (i.e., mathematics, physical sciences, biological and life sciences, computer and information sciences, engineering and engineering technologies, and science technologies) was lower than in many non-STEM fields.

- About half of the beginning bachelor's degree students who declared these STEM majors between 2003 and 2009 had either left school altogether by spring 2009 (20%) or left STEM for another field (28%).
- Bachelor's degree students in the humanities, education, and health sciences had higher attrition rates (56%–62%) than students in STEM fields (48%), in the social and behavioral sciences (45%), and in business (50%).
- At the associate's level, attrition was higher than at the bachelor's level (69%) and was similar in STEM and non-STEM fields.

Graduate Education, Enrollment, and Degrees

Graduate enrollment in S&E increased from about 493,000 to more than 615,000 between 2000 and 2013.

- Graduate enrollment grew in most S&E fields, with particularly strong growth in engineering and in the biological and social sciences.
- Women continued to enroll at disproportionately low rates in engineering (24%), computer sciences (26%), physical sciences (33%), and economics (37%).
- In 2013, underrepresented minority students (blacks, Hispanics, and American Indians and Alaska Natives) made up 12% of all students enrolled in graduate S&E programs. Asians and Pacific Islanders represented 6%, and whites represented 44%. Temporary residents accounted for almost one-third of graduate S&E enrollment.

In 2013, the federal government was the primary source of financial support for 17% of full-time S&E graduate students, the lowest proportion since at least 1998.

- The recent decline in the share of S&E graduate students with federal financial support was especially pronounced in the biological sciences (from 35% in 1998 to 29% in 2013) and in the physical sciences (from 35% in 1998 to 28% in 2013).
- In 2013, the federal government funded 60% of S&E graduate students with traineeships, 48% of those with research assistantships, and 23% of those with fellowships.
- Graduate students in the biological sciences, the physical sciences, and engineering received relatively more federal financial support than those in computer sciences, mathematics and statistics, medical and other health sciences, psychology, and social sciences.

Between fall 2013 and fall 2014, the number of international graduate students increased by 18% in S&E fields and by 6% in non-S&E fields.

- A larger proportion of international graduate students than international undergraduate students enrolled in S&E. More than 6 out of 10 international graduate students in the United States in fall 2014 were enrolled in S&E fields, compared with almost 4 in 10 international undergraduates.

- Between fall 2013 and fall 2014, the number of international graduate students enrolled in S&E fields increased most in computer sciences and engineering.
- In fall 2014, more than two-thirds of the international S&E graduate students in the United States came from China and India.

Master's degrees awarded in S&E fields increased from about 96,000 in 2000 to about 166,000 in 2013. In this period, the growth of S&E degrees at the master's level (73%) was higher than growth at the bachelor's (54%) and doctoral levels (47%).

- The number of master's degrees awarded in engineering in 2013 was the highest in the last 14 years. The number of master's degrees in computer sciences awarded in 2013 surpassed its peak in 2004.
- Increases occurred in most major S&E fields, with the largest in engineering, psychology, and political sciences and public administration.
- The number and percentage of master's degrees awarded to women in most major S&E fields have increased since 2000.
- The number of S&E master's degrees awarded increased for all racial and ethnic groups from 2000 to 2013. While the proportion of degrees earned by blacks and Hispanics increased, that of Asians and Pacific Islanders and American Indians and Alaska Natives remained flat, and that of whites decreased.

In 2013, U.S. academic institutions awarded about 39,000 S&E doctorates (excluding other health sciences).

- The number of S&E doctorates conferred annually by U.S. universities increased steadily from 2002 to 2008 then flattened and declined slightly in 2010 but has been growing since then.
- Among fields that award large numbers of doctorates, the biggest increases in degrees awarded between 2000 and 2013 were in engineering (76%) and in the biological sciences (57%).

Students on temporary visas continue to earn high proportions of U.S. S&E doctorates, including the majority of degrees in some fields. They also earned large shares of the master's degrees in S&E fields.

- In 2013, international students earned 57% of all engineering doctorates, 56% of all economics doctorates, 53% of all computer sciences doctorates, and 44% of all physics doctorates. Their overall share of S&E degrees was 37%.
- After steep growth from 2002 to 2008, the number of temporary residents earning S&E doctoral degrees declined through 2010 but has been growing since then.

International S&E Higher Education

In 2012, more than 6 million first university degrees were awarded in S&E worldwide. Students in China earned about 23%, those in the European Union earned about 12%, and those in the United States earned about 9% of these degrees.

- Between 2000 and 2012, the number of S&E first university degrees awarded in China, Taiwan, Germany, Turkey, and Mexico at least doubled. It rose more slowly (by about 50%) in Australia, the United States, and Poland, and declined in France, Japan, and Spain.
- S&E degrees continue to account for about one-third of all bachelor's degrees awarded in the United States. In Japan, nearly 6 out of 10 first degrees were awarded in S&E fields in 2012; in China, nearly half.

- In the United States, about 5% of all bachelor's degrees awarded in 2012 were in engineering. This compares with about 17% throughout Asia and nearly one-third (32%) in China.

In 2012, the United States awarded the largest number of S&E doctoral degrees of any individual country, followed by China, Germany, and the United Kingdom.

- The numbers of S&E doctoral degrees awarded in China and the United States have risen substantially in recent years. S&E doctorates awarded in South Korea and in many European countries have risen more modestly. S&E doctorates awarded in Japan increased fairly steadily through 2006 but have declined since then.
- In 2007, China overtook the United States as the world leader in the number of doctoral degrees awarded in the natural sciences and engineering; since 2010, this number in China was fairly stable.

International student mobility expanded over the past two decades, as countries are increasingly competing for international students.

- The United States remains the destination for the largest number of internationally mobile students worldwide (undergraduate and graduate), although its share decreased from 25% in 2000 to 19% in 2013.
- In addition to the United States, other countries that are among the top destinations for international students include the United Kingdom, France, Australia, and Germany.

Introduction

Chapter Overview

Higher education develops human capital; builds the knowledge base through research and knowledge development; and disseminates, uses, and maintains knowledge (OECD 2008). S&E higher education provides the advanced skills needed for a competitive workforce and, particularly in the case of graduate-level S&E education, the research capability necessary for innovation. This chapter focuses on the development of human capital through higher education.

Indicators presented in this chapter are discussed in the context of national and global developments, including changing demographics, increasing international student mobility, and increasing global competition in higher education. The composition of the U.S. college-age population is becoming more diverse as the Asian and Hispanic shares of the population increase. During the latest economic downturn, public institutions of higher education faced unique pressures from a combination of increasing enrollments and tight state budgets. Private institutions likewise experienced financial challenges stemming from declining incomes and the effects of stock market fluctuations on endowment growth. Technology has enabled very rapid growth in the delivery of online courses; the consequences of these changes are not well understood.

Over the past decade and a half, governments around the globe have increasingly regarded higher education as an essential national resource. Although the United States has historically been a world leader in providing broad access to higher education and in attracting international students, many other countries are providing expanded educational access to their own populations and attracting growing numbers of international students. Nevertheless, increases in international students contributed to most of the growth in overall S&E graduate enrollment in the United States in recent years. Following a decline in the number of international students coming to the United States after 11 September 2001, international student enrollment in S&E has recovered.

Chapter Organization

This chapter begins with an overview of the characteristics of U.S. higher education institutions that provide instruction in S&E, followed by a discussion of characteristics of U.S. undergraduate and graduate education.[i] Trends are discussed by field and demographic group, with attention to the flow of international students into the United States by country of origin. Various international higher education indicators include comparative S&E degree production in several world regions and measures of the growing dependence of industrialized countries on international S&E students.

The data in this chapter come from a variety of federal and nonfederal sources, primarily surveys conducted by the National Science Foundation's (NSF's) National Center for Science and Engineering Statistics (NCSES) and the National Center for Education Statistics (NCES) at the U.S. Department of Education. Data also come from international organizations, such as the Organisation for Economic Co-operation and Development (OECD) and the United Nations Educational, Scientific and Cultural Organization (UNESCO) Institute for Statistics (UIS), as well as individual countries. Most of the data in this chapter are from censuses of the population—for example, all students receiving degrees from U.S. academic institutions—and are not subject to sampling variability.

Data on postdoctoral scientists and engineers are included in chapters 3 and 5. Data on stay rates of doctorate recipients are included in chapter 3.

The U.S. Higher Education System

Higher education in S&E produces an educated S&E workforce and an informed citizenry. It has also received increased attention as an important component of U.S. economic competitiveness. In his 24 February 2009 address to a joint session of Congress, President Barack Obama called for every American to commit to at least 1 year of education or career training after completing high school. A 2012 report by the President's Council of Advisors on Science and Technology (PCAST 2012) states that economic forecasts point to a need to increase the proportion of college graduates going into the natural sciences and engineering over the next decade. This section discusses the characteristics of U.S. higher education institutions providing S&E education and the financing of higher education.

Institutions Providing S&E Education

The U.S. higher education system consists of a large number of diverse academic institutions that vary in their missions, learning environments, selectivity levels, religious affiliations, types of students served, types of degrees offered, and sectors (public, private nonprofit, or private for-profit) (Kena et al. 2014). There were approximately 4,700 postsecondary degree-granting institutions in the United States in the 2013–14 academic year. Of these, 64% offered bachelor's or higher degrees, 30% offered only associate's degrees, and 6% offered degrees that were at least 2-year but less than 4-year as the highest degree awarded (Table 2-1). More than half of the institutions offering bachelor's degrees or above are private nonprofit, 23% are public, and 25% are private for-profit. The majority of the institutions granting associate's degrees are public (53%) or private for-profit (42%) (Table 2-1). In 2013, U.S. academic institutions awarded nearly 3.7 million associate's, bachelor's, master's, and doctoral degrees; 25% of the degrees were in S&E (Appendix Table 2-1).[i] Public institutions produce a larger share of bachelor's and higher-level degrees than private institutions. In 2013, public institutions awarded 63% of all bachelor's and doctoral degrees awarded in the United States and 46% of the master's degrees awarded (Table 2-2).

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[i] For a crosswalk between the Classification of Instructional Programs codes and the academic fields in enrollment and completion tables, see https://webcaspar.nsf.gov/Help/dataMapHelpDisplay.jsp?subHeader=DataSourceBySubject&type=DS&abbr=DEGS&noHeader=1&JS=No, accessed 16 June 2015.

Table 2-1 **Degree-granting institutions, by control and highest degree awarded: 2013–14**

Highest degree awarded	All degree-granting institutions	Public	Private nonprofit	Private for-profit
Total	4,724	1,625	1,675	1,424
Associate's degree	1,410	743	80	587
At least 2 years but less than 4 years	275	191	8	76
Bachelor's degree or above	3,039	691	1,587	761

SOURCE: U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System, Institutional Characteristics component, 2013–14.

Science and Engineering Indicators 2016

Table 2-2 Degree awards, by degree level and institutional control: 2013

Degree awards	Total	Public	Private nonprofit	Private for-profit
Bachelor's	1,861,034	1,171,656	547,408	141,970
Master's	756,975	347,706	330,990	78,279
Doctorate	64,887	41,021	20,308	3,558

SOURCES: National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey; National Science Foundation, National Center for Science and Engineering Statistics, WebCASPAR database, http://webcaspar.nsf.gov.

Science and Engineering Indicators 2016

Although few in number, doctorate-granting institutions with very high research activity are the leading producers of S&E degrees at the bachelor's, master's, and doctoral levels. In 2013, these research institutions awarded 73% of doctoral degrees, 41% of master's degrees, and 37% of bachelor's degrees in S&E fields (Appendix Table 2-1) (see sidebar, Carnegie Classification of Academic Institutions). Master's colleges and universities awarded another 29% of S&E bachelor's degrees and 25% of S&E master's degrees in 2013.

Carnegie Classification of Academic Institutions

The Carnegie Classification of Institutions of Higher Education is widely used in higher education research to characterize and control for differences in academic institutions.

The 2010 classification update retains the structure adopted in 2005. It includes 4,634 institutions, 483 of which were added after the 2005 update. More than three-quarters of the new institutions (77%) are from the private for-profit sector, 19% are from the private nonprofit sector, and 4% are from the public sector.

The Carnegie classification categorizes academic institutions primarily on the basis of highest degree conferred, level of degree production, and research activity.* In this report, several Carnegie categories have been aggregated for statistical purposes. The characteristics of those aggregated groups are as follows:

- *Doctorate-granting universities* include institutions that award at least 20 doctoral degrees per year. They include three subgroups based on level of research activity: very high research activity (108 institutions), high research activity (99 institutions), and doctoral/research universities (90 institutions). Because doctorate-granting institutions with very high research activity are central to S&E education and research, data on these institutions are reported separately.
- *Master's colleges and universities* include the 724 institutions that award at least 50 master's degrees and fewer than 20 doctoral degrees per year.
- *Baccalaureate colleges* include the 810 institutions at which baccalaureate degrees represent at least 10% of all undergraduate degrees and that award fewer than 50 master's degrees or 20 doctoral degrees per year.
- *Associate's colleges* include the 1,920 institutions at which all degrees awarded are associate's degrees or at which bachelor's degrees account for less than 10% of all undergraduate degrees.

- *Special-focus institutions* are the 851 institutions at which at least 75% of degrees are concentrated in a single field or a set of related fields (e.g., medical schools and medical centers, schools of engineering, schools of business and management).
- *Tribal colleges* are the 32 colleges and universities that are members of the American Indian Higher Education Consortium.

* Research activity is based on two indexes (aggregate level of research and per capita research activity) derived from a principal components analysis of data on research and development expenditures, S&E research staff, and field of doctoral degree. See http://carnegieclassifications.iu.edu/ for more information on the classification system and on the methodology used in defining the categories.

Baccalaureate colleges were the source of relatively few S&E bachelor's degrees (11%) (Appendix Table 2-1), but they produce a larger proportion of future S&E doctorate recipients (14%) (NSF/NCSES 2013). When adjusted by the number of bachelor's degrees awarded in all fields, baccalaureate colleges as a group yield more future S&E doctorates per 100 bachelor's degrees awarded than all other types of institutions except very high research universities (NSF/NCSES 2008, 2013).

Minority-serving academic institutions enroll a substantial fraction of underrepresented minority undergraduates (NSF/NCSES 2015c).[ii] In 2012, historically black colleges and universities (HBCUs) awarded 18% of the 50,000 S&E bachelor's degrees earned by black U.S. citizens and permanent residents, and high Hispanic enrollment institutions (HHEs) awarded about 34% of the 58,000 S&E bachelor's degrees earned by Hispanics. However, the proportion of blacks earning S&E bachelor's degrees from HBCUs and the proportion of Hispanics earning S&E bachelor's degrees from HHEs have both declined in the recent past. Tribal colleges, which mainly offer 2-year degrees, account for about 2% of S&E bachelor's degrees awarded to American Indians; this proportion has been fairly stable over time.[iii]

HHEs and HBCUs also play an important role in training Hispanic and black students for doctoral-level study in S&E fields. Of Hispanics who earned an S&E doctorate between 2009 and 2013, about 30% had obtained their baccalaureate credential at an HHE (Table 2-3). Similarly, 25% of black S&E doctorate recipients had obtained their baccalaureate degree at an HBCU during the same period (Table 2-4), making HBCUs the second-largest contributor of black S&E doctorate recipients, behind only institutions with very high research activity (NSF/NCSES 2013).

[ii] Minority-serving academic institutions include historically black colleges and universities (HBCUs), high Hispanic enrollment institutions (HHEs), and tribal colleges. HBCUs are listed by the White House Initiative on Historically Black Colleges and Universities. The Higher Education Act of 1965, as amended, defines an HBCU as "any historically black college or university that was established prior to 1964, whose principal mission was, and is, the education of black Americans, and that is accredited by a nationally recognized accrediting agency or association determined by the Secretary [of Education] to be a reliable authority as to the quality of training offered or is, according to such an agency or association, making reasonable progress toward accreditation." HHEs are those public and private non-profit institutions whose undergraduate, full-time equivalent student enrollment is at least 25% Hispanic, according to fall 2011 data in the IPEDS, directed by the National Center for Education Statistics. Tribal colleges are fully accredited academic institutions on a list maintained by the White House Initiative on Tribal

Colleges and Universities. These institutions are included in the Tribal Colleges category in the basic classification scheme of the 2010 Carnegie Classification of Institutions of Higher Education. See http://carnegieclassifications.iu.edu/.

[iii] See (NSF/NCSES 2015c, tables 5-8–5-10) for additional details.

Table 2-3 **U.S. citizen and permanent resident S&E doctorate recipients whose baccalaureate origin is a high Hispanic enrollment institution, by ethnicity and race: 2009–13**

		Earned baccalaureate degree from a high Hispanic enrollment institution		
Ethnicity and race	All	Yes	No	Yes (%)
All ethnicities and races	109,106	4,958	104,148	4.5
Hispanic or Latino	6,509	1,938	4,571	29.8
Not Hispanic or Latino				
American Indian or Alaska Native	353	26	327	7.4
Asian	10,926	251	10,675	2.3
Black or African American	5,516	240	5,276	4.4
White	80,008	2,237	77,771	2.8
More than one race	2,619	126	2,493	4.8
Other race or race not reported	899	42	857	4.7
Ethnicity not reported	2,276	98	2,178	4.3

NOTE: Reporting categories for ethnicity and race were expanded in 2013; comparisons with prior-year data should be made with caution.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2014) of the 2013 Survey of Earned Doctorates.

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Table 2-4 **U.S. citizen and permanent resident S&E doctorate recipients whose baccalaureate origin is an HBCU, by ethnicity and race: 2009–13**

		Earned baccalaureate degree from an HBCU		
Ethnicity and race	All	Yes	No	Yes (%)
All ethnicities and races	109,106	1,590	107,516	1.5
Hispanic or Latino	6,509	23	6486	0.4
Not Hispanic or Latino				
American Indian or Alaska Native	353	D	D	D
Asian	10,926	10	10,916	0.1

		Earned baccalaureate degree from an HBCU		
Ethnicity and race	All	Yes	No	Yes (%)
Black or African American	5,516	1,389	4,127	25.2
White	80,008	87	79,921	0.1
More than one race	2,619	42	2,577	1.6
Other race or race not reported	899	D	D	D
Ethnicity not reported	2,276	30	2246	1.3

D = suppressed to avoid disclosure of confidential information.

HBCU = historically black college or university.

NOTE: Reporting categories for ethnicity and race were expanded in 2013; comparisons with prior-year data should be made with caution.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2014) of the 2013 Survey of Earned Doctorates.

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Community Colleges

Community colleges (also known as public 2-year colleges or associate's colleges) play a key role in increasing access to higher education for all citizens. These institutions serve diverse groups of students and offer a more affordable means of participating in postsecondary education. Community colleges are important in preparing students to enter the workforce with certificates or associate's degrees or to transition to 4-year colleges or universities, often before receiving a 2-year degree. Community colleges tend to be closely connected with local businesses, community organizations, and government, so they can be more responsive to local workforce needs (Olson and Labov 2012).

In the 2013–14 academic year, there were nearly 950 community colleges in the United States, enrolling 6.6 million students, or nearly one-third of all postsecondary students (NCES 2015). More than 6 out of 10 community college students were enrolled part time. With the economic recession between 2007 and 2010, enrollment in community colleges increased by about 910,000 students; however, it has declined by nearly 600,000 between 2010 and 2013 as the labor market improved (Knapp, Kelly-Reid, and Ginder 2009, 2011; Ginder, Kelly-Reid, and Mann 2014).

Community colleges play a significant role in the education of individuals who go on to acquire advanced S&E degrees. About 18% of recent (2009–13) U.S. citizen and permanent resident S&E doctorate holders reported earning some college credit from a community or 2-year college (Table 2-5). According to 2013 data from the National Survey of College Graduates (NSCG), 47% of all recent S&E graduates had done some coursework in a community college, similar to the proportion in 2003 (48%).[iv] Recent S&E bachelor's degree earners reported slightly higher levels of community college course taking than did recent S&E master's degree holders (49% versus 39%). Graduates in the physical sciences and engineering were less likely than those in the biological and social sciences to have attended a community college.

[iv] For the 2003 NSCG, recent graduates include those who received their most recent degree between 1 July 1994 and 30 June 1999; for the 2013 NSCG, recent graduates include those who received their most recent degree in the 5 years between 1 July 2006 and 30 June 2011.

Table 2-5 **U.S. citizen and permanent resident S&E doctorate recipients who reported earning college credit from a community or 2-year college, by ethnicity and race: 2009–13**

		Earned college credit from a community or 2-year college		
Ethnicity and race	All	Yes	No	Yes (%)
All ethnicities and races	107,376	19,774	87,602	18.4
Hispanic or Latino	6,306	1,375	4,931	21.8
Not Hispanic or Latino				
American Indian or Alaska Native	347	112	235	32.3
Asian	11,003	1,393	9,610	12.7
Black or African American	5,433	981	4,452	18.1
White	79,407	14,918	64,489	18.8
More than one race	2,606	559	2,047	21.5
Other race or race not reported	857	201	656	23.5
Ethnicity not reported	1,417	235	1,182	16.6

NOTES: Includes only respondents to the community college question. Reporting categories for ethnicity and race were expanded in 2013; comparisons with prior-year data should be made with caution.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2014) of the 2013 Survey of Earned Doctorates.

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In 2013, recent female S&E bachelor's and master's degree recipients were more likely than their male counterparts to have attended a community college (Table 2-6). Attendance levels as measured by the proportion who attended community college were highest among U.S. citizens, followed by permanent visa holders, and were much lower among temporary visa holders. Among racial and ethnic groups, the proportion attending community college was highest among Hispanics and lowest among Asians. Attendance at the community college level fell with rising parental education level, illustrating the special access function of these institutions.

Table 2-6 **Community college attendance among recent recipients of S&E degrees, by sex, race, ethnicity, citizenship status, and parents' education level: 2013**

Characteristic	Number	Percent who attended community college
All recent S&E degree recipients	1,164,000	47
Sex		
Female	579,000	50
Male	585,000	44

Characteristic	Number	Percent who attended community college
Race or ethnicity		
American Indian or Alaska Native	1,000	40
Asian	130,000	37
Black or African American	97,000	51
Hispanic[a]	176,000	57
Native Hawaiian or Other Pacific Islander	4,000	64
White	715,000	46
More than one race	40,000	55
Citizenship status		
U.S. citizen	1,116,000	50
Permanent visa	33,000	36
Temporary visa	15,000	9
Father's education		
Less than high school	100,000	57
High school diploma or equivalent	270,000	54
Some college, vocational, or trade school	263,000	52
Bachelor's	266,000	42
Master's	152,000	42
Professional degree	48,000	33
Doctorate	44,000	34
Not applicable	19,000	51
Mother's education		
Less than high school	100,000	55
High school diploma or equivalent	271,000	50
Some college, vocational, or trade school	307,000	50
Bachelor's	282,000	43
Master's	157,000	42
Professional degree	18,000	31
Doctorate	17,000	39
Not applicable	12,000	53

	[a] Hispanic may be any race. American Indian or Alaska Native, Asian, black or African American, Native Hawaiian or Other Pacific Islander, white, and more than one race refer to individuals who are not of Hispanic origin.
NOTES:	Recent S&E degree recipients are those who earned their bachelor's or master's degrees between 1 July 2006 and 30 June 2011. Data are rounded to the nearest 1,000.
SOURCE:	National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2015) of the 2013 National Survey of College Graduates.
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About one in four of the recent S&E graduates who indicated attending a community college reported doing so after high school but before ever enrolling in a 4-year college or university or while enrolled in college but before receiving a bachelor's degree. About one in three used a community college as a bridge between high school and college enrollment in dual enrollment. Another one-third attended a community college after receiving their first bachelor's degree. One in 10 reported taking courses in a community college after leaving a 4-year college without receiving their first bachelor's degree.[iv]

The most prevalent reason for attending a community college among recent recipients of S&E bachelor's and master's degrees was to earn credits toward a bachelor's degree (31%). Other reasons mentioned included financial reasons (13%); to prepare for college to increase the chance of acceptance at a 4-year institution (12%); to earn credits while still completing high school (10%); to complete an associate's degree (8%); to gain further skills or knowledge in their academic or occupational fields (8%); to facilitate a change in their academic or occupational fields (7%); for leisure or personal interest (5%); to increase opportunities for promotion, advancement, or higher salary (2%); and for other reasons (5%).[v]

For-Profit Institutions

In 2013–14, more than 1,400 degree-granting institutions in the United States operated on a for-profit basis; 53% of these were 4-year institutions (Table 2-1). Over the last 10 years, the number of degree-granting, for-profit institutions has grown by nearly 67% (NCES 2015). For-profit institutions enroll considerably fewer students than public institutions, particularly at the 2-year level; in 2013, nearly 6.9 million students were enrolled in community colleges, compared with 155,000 students enrolled in 2-year, for-profit institutions.[vi] For-profit institutions play a disproportionate role in the education of blacks, who are more likely than other racial or ethnic groups to enroll in private for-profit academic institutions (NSF/NCSES 2015c). Although the number of degrees awarded by for-profit institutions nearly quadrupled between 2000 and 2013, the upward trend has recently stopped. Enrollment in for-profit institutions has declined by about 16% since 2010, and the number of degrees they awarded in 2013 was 4% lower than in the previous year (Appendix Table 2-2).

[iv] Special tabulation from the 2013 NSCG.

[v] Special tabulation from the 2013 NSCG.

[vi] Special tabulation from the Integrated Science and Engineering Resources Data System (WebCASPAR) database (12 December 2014 run).

In 2013, for-profit academic institutions awarded between 2% and 6% of S&E degrees at the bachelor's, master's, and doctoral levels, as well as 25% of S&E degrees at the associate's level (Appendix Table 2-1 and Appendix Table 2-2). Computer sciences accounted for 74% of the associate's degrees and 47% of the bachelor's degrees awarded by for-profit institutions in S&E fields in 2013 (Appendix Table 2-3). For-profit institutions awarded fewer S&E

master's and doctoral degrees than associate's and bachelor's degrees. At the master's level, S&E degrees were mainly in psychology, social sciences, and computer sciences; at the doctoral level, they were almost exclusively in psychology and social sciences. In 2013, degrees in psychology represented nearly 41% of the master's and 74% of the doctoral degrees awarded by for-profit institutions in S&E fields. Degrees in social sciences accounted for 32% of the master's and 18% of the doctoral degrees awarded in S&E fields.

Online and Distance Education

Online and distance education enable institutions of higher education to reach a wider audience by expanding access for students in remote locations while providing greater flexibility for students who face time constraints, physical impairments, responsibility to care for dependents, and similar challenges. Distance education has been around for more than 100 years (Perna et al. 2014), whereas online education is a relatively new phenomenon.

Online enrollment has grown substantially in recent years. According to a report by Allen and Seaman (2014), between fall 2011 and fall 2012, the number of students taking at least one online course increased by nearly 412,000 to 7.1 million. According to Integrated Postsecondary Education Data System (IPEDS) 2012 Fall Enrollment survey data, 13% of all students in 4-year Title IV institutions (i.e., institutions that participate in federal financial aid programs) were enrolled exclusively in distance education courses, and another 13% were enrolled in distance education and regular on-campus courses; however, about 74% of these students were not enrolled in any distance education course at all (Table 2-7) (Ginder 2014).[vii] Exclusive enrollment in distance education courses was considerably higher at private for-profit 4-year institutions than at either 2- or 4-year public or private nonprofit institutions or at private for-profit 2-year institutions. Enrollment in some distance education courses was highest at public institutions. Exclusive enrollment in distance education courses was higher at the graduate level than at the undergraduate level, whereas enrollment in some distance education courses was higher at the undergraduate level rather than the graduate level.

[vii] In 2011–12, IPEDS began asking institutions whether they were exclusively a distance education institution (i.e., whether all of their programs were offered via distance education, defined as "education that uses one or more technologies to deliver instruction to students who are separated from the instructor and to support regular and substantive interaction between the students and the instructor synchronously or asynchronously"). A distance education course is a course in which the instructional content is delivered exclusively via distance education. A distance education program is a program for which all the required coursework for program completion can be completed via distance education courses. Examinations, orientation, and practical experience components of courses or programs are not considered instructional content. For more details, see the IPEDS online glossary at http://nces.ed.gov/ipeds/glossary/.

Table 2-7 **Enrollment in Title IV institutions, by distance education enrollment status, control, and level of institution: Fall 2012**

(Percent)

Institutional control and level	All (number)	Exclusively distance education courses	Some distance education courses	No distance education courses
Total enrollment				
Number	21,147,055	2,642,158	2,809,942	15,694,955
Percent	100	13.3	13.0	74.2

Institutional control and level	All (number)	Exclusively distance education courses	Some distance education courses	No distance education courses
Degree level				
Undergraduate	18,236,340	11.0	14.2	74.9
Degree /certificate-seeking	16,225,545	11.1	15.2	73.7
Non-degree /certificate-seeking	1,623,082	11.9	7.0	81.1
Graduate	2,910,715	22.0	7.8	70.2
Control and level of institution				
Public				
2-year	6,845,174	9.8	17.3	72.9
4-year	8,092,727	7.1	15.1	77.8
Private nonprofit				
2-year	47,524	1.7	4.6	93.7
4-year	3,916,356	11.9	6.6	81.5
Private for-profit				
2-year	413,377	5.3	4.8	90.0
4-year	1,470,191	61.3	8.3	30.4
Institutional category				
All degree-granting	20,642,819	12.8	13.6	73.6
All non-degree-granting	504,236	0.7	0.8	98.5

NOTE: Title IV institutions are those with a written agreement with the Secretary of Education that allows the institution to participate in any of the Title IV federal student financial assistance programs.

SOURCES: U.S. Department of Education, National Center for Education Statistics (NCES), Integrated Postsecondary Education Data System, Fall 2012, Fall Enrollment Component; NCES, 2014, and *Enrollment in Distance Education Courses, by State: Fall 2012*. NCES 2014-023. Washington DC. http://nces.ed.gov/pubs2014/2014023.pdf. Accessed 3 February 2015.

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Allen and Seaman's most recent survey of academic leaders revealed that 90% of them believe that it is "likely" or "very likely" that a majority of all higher education students will take at least one online course within 5 years

(Allen and Seaman 2014). The survey also showed that a very small segment of higher education institutions (5%) are experimenting with massive open online courses (MOOCs). Doctoral research institutions were much more likely than other types of institutions to offer a MOOC.

MOOCs can provide broad access to higher education for free or at a very low cost. Through their online platforms, MOOCs also have the potential to collect massive amounts of information that can be used to conduct experimental research on how people learn and to identify online practices that improve learning (ED/OET 2013).

Nationally representative data on MOOCs are not available. However, research conducted on the first 17 online courses offered by HarvardX and MITx on the edX platform reveals that completion rates were low (Ho et al. 2014).[viii] Out of more than 840,000 registrants in these courses, 5% earned certificates of completion, but 4% explored more than half of the content of the course without receiving their certification, and 54% accessed less than half of the course content. Ho and colleagues (2014) point out that open online registration in a MOOC is different from enrollment in traditional courses because students can enroll at no monetary cost and with a small time commitment. Others emphasize that many students register for MOOCs to explore the course material and do not intend to complete the courses in which they enroll. The low overall completion rates do not take into account students' intentions (Ho et al. 2014).

Online education companies offering MOOCs have recently expanded their offerings to certificate programs. For instance, Coursera began to offer courses in its fee-based Signature Track with a variety of specializations, most of which are in practical fields such as project management, cloud computing, and data mining (Kolowich 2014). Udacity partnered with AT&T to offer "nanodegrees" that teach students a specific set of skills that can be clearly applied to a job; AT&T accepts the nanodegrees as a credential for entry-level jobs and has reserved 100 internships for its graduates (Porter 2014). The Georgia Institute of Technology, in collaboration with Udacity and AT&T, began to offer an online master's program in computer science, which combines MOOC-like course videos and assessments with a support system that works directly with students. The university's goal is to create a master's degree program that is just as rigorous as the one offered on campus but at a much lower cost.

Changing modes of online education are prompting questions about how the use of this technology will affect the higher education sector. In particular, it is not yet clear how many students can sustain commitment to learning in the absence of more personal contact and to what extent the growing access to higher education facilitated by MOOCs will translate into learning and, in the long run, to higher levels of educational achievement.

[viii] HarvardX and MITx are "collaborative institutional efforts between Harvard University and MIT to enhance campus-based education, advance educational research, and increase access to online learning opportunities worldwide" (Ho et al. 2014).

Trends in Higher Education Expenditures and Revenues

Higher education spending and revenue patterns changed substantially over the last two decades, in trends that intensified during the economic downturn of the late 2000s. Although all types of higher education institutions faced competing demands in a stringent budget environment, each type faced unique challenges. Through 2010, increases in the number of students seeking an affordable college education compounded the challenges created by tight budgets. Despite declines in enrollment in 2011–13 (Appendix Table 2-4), these challenges have remained. This section shows trends in inflation-adjusted average spending and revenue per full-time equivalent (FTE) student from 1987 to 2012,[i] based on data from the Delta Cost Project.[ii]

Very High Research Universities—Public and Private Institutions

Net tuition and federal appropriations, grants, and contracts are two large sources of revenues centrally involved with education for both public and private very high research institutions (Appendix Table 2-5).[iii] For public institutions, state and local appropriations are also critical, supplying an amount of revenue similar to either of the other two sources (nearly $8,500 per FTE in 2012); in contrast, they are a small source of revenue for their private counterparts (about $400 per FTE in 2012). Much more important for private institutions are private and affiliated gifts, investment returns,[iv] and endowment income, which are usually the largest sources of revenue other than that from hospitals and other independent operations.[v]

State and local appropriations for public very high research universities have declined since 1987, with a particularly steep drop between 2008 and 2012 (Figure 2-1). This decline coincided with a compensating increase in net tuition. In 1987, average state appropriations per FTE at public very high research institutions were more than three times the amount of net tuition ($13,800 versus $4,000). By 2012, however, appropriations had dropped to almost $8,500 per FTE, whereas net tuition had increased from about $4,000 to about $11,100 per FTE (Appendix Table 2-5). This change represents a shift in tuition burden from state and local governments to individual students and their families. Starting at a higher level, net tuition at private very high research universities also increased during this period. The increase, from almost $17,000 to almost $25,000, was proportionally much smaller.

