

**HELP WANTED**

**JUNE  
2010**

**PROJECTIONS  
of JOBS and  
EDUCATION  
REQUIREMENTS  
Through 2018**



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# Introduction

## Why is this forecast of education supply and demand necessary?

We set out to provide a detailed forecast of jobs and their education requirements for two reasons:

**First:** The ability of individuals to connect education, training, and careers has become key to employability and to attaining and maintaining middle class status.

**Second:** In spite of its growing importance, our ability to match education alternatives with career options is woefully underdeveloped.

The United States is unable to help people match their educational preparation with their career ambitions—not because it cannot be done but because it simply is not being done. All the information required to align postsecondary educational choices with careers is available, but unused. The forecast in this report demonstrates that projecting education and job requirements is technically feasible with a minimum amount of error. But the current education projections by the Bureau of Labor Statistics (BLS), use a methodology that underestimates the demand for postsecondary education. Compare, for example, the results of a simple test pitting our methodology against the Bureau's. In its 1998 forecast, which covered a 10-year timeline through 2008, the Bureau under-predicted how many workers in the U.S. labor force would have Associate's degrees or better by 19 million. That projection was off by 47 percent. Our methodology, for that same period, over-predicted postsecondary educational demand by about 2 million workers—an error rate of just 4 percent.<sup>i,iii</sup>

Unfortunately, the poor quality of the official projections cascades downward through state and local data systems into the hands of policy makers. These numbers are not the only factor that determines policy, but they are the only data available on the economy's demand for postsecondary education. Because the official data consistently underestimate the demand for postsecondary education, they encourage a consistent bias against investing in postsecondary education and training. Ultimately, the official data misinform the

educational choices and career plans of individuals and their counselors.

These are the wrong times for inadequate information on jobs and skill requirements. Not only is the United States climbing out of the worst downturn since the Great Depression, it has transformed from an industrial to a services economy, with all of the pain and upheaval that accompanies such change. Educational and career planning need to catch up and adjust to this new reality.

In the following pages of this introduction, we lay out our case for why postsecondary education and training is critical to helping our nation's workers navigate this transformation successfully. We follow with a brief overview of the report as a whole.

### EDUCATION IS A GATEWAY TO FURTHER TRAINING AND GREATER EARNING POTENTIAL.

One key to understanding this issue is an appreciation of the overall landscape of postsecondary education and training. College is only one piece of the puzzle. In fact, colleges and universities represent only 35 percent of the entire postsecondary education and training system. The rest consists of on-the-job training, formal employer-provided education programs, military training, apprenticeships, and a variety of other programs (Figure I).

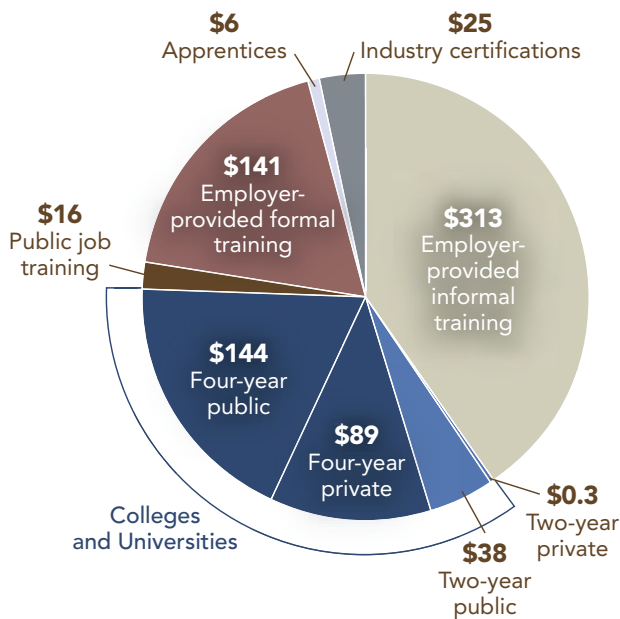
Still, the role of colleges and universities is vital. Among other things, higher education acts as an important gateway to other parts of the postsecondary learning system. Postsecondary education provides entry to the jobs offering the most employer-provided training, plus access to the most powerful, flexible workplace technology. This is reflected in the positive correlation between employer-provided training and employee education levels. College graduates are almost twice as likely as high school graduates to receive formal training from their employers (Figure II).

**FIGURE I**

\$772 billion is spent annually on postsecondary education and training. About 65 percent of these dollars are spent outside of the formal postsecondary education system.