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[i] FTE enrollments are derived from the "Enrollment by Race/Ethnicity" section of the IPEDS Fall Enrollment survey. The FTE of an institution's part-time enrollment is estimated by multiplying part-time enrollment by factors that vary by control and level of institution and level of student; the estimated FTE of part-time enrollment is then added to the institution's FTE. This formula is used by the U.S. Department of Education to produce the FTE enrollment data published annually in the *Digest of Education Statistics*.

[ii] For the definition of "net tuition revenue," see "Glossary." Definitions of standard expense categories are available in the Data Dictionary at http://www.deltacostproject.org/delta-cost-project-database, and an explanation of revenue sources is available at http://www.deltacostproject.org/sites/default/files/products /Revenue_Trends_Production.pdf.

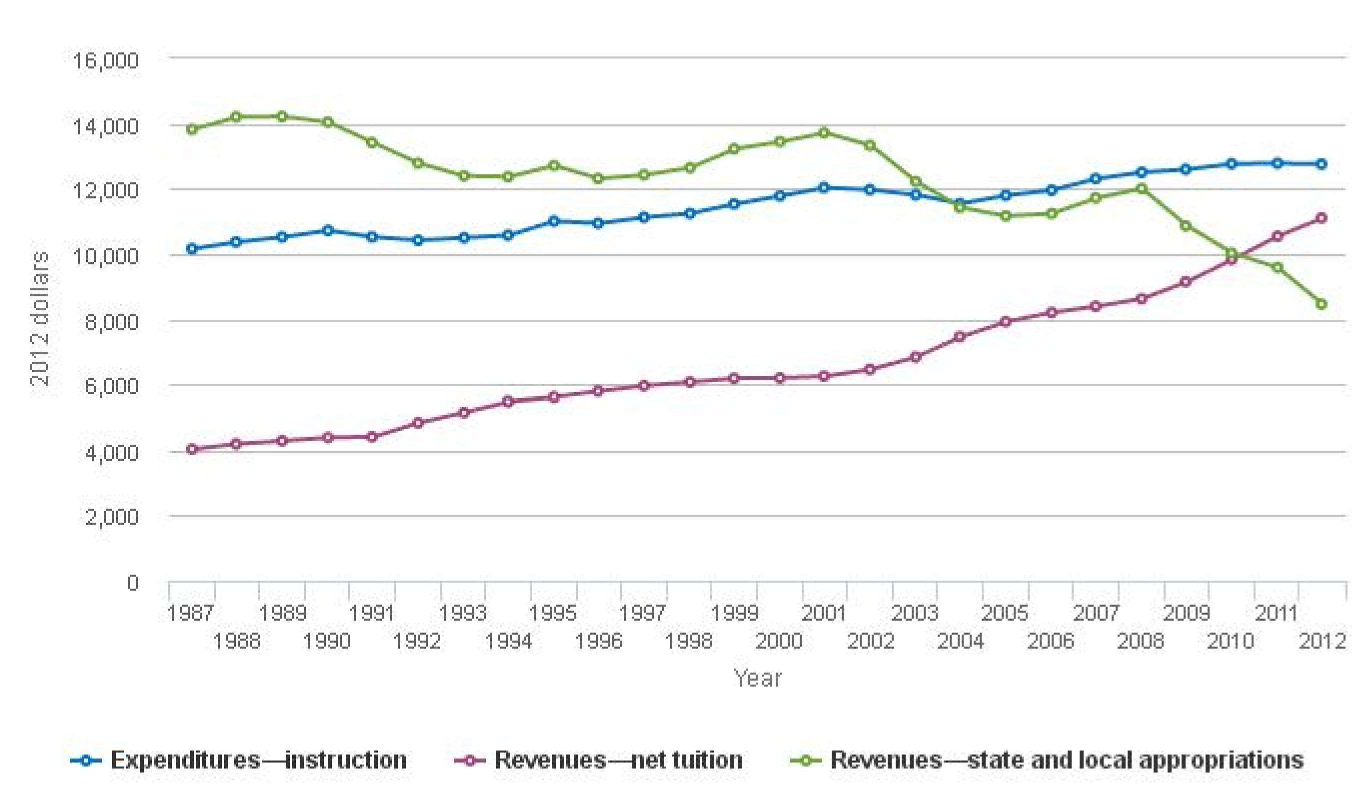
[iii] Another large source of revenue for very high research institutions is "hospitals, independent operations, and other sources," which includes revenue generated by hospitals operated by the institution and revenues independent of or unrelated to instruction, research, or public services.

[iv] Investment returns include both realized and unrealized gains and losses. Institutions report the change in the value of their investment account, which is the reason behind the negative values under this category in Appendix Table 2-5. So investment returns may not always represent revenue for the institution.

[v] In 2012, income from private and affiliated gifts, investment returns, and endowment income at private very high research institutions was $37,000 per FTE compared with $25,000 in income from net tuition and $28,000 in income from federal appropriations (appendix table 2-5).

Figure 2-1

Selected average revenues and expenditures at public very high research universities: 1987–2012



NOTE: Data are per full-time equivalent.

SOURCE: IPEDS Analytics: Delta Cost Project Database, 1987–2012, special tabulations (2015).

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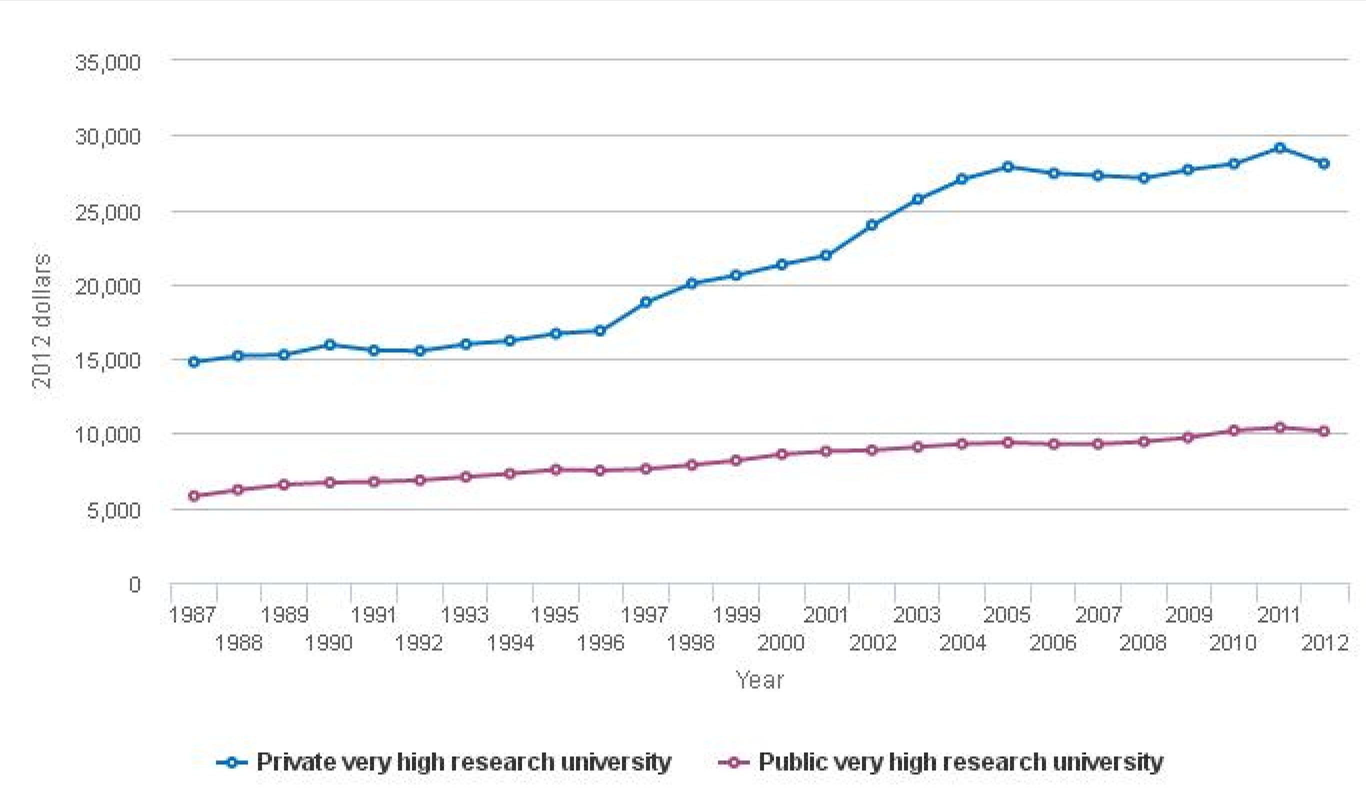
Revenue from federal appropriations, grants, and contracts, the source used for most research expenditures, is highest at the most research-intensive universities (Appendix Table 2-5). Between 1987 and 2012, revenue per FTE from these funds increased at public and private very high research institutions. At the public universities, these funds increased by 78%, reaching a level similar to the state and local appropriations (about $8,700). At private very high research institutions, the funds increased by about 60% in this 25-year period.

Research and instruction are the two largest core education expenditures at public and private very high research universities. Between 1987 and 2012, research expenditures per FTE increased substantially at both types of institutions—by 90% at private universities and by 75% at their public counterparts (Figure 2-2; Appendix Table 2-6). See chapter 5 section Academic R&D, by Public and Private Institutions for greater deatil on university research spending.

Figure 2-2

Average expenditures per FTE on research at public and private very high research universities: 1987–2012



FTE = full-time equivalent.

SOURCE: IPEDS Analytics: Delta Cost Project Database, 1987–2012, special tabulations (2015).

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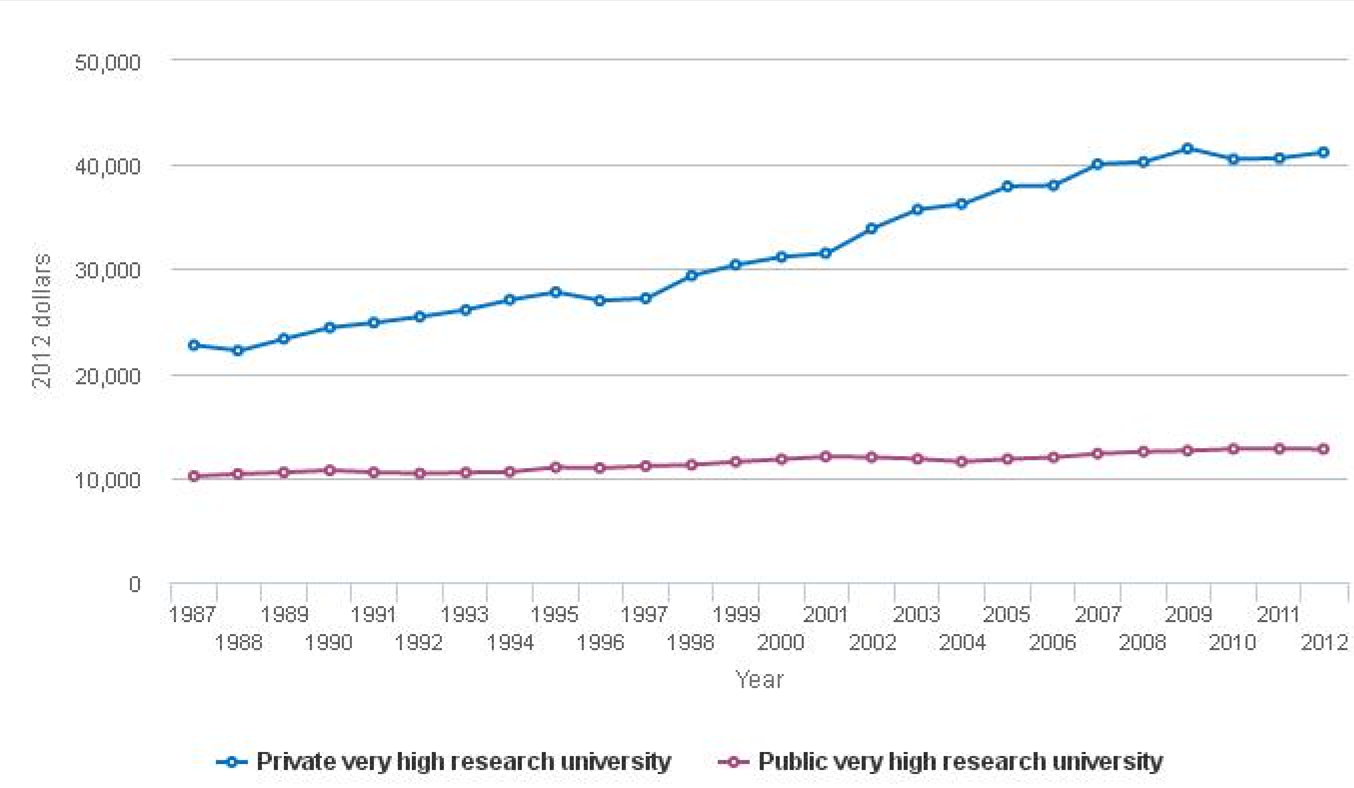
Instructional spending per FTE followed a pattern similar to that of research expenditures. It was much higher at private very high research institutions than at their public counterparts, and it increased at a higher rate. In the late 1980s and early 1990s, instructional spending at private very high research universities was slightly more than double that of the public universities. By the mid-2000s, it was more than triple (Figure 2-3).

Figure 2-3

Average expenditures per FTE on instruction at public and private very high research universities: 1987–2012



FTE = full-time equivalent.

SOURCE: IPEDS Analytics: Delta Cost Project Database, 1987–2012, special tabulations (2015).

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Most other expenditures also increased at both types of very high research institutions; however, at the public ones, spending on plant operation and maintenance declined from 2007 to 2010, with a sharp drop between 2009 and 2010; in 2011 and 2012, this expenditure has remained fairly stable (Appendix Table 2-6). Deferred spending in maintenance may create problems for these institutions in the future.

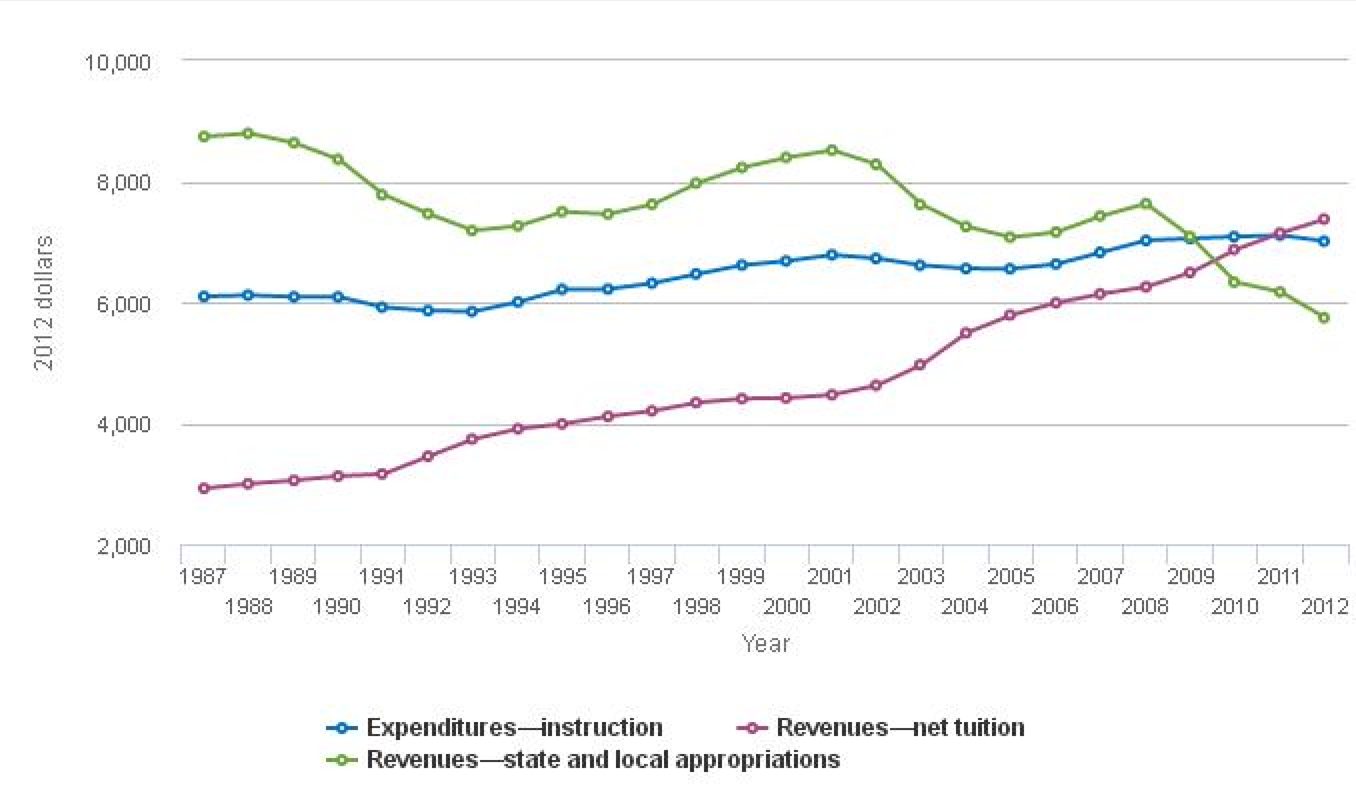
Four-Year and Other Graduate Public Institutions

From 1987 to 2012, state and local appropriations and net student tuition were the largest sources of revenues centrally involved with education at other public institutions offering 4-year and graduate degrees (Appendix Table 2-5).[vi] At these institutions, total revenues from these two sources were lower than those at public very high research universities and higher than those at community colleges. Overall, the percentage drop in revenue per FTE from state and local appropriations was similar to that experienced at the public very high research institutions. In 2010, net student tuition replaced state and local appropriations as the largest source of revenue in the public 4-year institutions. Average state appropriations per FTE in 1987 ($8,700) were three times higher than the corresponding amount of tuition revenue ($2,900). By 2010, average revenues from net student tuition, at almost $6,900 per FTE, exceeded average revenues from state appropriations per FTE by more than $500. By 2012, average revenues from net tuition increased even further, to more than $1,600 over the average revenues from state appropriations (Figure 2-4). As in the case of public very high research institutions, this change represents a shift in tuition burden from state and local governments to individual students and their families.

[vi] The 4-year and graduate institutions category includes the following 2010 Carnegie institution types: doctorate-granting universities—high research activity, doctoral/research universities, master's colleges and universities, and baccalaureate colleges. The data in this section correspond to the public institutions.

Figure 2-4

Selected average revenues and expenditures at public 4-year and other postsecondary institutions: 1987–2012



NOTES: Average expenditures and revenues are per full-time equivalent. Four-year and other postsecondary institutions include doctorate-granting universities—high research activity, doctoral/research universities, master's colleges and universities, and baccalaureate colleges, according to the 2005 Carnegie Classification of Institutions of Higher Education.

SOURCE: IPEDS Analytics: Delta Cost Project Database, 1987–2012, special tabulations (2015).

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Spending on instruction at these institutions has been at least three times as high as almost all the other standard expense categories. It increased from an average of nearly $6,100 per FTE in 1987 to about $7,000 per FTE in 2012 (Appendix Table 2-6). Other expenditures represented much smaller shares of total spending; most of these expenditures increased. Spending on plant operation and maintenance fell by 6% over the 25-year period, with a steep decline from 2009 to 2010 (18%).

Community Colleges

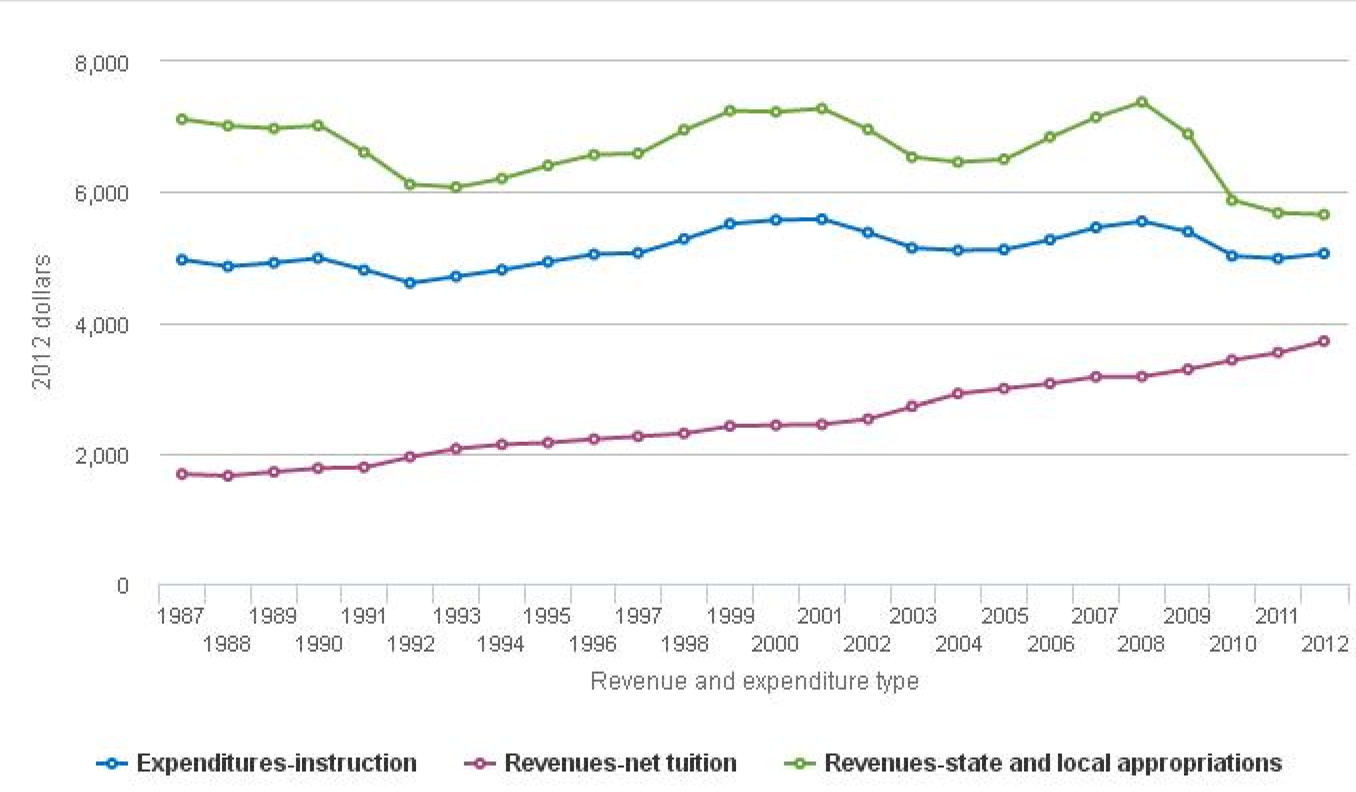
Revenues and expenditures are much lower for community colleges than for other public institutions of higher education.[vii] As in the other institutions, the main sources of revenue at community colleges are state and local appropriations and net student tuition (Appendix Table 2-5). In 2012, average revenues from state and local appropriations at community colleges were about $5,700 per FTE, compared with $8,500 at public very high research institutions; average revenues from net tuition were about $3,700 per FTE, compared with about $11,100 at public very high research institutions. Unlike other public institutions, revenue from state and local appropriations at community colleges still exceeded net tuition revenue in 2012.

Between 1987 and 2012, revenues from state and local appropriations at community colleges decreased from an average of $7,100 per FTE to $5,700 per FTE, with a steep drop from 2008 to 2010 (Figure 2-5). During this 25-year period, as state support declined, revenues from net tuition more than doubled. In 1987, revenues from state and local appropriations represented 64% of total revenues at community colleges, and tuition accounted for 15%. By 2012, state and local appropriations had dropped to 46% of total revenues, whereas the proportion of revenues from tuition doubled to 30%.

[vii] Community colleges are the public “associate’s colleges” in the 2010 Carnegie Classification of Institutions of Higher Education.

Figure 2-5

Selected average revenues and expenditures at community colleges: 1987–2012



NOTES: Revenues and expenditures are per full-time equivalent. Community colleges are public associate's colleges according to the 2005 Carnegie Classification of Institutions of Higher Education.

SOURCE: IPEDS Analytics: Delta Cost Project Database, 1987–2012, special tabulations (2015).

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At community colleges, instruction is by far the largest expenditure (Appendix Table 2-6). In 1987, spending on instruction was about $5,000 per FTE, about 43% of total expenditures. In 2012, average instructional spending per FTE ($5,100) was nearly identical to the 1987 level. Overall, these expenditures had increased somewhat through 2008, dropped by about 10% between 2008 and 2011, and increased by 2% in 2012 (Figure 2-5). Expenditures on student services and institutional and academic support declined in the late 2000s but increased somewhat in 2012. Expenditures in plant operation and maintenance also declined between 2007 and 2011 and remained stable in 2012.

Public Institutions Comparison

Between 1987 and 2012, revenues from state and local appropriations and net tuition, the main two revenue sources at public institutions, grew less at community colleges than at the other two types of public institutions. In community colleges, these two revenue sources combined increased by 6% during this period, lower than the comparable increases at the public 4-year and other graduate institutions (12%) and the very high research institutions (10%). However, trends in these individual revenue sources were substantially different. States and localities cut funding for all three categories of institutions, but the reduction was smaller in the community colleges (21%) than in the public very high research institutions (39%) and in the public 4-year and other graduate public institutions (34%). Unlike the community colleges, however, the other two types of public institutions were able to increase revenues from net tuition to a greater extent. FTE net tuition revenues increased by 175% at the public very high research universities and by 152% at the 4-year and other graduate public institutions, compared with 121% at community colleges (Appendix Table 2-5).

Expenditures for instruction followed a different pattern. They rose most rapidly at the public very high research institutions (26%), where there was pressure to keep faculty salaries (a major component of instructional expenses) competitive with those of their private counterparts, which spent more on instruction to begin with and were increasing these expenses at an even more rapid rate (82%) (Appendix Table 2-6). At community colleges, FTE instructional expenses were essentially the same at the end of the period as they were at the beginning;[viii] in 4-year and other graduate institutions, they fell somewhere in between. Overall, during this period, community colleges had more limited resources and less flexibility to draw on alternate revenue sources to support their instructional expenses. Despite the decline in enrollment in fall 2011 and fall 2012, average expenditures in instruction did not change much in these last 2 years (see section, Undergraduate Enrollment in the United States).

[viii] The proportion of U.S.-trained doctorate holders employed at community colleges in adjunct positions grew from 12% in 1993 to 27% in 2013, according to estimates from the Survey of Doctorate Recipients. This suggests that one of the ways community colleges may have reined in expenses during this period was to increase their reliance on adjuncts.

Financing Higher Education

Cost of Higher Education

Affordability and access to U.S. higher education institutions are continuing concerns (Sullivan et al. 2012; GAO 2014). According to the College Board, between 2009–10 and 2014–15, the estimated average net tuition and fees (i.e., the published prices minus grant aid and tax benefits) paid by full-time undergraduate students in public 4-year colleges increased by about 50% in constant 2014 U.S. dollars (College Board 2014a). Net prices at these institutions had increased considerably between 2009–10 and 2012–13 but declined slightly in the last 2 years. At private nonprofit institutions, net tuition and fees in 2014–15 were 3% lower than in 2009–10, although they increased by 4% in the last year. At public 2-year colleges, net tuition and fees have declined overall; since 2009–10, on average, students enrolled full time have received enough funding through federal and other sources to cover tuition, fees, and other expenses (–$1,740 net tuition in 2014–15) (Table 2-8) (College Board 2014a). Despite large percentage tuition increases in public institutions, they are still more affordable than their private counterparts.

Table 2-8 **Net tuition and fees for full-time undergraduate students by institutional control: 2009–10 through 2014–15**

(2014 U.S. dollars)

Institutional control	2009–10	2010–11	2011–12	2012–13	2013–14	2014–15[a]
Public 2-year	-1,240	-1,680	-1,610	-1,540	-1,780	-1,740
Public 4-year[b]	2,030	2,140	2,960	3,150	2,950	3,030
Private nonprofit 4-year	12,730	12,010	11,910	12,120	11,860	12,360

	[a]Estimated value.
	[b]In-state students.
NOTES:	Prices have been rounded to the nearest $10. Net tuition and fees equal published tuition and fees minus total grant aid and tax benefits.
SOURCE:	The College Board, *Annual Survey of Colleges,Trends in College Pricing* (2014).
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Between 1999–2000 and 2011–2012, changes in the net cost of higher education for dependent undergraduates varied by family income level and type of institution they attended (Table 2-9). During this period, net tuition and fees increased for students from higher income families across all types of institutions. For students from lower income families, net tuition and fees declined at public 2-year institutions and they were stable at public and private nonprofit 4-year master's and baccalaureate institutions and also at private nonprofit 4-year research and doctoral institutions. Net tuition and fees increased at public 4-year research and doctoral institutions for students in all income brackets. Research shows that the vast majority of low-income, high-achieving high school seniors do not apply to any selective college, even though selective institutions cost them less than nonselective ones because of the large amounts of financial aid they are able to offer (Hoxby and Avery 2013). [i]

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[i] In this study, "low-income" referred to high school seniors whose families are in the bottom quartile of the income distribution. "High-achieving" referred to a student who scores at or above the 90th percentile on the ACT comprehensive or the SAT I (math and verbal) and whose high school grade point average is A- or higher. In this research, a "selective college" meant colleges and universities included in the categories from "Very Competitive Plus" to "Most Competitive" in Barron's *Profiles of American Colleges* (Hoxby and Avery 2013).

Table 2-9 **Net tuition and fees for dependent undergraduates attending college or university full time for a full year, by family income quartiles, type of institution, and Carnegie classification: 1999–2000 and 2011–12**

(2012 U.S. dollars)

	Public 2-year		Public 4-year		Private nonprofit 4-year	
Institution type and dependent student family income	1999–2000	2011–12	1999–2000	2011–12	1999–2000	2011–12
All institutions[a]						
Lowest 25%	700	400	1,700	1,900	6,500	8,200
Lower-middle 25%	1,700	1,300	3,600	4,200	10,400	10,500
Upper-middle 25%	1,900	2,300	4,700	7,200	12,600	15,200
Upper 25%	1,800	2,500	5,500	9,000	18,300	21,100
Research and doctoral institutions						
Lowest 25%	NA	NA	2,100	2,600	8,900	12,300
Lower-middle 25%	NA	NA	4,100	5,000	13,600	13,100
Upper-middle 25%	NA	NA	5,000	8,200	16,000	18,000
Upper 25%	NA	NA	6,000	10,200	21,700	25,900

	Public 2-year		Public 4-year		Private nonprofit 4-year	
Institution type and dependent student family income	1999–2000	2011–12	1999–2000	2011–12	1999–2000	2011–12
Master's and baccalaureate institutions						
Lowest 25%	NA	NA	1,300	1,200	5,400	6,500
Lower-middle 25%	NA	NA	2,900	3,400	9,100	9,600
Upper-middle 25%	NA	NA	4,300	6,100	11,000	13,800
Upper 25%	NA	NA	4,400	7,100	15,700	18,600

NA = not available.

[a] Includes all degree-granting institutions: associate's, master's, baccalaureate, research and doctoral, and special focus and other institutions.

NOTES: Full-time status for the purposes of financial aid eligibility was based on 12 credit hours, unless the awarding institution employed a different standard. Data are rounded to the nearest 100. Not all changes observed over time are statistically significant.

SOURCE: U.S. Department of Education, National Center for Educational Statistics, 1999–2000 and 2011–12 National Postsecondary Student Aid Study, 1999–2000 and 2011–12.

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Undergraduate Financial Support Patterns and Debt

Financial Support for Undergraduate Education. With rising tuition, students increasingly rely on financial aid to fund their education. Financial aid for undergraduate students comes mainly in the form of student loans (federal and nonfederal), grants (federal, state, institutional, and private), and tuition tax credits. A financial aid package may contain one or more of these kinds of support. In the 2013–14 academic year,[ii] federal loans constituted 33% of the $185 billion in student aid that undergraduate students received, down from 37% in 2003–04, followed by federal grants (24%, up from 18%), institutional grants (20%, up from 17%), education tax benefits (8% versus 5%), private and employer grants (6%, the same proportion in 2003–04 and in 2013–14), state grants (5% versus 7%), and federal work-study programs (about 1% in both of those years) (College Board 2014b). According to the latest data available from the NCES National Postsecondary Student Aid Study, a higher proportion of undergraduates in private for-profit institutions (90%) and in private nonprofit 4-year institutions (86%) than those in public 4-year (74%) or public 2-year (57%) institutions received some type of financial aid. Undergraduates in private for-profit and private nonprofit institutions were also more likely to incur student loans (75% and 62%) than those in public 4-year institutions (50%) and public 2-year institutions (18%) (Ifill and Shaw 2013).[iii]

Undergraduate Debt. Among recent graduates with S&E bachelor's degrees, the level of undergraduate debt does not vary much by undergraduate major, although it is somewhat higher for recent recipients of life sciences and social and related sciences bachelor's degrees.[iv] Levels of debt vary to a greater extent by type of institution and state. The extent of undergraduate indebtedness of students from public colleges and universities is almost as high as that for students from private nonprofit universities (about 60% at graduation). The level of debt differs, however: $25,600 per borrower for those graduating from a public institution and $31,200 for those graduating from private nonprofits. Students who attend private for-profit institutions are more likely to borrow, and to borrow larger amounts, than those who attend public and private nonprofit institutions (College Board 2014b).

Levels of debt varied widely by state. Average debt for 2013 graduates of public 4-year colleges and universities ranged from $18,065 in Utah to $34,170 in New Hampshire. Average debt for graduates of private nonprofit colleges and universities ranged from $9,757 in Alaska to $36,300 in Connecticut (Institute for College Access & Success, College InSight 2014). Cost of living may account for some of the differences by state.

Graduate Financial Support Patterns and Debt

Financial Support for S&E Graduate Education. In 2013, nearly 40% of all S&E graduate students were primarily self-supporting (i.e., they rely primarily on loans, their own funds, or family funds for financial support) (Appendix Table 2-7). The other 60% receive primary financial support from a variety of sources, including the federal government, universities, employers, nonprofit organizations, and foreign governments. The proportion of S&E graduate students who are self-supporting has been gradually increasing in the last 15 years, from about one-third in 1998 to 38% in 2013. The growth in self-supporting students is related to increasing enrollment of graduate students on temporary visas, who are mostly self-supporting (NSF/NCSES 2015b; IIE 2014).

Sources of funding include federal agency support, nonfederal support, and self-support. Nonfederal support includes state funds, particularly in the large public university systems; these funds are affected by the condition of overall state budgets. Support mechanisms include research assistantships (RAs), teaching assistantships (TAs), fellowships, and traineeships. Most graduate students, especially those who pursue doctoral degrees, are supported by more than one source or mechanism during their time in graduate school, and some receive support from several different sources and mechanisms in any given academic year.

Other than self-support, over time RAs have been the most prevalent primary mechanism of financial support for full-time S&E graduate students (Appendix Table 2-7). In 2013, 25% of full-time S&E graduate students were supported primarily by RAs, 19% primarily by TAs, and 12% primarily by fellowships or traineeships (Appendix Table 2-7).

Primary mechanisms of support differ widely by S&E field of study (Figure 2-6; Appendix Table 2-8). In fall 2013, full-time students in physical sciences were financially supported mainly through TAs (40%) and RAs (37%). RAs were also important in agricultural sciences (49%); earth, atmospheric, and ocean sciences (36%); biological sciences (36%); and engineering (34%; in particular, in materials and chemical engineering). In mathematics, nearly half (49%) of the full-time students were supported primarily through TAs, and 26% were self-supported. Full-time students in computer sciences and the social and behavioral sciences were mainly self-supported (56% and 47%, respectively). About 20% of full-time students in computer sciences received an RA, and 13% had a TA; 21% of those in the social and behavioral sciences had a TA, and only 11% received an RA. Students in medical and other health sciences were mainly self-supported (60%).[v]

[ii] Data for 2013–14 are preliminary (College Board 2014b).

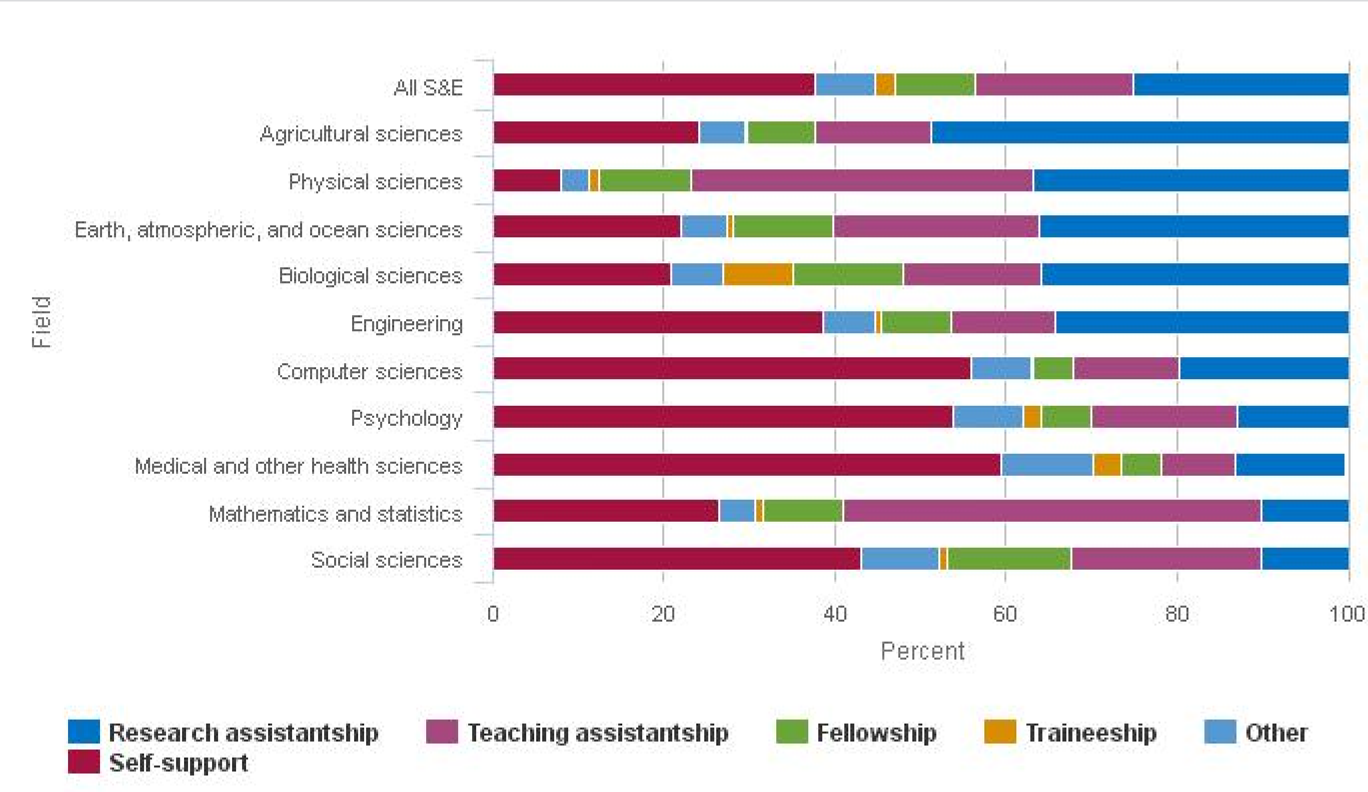
[iii] These percentages include students whose financial aid package included student loans in combination with grants or other student aid, as well as those who only had student loans.

[iv] Based on a special tabulation of the 2013 NSCG. A recent graduate is a respondent who received his or her most recent bachelor's degree between 1 July 2006 and 30 June 2011.

[v] The NSF/NCSES Survey of Graduate Students and Postdoctorates in Science and Engineering does not collect separate data for the master's and the doctoral level. For data on the primary source of financial support of doctorate recipients by broad field of study, see Appendix Table 2-13.

Figure 2-6

Full-time S&E graduate students, by field and mechanism of primary support: 2013



NOTE: Self-support includes any loans (including federal) and support from personal or family financial contributions.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2014) of the 2013 Survey of Graduate Students and Postdoctorates in Science and Engineering.

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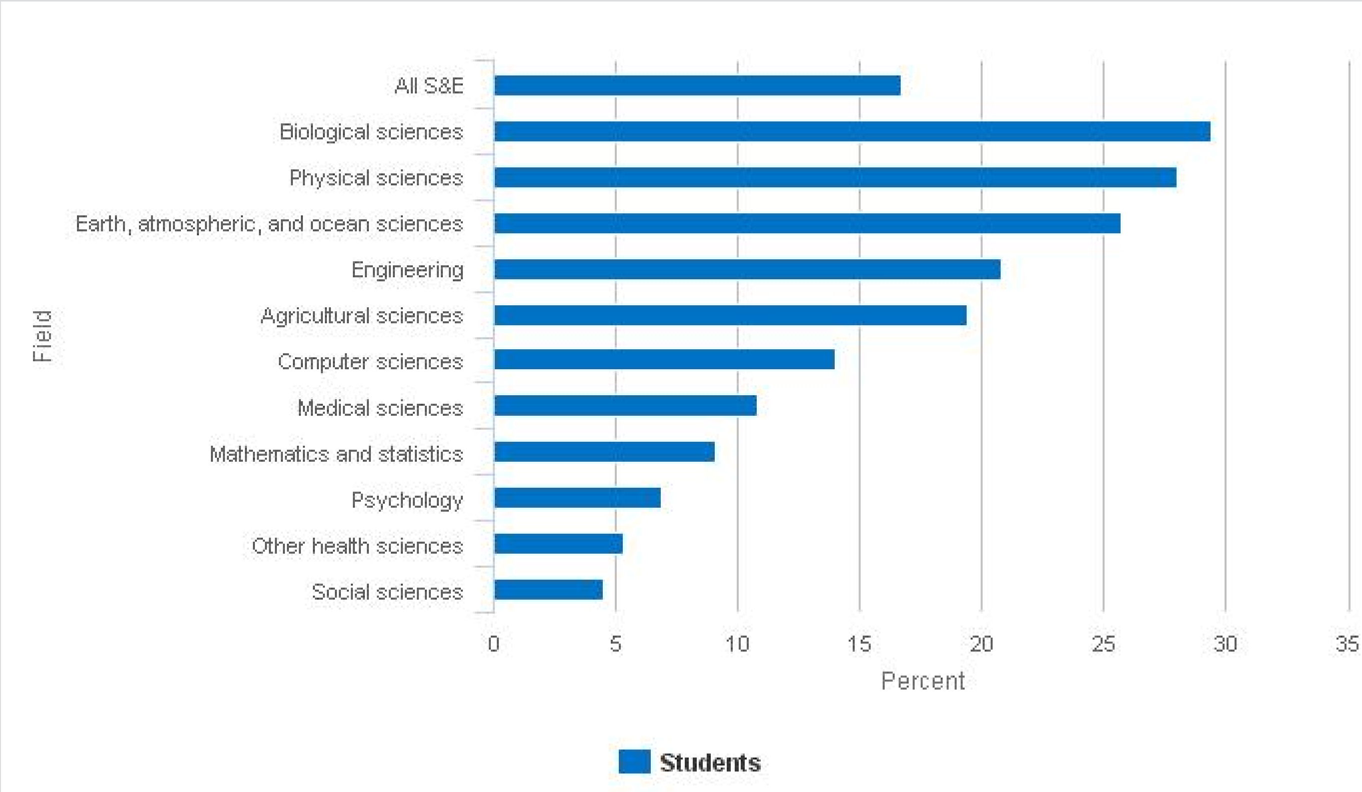
The federal government plays a substantial role in supporting S&E graduate students in some fields but a smaller role in others. Federal financial support for graduate education reaches a larger proportion of students in the biological sciences; the physical sciences; the earth, atmospheric, and ocean sciences; and engineering. Lower proportions of students in computer sciences, mathematics and statistics, medical and other health sciences, psychology, and the social sciences receive federal support (Figure 2-7). Appendix Table 2-9 provides detailed information by field and mechanism.

Figure 2-7

Full-time S&E graduate students with primary support from federal government, by field: 2013



SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2014) of the 2013 Survey of Graduate Students and Postdoctorates in Science and Engineering.

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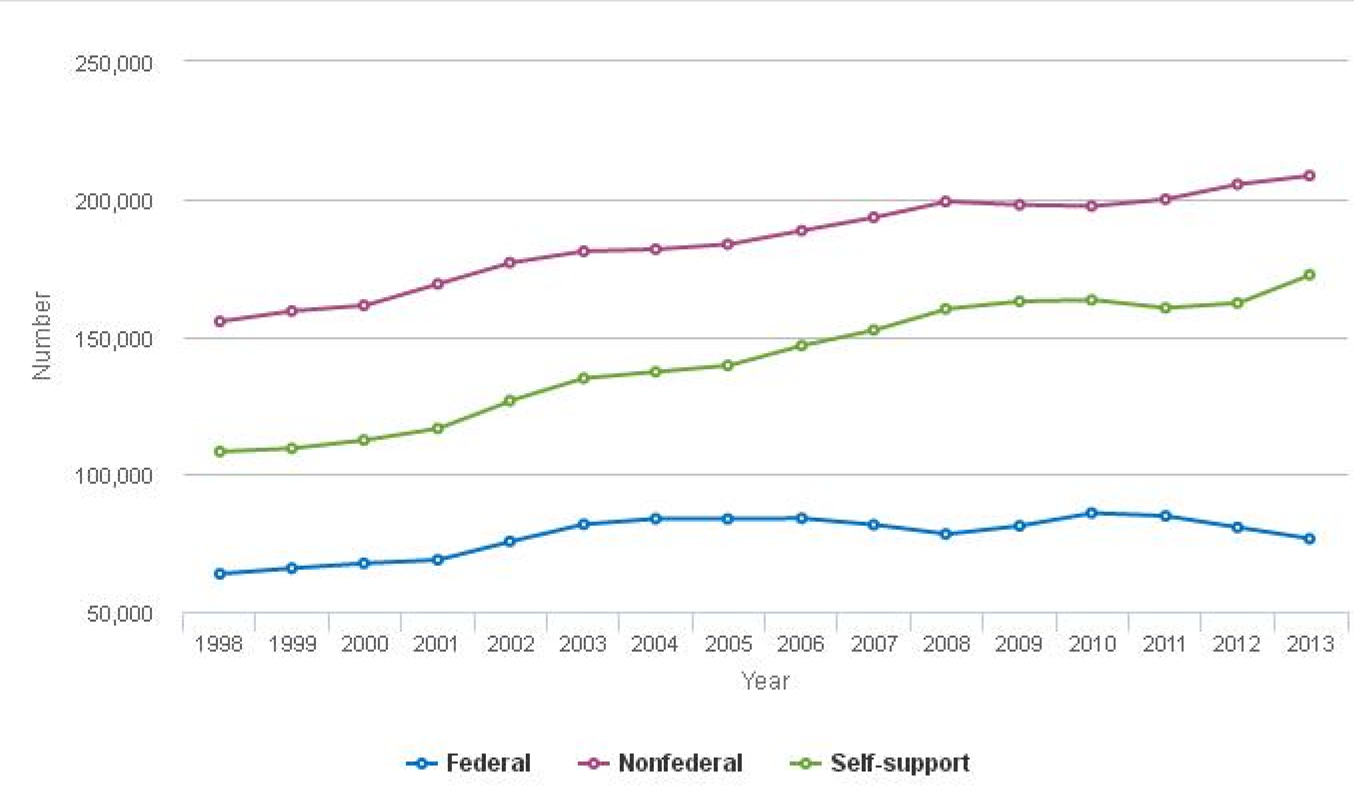
The federal government was the primary source of financial support for 17% of full-time S&E graduate students in 2013, whereas 46% were supported by nonfederal sources (institutional, state or local government, other U.S. sources, or other non-U.S. sources), and 38% were self-supported (Appendix Table 2-7). The number of full-time S&E graduate students supported by the federal government increased between 1998 and 2004 and was fairly stable through 2011, but it declined by 10% in the following 2 years. The number of students supported by nonfederal sources or through self-support has gradually increased in the last 15 years (Figure 2-8). The proportion of full-time S&E students primarily supported by the federal government remained fairly stable at 19%–21% between 1998 and 2006, but has declined since then, reaching its lowest level in at least 15 years in 2013 (17%) (Appendix Table 2-10). This decline was more pronounced in the biological and the physical sciences.

Figure 2-8

Full-time S&E graduate students, by source of primary support: 1998–2013



NOTES: Self-support includes any loans (including federal) and support from personal or family financial contributions. In 2007, the survey was redesigned to improve reporting. In this figure, "2007" shows data as collected in 2007. Because of methodological changes, counts should be used with caution for trend analysis. See http://www.nsf.gov/statistics/nsf10307/ for more detail. S&E excludes fields that were collected in this survey starting in 2007 (architecture, communication, and family and consumer sciences/human sciences) that are not included in other tables in this report from other data sources.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2014) of the 2013 Survey of Graduate Students and Postdoctorates in Science and Engineering.

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For some mechanisms of support, the federal role is fairly large. In 2013, the federal government funded 60% of S&E graduate students who were on traineeships, 48% of those with RAs, and 23% of those with fellowships (Appendix Table 2-9).

Most federal financial support for graduate education is in the form of RAs funded through grants to universities for academic research. RAs are the primary mechanism of support for 72% of federally supported full-time S&E graduate students. Fellowships and traineeships are the means of funding for 21% of the federally funded full-time S&E graduate students. For students supported through nonfederal sources in 2013, TAs (i.e., institutional funds) were the most prominent mechanism (40%), followed by RAs (29%) (Appendix Table 2-7).

The National Institutes of Health (NIH) and NSF support most of the full-time S&E graduate students whose primary support comes from the federal government, followed by the U.S. Department of Defense (DOD) (Appendix Table 2-11). In 2013, NIH supported about 22,000 S&E graduate students, NSF about 23,000, and DOD about 8,000. Trends in federal agency support of graduate students show considerable increases from 1998 to 2013 in the proportion of students funded by NSF, from 21% to 30% (Appendix Table 2-11). NSF supported nearly 57% of students in computer sciences or mathematics whose primary support comes from the federal government; 49% of those in earth, atmospheric, and ocean sciences; 40% of those in the physical sciences; and 36% of those in engineering overall (about 46% of those in chemical engineering and 44% of those in electrical engineering) (Appendix Table 2-12). The proportion of students funded by NIH increased from 29% to 33% between 1998 and 2008 but has since decreased to 29%. In 2013, NIH funded about 71% of such students in the biological sciences, 56% of those in the medical sciences, and 38% of those in psychology. The proportion of graduate students supported by DOD decreased slightly between 1998 and 2013. In 2013, DOD supported 44% of the S&E graduate students in aerospace engineering, 33% of those in industrial engineering, 29% of those in electrical engineering, and 21%-23% of those in materials and mechanical engineering and in computer sciences.

For doctoral degree students, notable differences exist in primary support mechanisms by type of doctorate-granting institution (Table 2-10). In 2013, RAs were the primary support mechanism for S&E doctorate recipients from research universities (i.e., doctorate-granting institutions with very high research activity, which receive the most federal funding, as well as those with high research activity). For those from medical schools, which are heavily funded by NIH, fellowships or traineeships accounted for the main mechanism of support. Students at less research-intensive universities relied mostly on personal funds.

Table 2-10 **Primary support mechanisms for S&E doctorate recipients, by 2010 Carnegie classification of doctorate-granting institution: 2013**

Mechanism	All institutions	Research universities—very high research activity	Research universities—high research activity	Doctoral/research universities	Medical schools and medical centers	Other/not classified
Doctorate recipients (number)	39,334	29,415	6,409	1,468	1,250	792
All mechanisms	100.0	100.0	100.0	100.0	100.0	100.0
Fellowship or traineeship	19.8	21.5	12.7	10.7	32.6	11.5
Grant	6.5	6.9	3.3	3.1	19.1	4.5
Teaching assistantship	16.5	16.7	21.8	8.0	1.0	8.0
Research assistantship	33.8	36.8	30.7	12.2	19.0	11.0
Personal	9.0	5.7	14.3	41.5	9.1	28.2
Other	3.8	3.3	5.3	7.1	5.4	4.8
Unknown	10.5	9.2	11.9	17.4	13.8	32.1

NOTES: Personal support mechanisms include personal savings, other personal earnings, other family earnings or savings, and loans. Research assistantships include research assistantships and other assistantships. Traineeships include internships and residencies. Other support mechanisms include employer reimbursement or assistance, foreign support, and other sources. Percentages may not add to total because of rounding.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2014) of the 2013 Survey of Earned Doctorates.

Notable differences also exist in primary support mechanisms for doctoral degree students by sex, race and ethnicity, and citizenship (Appendix Table 2-13). In 2011–13, among U.S. citizens and permanent residents, male S&E doctorate recipients were more likely than their female peers to be supported by RAs (31% compared with 23%). Female S&E doctorate recipients were more likely than their male counterparts to receive fellowships or traineeships (28% versus 24%) and to support themselves from personal sources (18% versus 11%). Also, Asians were more likely than any other racial or ethnic group to have primary RA support (32%), followed by whites (28%). Compared with other racial and ethnic groups, Hispanic, black, and American Indian or Alaska Native doctorate recipients depended more on fellowships or traineeships (34%, 35%, and 44%, respectively), and blacks and American Indians or Alaska Natives were more likely to use personal sources (25% and 20%, respectively). S&E doctorate recipients on temporary visas were more likely to have an RA (51%) than their U.S. citizen and permanent resident peers (27%); this is has been a long-standing pattern.

To some extent, the sex, citizenship, and racial and ethnic differences in types of support mechanisms are related to differences in field of study. White and Asian men, as well as international doctoral degree students, are more likely than white and Asian women, along with underrepresented minority students of both sexes, to receive doctorates in engineering and physical sciences, fields that are largely supported by RAs. In turn, women and underrepresented minorities are more likely to receive doctorates in social sciences and psychology, in which self-support is prevalent. However, differences in type of support by sex, race and ethnicity, or citizenship largely remain after accounting for these doctoral field patterns (Appendix Table 2-13).

Graduate Debt. At the time of doctoral degree conferral, 45% of 2013 S&E doctorate recipients have debt related to their undergraduate or graduate education. In 2013, 30% of S&E doctorate recipients reported having undergraduate debt, 33% reported having graduate debt, and 45% had undergraduate and graduate debt. For some S&E doctorate recipients, debt levels were high, especially for graduate debt: 5% reported more than $40,000 of undergraduate debt, 13% reported more than $40,000 of graduate debt, and 21% reported more than $40,000 in cumulative undergraduate and graduate debt (Appendix Table 2-14).

Levels of debt vary widely by doctoral field. A higher percentage of doctorate recipients in non-S&E fields (52%) than those in S&E fields (33%) reported graduate debt. In 2013, within S&E, high levels of graduate debt were most common among doctorate recipients in the social sciences, psychology, and the medical and other health sciences. The proportion of doctorate recipients in these fields who reported graduate debt has increased since 2003.[vi] Psychology doctorate recipients were most likely to report having graduate debt and high levels of debt.[vii] In 2013, 26% of psychology doctoral degree recipients reported graduate debt of more than $70,000 (Appendix Table 2-14). Doctorate recipients in mathematics and computer sciences were the least likely to report graduate debt.

Men and women differed little in level of undergraduate debt, but women were more likely to have accumulated higher graduate debt. U.S. doctorate holders accumulated more debt than temporary visa holders. Blacks, Hispanics, and American Indians and Alaska Natives had higher levels of graduate debt than whites, even accounting for differences in field of doctorate (NSF/NCSES 2015a).

[vi] For the proportions corresponding to the 2003 Survey of Earned Doctorates, please see NSB 2006, Appendix Table 2-23 at http://nsf.gov/statistics/seind06/append/c2/at02-23.pdf.

[vii] Clinical psychology programs and programs that emphasize professional practice (professional schools and PsyD programs) are associated with higher debt, but even in the more research-focused subfields of psychology, lower percentages of doctorate recipients were debt free, and higher percentages had higher levels of debt, than those in other S&E fields. For information on debt levels of clinical versus nonclinical psychology doctorates in 1993–96, see *Psychology Doctorate Recipients: How Much Financial Debt at Graduation?* (NSF 00-321) at http://www.nsf.gov/statistics/issuebrf/sib00321.htm. Accessed 5 October 2015.

Undergraduate Education, Enrollment, and Degrees in the United States

Undergraduate education in S&E courses prepares students majoring in S&E for the workforce. It also prepares nonmajors to become knowledgeable citizens with a basic understanding of science and mathematics concepts. This section includes indicators related to enrollment by type of institution, field, and demographic characteristics; intentions to major in S&E fields; and recent trends in the number of earned S&E degrees.

Undergraduate Enrollment in the United States

Overall Undergraduate Enrollment

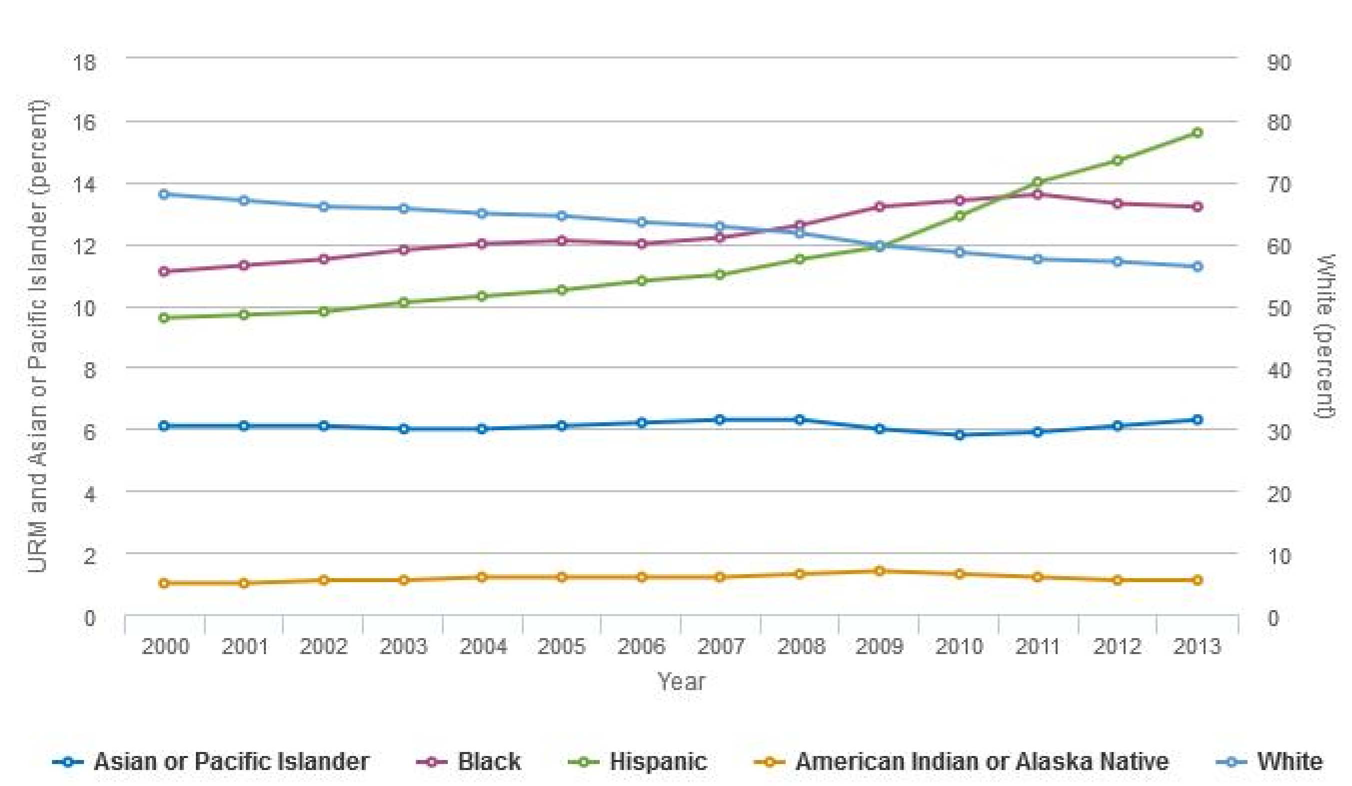
Enrollment in U.S. institutions of higher education at all levels rose from 15.5 million students in fall 2000 to 20.6 million in fall 2013, with two main periods of high growth—between 2000 and 2002 and between 2007 and 2010, continuing a pattern of rising enrollments when there are downturns in the economy. Undergraduate enrollment typically represents about 86% of all postsecondary enrollment (Appendix Table 2-4).

Undergraduate enrollment peaked at 18.3 million in 2010 but has declined to 17.7 million in 2013. As in previous years, the types of institutions enrolling the largest numbers of students at the undergraduate level in 2013 were associate's colleges (7.7 million, 43% of all undergraduates enrolled), master's colleges/universities (3.7 million, 21%), and doctorate-granting universities with very high research activity (2.1 million, 12%). Between 2000 and 2013, undergraduate enrollment increased by 62% at doctoral/research universities, by 37% at master's colleges, by 34% at associate's colleges, and by 27% at baccalaureate colleges (Appendix Table 2-4). (see sidebar, Carnegie Classification of Academic Institutions, for definitions of the types of academic institutions.)

Between 2000 and 2013, the share of Hispanics enrolled full time in undergraduate programs among U.S. citizens and permanent residents increased from 11% to 16%, and the share of blacks increased from 11% to 13%. The shares of Asians or Pacific Islanders and of American Indians or Alaska Natives remained stable at 6% and 1%, respectively. The share of whites declined from 68% to 56% in the same period (Figure 2-9).

Figure 2-9

Share of full-time undergraduate enrollment among U.S. citizens and permanent residents, by race and ethnicity: 2000–13



URM = underrepresented minorities (black, Hispanic, and American Indian or Alaska Native).

NOTES: Hispanic may be any race. American Indian or Alaska Native, Asian or Pacific Islander, black, and white refer to individuals who are not of Hispanic origin. Percentages do not add to total because data do not include individuals who did not report their race and ethnicity.

SOURCES: National Center for Education Statistics, Integrated Postsecondary Education Data System, Fall Enrollment Survey; National Science Foundation, National Center for Science and Engineering Statistics, WebCASPAR database, http://webcaspar.nsf.gov.

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According to the latest Census Bureau projections, increased enrollment in higher education is projected to come mainly from minority groups, particularly Hispanics. The latest Census Bureau projections report that the number of college-age individuals (ages 20–24) is expected to decline between 2015 and 2020 but increase in the longer term to 24.0 million by 2060 (Appendix Table 2-15). The short-term decline in this segment of the population is mostly due to a drop in the number of non-Hispanic whites, which is projected overall to continue to fall through 2060, and a decline in the population of non-Hispanic blacks between 2015 and 2035. The populations of 20–24-year-old Hispanics and of Asians who are not Hispanic are expected to increase continuously between 2015 and 2060. The proportion of Asians in this age group is expected to increase from 5% to 9%. The proportion of Hispanics in this age group is expected to grow from 22% in 2015 to 32% in 2060. This increase may result in a larger number of academic institutions becoming high Hispanic enrollment and also in considerable increases in the overall enrollment in community colleges, as nearly half of all Hispanic undergraduates are enrolled in community colleges. [i]

Undergraduate Enrollment in S&E

Freshmen intentions to major in S&E. Since 1971, the annual The American Freshman: National Norms survey, administered by the Higher Education Research Institute at the University of California, Los Angeles, has asked freshmen at a large number of universities and colleges about their intended majors.[ii] Data show that up until 2007, about one-third of all freshmen planned to study S&E; this proportion gradually rose to 45% by 2014. Increases in the proportion of freshmen planning to major in biological and agricultural sciences and in engineering account for most of this growth. In 2014, about 14% of freshmen intended to major in the biological and agricultural sciences (up from about 9% in 2007), and a similar proportion intended to major in engineering (up from about 8% in 2007). About 14% planned to major in engineering; 10% in the social and behavioral sciences; 5% in mathematics, statistics, or computer sciences; and 3% in the physical sciences (Appendix Table 2-16). The percentage of all freshmen intending to major in mathematics, statistics, or computer sciences declined for more than 10 years since the late 1990s, but has increased since 2011.

In 2014, more than half of Asian American or Asian freshmen reported that they intended to major in S&E; proportions were lower for Hispanic or Latino freshmen (45%) and lower still for whites and blacks (40% each) and for American Indian or Alaska Native (30%) freshmen (Figure 2-10). Since the late 1990s, the proportions intending to major in S&E increased in all racial and ethnic groups except in the American Indian or Alaska Native group.[iii]

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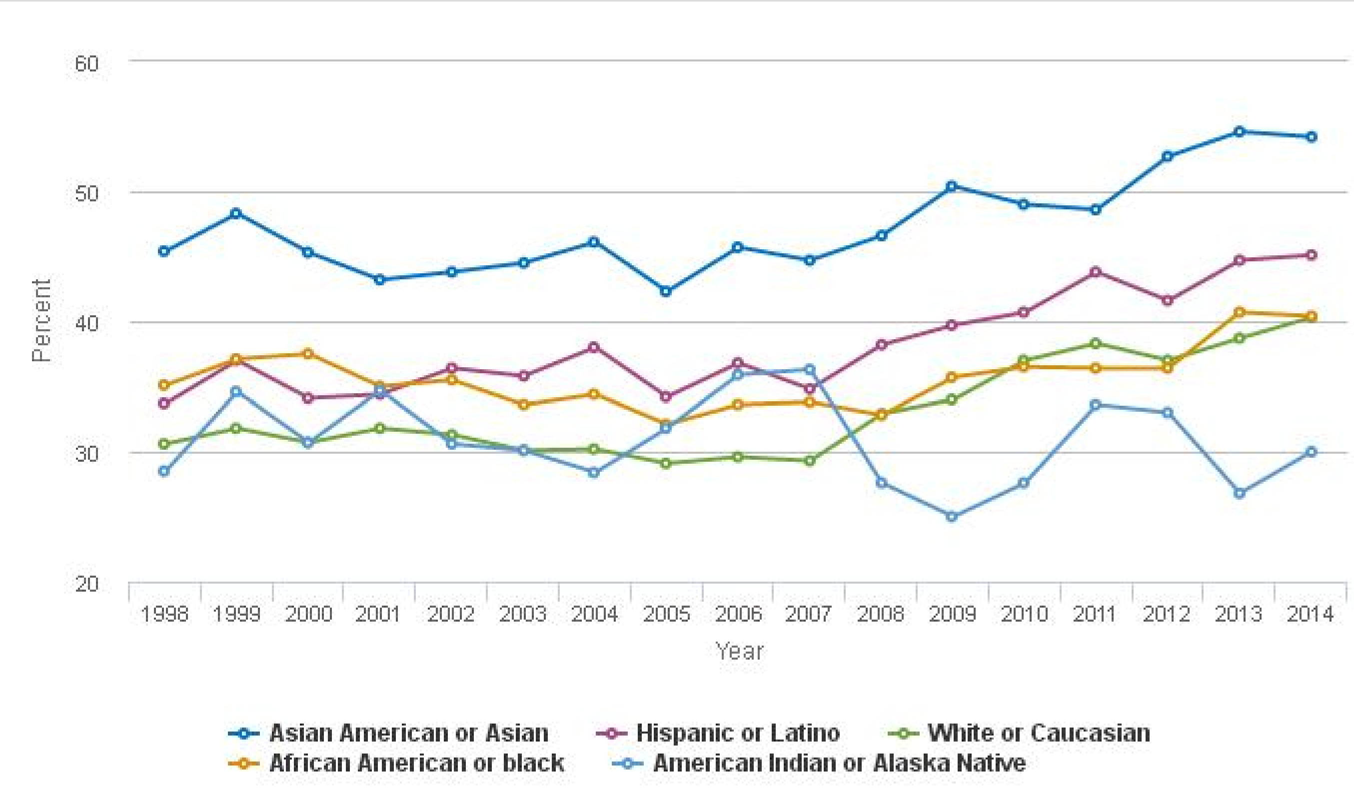
[i] Special tabulation from the IPEDS Fall Enrollment survey, available at https://ncsesdata.nsf.gov/webcaspar/.