(in billions of dollars)

Source: Authors' calculations using data from Integrated Postsecondary Education Data System (IPEDS), Department of Labor Employment and Training Administration (DOLETA), American Association of Community Colleges (AACC), Office of Vocational and Adult Education (OVAE), Survey of Employer Provided Training (DOL), and Bureau of Labor Statistics (BLS)



Access to that training is important because it directly affects an employee's earning power. Training can increase employee wages by 3 to 11 percent, with formal training providing higher returns than informal training (Altonji and Spletzer, 1991; Bishop, 1996; Loewenstein and Spletzer, 1998; Mincer, 1988).

Education, workplace training, and workplace technology tend to be *sequential and complementary* in producing productivity and earnings. Higher levels of formal education not only increase access to jobs that provide further training, they also increase access to technology that complements, rather than replaces, skills. More highly educated workers use technologies that increase worker autonomy and enhance skills—desktop computers or flexible machine tools, for instance. But less-educated workers tend to use technologies that substitute for skills. Narrow training can compensate for broader educational deficiencies, although it does not provide long-term adaptability—which can be disastrous when narrow tasks are fully automated or shifted offshore.

Access to technology on the job is important to a worker's earning power. Even high school dropouts who use technology at work earn about 15 percent more than those who do not—and the earnings premium for college graduates who use technology is even more significant (Figure III). Good pay and benefits, then, are linked to the sequence of postsecondary educational attainment, achievement, workplace training, and the use of technology on the job.

**FIGURE II**

Workers with the most education receive the most training. (percent receiving training)

Source: Estimate based on Eck, 1993.

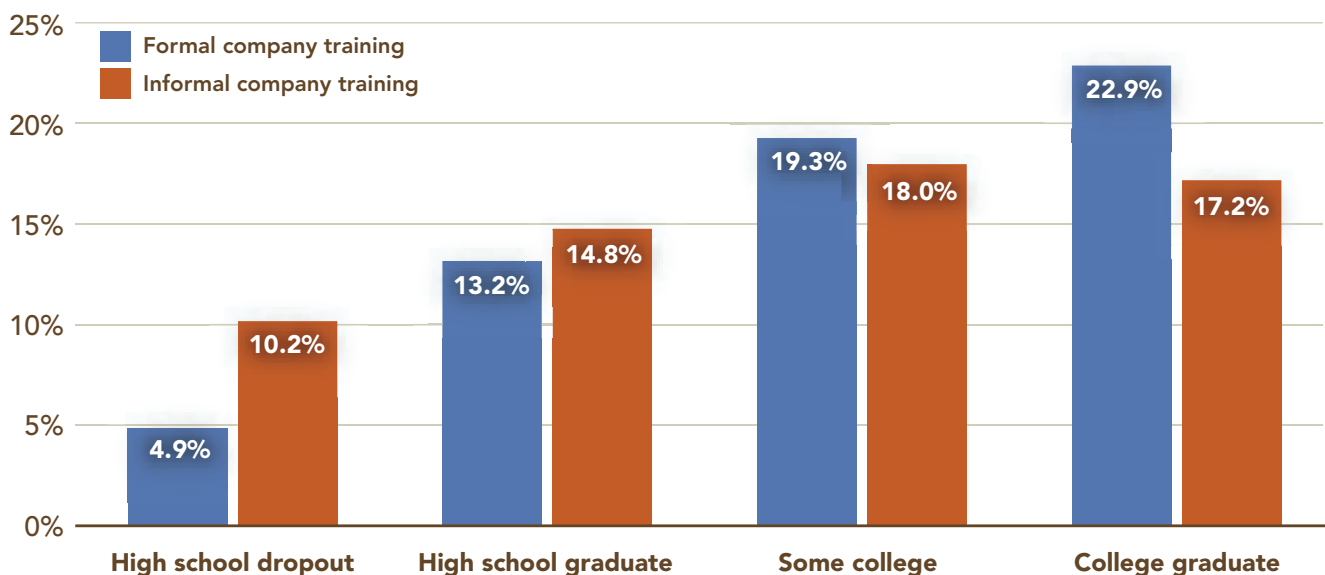
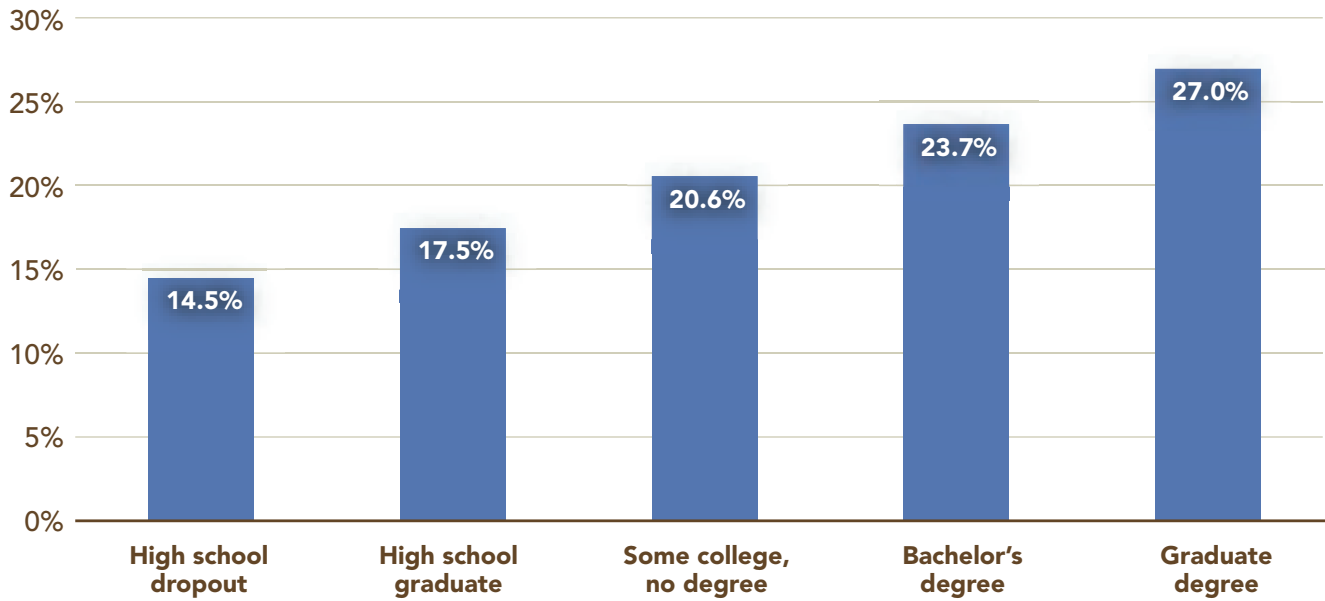