[ii] For details on the methodology of this survey and its limitations, please see appendix A of the annual report *The American Freshman: National Norms Fall 2014*, published by the Cooperative Institutional Research Program at the Higher Education Research Institute at the University of California, Los Angeles (http://www.heri.ucla.edu /monographs/TheAmericanFreshman2014.pdf). These data are subject to sampling error. Information on estimated standard errors can be found in appendix D. Data reported here are significant at the 0.05 level.

[iii] Data for racial and ethnic groups are for U.S. citizens and permanent residents only.

Figure 2-10

Freshmen intending S&E major, by race and ethnicity: 1998–2014



NOTE: In 2001, Native Hawaiian or Pacific Islander was added as a category under Asian American or Asian.

SOURCE: Higher Education Research Institute, University of California, Los Angeles, special tabulations (2015) of The American Freshman: National Norms.

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Among whites, Asians, and Hispanics, the proportions planning to major in S&E were higher for men than for women (Appendix Table 2-16). A higher proportion of Asian American or Asian freshmen than of those from other racial and ethnic groups planned to major in the natural sciences and engineering, and higher proportions of blacks and Hispanics or Latinos intended to major in the social and behavioral sciences.

There has been growing concern about the ability to produce and retain science, technology, engineering, and mathematics (STEM) talent in the United States (PCAST 2012). Some students start undergraduate programs and do not complete their degrees, or they complete their degrees but switch majors (see sidebar, Attrition in STEM Fields).

Generally, the percentages of students earning bachelor's degrees in specific S&E fields are similar to the percentages planning to major in those fields, with the exception of engineering and social and behavioral sciences. (See the Undergraduate Degree Awards and Appendix Table 2-17 and Appendix Table 2-18 for trends in bachelor's degrees; see the section on "Persistence and Retention in Undergraduate Education [S&E versus Non-S&E Fields]" in [NSB 2012] for a discussion of longitudinal data on undergraduate attrition in S&E.) For both sexes and all racial and ethnic groups, the percentage of students earning bachelor's degrees in engineering is smaller than the percentage planning to major in it (Figure 2-11 and Figure 2-12). The percentage earning bachelor's degrees in social and behavioral sciences in 2013 (16%) (Appendix Table 2-17) is larger than the percentage that planned to major in those fields as freshmen 6 years earlier (10%) (Appendix Table 2-16). For women, Asians, blacks, and Hispanics, the proportion earning bachelor's degrees in the natural sciences is smaller than the proportion that begins college planning to major in these fields (Figure 2-13 and Figure 2-14).

Attrition in STEM Fields

The retention of undergraduate students with declared science, technology, engineering, and mathematics (STEM) majors has become a policy focus. In 2014, nearly 45% of incoming freshmen intended to major in S&E, and just over 1 in 10 of these freshmen indicated that there was "a very good chance" that they would change their major down the road (Eagan et al. 2014). During their undergraduate years, several of these students switch to other majors—for a variety of reasons—but are essentially replaced by students without declared majors or majors in non-STEM fields (for detailed data on field-switching from STEM, non-STEM fields, and undeclared majors, see [Table (NSB 2012) 2-9]).

These broad relationships provide no information about the specific paths and factors that make students declare, enter, and leave an S&E major and earn STEM degrees. To provide more insight into these questions, the National Center for Education Statistics followed the 2003–04 college cohort through 2009 and examined potential factors underlying STEM attrition (Chen and Soldner 2013). The study focused on identifying the factors related to attrition from STEM fields and did not include students who switched from non-STEM fields into STEM fields, or those who had not initially declared a major but later decided to major in a STEM field. The study's STEM definition included engineering and science technologies together with engineering, information sciences together with computer sciences, and excluded all social and behavioral science fields. Appropriate statistical controls were applied throughout the study.

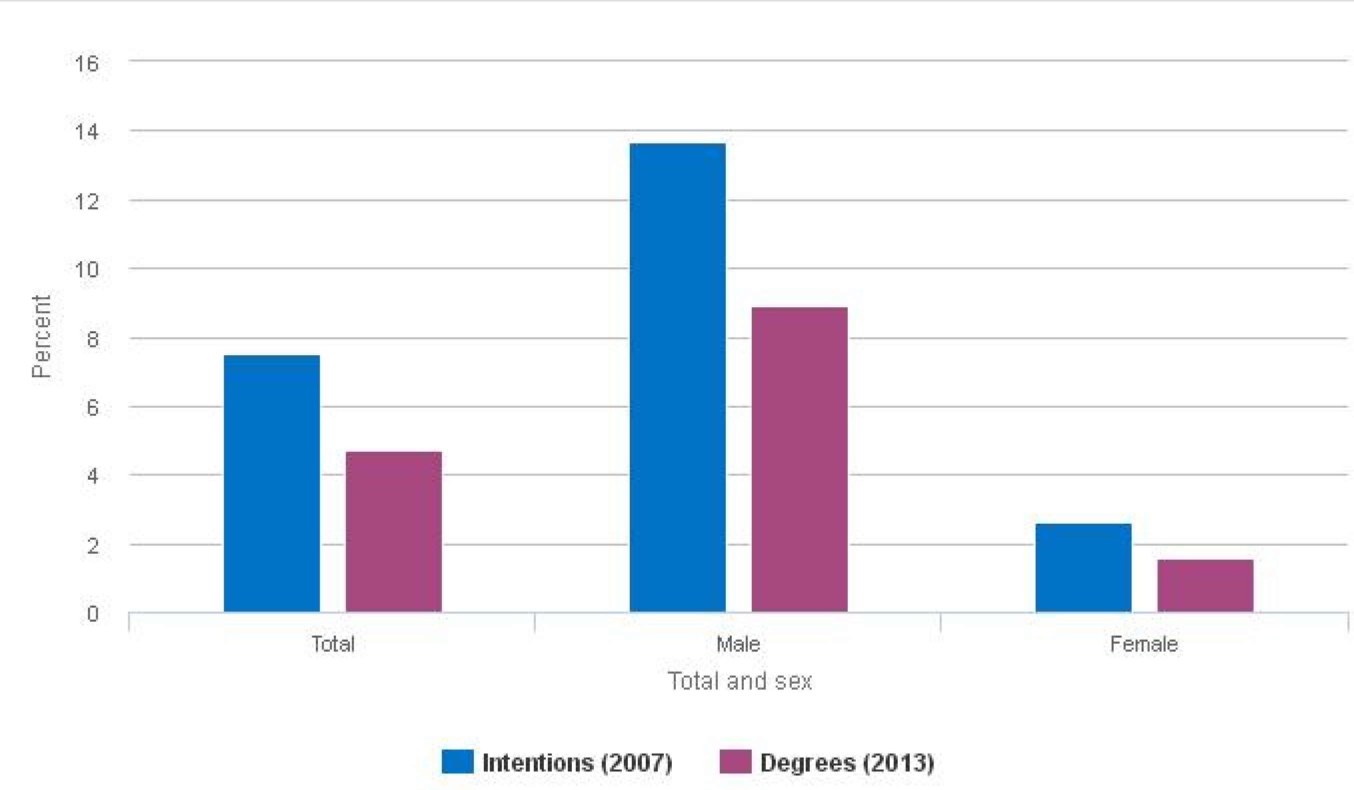
About half of the beginning bachelor's degree students who declared STEM majors during any of these years had either left college altogether by 2009 (20%) or left STEM for another field (28%). Attrition was particularly high among computer and information sciences majors and among associate's degree students. Overall, however, attrition from STEM majors was lower than in most other fields. For bachelor's and associate's students who declared STEM majors, taking fewer STEM courses in the first year, choosing less demanding mathematics courses in the first year, and performing poorly in STEM classes relative to non-STEM classes were factors associated with an increased probability of switching out of STEM majors. For bachelor's degree students, withdrawing or failing STEM courses was associated with an increased probability of switching out of STEM majors.

With regard to students leaving STEM fields by dropping out of college, overall college performance and the level of success in STEM courses was critical. Bachelor's and associate's STEM entrants who earned a low college grade point average and accumulated a large number of incompletes in STEM courses dropped out of college at higher rates. For associate's degree students, being less successful in STEM courses than in non-STEM courses was also a factor for dropping out of college.

Beginning bachelor's degree students starting at private nonprofit 4-year colleges were less likely than those starting at public 4-year institutions to abandon STEM majors by switching to another field. In addition, students from selective colleges were less likely to leave college than their counterparts who started at nonselective institutions.

Figure 2-11

Engineering: Freshmen intentions and degrees, by sex



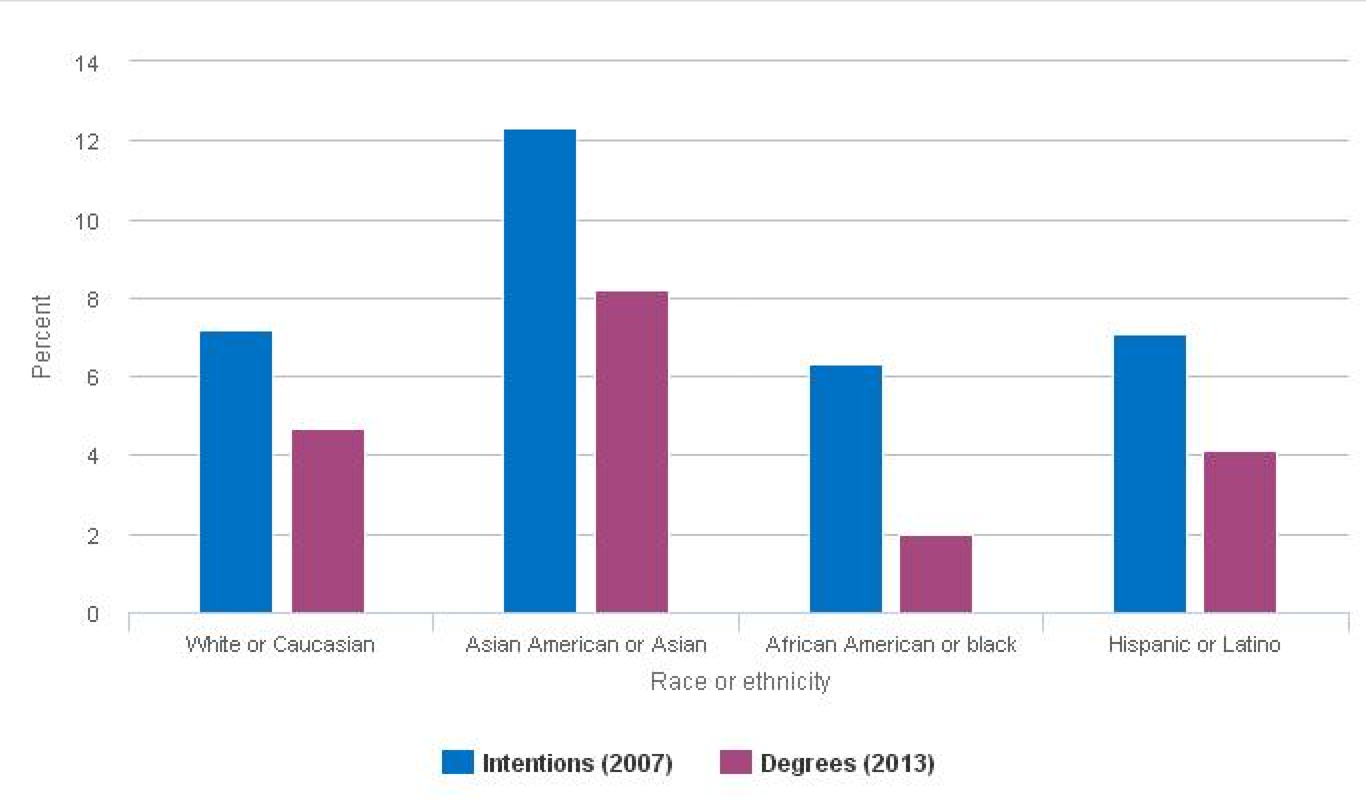
NOTE: Degrees do not reflect the same student cohort.

SOURCES: Higher Education Research Institute, University of California, Los Angeles, special tabulations (2015) of The American Freshman: National Norms; National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey, 2013; National Science Foundation, National Center for Science and Engineering Statistics, WebCASPAR database, http://webcaspar.nsf.gov.

Science and Engineering Indicators 2016

Figure 2-12

Engineering: Freshmen intentions and degrees, by race and ethnicity



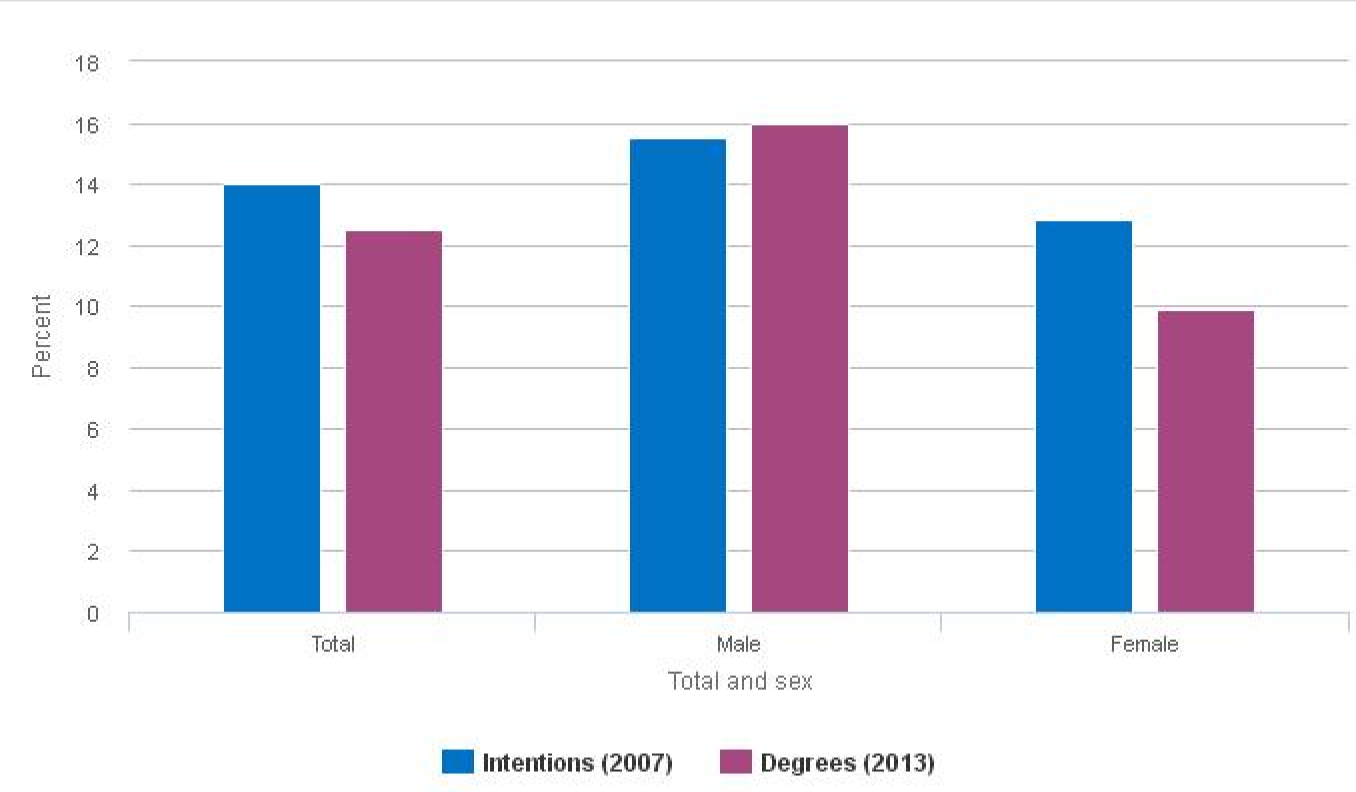
NOTES: Degrees do not reflect the same student cohort. Asian American or Asian includes Native Hawaiian or Pacific Islander.

SOURCES: Higher Education Research Institute, University of California, Los Angeles, special tabulations (2015) of The American Freshman: National Norms; National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey, 2013; National Science Foundation, National Center for Science and Engineering Statistics, WebCASPAR database, http://webcaspar.nsf.gov.

Science and Engineering Indicators 2016

Figure 2-13

Natural sciences: Freshmen intentions and degrees, by sex



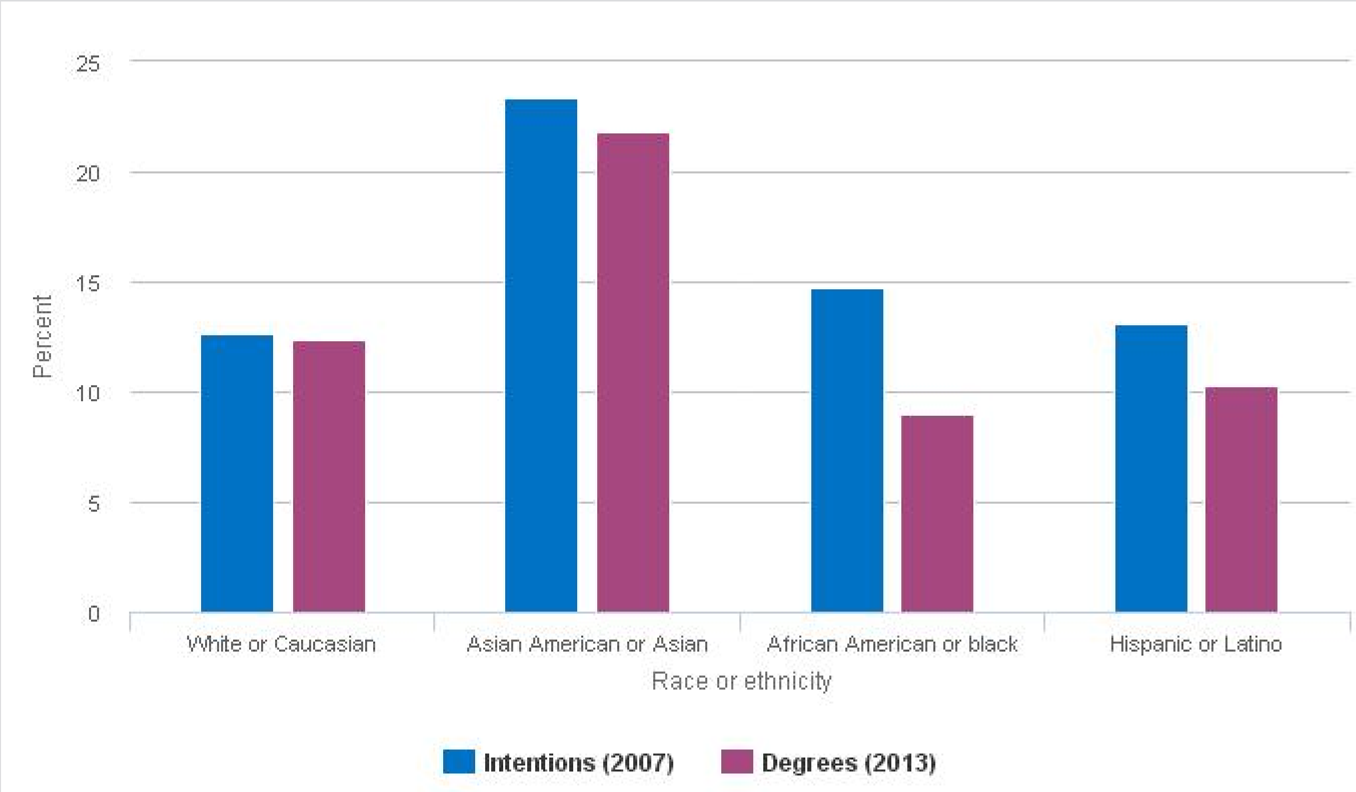
NOTE: Degrees do not reflect the same student cohort.

SOURCES: Higher Education Research Institute, University of California, Los Angeles, special tabulations (2015) of The American Freshman: National Norms; National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey, 2013; National Science Foundation, National Center for Science and Engineering Statistics, WebCASPAR database, http://webcaspar.nsf.gov.

Science and Engineering Indicators 2016

Figure 2-14

Natural sciences: Freshmen intentions and degrees, by race and ethnicity



NOTES: Degrees do not reflect the same student cohort. Asian American or Asian includes Native Hawaiian or Pacific Islander.

SOURCES: Higher Education Research Institute, University of California, Los Angeles, special tabulations (2015) of The American Freshman: National Norms; National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey, 2013; National Science Foundation, National Center for Science and Engineering Statistics, WebCASPAR database, http://webcaspar.nsf.gov.

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The demographic profile of students planning to major in S&E has become more diverse over time. The proportion of white students declined from about three-quarters in 1998 to less than two-thirds in 2014. On the other hand, in the same period, the proportion of Asian American or Asian students more than doubled to 18%, and the proportion of Hispanic students more than tripled, to 17%, in 2014. American Indian or Alaska Native and black students accounted for roughly 2% and 10%, respectively, of freshmen intending to major in S&E in both 1998 and 2014 (Appendix Table 2-19).

International undergraduate enrollment. In recent years, international undergraduate enrollment has been on the rise.[iv] In the 2013–14 academic year, the number of international students enrolled in undergraduate programs in U.S. academic institutions rose 9% from the previous year, to approximately 370,000 (IIE 2014). The number of international undergraduates enrolled in 2013–14 was 42% above the number in 2001–02 before the post-9/11 decline. New enrollments of international undergraduates in the 2013–14 academic year increased by 7% over the previous academic year. The countries that accounted for the largest numbers of international undergraduates enrolled in a U.S. institution in 2013–14 were China (111,000), South Korea (37,000), Saudi Arabia (27,000), Canada (14,000), India (13,000), and Vietnam (12,000). The numbers of undergraduates from Saudi Arabia increased by 30% over the previous year; the number of Chinese by 18%; the number of students from the United Kingdom by 11%; from Brazil, by 9%; and from Indonesia, 8%. The numbers of South Korean, Taiwanese, and Indian undergraduates decreased by 3%, 2%, and 1%, respectively. In 2013–14, among all international students (undergraduate and graduate), the number of those studying mathematics and computer sciences increased by 18% over the preceding year, the number of those studying engineering increased by 10%, and the number of those studying social sciences increased by 7%. The number of those studying physical and life sciences grew by 2% (IIE 2014).

More recent data from the Student and Exchange Visitor Information System (SEVIS) at the Department of Homeland Security show a substantial increase in international undergraduate enrollment in the United States between November 2013 and November 2014 (Table 2-11; Appendix Table 2-20).[v] This increase reflects a larger influx of international students in the United States, and because of the way these data are collected, the increase may also reflect a larger portion of international students staying in the United States to pursue another degree.[vi] The increase in international enrollment was higher in S&E (14%) than in non-S&E fields (7%). A growing proportion of foreign undergraduates enrolled come to study in S&E fields, from 29% in 2008 to 37% in 2014. Within S&E, the largest increases were in engineering and computer sciences. The top five countries of origin of international S&E undergraduate students in fall 2014 (China, Saudi Arabia, South Korea, India, and Kuwait) were similar to those in the preceding year (Appendix Table 2-20). In 2014, the proportion of undergraduate students enrolled in S&E fields was 50% or higher among students from Kuwait, Oman, Malaysia, India, Nepal, and Nigeria.[vii] Between 2008 and 2011, international S&E enrollment at the undergraduate level increased each year by about 6%–10%, with the growth rate spiking in 2012 (21%). In the last 2 years, the growth rate was lower but remained high (12% in 2013 and 14% in 2014) (Table 2-11). About 45% of the growth in international undergraduate enrollment in the last year, both in S&E and non-S&E fields, is accounted for by the increase in the number of students from China.

[iv] The data in this section come from the Institute of International Education (IIE) and the Student and Exchange Visitor Information System (SEVIS). IIE conducts an annual survey of about 3,000 accredited U.S. higher education institutions. In this survey, an *international student* is defined as anyone studying at an institution of higher education in the United States on a temporary visa that allows academic coursework, primarily F and J visas. SEVIS collects administrative data, including the numbers of all international students enrolled in colleges and universities in the United States.

[v] The figures include active foreign national students on F-1 visas in the SEVIS database, excluding those participating in optional practical training (OPT). Students with F visas have the option of working in the United States by engaging in OPT, temporary employment directly related to the student's major area of study, either during or after completion of the degree program. Students can apply for 12 months of OPT at each level of education. Starting in 2008, students in certain STEM fields became eligible for an additional 17 months of OPT. The number of students in OPT varies according to labor market conditions. According to data from SEVIS, the number of students with F-1 visas in OPT declined sharply between November 2010 and November 2011 and rose back up steeply by November 2012 (68,510 in November 2010, 22,820 in November 2011, and 80,680 in November 2012).

[vi] For example, an international student who is about to earn a bachelor's degree and stays in the United States to pursue a graduate degree would remain in the SEVIS database. It is not possible to determine the extent to which international students stay to pursue another degree because of the way the data are collected.

[vii] These data include international students pursuing both bachelor's and associate's degrees. Comparable data for U.S. citizen and permanent resident students do not exist. However, the proportion of S&E associate's and bachelor's degree awards earned by U.S. citizens and permanent residents is considerably lower.

Table 2-11 **International students enrolled in U.S. higher education institutions, by broad field and academic level: 2008–14**

Field and level	2008	2009	2010	2011	2012	2013	2014
All fields							
All levels	526,570	525,680	537,650	574,360	635,650	676,280	750,360
Undergraduate	266,320	272,980	284,770	297,950	351,030	373,740	407,810
Graduate	260,260	252,710	252,890	276,400	284,620	302,540	342,540
S&E fields							
All levels	229,010	229,230	235,990	260,280	280,020	307,480	358,100
Undergraduate	76,780	81,110	87,590	96,400	116,640	130,990	149,090
Graduate	152,230	148,120	148,400	163,880	163,390	176,490	209,020
Non-S&E fields							
All levels	297,560	296,460	301,670	314,080	355,630	368,810	392,250
Undergraduate	189,530	191,870	197,180	201,560	234,390	242,750	258,730
Graduate	108,030	104,590	104,490	112,520	121,240	126,060	133,530

NOTES: Data include active foreign national students on F-1 visas and exclude those on optional practical training. Undergraduate level includes associate's and bachelor's degrees; graduate level includes master's and doctoral degrees. Numbers are rounded to the nearest 10. Detail may not add to total because of rounding.

SOURCE: U.S. Department of Homeland Security, U.S. Immigration and Customs Enforcement, special tabulations (2014) of the Student and Exchange Visitor Information System database.

Science and Engineering Indicators 2016

Engineering enrollment. For the most part, students do not declare majors until their sophomore year. Because of this, undergraduate enrollment data for domestic students are not available by field. However, engineering is an exception. Engineering programs generally require students to declare a major or an intent to major in the first year of college, so engineering enrollment data can serve as an early indicator of both future undergraduate engineering degrees and student interest in engineering careers. The Engineering Workforce Commission administers an annual fall survey that tracks enrollment in undergraduate and graduate engineering programs (EWC 2014).

Undergraduate engineering enrollment was flat in the late 1990s, increased from 2000 to 2003, declined slightly through 2006, rose steadily to a peak of 544,000 in 2012, and declined slightly to 542,000 in 2013 (Appendix Table 2-21). The number of undergraduate engineering students increased by 34% between 2006 and 2013. Full-time freshman enrollment followed a similar pattern, reaching 131,000 in 2012, the highest since 1982, but declining slightly in 2013. These trends correspond with declines in the college-age population through the mid-1990s, particularly the drop in white 20–24-year-olds, who account for the majority of engineering students (NSF/NCSES 2015c).

Enrollment by disability status. According to the most recent available estimates, 11% of undergraduate students reported a disability in 2012 (NSF/NCSES 2015c).[viii] Undergraduates with disabilities were older than those without disabilities and were somewhat more likely to attend a 2-year institution. About one in four undergraduates with a disability was in an S&E field, a similar proportion among undergraduates without disabilities, and there were no major differences in field distribution at the broad field level.

[viii] See (NSF/NCSES 2015c, tables 2-6 and 2-7; Figure 1-E).

Undergraduate Degree Awards

The number of undergraduate degrees awarded by U.S. academic institutions has been increasing over the past two decades in S&E and non-S&E fields. According to projections from the U.S. Department of Education, these trends are expected to continue at least through 2022 (Hussar and Bailey 2014).

S&E Associate's Degrees

Community colleges often are an important and relatively inexpensive gateway for students entering higher education. Associate's degrees, largely offered by 2-year programs at community colleges, are the terminal degree for some, but others continue their education at 4-year colleges or universities and subsequently earn higher degrees. About 18% of recent S&E bachelor's degree holders in 2013—those who had earned their degree between academic years 2006–07 and 2010–11—had previously earned an associate's degree.[i] Many who transfer to baccalaureate-granting institutions do not earn associate's degrees before transferring; they may be able to transfer credit for specific courses.[ii]

In 2013, 86,000 out of more than 1 million associate's degrees were in S&E fields. S&E associate's degrees from all types of academic institutions have been rising continuously since 2000, after a steep decline between 2003 and 2007. The overall trend mirrors the pattern of computer sciences, which account for a large portion of S&E associate's degrees and peaked in 2003, declined through 2007, and increased through 2012.[iii]

The number of associate's degrees in S&E technologies, not included in S&E degree totals because of their applied focus, has nearly doubled since 2000. In 2013, nearly 157,000 associate's degrees were in S&E technologies. Associate's degrees in these fields accounted for 15% of all associate's degrees in 2013; this proportion has ranged between 13% and 16% since 2000. Nearly three-quarters of the associate's degrees in S&E technologies are in health technologies, and close to one-quarter are in engineering technologies. The proportion of associate's degrees in engineering technologies, however, has declined from 48% of all S&E technologies degrees in 2000 to 24% in 2013 (or from 7% of all associate's degrees to 4%), whereas the proportion of associate's degrees in health technologies has increased from 50% in 2000 to 74% in 2013 (or from 7% of all associate's degrees to 11%).

Women have earned between 60% and 62% of all associate's degrees awarded between 2000 and 2013 (Appendix Table 2-22). The proportion of women earning S&E associate's degrees, however, declined from 48% in 2000 to 43% in 2013. Most of the decline is attributable to a decrease in women's share of computer sciences associate's degrees, which dropped continuously from 42% in 2000 to 21% in 2013.

Students from underrepresented minority groups (blacks, Hispanics, and American Indians and Alaska Natives) earn a higher proportion of associate's degrees than of bachelor's or more advanced degrees, both in S&E fields and in all fields.[iv] (See the "S&E Bachelor's Degrees by Race and Ethnicity" and "S&E Doctoral Degrees by Race and Ethnicity" sections.) In 2013, underrepresented minorities earned 31% of S&E associate's degrees—more than one-third of all associate's degrees in social and behavioral sciences and biological sciences; about 30% of those in physical sciences, mathematics, and computer sciences; and 24% of those in engineering (Appendix Table 2-23).

S&E Bachelor's Degrees

The baccalaureate is the most prevalent S&E degree, accounting for nearly 70% of all S&E degrees awarded. S&E bachelor's degrees have consistently accounted for roughly one-third of all bachelor's degrees for at least the past 15 years. The number of S&E bachelor's degrees awarded rose steadily from about 400,000 in 2000 to more than 615,000 in 2013 (Appendix Table 2-17).[v]

In the last decade, the number of bachelor's degrees awarded increased fairly consistently, although to different extents, in all S&E fields. The exception was computer sciences, where the number increased sharply from 2000 to 2004, dropped as sharply through 2009, but increased again since then (Figure 2-15; Appendix Table 2-17).

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[i] Based on a special tabulation of the 2013 NSCG. A recent graduate is a respondent who received his or her most recent degree between 1 July 2006 and 30 June 2011.

[ii] Some credentials in the form of certificates take up to a year or less to complete. The most recent research on licenses and certification from the U.S. Census Bureau's Survey of Income and Program Participation shows that the vast majority of these types of credentials are in health care, education, and trades; business/finance management; legal/social services; and other non-S&E fields. Only 2% of the licenses and certifications are in S&E, specifically in computer sciences (Ewert and Kominski 2014).

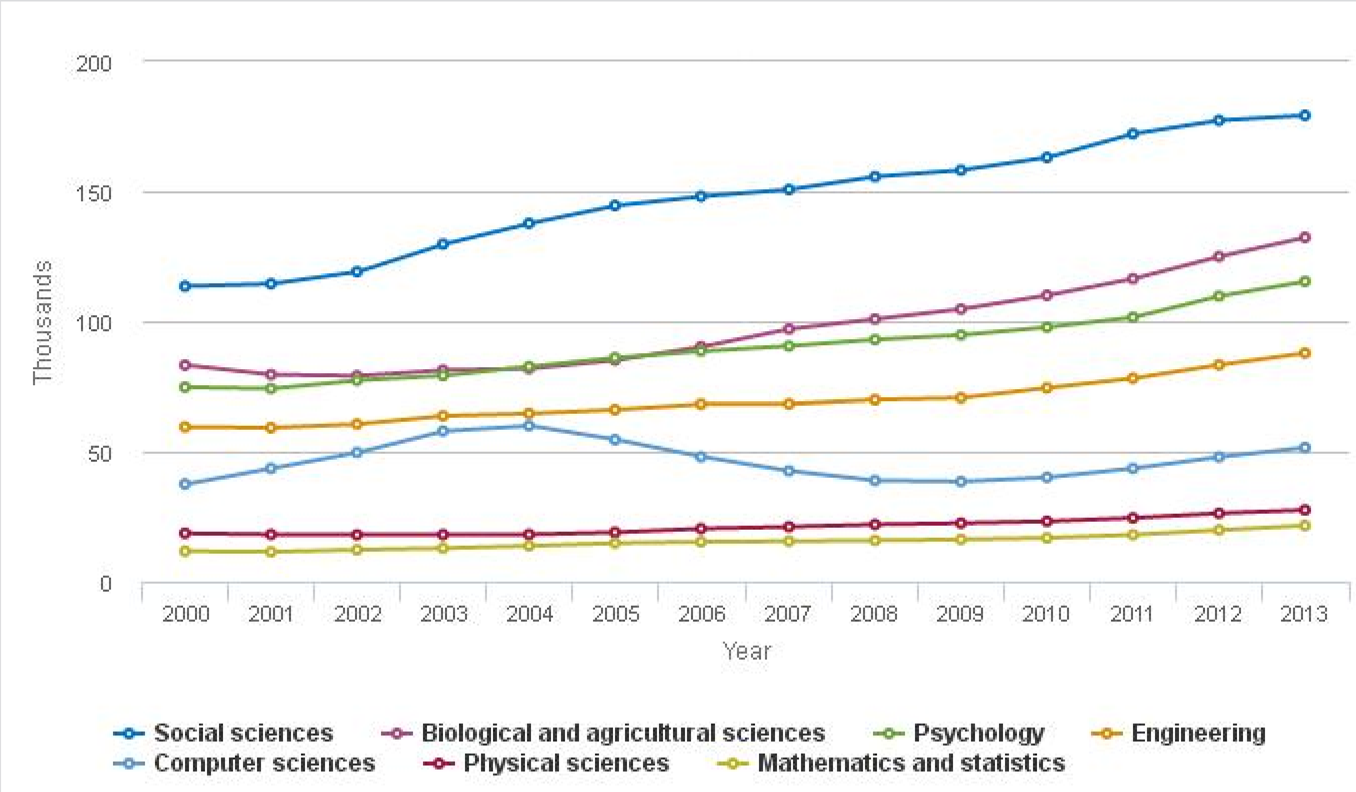
[iii] Data on degree completion from the NCES were obtained from WebCASPAR (https://webcaspar.nsf.gov/). Data uploaded in WebCASPAR correspond to NCES provisional data, which undergo all NCES data quality control procedures and are imputed for nonresponding institutions. These data are used by NCES in its First Look (Provisional Data) publications.

[iv] Data for racial and ethnic groups are for U.S. citizens and permanent residents only.

[v] Data on degree completion from NCES were obtained from WebCASPAR (https://webcaspar.nsf.gov/). Data uploaded in WebCASPAR correspond to NCES provisional data, which undergo all NCES data quality control procedures and are imputed for nonresponding institutions. These data are used by NCES in its First Look (Provisional Data) publications.

Figure 2-15

S&E bachelor's degrees, by field: 2000–13



NOTE: Physical sciences include earth, atmospheric, and ocean sciences.

SOURCES: National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey; National Science Foundation, National Center for Science and Engineering Statistics, WebCASPAR database, http://webcaspar.nsf.gov.

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S&E bachelor's degrees by sex. Since 1982, women have outnumbered men in undergraduate education. They have earned relatively constant fractions of all bachelor's and S&E bachelor's degrees for several years. Since the late 1990s, women have earned about 57% of all bachelor's degrees and about half of all S&E bachelor's degrees. Among U.S. citizens and permanent residents, women also earn about half of all S&E bachelor's degrees (NSF/NCSES 2015c).

Men and women tend to study different fields; these tendencies are also observed at the master's and doctoral levels, as will be seen below and in the workforce data in chapter 3. In 2013, men earned the vast majority of bachelor's degrees awarded in engineering, computer sciences, and physics and more than half of the degrees in mathematics and statistics. Women earned half or more of the bachelor's degrees in psychology, biological sciences, agricultural sciences, and all the broad fields within social sciences except for economics (Appendix Table 2-17).

Since 2000, changes have not followed a consistent pattern. The share of bachelor's degrees awarded to women declined in computer sciences (by 10%) (see sidebar, Retention of Women in Computer Sciences Programs), mathematics and statistics (by 5%), physics (by 3%), and engineering (by 1%) (Figure 2-16; Appendix Table 2-17). Fields in which the proportion of bachelor's degrees awarded to women grew during this period include atmospheric sciences (by 10%); agricultural sciences (by 7%); anthropology (by 4%); and astronomy, area and ethnic studies, and political science and public administration (by 2% each) (Appendix Table 2-17).

Retention of Women in Computer Sciences Programs

In the last two decades, the proportion of women earning bachelor's degrees in computer sciences has declined from 28% to 18% (NSF/NCSES 2015c), even though the proportion of freshmen women declaring a computer sciences major when first enrolled in a 4-year institution has remained stable (at about 20% in recent years).* Several studies have attempted to identify possible factors that affect retention of women in computer sciences departments (Margolis and Fisher 2002; Cohoon and Aspray 2006). One nationwide study concluded that departmental environment had measurable consequences on the gender composition of enrolled students and the likelihood that women who declared a computer science major would remain in the program at rates comparable to their male classmates (Cohoon 2006).[†] The study statistically controlled for a range of characteristics across the programs under study that are likely to affect retention, including size, highest degree level offered, geographic location, and administrative type of institution.

The study concluded that the most important factor was the ability to rely on same-sex peer support, measured by the proportion of enrolled women. Findings from focus group research suggested that women preferred to ask questions and get help from female classmates. Women's retention rates were higher in departments with higher proportions of female students, suggesting greater ease in drawing on the support of same-sex peers. In addition, three factors related to faculty characteristics were important. Broad faculty encouragement of women to persist in this male-dominated field was important, as was faculty mentoring if it aimed explicitly at overcoming underrepresentation. Faculty concern over insufficient staffing—especially prevalent in public institutions in the post dot-com boom period—was related to higher female attrition. Finally, high demand from faculty (e.g., expectation of long hours of study, extensive homework assignments, and limited extracurricular activities) was related to lower rates of women's attrition.

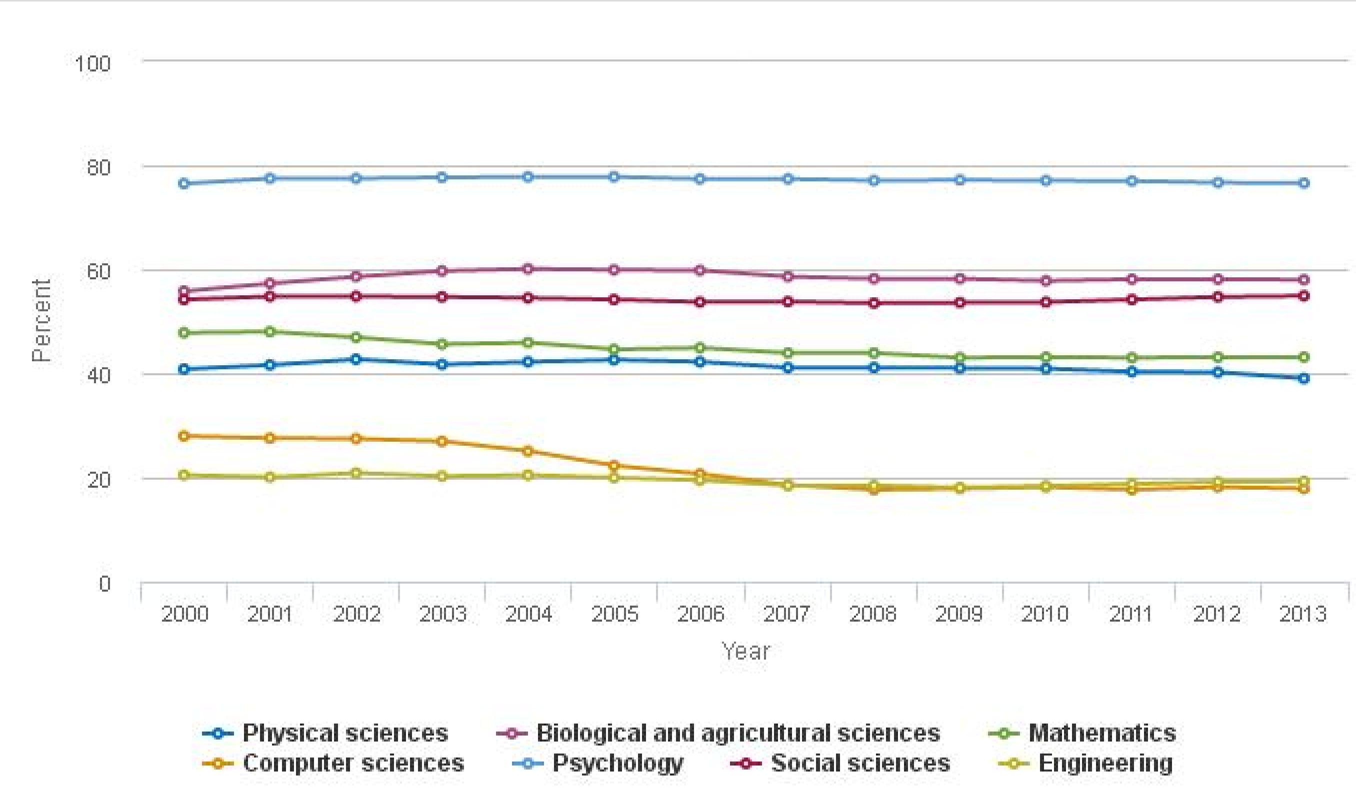
Recent nationally representative data on factors that are important for retention are not available. However, some computer science departments have shown success in increasing recruitment and retention of women. For example, the computer science department at Harvey Mudd College has succeeded in increasing the proportion of women computer science majors from 12% in 2005 to around 35% to 40% in recent years, as had the Carnegie Mellon University computer science department in the early 2000s. The strategies implemented included, but were not limited to, expanding the required first-year computer science courses to include social impacts of computer science and creative, real-world applications; providing summer research opportunities for women after their first year; and increasing the number of women computer science faculty members (DuBow et al. 2012; Miller 2014).

* Special tabulations, Beginning Postsecondary Students Longitudinal Study, Second Follow-up (BPS:96/01 and BPS:04/09)

[†]The study first conducted interviews and focus groups at 18 undergraduate computer science departments that varied by region, institution type, highest degree granted, reputation, and sex composition. The results of the focus groups were then used to design a survey of faculty and chairs in 209 largest or most highly ranked computer science departments in the United States. The study relied on official enrollment and disposition data to calculate attrition rates of males and females.

Figure 2-16

Women's share of S&E bachelor's degrees, by field: 2000–13



NOTE: Physical sciences include earth, atmospheric, and ocean sciences.

SOURCES: National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey; National Science Foundation, National Center for Science and Engineering Statistics, WebCASPAR database, http://webcaspar.nsf.gov.

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S&E bachelor's degrees by race and ethnicity. The racial and ethnic composition of the cohort of S&E bachelor's degree recipients has changed over time, reflecting population changes and increasing rates of college attendance by members of minority groups.[vi] Between 2000 and 2013, the share of S&E degrees, but not the number, earned by white students among U.S. citizens and permanent residents declined from 71% to 62% (Figure 2-17; Appendix Table 2-18). The share awarded to Hispanic students increased from 7% to 11%. The shares awarded to Asian and Pacific Islander (9%), black (9%), and American Indian or Alaska Native students (1%) have remained flat since 2000. The number of S&E bachelor's degrees earned by students of other or unknown race or ethnicity nearly tripled in this period, to about 44,000 in 2013 (about 7% of all S&E bachelor's recipients), suggesting that the specific percentages just cited are best viewed as approximations.[vii]

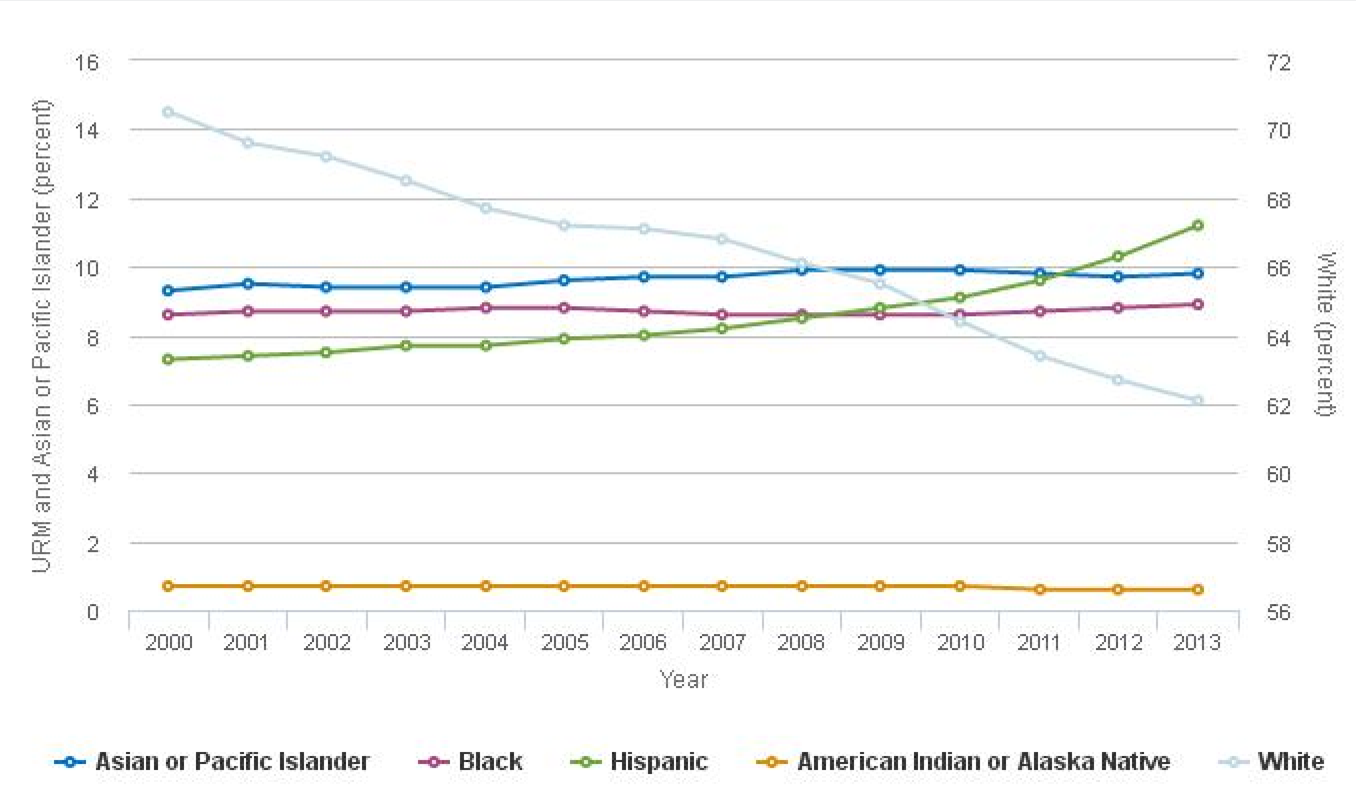
[vi] Data for racial and ethnic groups are for U.S. citizens and permanent residents only.

[vii] In 2011, institutions in IPEDS were required to report race and ethnicity in the categories mandated by the U.S. Office of Management and Budget effective 1 January 2003. So for the first time, the 2011 Completions Survey provides data on degree recipients of multiple races. In the appendix tables, this category is included under "other

or unknown race or ethnicity" because institutions were not required to update the race and ethnicity data of individuals who were already in the system; therefore, the number is likely to be an undercount. Of the 44,159 S&E bachelor's degrees earned by individuals in the "other or unknown race or ethnicity" category, 12,149 are of multiple race (special tabulations from WebCASPAR).

Figure 2-17

Share of S&E bachelor's degrees among U.S. citizens and permanent residents, by race and ethnicity: 2000–13



URM = underrepresented minorities (black, Hispanic, and American Indian or Alaska Native).

NOTES: Hispanic may be any race. American Indian or Alaska Native, Asian or Pacific Islander, black, and white refer to individuals who are not of Hispanic origin. Percentages do not add to 100% because data do not include individuals who did not report their race and ethnicity.

SOURCES: National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey; National Science Foundation, National Center for Science and Engineering Statistics, WebCASPAR database, http://webcaspar.nsf. gov.

Science and Engineering Indicators 2016

The gap in educational attainment at the bachelor's level between young minorities and whites continues to be wide, despite considerable progress for underrepresented minority groups over the past two decades. From 1980 to 2014, the percentage of the population ages 25–29 with bachelor's or higher degrees changed from 12% to 22% for blacks, 8% to 15% for Hispanics, and 25% to 41% for whites (NCES 2015). Continuing differences in completion of S&E bachelor's degrees reflect lower rates of high school completion, college enrollment, and college persistence and attainment by blacks, Hispanics, and American Indians and Alaska Natives. (For information on immediate post–high school college enrollment rates, see the Transition to Higher Education section in chapter 1.)

Among those who do graduate from college, blacks, Hispanics, and American Indians and Alaska Natives are about as likely as whites to earn bachelor's degrees in S&E fields. Asians or Pacific Islanders are far more likely to earn an S&E bachelor's degree than any other group. S&E degrees make up almost half of all degrees for Asians and Pacific

Islanders, compared with about one-third of all bachelor's degrees earned by each of the other racial and ethnic groups. However, Asians and Pacific Islanders earn degrees in the social and behavioral sciences at rates similar to those of other groups (Appendix Table 2-18).

The contrast in field distribution among whites, blacks, Hispanics, and American Indians and Alaska Natives on the one hand and Asians and Pacific Islanders on the other is apparent in S&E. White, black, Hispanic, and American Indian or Alaska Native S&E baccalaureate recipients share a similar distribution across broad S&E fields. In 2013, between 9% and 12% of all baccalaureate recipients in each of these racial and ethnic groups earned their degrees in the natural sciences and 2%–5% in engineering. Asian and Pacific Islander baccalaureate recipients earned 22% of their bachelor's degrees in the natural sciences and 8% in engineering (Appendix Table 2-23).

Since 2000, the total number of bachelor's degrees and the number of S&E bachelor's degrees rose for all racial and ethnic groups. The number of bachelor's degrees in all broad S&E fields except computer sciences also rose for most racial and ethnic groups (Appendix Table 2-18). In all racial and ethnic groups, the number of degrees in computer sciences followed the pattern for the general population: it increased considerably through 2003–04 and then sharply declined through 2008–09. In the last 2 or 3 years, the numbers started to increase, and in the case of Hispanics, the number of earned bachelor's degrees in computer sciences in 2013 was 26% above the peak reached in 2004.[viii]

S&E bachelor's degrees by citizenship. Students on temporary visas in the United States have consistently earned a small share (about 4%) of S&E degrees at the bachelor's level. In 2013, these students earned a larger share of bachelor's degrees awarded in economics and in chemical, electrical, and industrial engineering (10%–15%). The number of S&E bachelor's degrees awarded to students on temporary visas increased from about 15,000 in 2000 to about 19,000 in 2004, then declined to nearly 17,000 by 2008, but it increased through 2013, peaking at almost 27,000 (appendix table 2-18).

[viii] For patterns on S&E bachelor's degrees awarded to minority men and minority women, see (NSF/NCSES 2015c).

Graduate Education, Enrollment, and Degrees in the United States

Graduate education in S&E contributes to global competitiveness, producing the highly skilled workers of the future and the research needed for a knowledge-based economy. This section includes indicators related to U.S. graduate enrollment; recent trends in the number of advanced degrees in S&E fields; and the participation by women, minorities, and international students in graduate education in U.S. academic institutions.

Graduate Enrollment by Field

S&E graduate enrollment in the United States increased by 25% between 2000 and 2013, to more than 615,000 (Appendix Table 2-24).[i] Most of the growth occurred in the 2000s; since 2008, graduate enrollment in S&E has been fairly stable. In the period between 2000 and 2013, graduate enrollment grew considerably in most S&E fields, particularly in engineering and in the biological sciences, where enrollment has reached record numbers and risen faster than enrollment for all S&E fields. Three-quarters of the graduate students in engineering were enrolled full time in 2013, up from 69% in 2000.[ii]

Enrollment has also grown in the social sciences (where most of the growth is accounted for by the increase of graduate enrollment in political science and public administration). Graduate enrollment in computer sciences grew rapidly in the early 2000s, then decreased through 2006, but it has generally increased since then.

The number of full-time students enrolled for the first time in S&E graduate departments is an indicator of developing trends. First-time, full-time graduate enrollees are typically students pursuing a master's or a doctoral degree right after or within about a year after earning their undergraduate degrees. This indicator can be sensitive to economic conditions; for example, high unemployment tends to lead to an increase in first-time, full-time graduate enrollment. Despite some drops in first-time, full-time enrollment in engineering and computer sciences in the early to mid-2000s, this indicator has increased fairly steadily in most broad S&E fields. In 2013, the number of first-time, full-time S&E graduate students reached a new peak in both of these fields (Appendix Table 2-25).

Graduate Enrollment by Sex

In 2013, 45% of the S&E graduate students enrolled in the United States were women (Appendix Table 2-24). The proportions of female graduate students enrolled in S&E differed considerably by field, with the lowest proportions in engineering, computer sciences, and physical sciences (particularly in physics). Women constituted the majority of graduate students in psychology, medical and other health sciences, biological sciences, and social sciences, and they represented half or close to half of graduate students in agricultural sciences and earth, atmospheric, and ocean sciences. Among the social sciences, economics has an unusually low proportion of women. Between 2000 and 2013, the proportion of women enrolled increased in most broad S&E fields except for computer sciences and mathematics. The proportion of women enrolled in graduate programs in computer sciences peaked in 2000 and declined through 2011 but increased slightly in the last 2 years. In mathematics and statistics, the proportion of women peaked in 2000 and has declined slightly and gradually since then.

Graduate Enrollment of Underrepresented Groups

In 2013, among U.S. citizens and permanent residents, underrepresented minority students (blacks, Hispanics, and American Indians and Alaska Natives) accounted for 18% of students enrolled in graduate S&E programs (Appendix Table 2-26).[iii] The proportion of underrepresented minorities was highest in psychology and the social sciences (23%), medical and other health sciences (20%), and computer sciences (16%); it was lowest in the earth, atmospheric, and ocean sciences (9%) and in the physical sciences (11%). Between 2000 and 2013, the proportion of underrepresented minorities enrolled has increased in all broad S&E fields, particularly in computer sciences and psychology.

In 2013, whites accounted for about 64% of S&E graduate enrollment among U.S. citizens and permanent residents. They constituted a larger proportion of graduate students enrolled in agricultural sciences and in earth, atmospheric, and ocean sciences (about 80%) and a smaller proportion of those enrolled in computer sciences and social sciences (about 60%). The proportions of whites in other fields fell in between. Over time, however, the proportion of whites among graduates enrolled in S&E has declined in all broad S&E fields except for computer sciences, where the proportion of whites has been fairly stable.

Asians and Pacific Islanders accounted for 9% of S&E graduate enrollment among U.S. citizens and permanent residents in 2013, with larger proportions in computer sciences (15%), engineering (13%), and the biological and medical sciences (about 11% each), as well as a lower proportion in the agricultural sciences (4%); earth, atmospheric, and ocean sciences (4%); psychology (5%); and the social sciences (6%). Between 2000 and 2013, the proportion of Asians and Pacific Islanders enrolled increased slightly in most broad fields, but it declined in computer sciences (from 21% in 2000 to 15% in 2013).

About 20% of graduate students reporting a disability were enrolled in S&E fields. About 60% of those enrolled in S&E fields and reporting a disability were women, and about 90% were 24 years old or older (NSF/NCSES 2015c).

Graduate Enrollment of International Students

In recent years, enrollment of international students in S&E fields has been on the rise while overall graduate enrollment has remained flat (NSF/NCSES 2014). In 2013, nearly 200,000 international students on temporary visas were enrolled in S&E graduate programs (Appendix Table 2-26). The concentration of international enrollment was highest in computer sciences, engineering, physical sciences, mathematics and statistics, and economics.[iv]

After a post-9/11 decline, the numbers of first-time, full-time international graduate students enrolled increased more or less consistently in most broad fields through 2013 (Appendix Table 2-25). Declines and subsequent increases in number were concentrated in engineering and computer sciences, the fields heavily favored by international students. Between 2000 and 2013, international students’ share of first-time, full-time S&E graduate enrollment increased in most broad fields, except for the physical sciences (from 43% to 38%), the biological sciences (from 24% to 21%), and the social sciences (from 29% to 27%).

According to data collected by IIE, the overall number of international graduate students in all fields increased by 6% from academic years 2012–13 to 2013–14 (IIE 2014). The number of international graduate students enrolling for the first time in a U.S. institution in fall 2013 increased by 8%. China, India, South Korea, Canada, Saudi Arabia, and Taiwan were the top originating locations for international graduate students, similar to the leading international sources of undergraduate enrollment.

More recent data from SEVIS show an overall 13% increase in international graduate students from November 2013 to November 2014 in all fields (Table 2-11; Appendix Table 2-27).[v] As stated previously, this increase reflects a larger influx of international students in the United States, and because of the way these data are collected, the increase may also reflect a larger portion of international students staying in the United States to pursue another degree.[vi] In 2014, 61% of all international students in graduate programs at U.S. institutions were enrolled in S&E fields. Between fall 2013 and fall 2014, the number of international graduate students enrolled in S&E fields increased most in computer sciences and engineering, with both combined accounting for more than 75% of the total increase in international enrollment in this period. The top sending locations were India and China, accounting for 68% of the international S&E graduate students in the United States in late 2014, followed by Iran, South Korea, Saudi Arabia, and Taiwan. More than 8 in 10 graduate students from Iran were enrolled in an S&E field, particularly in engineering. Graduate students from South Korea, Saudi Arabia, and Taiwan sent larger numbers of graduate students who enrolled in non-S&E than in S&E fields.

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[i] The Survey of Graduate Students and Postdoctorates in Science and Engineering (GSS) was redesigned in 2007. Because of methodological changes, the data collected from 2007 through 2010 are not strictly comparable with those collected before 2007. As a result, care should be used when assessing trends within the GSS data. Throughout the appendix tables in this chapter, "2007new" reports the data as collected in 2007, and "2007old" provides the data as they would have been collected in 2006. In addition, between 2008 and 2010, the survey conducted a more rigorous follow-up with institutions regarding the exclusion of practitioner-oriented graduate degree programs. Some or all of the declines in psychology and other health fields in 2008–10 are likely due to this increased effort to exclude practitioner-oriented graduate degree programs rather than changes in actual enrollments. Care should therefore be used when examining long-term trends. Because of this methodological change, in this section, "S&E" excludes psychology and other health fields. For a detailed discussion on the survey redesign, please see (NSF/SRS 2007, appendix A, "Technical Notes").

[ii] Special tabulation from the Graduate Student and Postdoctorates in Science and Engineering, available at https://ncsesdata.nsf.gov/webcaspar/ (10 August 2015).

[iii] For patterns on S&E graduate degrees awarded to minority men and minority women, see (NSF/NCSES 2015c).

[iv] See (NSF/NCSES 2015c) for more detail on enrollment of international students by sex.

[v] The data include active foreign national students on F-1 visas in the SEVIS database, excluding those on OPT (temporary employment directly related to the student's major area of study either during or after completing the degree program). See note 32.

[vi] For example, an international student who is about to earn a master's degree and stays in the United States to pursue a doctoral degree would remain in the SEVIS database. It is not possible to determine the extent to which international students stay to pursue another degree because of the way the data are collected.

Table 2-11 **International students enrolled in U.S. higher education institutions, by broad field and academic level: 2008–14**

Field and level	2008	2009	2010	2011	2012	2013	2014
All fields							
All levels	526,570	525,680	537,650	574,360	635,650	676,280	750,360
Undergraduate	266,320	272,980	284,770	297,950	351,030	373,740	407,810
Graduate	260,260	252,710	252,890	276,400	284,620	302,540	342,540
S&E fields							
All levels	229,010	229,230	235,990	260,280	280,020	307,480	358,100
Undergraduate	76,780	81,110	87,590	96,400	116,640	130,990	149,090
Graduate	152,230	148,120	148,400	163,880	163,390	176,490	209,020

Field and level	2008	2009	2010	2011	2012	2013	2014
Non-S&E fields							
All levels	297,560	296,460	301,670	314,080	355,630	368,810	392,250
Undergraduate	189,530	191,870	197,180	201,560	234,390	242,750	258,730
Graduate	108,030	104,590	104,490	112,520	121,240	126,060	133,530

NOTES: Data include active foreign national students on F-1 visas and exclude those on optional practical training. Undergraduate level includes associate's and bachelor's degrees; graduate level includes master's and doctoral degrees. Numbers are rounded to the nearest 10. Detail may not add to total because of rounding.

SOURCE: U.S. Department of Homeland Security, U.S. Immigration and Customs Enforcement, special tabulations (2014) of the Student and Exchange Visitor Information System database.

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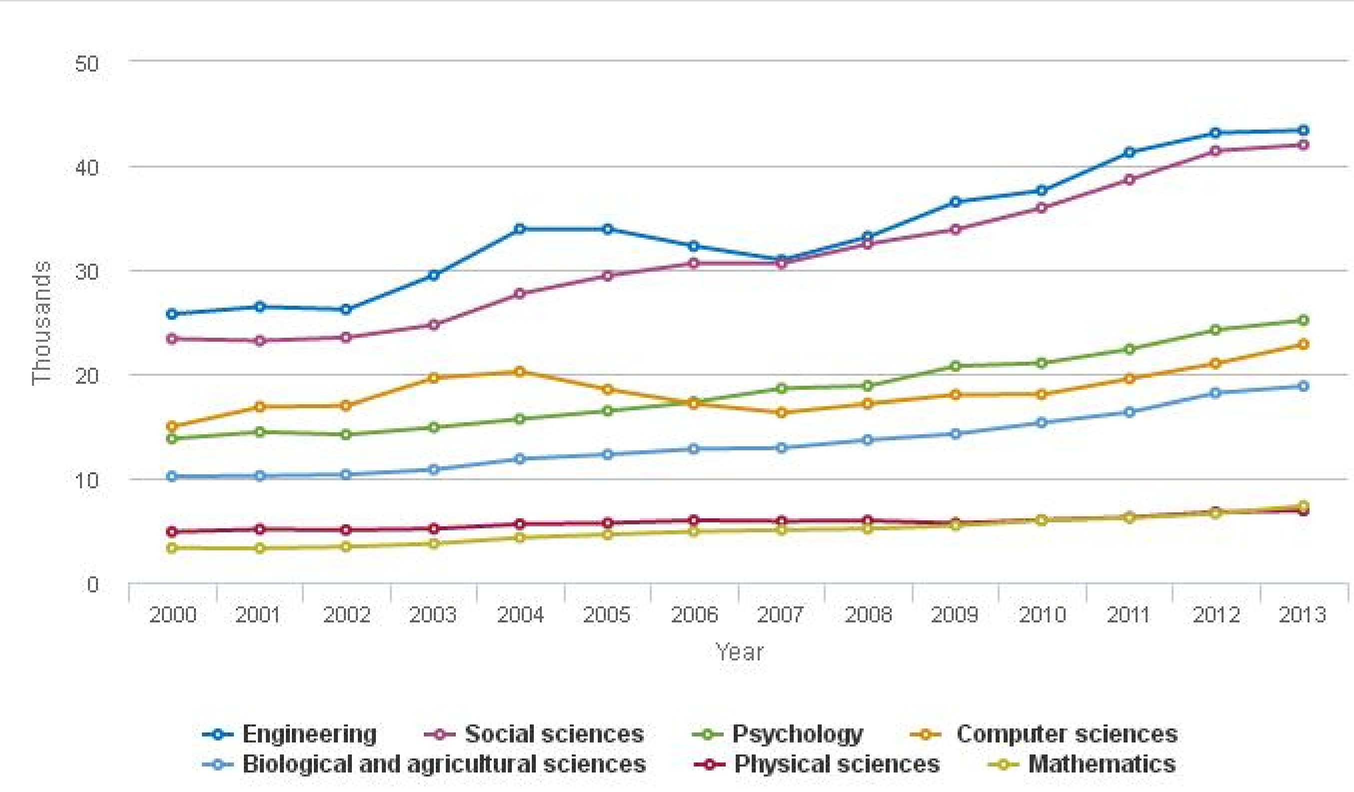
S&E Master's Degrees

Master's degrees awarded in S&E fields increased from about 96,000 in 2000 to about 166,000 in 2013, with growth concentrated in two periods, 2002–04 and 2007–13 (Appendix Table 2-28).[i] Increases occurred in all major science fields. Master's degrees awarded in engineering and computer sciences declined between 2004 and 2007, but they have since increased. The number of master's degrees awarded in engineering and in computer sciences in 2013 was the highest in the last 14 years (Figure 2-18). During this period, growth was largest in engineering, psychology, and the social sciences (particularly in political science and public administration) (Appendix Table 2-28). In some fields, such as engineering and geosciences, a master's degree can fully prepare students for an established career track. In other fields, master's degrees primarily mark a step toward doctoral degrees.

[i] Data on degree completion from NCES were obtained from WebCASPAR (https://webcaspar.nsf.gov/). Data uploaded in WebCASPAR correspond to NCES provisional data, which undergo all NCES data quality control procedures and are imputed for nonresponding institutions. These data are used by NCES in its First Look (Provisional Data) publications.

Figure 2-18

S&E master's degrees, by field: 2000–13



NOTE: Physical sciences include earth, atmospheric, and ocean sciences.

SOURCES: National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey; National Science Foundation, National Center for Science and Engineering Statistics, WebCASPAR database, http://webcaspar.nsf.gov.

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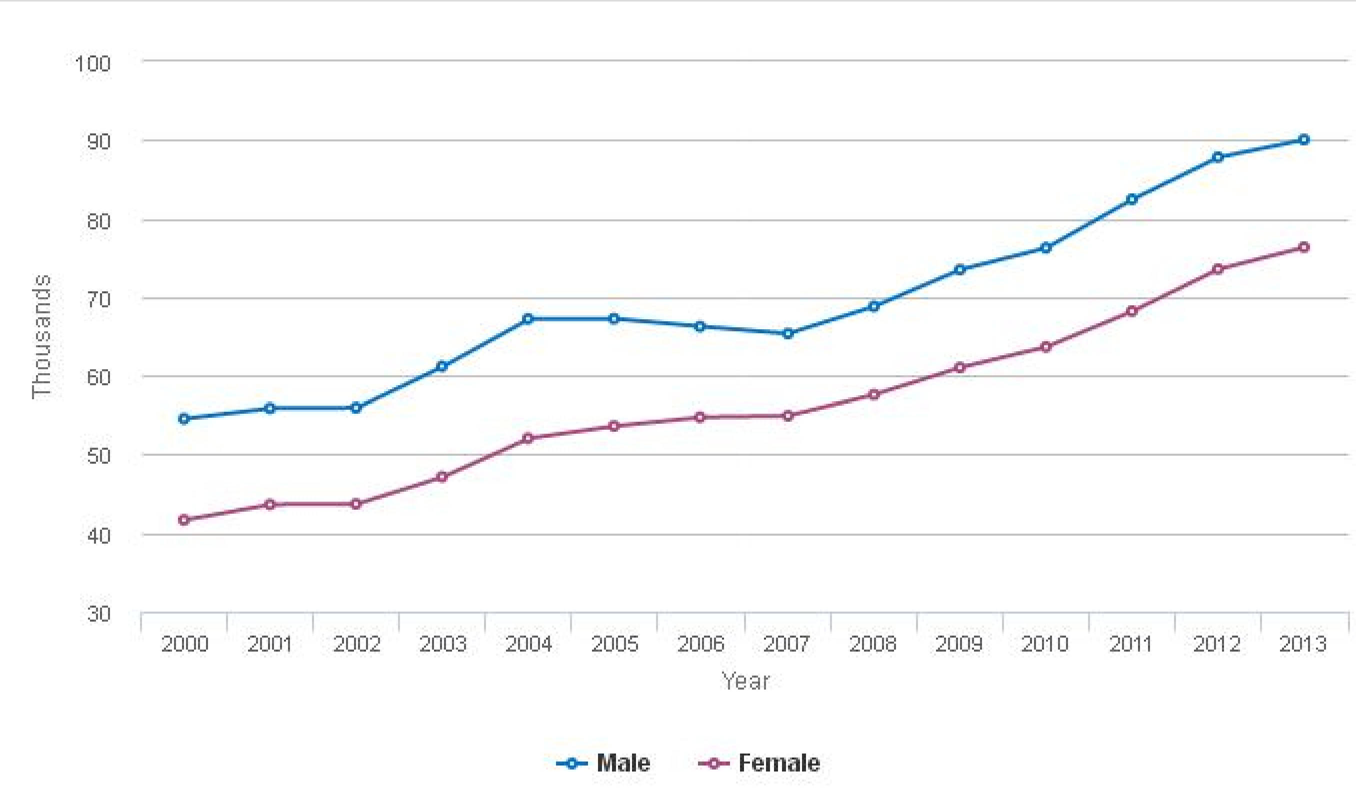
Professional Science Master's (PSM) programs, which stress interdisciplinary training, are a relatively new direction in graduate education. PSM degrees provide advanced training in an S&E field beyond the bachelor's degree level while also developing administrative and business skills that are valued by employers, such as leadership, project management, teamwork, and communication (for details on PSM degrees, see [NSB 2014:2–30]). As of April 2015, there were 334 PSM programs and 157 PSM-affiliated institutions (PSM 2015).

S&E Master's Degrees by Sex

The number of S&E master's degrees earned by both men and women rose between 2000 and 2013 (Figure 2-19). In 2000, women earned 43% of all S&E master's degrees; by 2013, they earned 46% (Appendix Table 2-28). Among U.S. citizens and permanent residents, women earned nearly half of all S&E master's degrees. However, among temporary residents, women earned slightly more than one-third of all S&E master's degrees (NSF/NCSES 2015c).

Figure 2-19

S&E master's degrees, by sex of recipient: 2000–13



SOURCES: National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey; National Science Foundation, National Center for Science and Engineering Statistics, WebCASPAR database, http://webcaspar.nsf.gov.

Science and Engineering Indicators 2016

Women's share of S&E master's degrees varies widely by field. As with bachelor's degrees, in 2013, women earned a majority of master's degrees in psychology, biological sciences, agricultural sciences, and most social sciences except economics, but low proportions of master's degrees in engineering, computer sciences, and physics. The proportion of master's degrees in engineering earned by women in 2013, however, was slightly higher than in 2000 (Appendix Table 2-28).

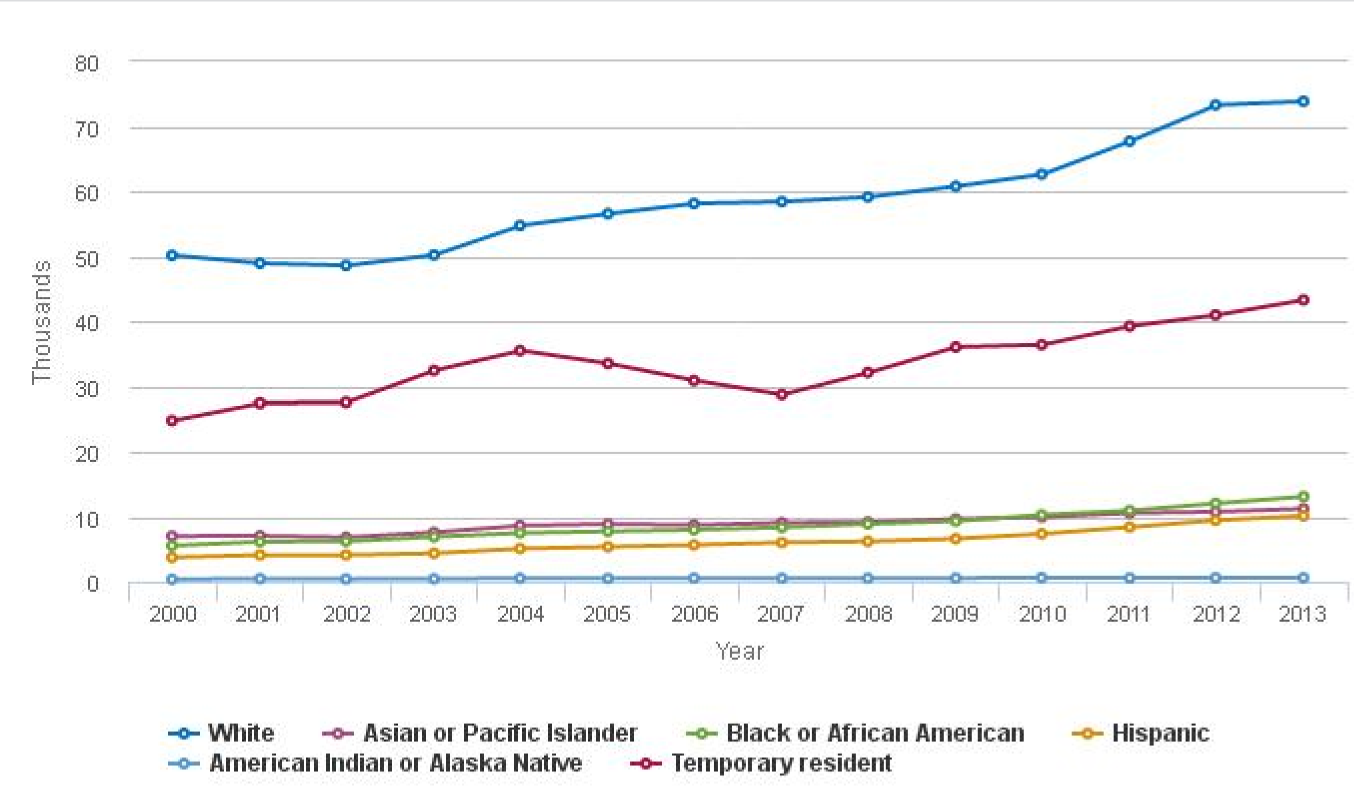
S&E Master's Degrees by Race and Ethnicity

The number of S&E master's degrees awarded to U.S. citizens and permanent residents increased for all racial and ethnic groups between 2000 and 2013 (Figure 2-20; Appendix Table 2-29).[ii]

[ii] Data for racial and ethnic groups are for U.S. citizens and permanent residents only.

Figure 2-20

S&E master's degrees, by race, ethnicity, and citizenship: 2000–13



NOTES: Data on race and ethnicity include U.S. citizens and permanent residents. Hispanic may be any race. American Indian or Alaska Native, Asian or Pacific Islander, black or African American, and white refer to individuals who are not of Hispanic origin.

SOURCES: National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey; National Science Foundation, National Center for Science and Engineering Statistics, WebCASPAR database, http://webcaspar.nsf.gov.

Science and Engineering Indicators 2016

The proportion of U.S. S&E master's degrees earned by underrepresented racial and ethnic minorities increased from 14% to 19% between 2000 and 2013; that earned by whites fell from 70% to 60%. The trends are not very different from those found in the data on bachelor's degree awards among racial and ethnic groups. Blacks accounted for 11% of S&E master's degree recipients in 2013, up from 8% in 2000; Hispanics accounted for 8%, up from 5%; and American Indians and Alaska Natives accounted for 0.5%, similar to the proportion in 2000. The proportion of Asian and Pacific Islander S&E recipients also remained flat in this period.[iii]

S&E Master's Degrees by Citizenship

The number of international master's students who earned an S&E degree increased from nearly 25,000 in 2000 to 43,000 in 2013. International students make up a much higher proportion of S&E master's degree recipients than of bachelor's or associate's degree recipients. In 2013, international students earned more than one-quarter of S&E master's degrees. Their degrees were heavily concentrated in computer sciences, economics, and engineering, where they received more than 4 out of 10 of all master's degrees awarded in 2013 (Appendix Table 2-29). Within engineering, students on temporary visas earned more than half of the master's degrees in electrical and chemical engineering.

The number of S&E master's degrees awarded to students on temporary visas reached its highest point in a decade in 2013 (43,000), after a sharp decline between 2004 and 2007. Most of the drop during this period was accounted for by decreasing numbers of temporary residents in the computer sciences and engineering fields, but in both fields, numbers rebounded by more than 50% in the following years.

[iii] For patterns on S&E master's degrees awarded to minority men and minority women, see (NSF/NCSES 2015c).

S&E Doctoral Degrees

Doctoral education in the United States generates new knowledge by closely linking specialized education and hands-on research experience. The results are important for the society as a whole and for U.S. competitiveness in a global knowledge-based economy. Doctoral education prepares a new generation of researchers in academia, industry, government, and nonprofits, as well as a highly skilled workforce for other sectors of the economy. Decades-long participation of large and growing numbers of temporary visa holders attests to the attractiveness of this model.

The number of S&E doctorates (excluding those in other health sciences[i]) conferred annually by U.S. universities increased steadily between 2002 and 2008, declined through 2010, and increased by 14% through 2013, to nearly 39,000 (Appendix Table 2-30).[ii] The growth in the number of S&E doctorates between 2000 and 2013 occurred among U.S. citizens and permanent residents as well as temporary visa holders. The largest increases in S&E doctorates were in engineering and the biological sciences (Figure 2-21).

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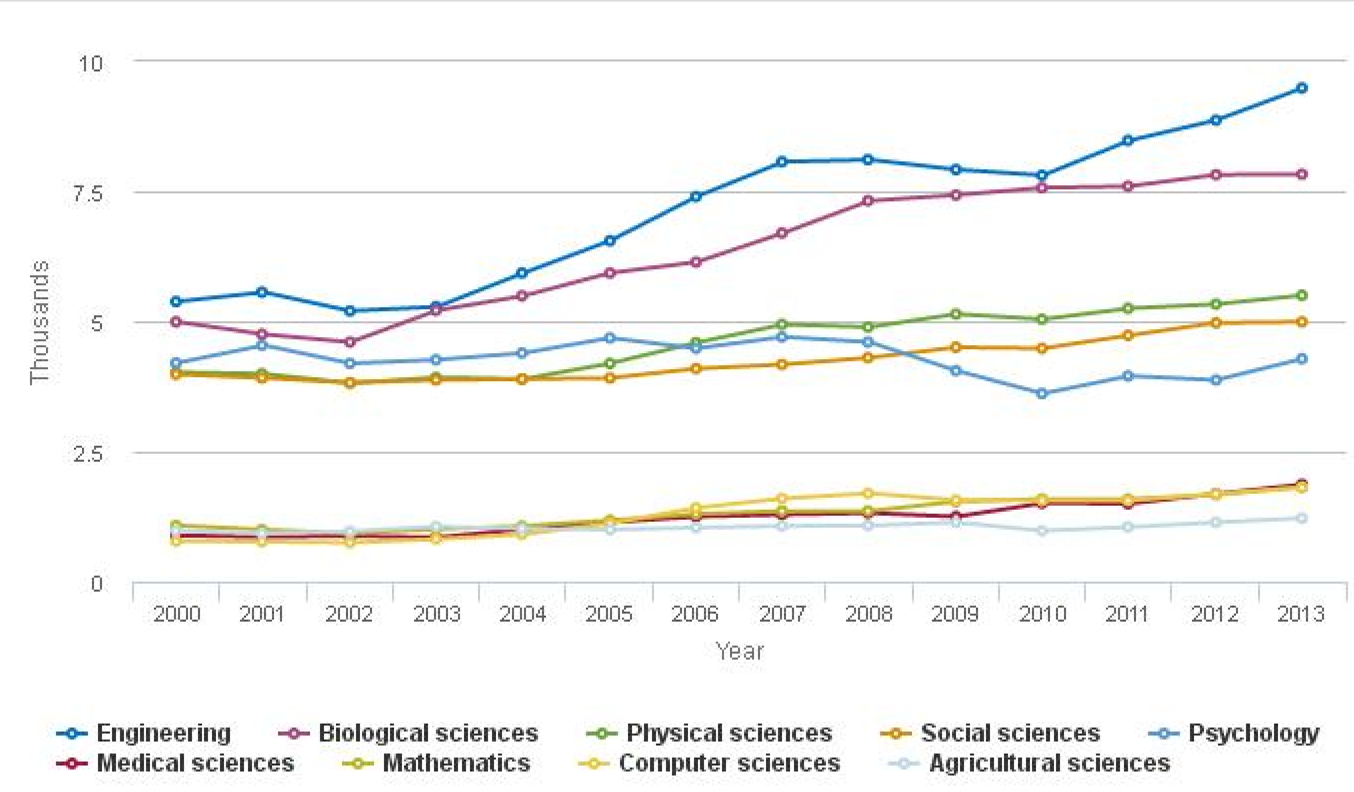
[i] Other health sciences include the fields of nursing; rehabilitation and therapeutic professions; and other health, professional, and related clinical sciences.

[ii] Data on degree completion from NCES were obtained from WebCASPAR (https://webcaspar.nsf.gov/). Data uploaded in WebCASPAR correspond to NCES provisional data, which undergo all NCES data quality control procedures and are imputed for nonresponding institutions. These data are used by NCES in its First Look (Provisional Data) publications.

Figure 2-21

S&E doctoral degrees earned in U.S. universities, by field: 2000–13



NOTES: Physical sciences include earth, atmospheric, and ocean sciences. Data differ from doctoral degree data in other tables and figures in this report that are based on the National Science Foundation Survey of Earned Doctorates and that refer to research doctorates only. Greatest differences are in psychology and medical sciences.

SOURCES: National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey; National Science Foundation, National Center for Science and Engineering Statistics, WebCASPAR database, http://webcaspar.nsf.gov.

Science and Engineering Indicators 2016

Time to Doctoral Degree Completion

The time required to earn a doctoral degree and the success rates of those entering doctoral programs are concerns for those pursuing a degree, the universities awarding the degree, and the agencies and organizations funding doctoral study. Longer times to degree mean lost earnings and a higher risk of attrition. Time to degree (as measured by time from graduate school entry to doctorate receipt) increased through the mid-1990s but has since decreased in all S&E fields from 7.7 to 6.9 years (Appendix Table 2-31). The physical sciences and mathematics had the shortest time to degree, whereas the social sciences and medical and other health sciences had the longest.

Time to degree varied among institution types (see sidebar, Carnegie Classification of Academic Institutions). Time to degree was shortest at research universities with very high research activity (6.7 years in 2013, down from 7.2 years in 1998). Doctorate recipients at medical schools also finished quickly (6.7 years in 2013). Time to degree was longer at universities that were less strongly oriented toward research (Table 2-12).

Table 2-12 **Median number of years from entering graduate school to receipt of S&E doctorate, by 2010 Carnegie classification of doctorate-granting institution: 1998–2013**

Year	All institutions	Research universities—very high research activity	Research universities—high research activity	Doctoral/research universities	Medical schools and medical centers	Other/not classified
1998	7.3	7.2	8.2	9.2	6.9	7.9
1999	7.2	7.2	7.9	9.0	6.7	7.7
2000	7.5	7.2	8.2	9.2	7.2	7.9
2001	7.2	7.2	8.2	9.7	6.9	7.7
2002	7.5	7.2	8.1	9.9	6.9	8.2
2003	7.6	7.2	8.2	9.7	6.9	9.0
2004	7.2	7.0	8.0	9.3	6.9	7.7
2005	7.3	7.2	7.9	9.3	7.0	8.1
2006	7.2	7.0	7.9	9.0	6.9	7.7
2007	7.0	6.9	7.7	8.9	6.9	7.7
2008	7.0	6.9	7.7	8.9	6.7	7.7
2009	7.0	6.9	7.7	9.2	6.8	7.7
2010	7.0	6.9	7.7	8.9	6.7	7.3
2011	7.0	6.9	7.7	8.7	6.7	7.7
2012	7.0	6.8	7.7	8.9	6.7	7.9
2013	6.9	6.7	7.4	9.3	6.7	7.7

NOTE: Includes only doctorate recipients who reported year of entry to first graduate school/program.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2014) of the 2013 Survey of Earned Doctorates.

Science and Engineering Indicators 2016

The median time to degree varies by demographic groups, but these variations reflect differences among broad fields of study. In 2013, across all doctorate recipients, women have a longer time to degree than men (7.7 versus 7.2 years, respectively) (Appendix Table 2-32). However, with few exceptions, these differences were very small when comparing men and women within broad S&E fields. In engineering, women took slightly less time than men (6.3 versus 6.7 years, respectively), and in medical and other health sciences, the difference reversed and was larger (9.7 for women versus 8.0 for men).

In most broad natural sciences and S&E fields, time to degree was longer for temporary visa holders than for U.S. students, particularly in the physical sciences (6.7 versus 5.9, respectively). However, in the medical and other health sciences, as in computer sciences, temporary visa holders finished faster. Among U.S. students, in most broad S&E fields, median time to degree was shorter for whites than for other groups. In computer sciences, time to degree of Hispanic doctorate recipients (7.3) was shorter than that of whites (7.6), Asians (9.6), and blacks (9.8).

S&E Doctoral Degrees by Sex

Among U.S. citizens and permanent residents, women's proportion of S&E doctoral degrees (excluding those in other health sciences[iii]) grew from 43% in 2000 to 48% in 2013 (Appendix Table 2-30). During this decade, women made gains in most major fields, among continuing disparities in other fields. In 2013, women earned half or more of doctorates in non-S&E fields, in most social and behavioral sciences except for economics, in the biological sciences, and in the medical and other health sciences. They earned fewer than one-third of the doctorates awarded in physical sciences, mathematics and computer sciences, and engineering (Appendix Table 2-30). Although low, the proportions of degrees earned by women in computer sciences, engineering, and the physical sciences (particularly in physics) are higher than they were in 2000.

The number of S&E doctorates earned by women grew faster than that earned by men. The number of U.S. citizen or permanent resident women earning doctorates in S&E increased from nearly 9,000 in 2000 to nearly 12,000 in 2013, while the number earned by men increased from almost 11,000 to more than 13,000 (Appendix Table 2-33). The increase in the number of S&E doctorates earned by women occurred in most major S&E fields. For example, the number of engineering doctorates earned by U.S. women increased from approximately 500 in 2000 to more than 1,000 in 2013. Similar growth patterns occurred in women's biological sciences doctorates from 1,700 to 3,100, and in physical sciences doctorates from 600 to more than 900. These differential growth rates partly reflect a decrease in the number of doctorates earned by U.S. men in many S&E fields early in the last decade. However, since around 2005, the number of doctorates earned by men has increased in all major S&E fields except for psychology.

S&E Doctoral Degrees by Disability Status

In 2012, 5% of S&E doctorate recipients reported having a disability; they were similar to those who did not report a disability in terms of broad field of study. Nearly half of the S&E doctorate recipients who reported one or more disabilities of any type indicated that they had visual disabilities, 17% reported cognitive disabilities, 19% reported hearing disabilities, 11% reported lifting disabilities, and 7% reported walking disabilities (NSF/NCSES 2015c).

S&E Doctoral Degrees by Race and Ethnicity

The number and proportion of doctoral degrees in S&E fields earned by underrepresented minorities increased between 2000 and 2013. In 2013, blacks earned 1,434 S&E doctorates, Hispanics earned 1,569, and American Indians and Alaska Natives earned 114—altogether accounting for 8% of S&E doctoral degrees (excluding doctorates in other health sciences[iii]) earned that year, up from 6% in 2000 (Appendix Table 2-33).[iv] Their share of the S&E doctorates earned by U.S. doctorate holders rose from 9% to 13% in the same period. Gains by all groups contributed to this rise, although the number of S&E degrees earned by blacks and Hispanics rose considerably more than the number earned by American Indians and Alaska Natives (Figure 2-22). Asian or Pacific Islander U.S. citizens and permanent residents earned 6% of all S&E doctorates in 2013, similar to 2000.[v]

[iii] In 2008, NCES allowed optional reporting in three new doctoral degree categories: doctor's—research /scholarship, doctor's—professional practice, and doctor's—other. Degrees formerly classified as professional degrees (e.g., MDs and JDs) could then be reported as doctoral degrees, most often as doctor's—professional practice. Data for 2008 and 2009 included only those doctorates reported under the old category plus those reported as doctor's—research/scholarship. Data for 2010 and 2011 included data reported as doctor's—research /scholarship, as the old category was eliminated. As a result of these methodological changes, doctor's—research /scholarship degrees in "other health sciences" declined sharply between 2009 and 2010. To facilitate comparability

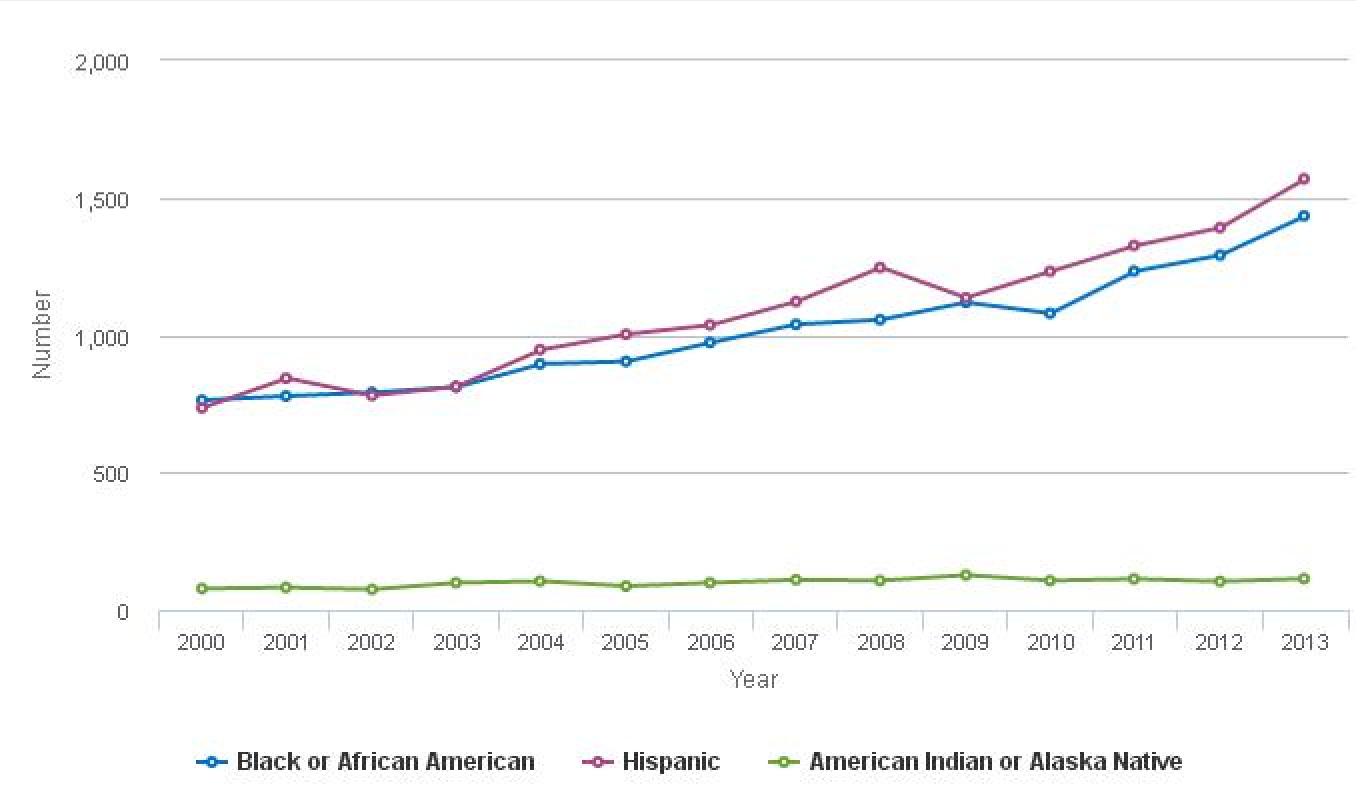
over time, “S&E” excludes “other health sciences” throughout the sections “S&E Doctoral Degrees,” “Doctoral Degrees by Sex,” and “Doctoral Degrees by Race and Ethnicity.”

[iv] For the corresponding proportion in the 1990s, see (NSB 2008).

[v] For patterns on S&E doctorates awarded to minority men and minority women, see (NSF/NCSES 2015c).

Figure 2-22

S&E doctoral degrees earned by U.S. citizen and permanent resident underrepresented minorities, by race and ethnicity: 2000–13



NOTES: Data differ from doctoral degree data in other tables and figures in this report that are based on the National Science Foundation Survey of Earned Doctorates and that refer to research doctorates only. Greatest differences are in psychology and medical/other health sciences. S&E excludes other health sciences. Hispanic may be of any race. American Indian or Alaska Native and black or African American refer to individuals who are not of Hispanic origin.

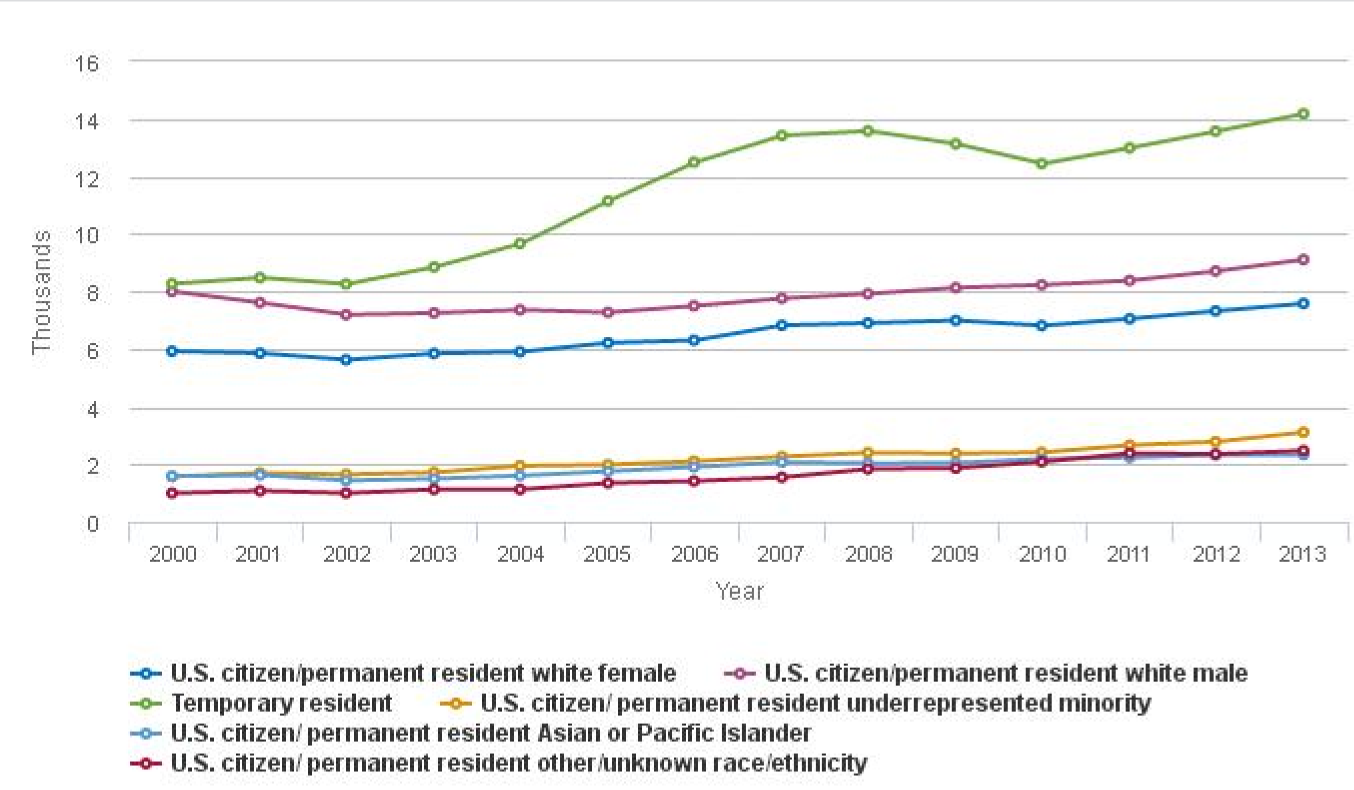
SOURCES: National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey; National Science Foundation, National Center for Science and Engineering Statistics, WebCASPAR database, http://webcaspar.nsf.gov.

Science and Engineering Indicators 2016

Although the number of S&E doctorates earned by white U.S. citizens and permanent residents increased between 2000 and 2013 (Figure 2-23), their share of all U.S. S&E doctorates fell from 53% in 2000 to 43% in 2013, reflecting the relatively faster growth among underrepresented minorities and temporary visa holders (Appendix Table 2-33).

Figure 2-23

S&E doctoral degrees, by sex, race, ethnicity, and citizenship: 2000–13



NOTES: Minority includes American Indian or Alaska Native, Asian or Pacific Islander, black or African American, and Hispanic. Data differ from doctoral degree data in other tables and figures in this report that are based on the National Science Foundation Survey of Earned Doctorates and that refer to research doctorates only. Greatest differences are in psychology and medical/other health sciences. S&E excludes other health sciences.

SOURCES: National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey; National Science Foundation, National Center for Science and Engineering Statistics, WebCASPAR database, http://webcaspar.nsf.gov. See appendix tables 2-30 and 2-33.

Science and Engineering Indicators 2016

International S&E Doctorate Recipients

Temporary residents earned more than 14,000 S&E doctorates in 2013, up from about 8,000 in 2000. International students on temporary visas earned a larger proportion of doctoral degrees than master's, bachelor's, or associate's degrees (Appendix Table 2-33, Appendix Table 2-29, Appendix Table 2-18, and Appendix Table 2-23, respectively). The temporary residents' share of S&E doctorates rose from 31% in 2000 to 37% in 2013. In some fields, these students earned even larger shares of doctoral degrees. In 2013, they earned half or more of doctoral degrees awarded in engineering, computer sciences, and economics. They earned relatively lower proportions of doctoral degrees in some S&E fields—for example, 27% in biological sciences, 25% in medical sciences, 6% in psychology, and between 12% and 22% in most social sciences (except economics) (Appendix Table 2-33).

Countries and Economies of Origin

In the two decades since 1993, U.S. universities have awarded almost 210,000 S&E doctorates to temporary visa holders. Over that period, the top 10 countries and economies of origin accounted for 70% of all international recipients of these degrees (Table 2-13). Six out of those top 10 locations are in Asia.

Table 2-13 **Recipients of U.S. S&E doctorates on temporary visas, by country/economy of origin: 1993–2013**

Country/economy	Number	Percent
All recipients on temporary visas	208,861	100.0
Top 10 total	145,232	69.5
China	55,760	26.7
India	27,655	13.2
South Korea	20,899	10.0
Taiwan	14,184	6.8
Canada	6,160	2.9
Turkey	6,110	2.9
Thailand	4,346	2.1
Japan	3,497	1.7
Mexico	3,419	1.6
Germany	3,202	1.5
All others	63,629	30.5

NOTE: Data include non-U.S. citizens with unknown visa status.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2014) of the 2013 Survey of Earned Doctorates.

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Asia. From 1993 to 2013, students from four Asian locations (China, India, South Korea, and Taiwan, in descending order) earned more than half of all U.S. S&E doctoral degrees awarded to international students (119,000 of 209,000)—exceeding students from Europe (25,000) more than fourfold. By itself, China accounted for more than one-quarter of all these S&E doctorates (56,000), followed by India (28,000), South Korea (21,000), and Taiwan (14,000). Most of these degrees were awarded in engineering, biological sciences, and physical sciences (Table 2-14). A larger proportion of South Korean and Taiwanese doctorate recipients (exceeding 20%) than Chinese and Indian (approaching 10%) earned a doctorate in a non-S&E field.

Table 2-14 **Asian recipients of U.S. S&E doctorates on temporary visas, by field and country/economy of origin: 1993–2013**

Field	Asia	China	India	South Korea	Taiwan
All fields	157,823	59,798	30,182	26,740	17,981

Field	Asia	China	India	South Korea	Taiwan
S&E	137,602	55,760	27,655	20,899	14,184
Engineering	51,879	20,006	12,220	8,316	5,785
Science	85,723	35,754	15,435	12,583	8,399
Agricultural sciences	4,795	1,565	755	759	508
Biological sciences	23,487	11,178	4,856	2,530	2,449
Computer sciences	8,228	3,385	2,303	985	666
Earth, atmospheric, and ocean sciences	2,657	1,400	331	352	249
Mathematics	6,861	3,805	757	947	548
Medical and other health sciences	4,837	1,123	1,219	622	878
Physical sciences	19,574	9,888	3,220	2,365	1,399
Psychology	1,946	409	260	450	325
Social sciences	13,338	3,001	1,734	3,573	1,377
Non-S&E	20,221	4,038	2,527	5,841	3,797

NOTES: Asia includes Afghanistan, Armenia, Azerbaijan, Bangladesh, Bhutan, Brunei, Burma/Myanmar, Cambodia, China, Georgia, Hong Kong, India, Indonesia, Japan, Kazakhstan, Kyrgyzstan, Laos, Macau, Malaysia, Maldives, Mongolia, Nepal, Pakistan, Philippines, Singapore, South Korea, Spratly Islands, Sri Lanka, Taiwan, Tajikistan, Thailand, Turkmenistan, Uzbekistan, and Vietnam. Data include temporary residents and non-U.S. citizens with unknown visa status.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2014) of the 2013 Survey of Earned Doctorates.

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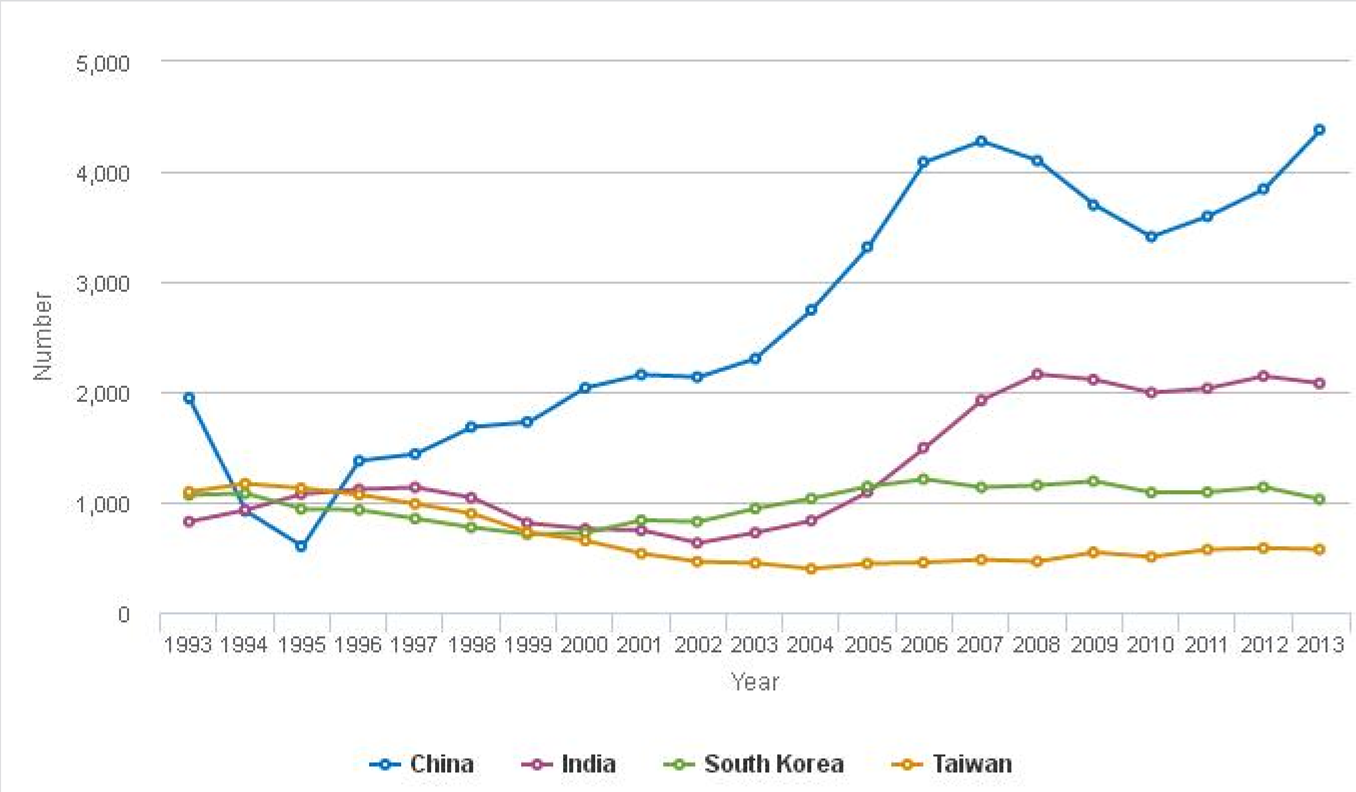
The number of S&E doctorates earned by students from China declined in the mid-1990s, increased through 2007, and dropped 16% in the following 3 years, but it rose nearly 30% since 2010, surpassing its peak in 2007 (Figure 2-24). Despite these fluctuations, the number of S&E doctorates earned by Chinese nationals more than doubled over the two decades. The number of S&E doctorates earned by students from India also declined in the late 1990s, and then increased almost every year since 2002 until it stabilized in 2009; it more than doubled over the last two decades. South Korea followed a similar trend but with a less dramatic increase in the early 2000s; since 2007, the number of S&E doctorates earned by South Koreans has been relatively stable. In contrast, Taiwan experienced a substantially different trajectory. In 1993, its students earned more U.S. S&E doctoral degrees than those from India or South Korea.[vi] As universities in Taiwan increased their capacity for advanced S&E education in the 1990s, the number of Taiwanese students earning U.S. S&E doctorates declined. Since 2004, however, their number has gradually risen.

[vi] The number of S&E doctorate recipients from China surpassed that of Taiwan in 1990. Up until that year, Taiwanese students earned more U.S. S&E doctorates than Chinese, Indian, or South Korean students (figure (NSB 2008) 2-25; figure (NSB 2010) 2-22).

Figure 2-24

U.S. S&E doctoral degree recipients, by selected Asian country/economy of origin: 1993–2013



NOTE: Degree recipients include temporary residents and non-U.S. citizens with unknown visa status.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2014) of the 2013 Survey of Earned Doctorates.

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Europe. European students earned far fewer U.S. S&E doctorates than Asian students between 1993 and 2013—a combined number broadly comparable with doctorates earned by students from India—and they tended to focus less on engineering than did their Asian counterparts (Table 2-14 and Table 2-15). European countries whose students earned the largest number of U.S. S&E doctorates from 1993 to 2013 were Germany, Russia, Greece, Italy, Romania, France, and the United Kingdom, in that order. Trends in doctorate recipients from individual Western European countries vary widely (Figure 2-25). The number of Central and Eastern European students earning S&E doctorates at U.S. universities nearly quadrupled between 1993 and 2013, to 390. Although their numbers almost reached the Western Europe total between 2005 and 2007, they have declined since then (Figure 2-26). A higher proportion of doctorate recipients from Russia, Romania, and Greece than from the United Kingdom, France, Italy, and Germany earned their doctorates in S&E. Russian and Romanian doctorate recipients were more likely than those from Western European countries to earn their doctorates in mathematics and physical sciences, and Greek and French doctorate recipients were more likely to earn doctoral degrees in engineering (Table 2-15).

Table 2-15 **European recipients of U.S. S&E doctorates on temporary visas, by field and region/country of origin: 1993–2013**

Field	All European countries	Germany	Russia	Greece	Italy	Romania	France	United Kingdom
All fields	31,139	4,102	2,939	2,309	2,587	2,105	2,154	2,413
S&E	25,167	3,202	2,653	2,041	2,011	1,876	1,733	1,690
Engineering	4,956	521	390	737	446	301	568	177
Science	20,211	2,681	2,263	1,304	1,565	1,575	1,165	1,513
Agricultural sciences	654	91	17	55	53	21	58	36
Biological sciences	3,678	506	372	213	187	219	243	334
Computer sciences	1,535	196	120	239	88	234	58	47
Earth, atmospheric, and ocean sciences	960	154	93	34	79	34	86	129
Mathematics	2,581	280	340	138	199	359	73	144
Medical and other health sciences	537	80	12	51	22	17	33	74
Physical sciences	5,183	626	955	304	349	490	356	307
Psychology	696	146	38	40	41	33	20	98
Social sciences	4,387	602	316	230	547	168	238	344
Non-S&E	5,972	900	286	268	576	229	421	723

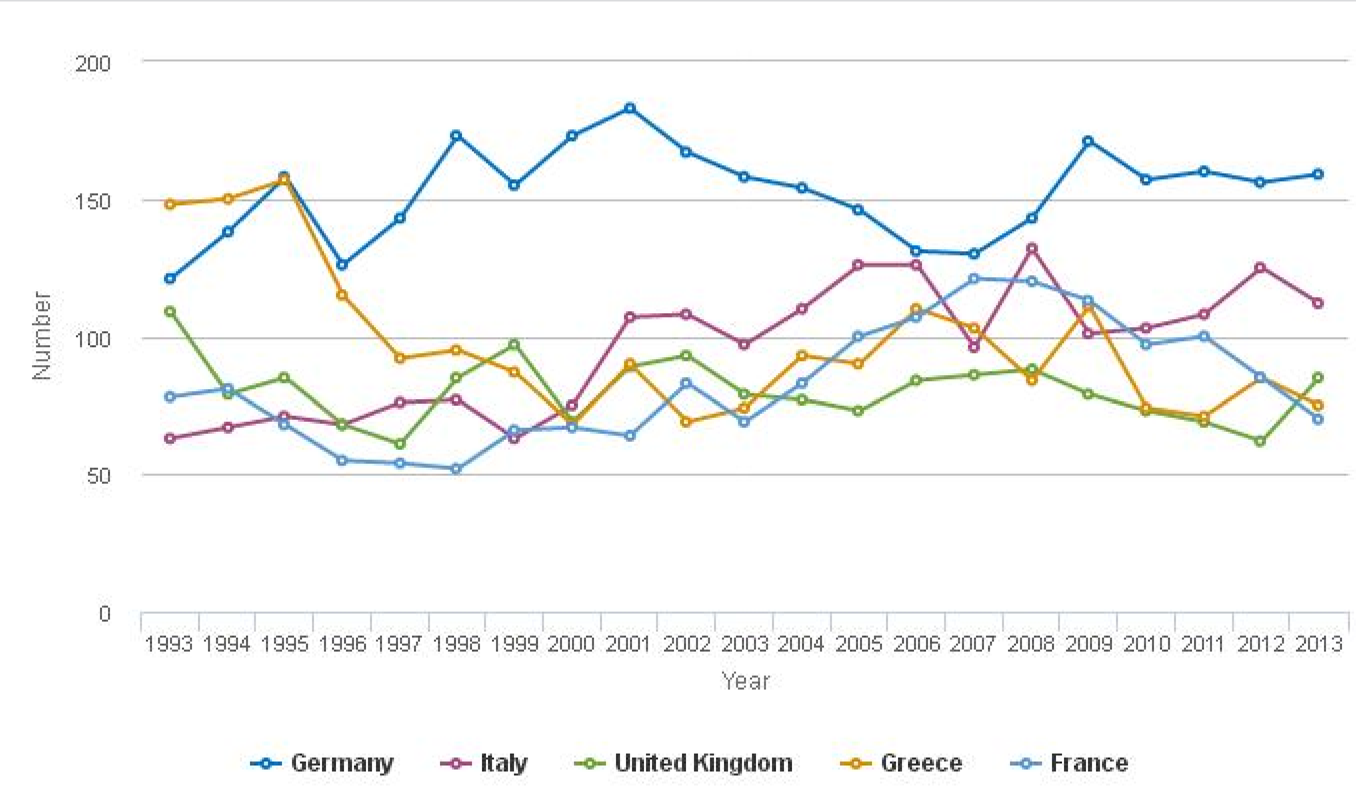
NOTE: Data include temporary residents and non-U.S. citizens with unknown visa status.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2014) of the 2013 Survey of Earned Doctorates.

Science and Engineering Indicators 2016

Figure 2-25

U.S. S&E doctoral degree recipients, by selected Western European country: 1993–2013



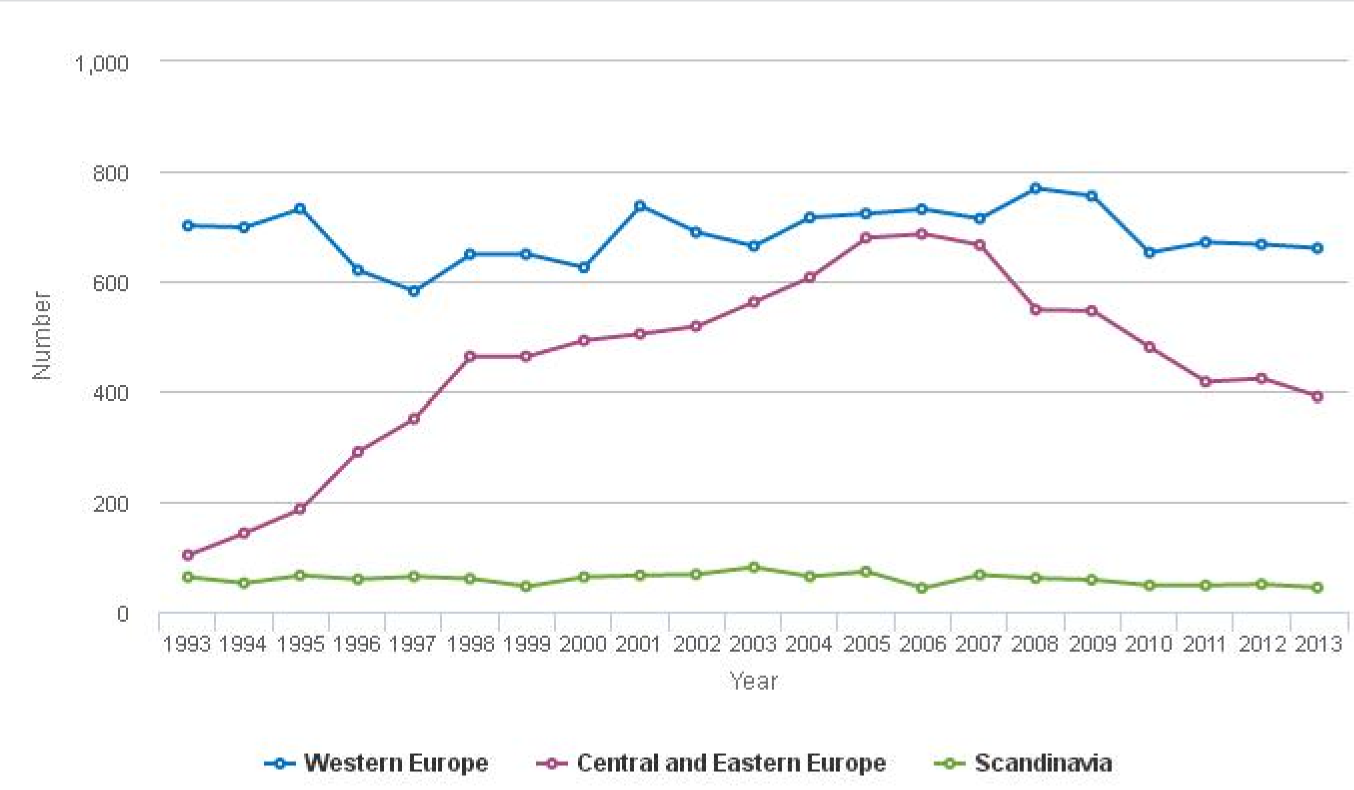
NOTE: Degree recipients include temporary residents and non-U.S. citizens with unknown visa status.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2014) of the 2013 Survey of Earned Doctorates.

Science and Engineering Indicators 2016

Figure 2-26

U.S. S&E doctoral degree recipients from Europe, by region: 1993–2013



NOTES: Degree recipients include temporary residents and non-U.S. citizens with unknown visa status. Western Europe includes Andorra, Austria, Belgium, France, Germany, Greece, Ireland, Italy, Liechtenstein, Luxembourg, Malta, Monaco, Netherlands, Portugal, San Marino, Spain, Switzerland, and United Kingdom. Central and Eastern Europe includes Albania, Belarus, Bosnia-Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Kosovo, Latvia, Lithuania, Macedonia, Moldova, Montenegro, Poland, Romania, Russia, Serbia, Slovakia, Slovenia, and Ukraine. Scandinavia includes Denmark, Finland, Iceland, Norway, and Sweden.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2014) of the 2013 Survey of Earned Doctorates.

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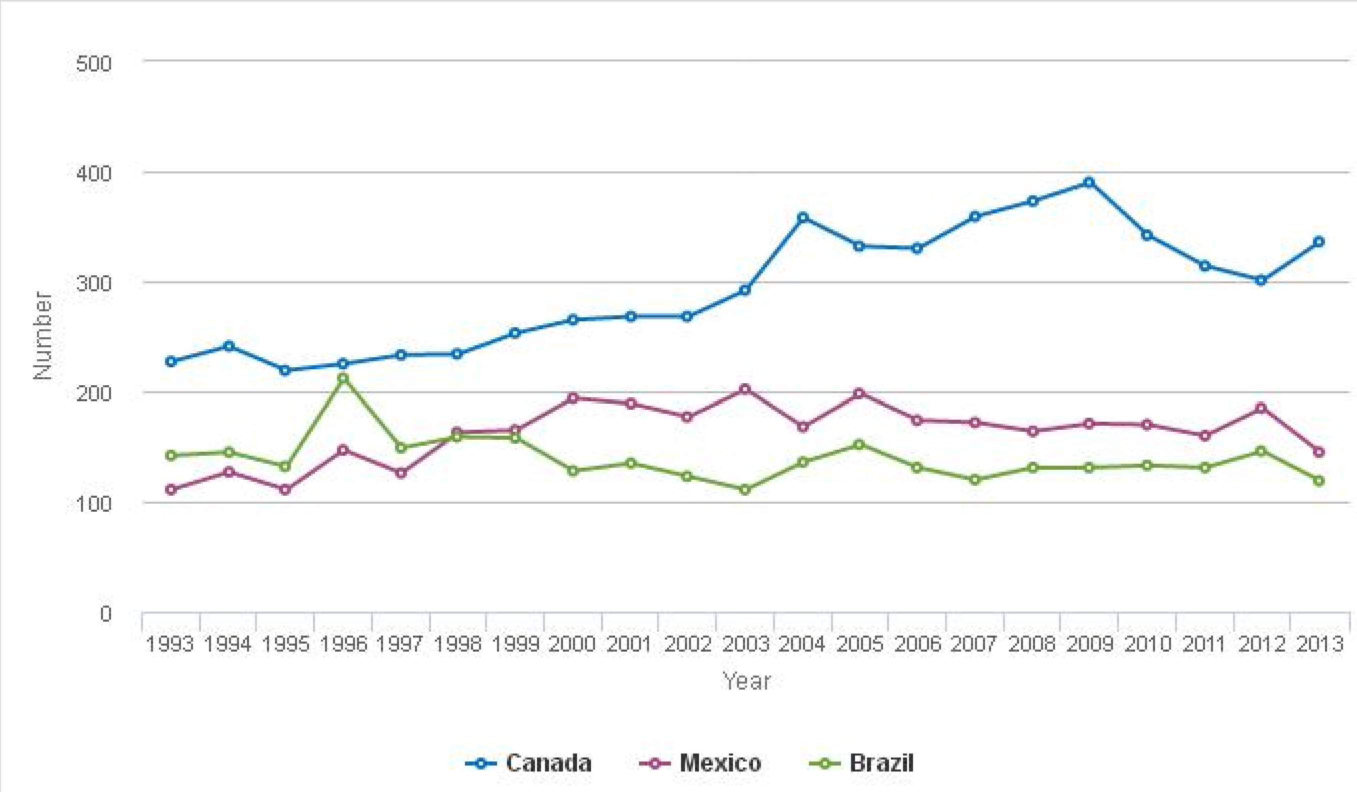
The Americas. Despite the proximity of Canada and Mexico to the United States, the shares of U.S. S&E doctoral degrees awarded to residents of these countries were small compared with those awarded to students from Asia and Europe. The number of U.S. doctoral S&E degrees earned by students from Canada increased from about 230 in 1993 to 390 in 2009, but it has mostly declined in the last 4 years. The overall numbers of doctoral degree recipients from Mexico and Brazil peaked earlier (2003 and 1996, respectively) and have been relatively stable in recent years (Figure 2-27).

Figure 2-27

U.S. S&E doctoral degree recipients from Canada, Mexico, and Brazil: 1993–2013



NOTE: Degree recipients include temporary residents and non-U.S. citizens with unknown visa status.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2014) of the 2013 Survey of Earned Doctorates.

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A higher proportion of Mexican and Brazilian students earned U.S. doctorates in S&E fields than the comparable proportion for Canadians (Table 2-16). In particular, higher proportions of Mexican and Brazilian students than Canadian students received U.S. doctoral degrees in engineering and agricultural sciences.

Table 2-16 **North American, South American, and Middle Eastern recipients of U.S. S&E doctorates, by field and region/country of origin: 1993–2013**

	North and South America[a]				Middle East[b]			
Field	All countries	Canada	Mexico	Brazil	All countries	Turkey	Iran	Jordan
All fields	24,518	8,994	3,989	3,503	17,558	7,242	2,560	1,790
S&E	19,076	6,160	3,419	2,924	14,440	6,110	2,450	1,551
Engineering	4,047	958	852	687	6,498	2,704	1,645	678
Science	15,029	5,202	2,567	2,237	7,942	3,406	805	873

	North and South America[a]				Middle East[b]			
Field	All countries	Canada	Mexico	Brazil	All countries	Turkey	Iran	Jordan
Agricultural sciences	1,872	220	536	403	536	241	38	77
Biological sciences	3,477	1,285	501	489	1,368	522	154	161
Computer sciences	676	217	111	161	923	365	122	105
Earth, atmospheric, and ocean sciences	686	208	139	111	232	94	24	11
Mathematics	985	314	201	155	687	306	112	83
Medical and other health sciences	810	387	81	164	496	45	40	144
Physical sciences	1,800	781	289	140	1,290	583	210	164
Psychology	901	683	39	59	316	124	12	6
Social sciences	3,822	1,107	670	555	2,094	1,126	93	122
Non-S&E	5,442	2,834	570	579	3,118	1,132	110	239

[a] North America includes Bermuda, Canada, and Mexico; South America includes Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Guyana, Paraguay, Peru, Suriname, Uruguay, and Venezuela.

[b] Middle East includes Bahrain, Gaza Strip, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, Turkey, United Arab Emirates, West Bank, and Yemen.

NOTE: Data include temporary residents and non-U.S. citizens with unknown visa status.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2014) of the 2013 Survey of Earned Doctorates.

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The Middle East. Between 1993 and 2013, Middle Eastern students earned far fewer U.S. S&E doctorates (about 14,000) than did students from Asia, Europe, or the Americas (Table 2-14, Table 2-15, and Table 2-16). Students from Turkey earned the largest number of U.S. S&E doctorates in this region, followed by those from Iran and Jordan. A larger proportion of Iranian (64%) than of Turkish (37%) or Jordanian (38%) doctorate recipients earned their doctorates in engineering.

International S&E Higher Education

In the 1990s, many countries, coming to view an educated population and workforce as a valuable national resource, expanded their higher education systems and eased access to higher education. At the same time, flows of students worldwide increased, often reflecting government incentives and programs. More recently, several countries have adopted policies to encourage the return of students who studied abroad, to attract international students, or both. As the world becomes more interconnected, students who enroll in tertiary (postsecondary) institutions outside their own countries have opportunities to expand their knowledge of other societies and languages and improve their employability in globalized labor markets.

Higher Education Expenditures

One indicator of the importance of higher education is the percentage of a nation's resources devoted to it as measured by the ratio of expenditures on tertiary education institutions to gross domestic product (GDP). This indicator varies widely among members of the OECD, an intergovernmental group of developed economies. Only about one-third of OECD members spend more than the average of 1.6% of a nation's GDP on tertiary education institutions, and only Canada, the United States, South Korea, and Chile spend more than 2%. According to the most recently available data from the OECD, in 2011, Canada spent the highest proportion of GDP on tertiary education institutions compared with all other OECD countries, followed by the United States, South Korea, and Chile (Appendix Table 2-34). Between 2000 and 2011, U.S. expenditures on tertiary education as a percentage of GDP were 60% higher than the OECD average and about 90% higher than the European Union (EU; see Glossary for member countries) average. Between 2000 and 2011, expenditures on tertiary education institutions as a percentage of GDP rose in most OECD countries, particularly in the United States, New Zealand, Turkey, the Czech Republic, Canada, and Estonia, as well as Russia. In the United Kingdom, expenditures on tertiary education institutions as a proportion of GDP rose between 2000 and 2009, but declined between 2009 and 2011.

Higher education financing data are not always fully comparable across different nations. They can vary between countries for reasons unrelated to actual expenditures, such as differences in measurement, types and levels of government funding included, types and levels of education included, and the prevalence of public versus private institutions. According to an international database compiled by the Program for Research on Private Higher Education at the State University of New York at Albany (2011), the United States and Japan have long-standing private higher education sectors, and Western Europe has an almost completely public higher education sector. Eastern and Central Europe and several African countries have recently seen growth in private higher education. In most countries in Latin America, more than half of all higher education institutions are private. In Asia, many governments have encouraged the expansion of private higher education as one of the strategies to deal with high enrollment growth (see sidebar, Trends in Higher Education in Asia). In 2011, about 80% of the students in South Korea and Japan and 60%–64% of the students in Singapore, the Philippines, Nepal, Indonesia, and Cambodia were enrolled in private institutions (UNESCO/UIS 2014).

Trends in Higher Education in Asia

Enrollment in higher education across Asia has grown considerably in the last two decades as a result of higher secondary school participation rates and a higher demand for an educated workforce in Asia's increasingly knowledge-oriented economies. According to a 2014 report by the United Nations Educational, Scientific and Cultural Organization Institute for Statistics (UNESCO/UIS 2014), to adapt to this enrollment growth, higher education systems had to "expand out" by building more campuses and universities. At the same time, higher education systems had to “expand up” by introducing new graduate programs to prepare and train qualified professors and researchers.

This expansion created a financial challenge for many governments. Their strategies for addressing this challenge include, for example, shifting some of the cost to students and their families by introducing fees or fee-based courses; encouraging public universities to find private funding; increasing the use of online instruction; and encouraging the expansion of private higher education, including the establishment of branch campuses of foreign universities.

In some Asian countries, this expansion also affected the quality of education because there were not enough qualified instructors to satisfy the demand. At the same time, increasing numbers of students meant heavier teaching loads, so student-instructor ratios also increased. For example, between 2000 and 2011, the student-instructor ratio increased in Bangladesh, Cambodia, China, Indonesia, Laos, Macau, and Vietnam. In the same period, however, the student-instructor ratio declined considerably in Thailand, Myanmar, South Korea, and Malaysia.

Many universities in Asia compete to obtain high placements in international university rankings. High rankings may influence public resource allocation and bring more government investment to top universities. High rankings may also attract more international students and thus increase revenues both for the university and the country where these students enroll. Publication rates in top-tier journals are a key component of these rankings, which implies that the competition for high rankings may put pressure on faculty to publish at top-tier international journals and in turn may affect teaching quality.

At the same time governments in Asia were trying to expand graduate education to meet the demand for university instructors, they also began to promote university-based research. University research is typically done at the graduate level, so expanding graduate education is viewed as a means to advance innovation and increase national competitiveness.

Educational Attainment

Higher education in the United States expanded greatly after World War II. As a result, the U.S. population led the world in educational attainment for several decades. Because of this, the United States offered clear advantages for firms whose work would benefit from the availability of a highly educated workforce. In the 1990s, however, many countries in Europe and Asia began to expand their higher education systems. Some of them have now surpassed the United States in the attainment of bachelor’s degrees or higher in their younger cohorts. Over time, the expansion of higher education elsewhere has substantially diminished the U.S. educational advantage.

Although the United States continues to be among those countries with the highest percentage of the population ages 25–64 with a bachelor’s degree or higher, several other countries have surpassed the United States in the percentage of the younger population (ages 25–34) with a bachelor’s degree or higher (Figure 2-28).[i]

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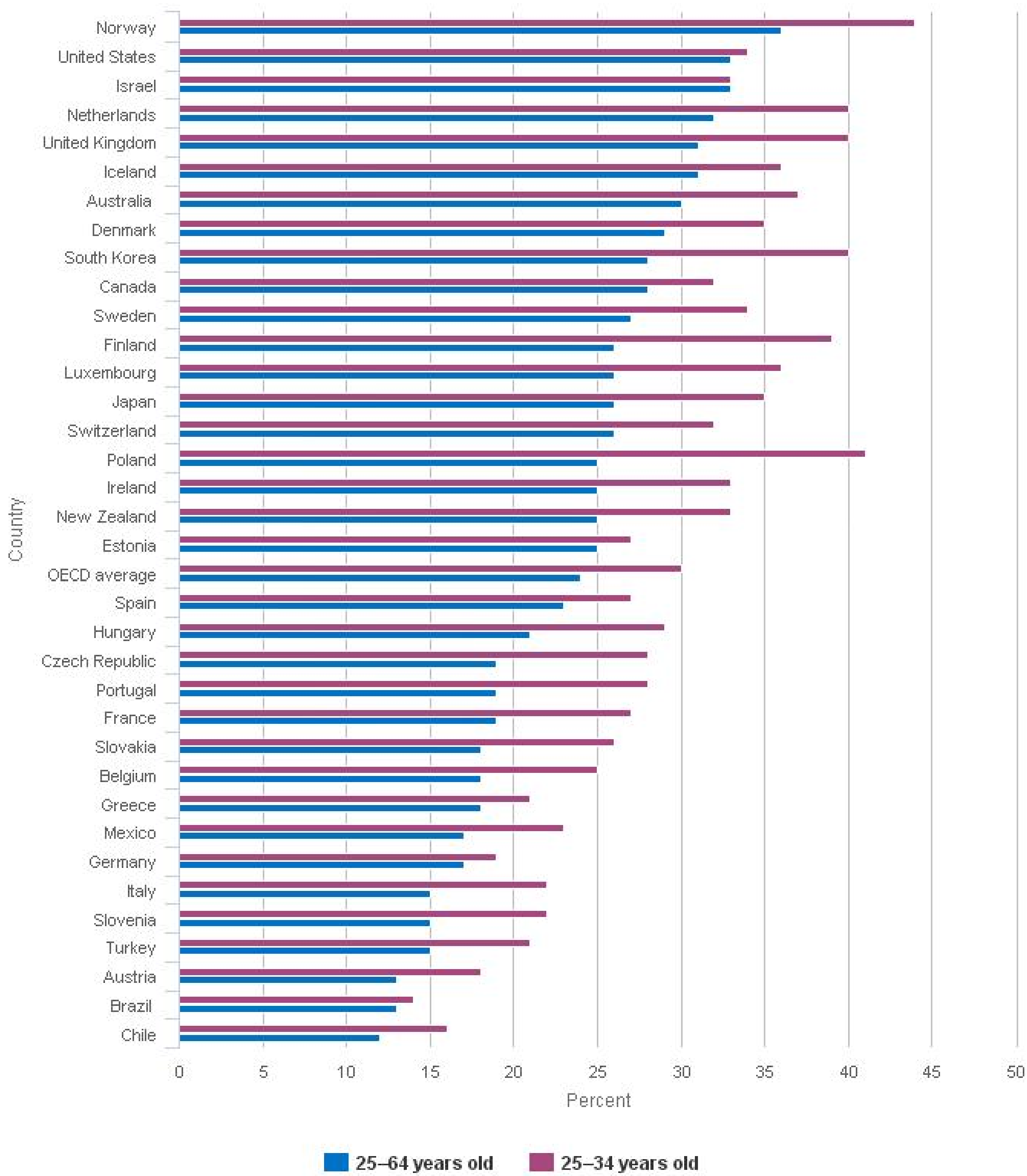
[i] These data are based on national labor force surveys and are subject to sampling error; therefore, small differences between countries may not be meaningful. The standard error for the U.S. percentage of 25–64-year-olds with a bachelor’s or higher degree is roughly 0.1, and the standard error for the U.S. percentage of 25–34-year-olds with a bachelor’s or higher degree is roughly 0.4.

Figure 2-28

Attainment of tertiary-type A and advanced research programs, by country and age group: 2012



OECD = Organisation for Economic Co-operation and Development.

NOTES: For Chile, the year of reference is 2011 instead of 2012. International Standard Classification of Education (ISCED) tertiary-type A programs, ISCED 5A, are largely theory based and designed to provide sufficient qualifications for entry to advanced research programs and professions with high-skill requirements such as medicine, dentistry, or architecture and have a minimum duration of 3 years' full-time equivalent, although they typically last 4 years or longer. In the United States, they correspond to bachelor's and master's degrees. Advanced research programs are tertiary programs leading directly to award of an advanced research qualification (e.g., doctorate).

SOURCE: OECD, *Education at a Glance 2014: OECD Indicators* (2014).

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First University Degrees in S&E Fields

More than 20 million students worldwide earned first university degrees (see Glossary) in 2012, with over 6 million of these in S&E fields (Appendix Table 2-35). These worldwide totals include only countries for which relatively recent data are available (primarily countries in Asia, Europe, and the Americas) and are therefore underestimates. Asian universities accounted for nearly 4 million of the world's S&E first university degrees in 2012, close to half of them in engineering. Students across Europe (including Eastern Europe and Russia) earned more than 1 million S&E first university degrees (nearly one-third of them in engineering),[i] and students in North America earned nearly 800,000 such degrees in 2012 (20% in engineering).

In several countries and economies around the world, the proportion of first university degrees in S&E fields was higher than in the United States. Nearly half or more of all first university degrees in China were in S&E fields, compared with about one-third in the United States. National differences in engineering degrees largely account for overall differences in the proportion of S&E degrees, given that the disparity was especially large in engineering. However, differences in the taxonomies and quality of engineering programs and level of reporting detail across countries make comparisons problematic. For example, according to Wadhwa and colleagues (2007), in China in the mid-2000s, the term "engineer" had no standard definition and did not translate well into different dialects, so the reports sent to the Ministry of Education from different Chinese provinces did not count degrees consistently. In the late 1990s, the Chinese government implemented top-down policy changes to increase enrollment in engineering. However, the total number of technical schools and the corresponding numbers of teachers and staff declined, which meant that degree awards were achieved by increasing class sizes and student-to-teacher ratios, leading to a decline in academic programs' quality.

China has traditionally awarded a large proportion of its first university degrees in engineering, although the percentage declined from 43% in 2000 to 32% in 2012 (Appendix Table 2-36). Other places with a high proportion of engineering degrees are Singapore, Taiwan, Iran, South Korea, Indonesia, Japan, Finland, Mexico, and Colombia (Appendix Table 2-35). In the United States, about 5% of all bachelor's degrees are in engineering. About 12% of all bachelor's degrees awarded in the United States and worldwide are in the natural sciences (physical, biological, computer, and agricultural sciences, as well as mathematics and statistics).

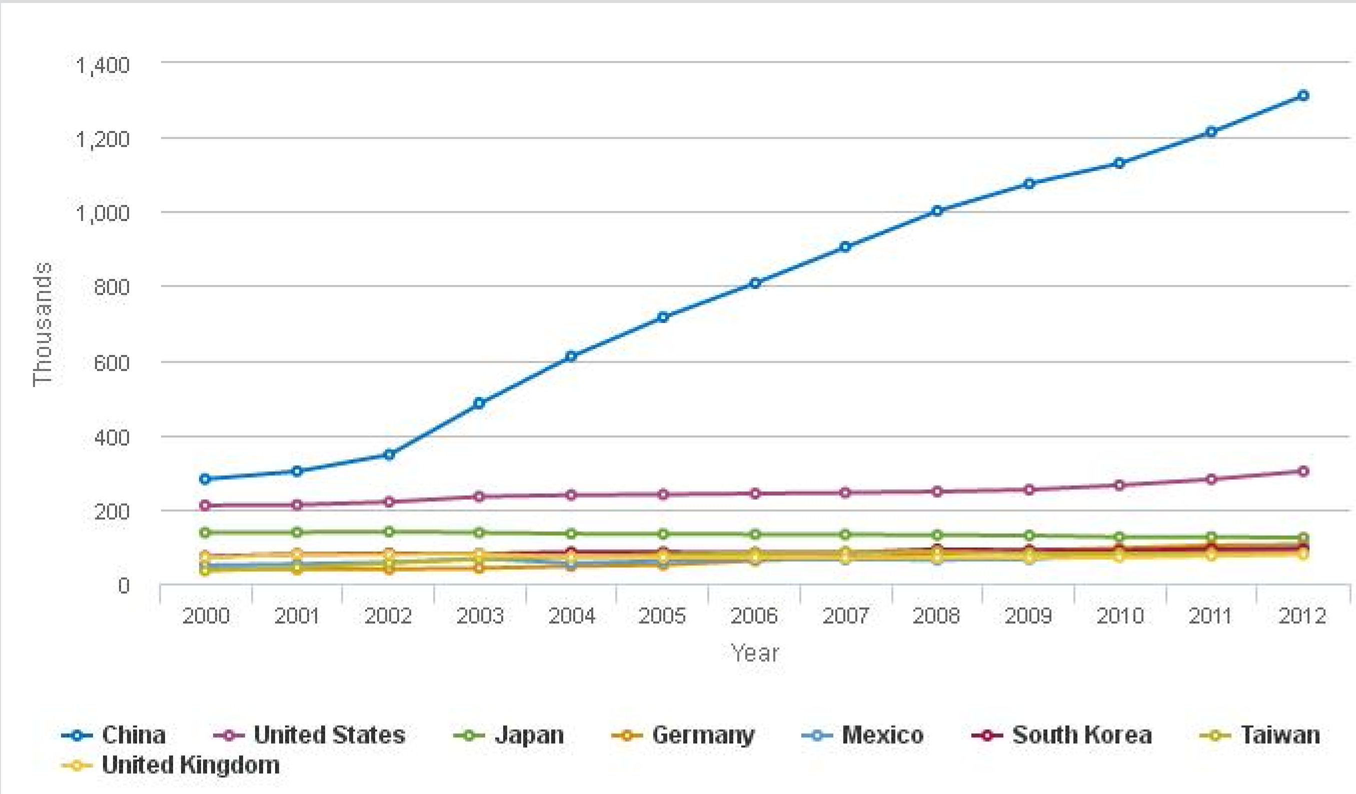
The number of S&E first university degrees awarded in China, Taiwan, Germany, Turkey, and Mexico doubled or more than doubled between 2000 and 2012. During this period, such degrees awarded in Australia grew by about two-thirds;[ii] those awarded in the United States and Poland increased by nearly 50%. S&E first university degrees awarded in France, Japan, and Spain declined by 24%, 10% and 3%, respectively. Growth in natural sciences and engineering degrees in China accounted for most of the country's increase in S&E first university degrees; about 1.3 million, up more than 300% from 2000 to 2012 (Figure 2-29; Appendix Table 2-36).

[i] For OECD countries, engineering includes “engineering and engineering trades” (International Standard Classification of Education [ISCED] 52), which is more specific than the code available in previous publications: “engineering, manufacturing, and construction” (ISC 5).

[ii] Comparison for Australia covers the 2000–11 period.

Figure 2-29

First university natural sciences and engineering degrees, by selected country: 2000–12



NOTE: Natural sciences include agricultural sciences; biological sciences; computer sciences; earth, atmospheric, and ocean sciences; and mathematics.

SOURCES: China—National Bureau of Statistics of China, *China Statistical Yearbook*, annual series (Beijing) (various years); Germany, Mexico, South Korea, and United Kingdom—Organisation for Economic Co-operation and Development, Online Education Database, http://stats.oecd.org/Index.aspx; Japan—Government of Japan, Ministry of Education, Culture, Sports, Science and Technology, Survey of Education;); Taiwan—Ministry of Education, Educational Statistics of the Republic of China (Taiwan): 2013 (2013); United States—National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey; National Science Foundation, National Center for Science and Engineering Statistics, WebCASPAR database, http://webcaspar.nsf.gov.

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In 1999, 29 European countries, through the Bologna Declaration, initiated a system of reforms in higher education throughout Europe. The goal of the Bologna Process was to harmonize certain aspects of higher education within participating countries so that degrees were comparable; credits were transferable; and students, teachers, and researchers could move freely from institution to institution across national borders. Ten years later, the European Higher Education Area was launched, and higher education reform in Europe was extended to 47 participating countries. In recent years, countries have made considerable changes: they have modified higher education structures by implementing three degree cycles (bachelor’s, master’s, and doctorate), developed quality assurance systems, and established mechanisms to facilitate mobility (EACEA 2012). A recent report that examined data in the areas of access, retention, and employability across 36 education systems, however, indicated that most European countries have been slow to set clear goals or monitor progress in those areas (EACEA 2014).

S&E First University Degrees by Sex

Women earned half or more of first university degrees in S&E in many countries around the world in 2012, including the United States and several smaller countries. Most large countries in Europe are not far behind, with more than 40% of S&E first university degrees earned by women. In the Middle East, women earned nearly half or more of the S&E first university degrees in most countries in the region, except for Iraq. In several Asian countries, women generally earn about one-third or fewer of the first university degrees awarded in S&E fields. For example, in Taiwan, women earn 26% of the S&E first university degrees; in Japan, 28%; and in South Korea, 30% (Appendix Table 2-37).

In Canada, the United States, and many smaller countries, more than half of the S&E first university degrees earned by women were in the social and behavioral sciences. In contrast, in Singapore and Colombia, about half of the S&E first university degrees earned by women were in engineering, much higher proportions than in the United States or most countries in Europe. Other countries with relatively high proportion of women earning first university degrees in engineering include South Korea (31% of their S&E first university degrees), Malaysia (31%), Iran (30%), Taiwan (28%), Finland (28%), and India (27%),

Global Comparison of S&E Doctoral Degrees

Nearly 200,000 S&E doctoral degrees were awarded worldwide in 2012.[i] The United States awarded the largest number of S&E doctoral degrees of any country (about 35,000), followed by China (about 32,000), India (about 14,000), Germany (about 12,000), the United Kingdom (about 11,000), and France (about 8,000) (Appendix Table 2-38). About 60,000 S&E doctoral degrees were earned in the EU.

The number of S&E doctoral degrees awarded in China rose steeply between 2000 and 2009 and has leveled off since then. Although the rise was steeper in China, the trend was similar to the recent trend in doctoral production in the United States (Appendix Table 2-39 and Appendix Table 2-40). In 2007, China surpassed the United States as the world's largest producer of natural sciences and engineering doctoral degrees (Figure 2-30). The high growth of graduate education in China has been the result of large government investments in higher education over the last 20 years, intended to establish world-class universities in this country. Project 211 and Project 985 are examples of programs launched by the Chinese government in the mid-1990s to establish and strengthen institutions of higher education and key fields of study as a national priority (Lixu 2004) (see sidebar, Trends in Higher Education in Asia).

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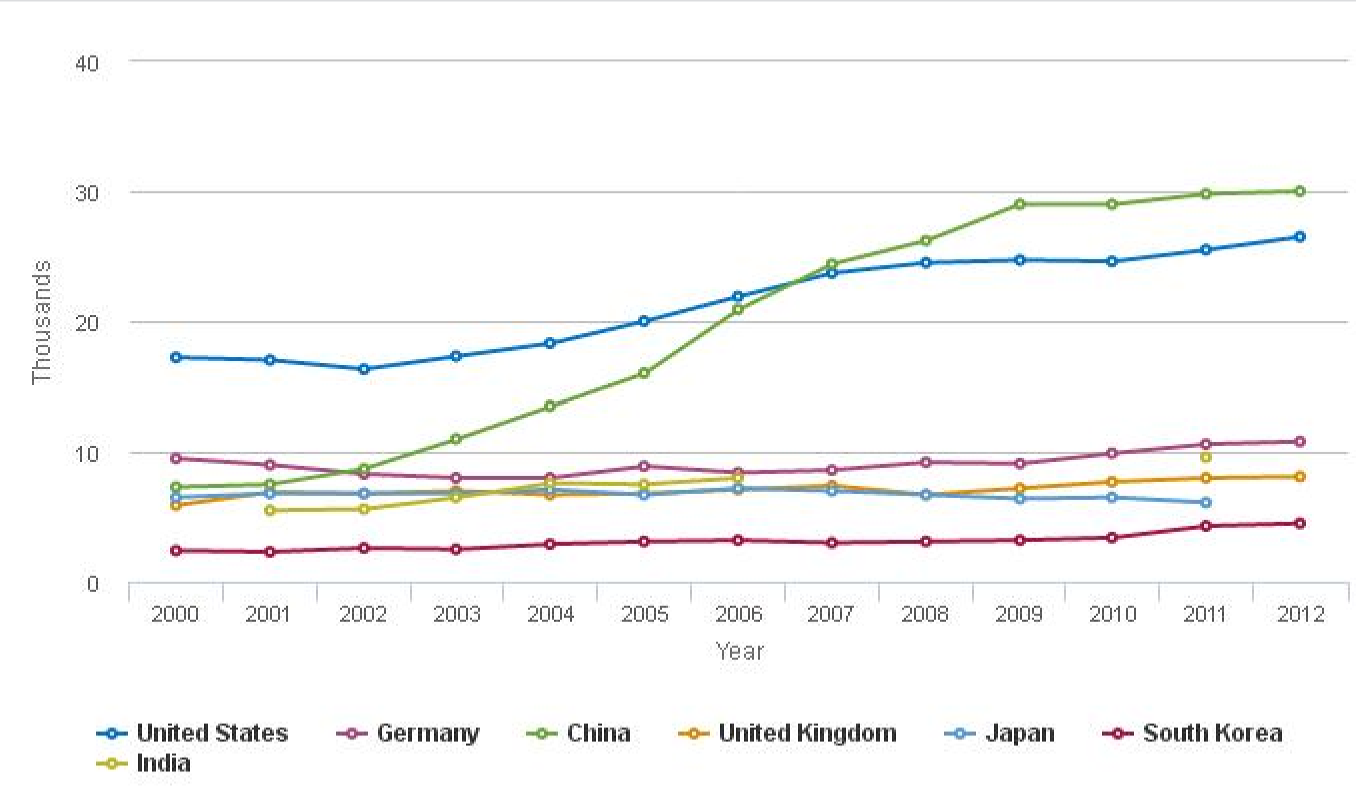
[i] In international degree comparisons, S&E does not include medical or other health fields. This is because international sources cannot separate the MD degrees from degrees in the health fields, and the MDs are professional or practitioner degrees, not research degrees.

Figure 2-30

Natural sciences and engineering doctoral degrees, by selected country: 2000–12



NA = not available.

NOTES: Natural sciences and engineering include biological, physical, earth, atmospheric, ocean, and agricultural sciences; computer sciences; mathematics; and engineering. Data for India are not available for 2007–10; data for Japan are not available for 2010.

SOURCES: China—National Bureau of Statistics of China, *China Statistical Yearbook*, annual series (Beijing) (various years); India—Department of Science and Technology; Japan—Government of Japan, Ministry of Education, Culture, Sports, Science and Technology, Survey of Education; Germany, South Korea, and United Kingdom—Organisation for Economic Co-operation and Development, Online Education Database, http://stats.oecd.org/; Russia—United Nations Educational, Scientific and Cultural Organization Institute for Statistics database, special tabulations (as of January 2015); United States—National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey; National Science Foundation, National Center for Science and Engineering Statistics, WebCASPAR database, http://webcaspar.nsf.gov.

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In the United States, as well as in France, Germany, Italy, Spain, Switzerland, and the United Kingdom, the largest numbers of S&E doctoral degrees were awarded in the physical and biological sciences (Appendix Table 2-39). In Sweden, the number of doctorates awarded in the physical and biological sciences is similar to the number of doctorates awarded in engineering.

In Asia, China has been the largest producer of S&E doctoral degrees since 2000 (Appendix Table 2-40). As China's capacity for advanced S&E education increased, the number of S&E doctorates awarded rose from about 6,000 in 1998 to more than 32,000 in 2012. Despite the growth in the quantity of doctorate recipients, some question the quality of the doctoral programs in China (Cyranoski et al. 2011). The rate of growth in doctoral degrees in S&E and in all fields has slowed in 2010 (Appendix Table 2-40), after an announcement by the Chinese Ministry of Education indicating that China would begin to limit admissions to doctoral programs and focus more on quality of graduates (Mooney 2007).

Between 1998 and 2012 (2011 in the case of India), the number of S&E doctorates awarded in India, South Korea, and Taiwan more than doubled; in Japan, the numbers rose consistently through 2006 but declined through 2011 (the most recent data available). In China, Japan, South Korea, and Taiwan, more than half of S&E doctorates were awarded in engineering. In India, 40% of the S&E doctorates were awarded in the physical and biological sciences and 31% in the social and behavioral sciences (Appendix Table 2-40).

Women earned 41% of S&E doctoral degrees awarded in the United States in 2012, about the same percentage earned by women in Canada and the EU (Appendix Table 2-41).[ii] Women earned more than half of S&E doctoral degrees in Norway, Portugal, Latvia, Lithuania, and Ukraine but less than 20% of those in South Korea and Taiwan.

[ii] In the United States, women earned nearly half of the S&E doctoral degrees awarded to U.S. citizens and permanent residents in 2012 (Appendix Table 2-30).

Global Student Mobility

Governments around the world have increasingly come to regard movement toward a knowledge-based economy as key to economic progress. Realizing that this requires a well-trained workforce, they have invested in upgrading and expanding their higher education systems and broadening participation in them. In most instances, government spending underwrites these initiatives. Recent investments by several governments to send large numbers of their students to study abroad are a strategy for workforce and economic development. Examples include the Brazil Scientific Mobility Program (also known as Science without Borders), launched officially in July 2011, which provides scholarships to Brazilian students to study in STEM fields in universities in the United States.[i] Similarly, the government of Saudi Arabia has invested considerably in a scholarship program launched in 2005 that has supported study abroad programs for more than 100,000 Saudi students throughout the world, at an estimated cost of at least $5 billion since the program’s inception (Knickmeyer 2012). In 2013, the Mexican government announced its Proyecta 100,000 program, which plans to send 100,000 students to study in the United States by 2018 (Lloyd 2014). The Chinese government has established the China Scholarship Council, a nonprofit affiliated with the Ministry of Education whose goal is to provide financial assistance to Chinese citizens to study abroad, as well as to foreign citizens to study in China (China Scholarship Council 2015).

Students have become more internationally mobile in the past two decades, and countries are increasingly competing for them. According to data from the OECD, the number of internationally mobile students who pursued a higher education degree more than doubled between 2000 and 2012, to 4.5 million (OECD 2014).[ii] In general, students migrate from developing countries to the more developed countries and from Europe and Asia to the United States. However, a few countries have emerged as regional hubs for certain geographic regions—for example, Australia, China, and South Korea for East Asia and South Africa for sub-Saharan Africa (UNESCO 2009; Bhandari, Belyavina, and Gutierrez 2011). In addition, several countries have set targets for increasing the numbers of international students they host; among these are Jordan (which plans to host 100,000 students by 2020), Singapore (150,000 by 2015), Japan (300,000 by 2025), and China (500,000 by 2020) (Bhandari and Belyavina 2012).

Some students migrate temporarily for education, whereas others remain abroad permanently after completing their studies. Some factors influencing the decision to seek a degree abroad include the policies of the countries of origin regarding sponsoring their citizens' studies abroad, the tuition fee policies of the countries of destination, the financial support the countries of destination offer to international students, the cost of living and exchange rates that affect the cost of international education, and the perceived value of obtaining a foreign credential. The long-term return on investment from international education also depends on how international degrees are recognized by the labor market in the country of origin (OECD 2010). For host countries, enrolling international students can help raise revenues from higher education and can be part of a larger strategy to attract highly skilled workers, particularly as demographic changes in many developed countries cause their own populations of college-age students to decrease (OECD 2012) (Appendix Table 2-42).

In recent years, many countries have expanded their provision of transnational education. One growing trend is the establishment of branch campuses: offshore programs established by higher education institutions in foreign countries. For local students, branch campuses provide the opportunity to earn degrees from foreign universities without leaving their home countries. For the institution venturing into a new country, meeting enrollment and financial goals without diluting quality standards is often a challenge. Branch campuses that bring in faculty from other countries can also fulfill some of the demand for highly qualified instructors that cannot be met by local higher education institutions (UNESCO/UIS 2014).

According to the State University of New York at Albany's Cross-Border Education Research Team (C-BERT) (Kinser and Lane 2015), a clearinghouse of information and research on transnational education, as of May 2015, there were 235 international branch campuses in operation and 23 with plans to open. C-BERT defines a branch campus as "an entity that is owned, at least in part, by a foreign education provider; is operated in the name of the foreign provider; engages in at least some face-to-face teaching; and provides access to an entire academic program that leads to a credential awarded by the foreign education provider." There were a total of 32 exporting countries (i.e., home countries of the institutions establishing branch campuses) and 73 importing countries (i.e., host countries for branch campuses). The largest exporters of branch campuses, in order of the number of branch campuses established, were the United States (83 branch campuses), the United Kingdom (34), Russia (20), Australia (17), and France (16). The largest importers of branch campuses, in order of the number of branch campuses they hosted, were the United Arab Emirates (33 branch campuses), China (28), Singapore (14), Qatar (11), and Malaysia (9). In some cases, branch campuses are a part of what countries designate as an international "education hub." Although there is no agreed-upon definition of "education hub," the term conveys the existence of cross-national education and research activities within a designated region. Examples of education hubs include Qatar, the United Arab Emirates, Abu Dhabi, Hong Kong, Malaysia, Singapore, and Botswana (Knight 2014; Kinser and Lane 2015).

More internationally mobile students (both undergraduate and graduate) go to the United States than to any other country (Figure 2-31). Other top destinations for international students include the United Kingdom (10%) Australia (6%), France (6%), and Germany (5%). Together with the United States, these countries receive about half of all internationally mobile students worldwide. Although the United States remains the destination for the largest number of internationally mobile students worldwide, its share in all fields has declined from 25% in 2000 to 19% in 2013 (OECD 2014).

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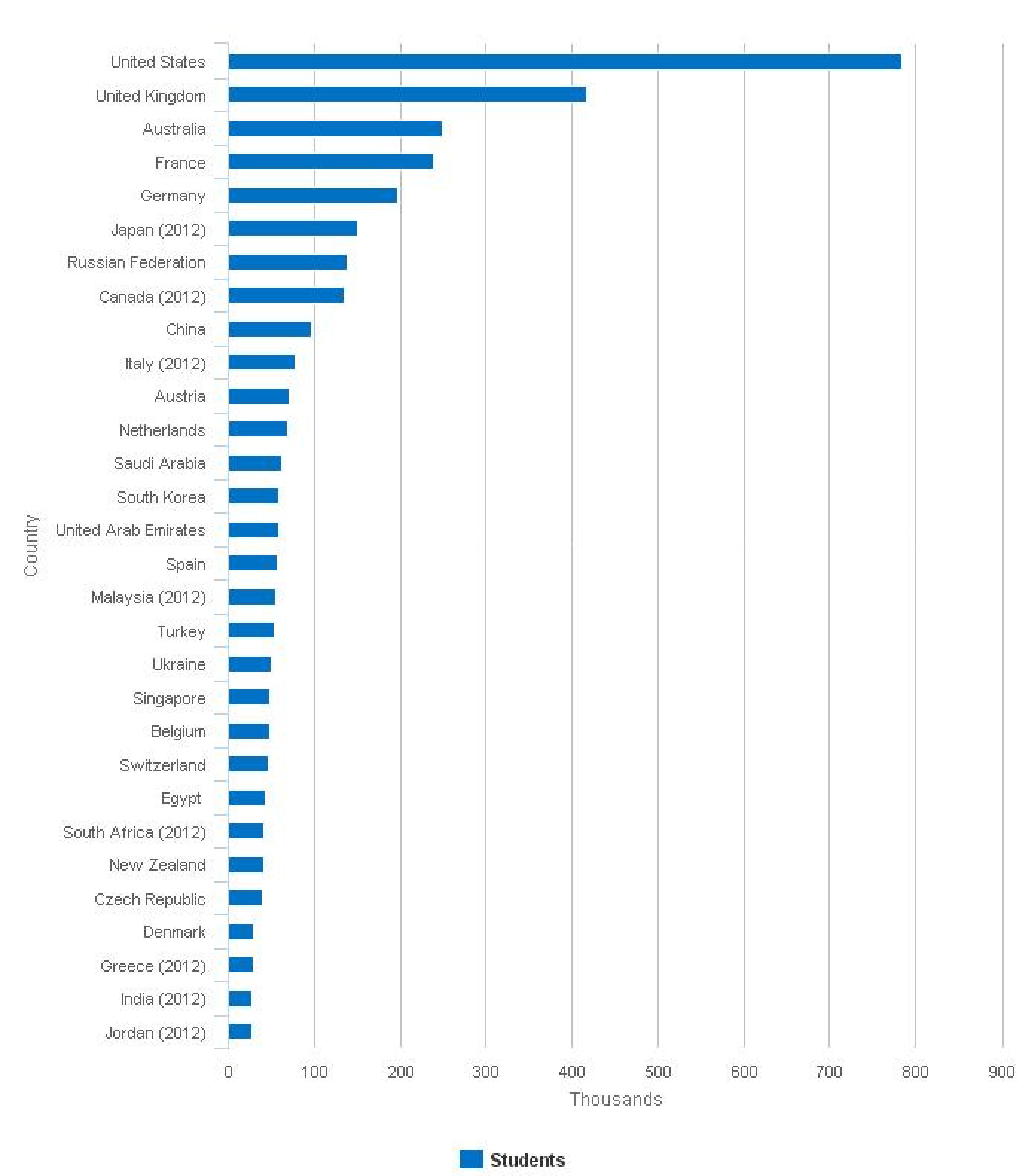
[i] This initiative is part of a broader effort from the Brazilian government to grant 100,000 scholarships to the best students to study abroad at the top universities around the world (IIE 2015a).

[ii] Internationally mobile students are those who have crossed a national or territorial border for the purposes of education and are now enrolled outside their country of origin. This concept is different from “foreign students,” which are those who are not citizens of the country where they are enrolled, but may, in some cases, be long-term residents or have been born in the country (OECD 2012).

Figure 2-31

Internationally mobile students enrolled in tertiary education, by selected country: 2013



NOTE: Data are based on the number of students who have crossed a national border and moved to another country with the objective of studying (i.e., mobile students).

SOURCE: United Nations Educational, Scientific and Cultural Organization Institute for Statistics database, special tabulations (2015).

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In the United States, international students are a small proportion (about 4%) of students enrolled in higher education (including both undergraduate and graduate levels); this proportion is higher at the graduate level. In other countries, the proportion of international students is much higher. Australia, with a much smaller higher education system than the United States, has a higher percentage of international students in tertiary-type A programs (19%) but a lower share (6%) of international students worldwide. Other countries with relatively high percentages of international students in tertiary-type A programs include the United Kingdom (18%), Austria (17%), Switzerland (17%), and New Zealand (13%).[iii] In Switzerland, more than 50% of doctoral students are international students, and in the United Kingdom, more than 41% of them are international students. Several other countries, including Belgium, New Zealand, Australia, the United States, Sweden, Canada, and Ireland have relatively high percentages (more than 20%) of doctoral students who are internationally mobile (OECD 2014).

Since the late 1990s, the United Kingdom has been actively working to improve its position in international education, by recruiting international students to study in the country and by expanding its provision of transnational education (British Council 2015; UKCISA 2013). Between 1995 and 2014, international student enrollment in S&E fields in the United Kingdom increased by nearly 51,000 international students at the undergraduate level and by close to 55,000 at the graduate level (Appendix Table 2-43), but the proportion of international students is much higher at the graduate than at the undergraduate level. For example, in 2013–14, international students were 14% of all undergraduates in the United Kingdom (an increase from 9% in 1994–95), compared with 48% at the graduate level (an increase from 29% in 1994–95). At the graduate level, international students accounted for 60% of graduate students in engineering and 56% in mathematics and computer sciences. Students from China accounted for most of the increase in international student enrollment, both at the graduate and the undergraduate levels. However, the number of undergraduate students from India, Hong Kong, Cyprus, and Nigeria, as well as the number of graduate students from Nigeria, India, Italy, Saudi Arabia, the United States, and Germany also increased considerably (Appendix Table 2-43).

In the context of slowing student enrollment in Japan, in 2008, the government announced plans to triple international enrollment within 12 years (McNeil 2008, 2010). Although Japan succeeded in increasing its enrollment of international students between 2004 and 2014 (in S&E and in all fields), growth has slowed considerably in the last 4 years (Appendix Table 2-44; appendix table [NSB 2012] 2-41; appendix table [NSB 2014] 2-45), perhaps caused in part by the March 2011 earthquake and tsunami (McNeil 2012). In 2014, nearly 70,000 international students were enrolled in S&E programs in Japanese universities, similar to the preceding 4 years and up from 57,000 in 2004. The number of international students in Japan was larger at the undergraduate than at the graduate level; however, international students accounted for a smaller proportion of students at the undergraduate than at the graduate level in 2014 (3% of undergraduate and 17% of graduate S&E students). The vast majority of the international students were from Asian countries. In 2014, Chinese students accounted for 65% of the international S&E undergraduate students and 56% of the international S&E graduate students in Japan. South Koreans were 18% of the international undergraduates and 7% of the international graduate students. Vietnam, Malaysia, Indonesia, Thailand, Taiwan, and Nepal were among the top 10 locations of origin for both undergraduates and graduate students (Appendix Table 2-44).

International students in Canada constitute a larger share of enrollment at the graduate than at the undergraduate level (Appendix Table 2-45). The proportion of international enrollment in Canadian universities has been growing, from 6% in 2002 to 8% in 2012 at the undergraduate level and from 20% to 24% at the graduate level. In 2012, at the undergraduate and graduate levels, the highest percentages of international S&E students were in mathematics and computer sciences and in engineering. At the undergraduate level, China was the top country of origin of international S&E students in Canada, accounting for 22% of international undergraduate students, followed by France and the United States (11% and 9%, respectively). The proportion of international undergraduate S&E students in Canada from China and France increased considerably between 2002 and 2012, while the proportion of students from the United States declined. At the graduate level, the top country of origin of international S&E students was also China (15%), followed by Iran and France (13% and 11%, respectively). The proportion of international graduate students from China declined, and the proportion of those from France and the United States remained stable. The proportion of Iranian S&E graduate students studying in Canada grew from 3% in 2002 to 13% in 2012; growth was higher in the natural sciences and in engineering.

Although the United States hosts the largest number of international students worldwide, U.S. students constitute a relatively small share of international students worldwide. About 70,000 U.S. students (in all fields) were reported as international students by OECD and OECD partner countries in 2012, far fewer than the number of international students from China, India, South Korea, Germany, Turkey, or France. The main destinations of U.S. students were the United Kingdom (16,600), Canada (9,600), Germany (4,300), France (3,900), New Zealand (3,200), and Australia (2,900)—mostly English-speaking OECD countries (OECD 2014). Given the relatively low number of U.S. students who study abroad and the importance of international experience in a globalized world, in 2014, IIE established Generation Study Abroad. This 5-year initiative has the goal to increase the number of U.S. students studying abroad, in credit and degree programs, to 600,000 by 2019 (IIE 2015b).

Nearly 290,000 U.S. university students enrolled in study abroad programs in the 2012–13 academic year (credit mobility—see Glossary), a 2% increase from the preceding year but an 88% rise from 2000–01 (IIE 2014). Nearly 40% were enrolled in programs during the summer term; about one-third enrolled in programs lasting one semester, 15% in short-term programs lasting up to 8 weeks, 3% for the academic or the calendar year, and the rest for one or two quarters or a month. Nearly three-quarters were undergraduates, primarily juniors and seniors; about 8% were master’s students, and 1% were doctoral students. Nearly two-thirds of the U.S. students studying abroad were women, and more than three-quarters were white. Nearly 40% were studying in S&E fields: 22% in social sciences, 9% in physical or life sciences, 4% in engineering, 2% in mathematics or computer sciences, and 1% in agricultural sciences; these proportions have been stable since 2000–01. The leading destinations for study abroad programs in the 2012–13 academic year were the United Kingdom, Italy, and Spain, followed by France and China.

According to a recent study conducted by IIE and Project Atlas (Belyavina, Li, and Bhandari 2013), in 2011–12, nearly 47,000 U.S. students were enrolled in academic degree programs in the 14 countries represented (degree mobility—see Glossary).[iv] The most frequent host countries for U.S. students pursuing degrees abroad were the United Kingdom (17,000), Canada (9,000), France (4,000), and Germany (4,000). Most students were enrolled in undergraduate or master’s degree programs (42% each), followed by doctoral programs (16%). Almost two-thirds of these students studied in anglophone countries; the top destination was the United Kingdom. Humanities, social sciences, business and management, and physical and life sciences were the most popular broad fields of study for students pursuing a degree abroad.

[iii] Luxembourg has a very high proportion of international students enrolled in tertiary-type A programs (34%) mostly because of the high level of integration with neighboring countries (OECD 2014).

[iv] The 14 countries represented in the study were Australia, Canada, China, Denmark, France, Germany, Ireland, Japan, Malaysia, New Zealand, the Netherlands, Spain, Sweden, and the United Kingdom.

Conclusion

S&E higher education in the United States is attracting growing numbers of students. The number of associate's, bachelor's, master's, and doctoral degrees awarded in all fields and in S&E fields continues to rise, having reached new peaks in 2013. Most of the growth in undergraduate S&E education occurred in science fields, particularly in the social and behavioral sciences and in the biological sciences. In engineering, bachelor's degrees have increased consistently for the last 10 years and have surpassed the record high numbers attained in the mid-1980s; graduate enrollment in engineering has reached record numbers. Computer sciences degree awards have increased continuously since 2009, after a steep decline in the mid- to late 2000s. The number of master's and doctoral degrees awarded grew in all major S&E fields. In the last decade, growth in doctoral degrees awarded occurred mostly in the natural sciences and engineering fields.

Community colleges play a key role in increasing access to higher education for all citizens. Many U.S. citizen and permanent resident degree holders report earning college credit from a community college. Nearly half of Hispanic undergraduates are enrolled in them. The expected demographic growth in number of Hispanic students between 20 and 24 years of age will affect community colleges and HHEs.

Over the last two decades, higher education spending and revenue patterns and trends have undergone substantial changes, which intensified during the recent economic downturn. Public institutions faced competing demands in a tight budget environment, caught between declining state appropriations and the need to maintain educational quality and access. Despite the decline in enrollment in 2011–12, net tuition per FTE student continued to increase with the decrease in revenues from state and local appropriations in public institutions, so challenges remain.

International student enrollment in S&E has recovered since the post-9/11 decline. In recent years, international student enrollment has increased considerably at the undergraduate and graduate levels, in both S&E and non-S&E fields.

Globalization of higher education continues to expand. Universities in several other countries have expanded their enrollment of international S&E students. The United States continues to attract the largest number and fraction of internationally mobile students worldwide, although its share of international students in all fields has decreased in recent years.

Higher education is undergoing rapid transformation. The growth of distance and online education through MOOCs and similar innovations expands access to knowledge and has the potential to decrease the cost of some degrees, at the same time as pressures have been increasing to reduce rising costs. However, it is too early to assess whether MOOCs will be widely adopted by different types of institutions, whether increased access will be accompanied by increased learning, and what consequences distance and online innovations will bring to the higher education landscape.

Glossary

Baccalaureate-origin institution: The college or university from which an S&E doctorate recipient earned a bachelor's degree.

Credit mobility: Temporary tertiary education within the framework of enrollment in a tertiary education program at a home institution (usually) for the purpose of gaining academic credit (i.e., credit that will be recognized in that home institution). It is mostly used for study, but it can also take other forms, such as traineeships.

Degree mobility: The physical crossing of a national border to enroll in a degree program at the tertiary level in the country of destination. The degree program would require the students' presence for the majority of courses taught.

European Union (EU): As of September 2015, the EU comprised 28 member nations: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and the United Kingdom. Unless otherwise noted, Organisation for Economic Co-operation and Development data on the EU include all of these 28 members.

First university degree: A terminal undergraduate degree program; these degrees are classified as "level 5A first university degree" in the International Standard Classification of Education, which is developed by UNESCO, although individual countries use different names for the first terminal degree (e.g., *corso di Laurea* in Italy, *diplom* in Germany, *licence* in France, and *bachelor's degree* in the United States and in Asian countries).

Internationally mobile students: Students who have crossed a national or territorial border for purposes of education and are now enrolled outside their countries of origin. This term refers to degree mobility in data collected by UNESCO/UIS, OECD, and Eurostat and excludes students who travel for credit mobility.

Natural sciences: Include agricultural; biological; computer; earth, atmospheric, and ocean; and physical sciences and mathematics.

Net price: The published price of an undergraduate college education minus the average grant aid and tax benefits that students receive.

Net tuition revenue: Total revenue from tuition and fees (including grant and loan aid used by students to pay tuition); excludes institutional student aid that is applied to tuition and fees.

Tertiary-type A programs: Higher education programs that are largely theory based and designed to provide sufficient qualifications for entry to advanced research programs and to professions with high skill requirements, such as medicine, dentistry, or architecture. These programs have a minimum duration of 3 years, although they typically last 4 or more years and correspond to bachelor's or master's degrees in the United States.

Tertiary-type B programs: Higher education programs that focus on practical, technical, or occupational skills for direct entry into the labor market and have a minimum duration of 2 years. These programs correspond to associate's degree programs in the United States.

Underrepresented minorities: Blacks, Hispanics, and American Indians and Alaska Natives are considered to be underrepresented minorities in S&E.

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