FIGURE III

Workers who use computers can earn more than workers who do not. (percent wage premium earned by workers who use the computer)

Source: Krueger, 1993; Mishel and Bernstein, 1995



### A COLLEGE DEGREE IS THE KEY TO UNLOCKING ACCESS TO THE MIDDLE CLASS—OR BETTER.

Postsecondary education has become the threshold requirement for a middle-class family income. But what does that mean at a time when economists fret that the American middle class is actually shrinking?

In the 37-year time frame shown in Table I, the share of people with some college or Associate's degrees in the middle class declined from 53 percent to 45 percent. But the key to understanding this phenomenon is discerning where those people are going when they leave the middle. For example, the share of people with Associate's degrees in the top three income deciles increased from around 28 percent to 35 percent.

Therefore, while it is true that the middle class is declining, a more accurate portrayal of the American class dynamic would be to say that the middle class is dispersing into two opposing streams of upwardly mobile college-haves and downwardly mobile college-have-nots.

Dropouts, high school graduates, and people with some college but no degree are on the down escalator of social mobility, falling out of the middle-income class and into the lower three deciles of family income. In 1970, almost half (46 percent) of high school dropouts were in the middle class. By 2007, the share of dropouts in the middle class had fallen to 33 percent.

TABLE I

Education distribution across household income deciles (1970/2007)

Source: Authors' analysis of March CPS data, various years

	Lower-income class (lower 3 deciles)	Middle-income class (middle 4 deciles)	Upper-income class (upper 3 deciles)
<b>1970:</b>			
High school dropouts	39%	46%	15%
High school graduates	22%	60%	18%
Some college/ Associate's degree	19%	53%	28%
Bachelor's degree	16%	47%	37%
Graduate degree	13%	46%	41%
<b>2007:</b>			
High school dropouts	59%	33%	7%
High school graduates	35%	45%	19%
Some college	29%	45%	26%
Associate's degree	20%	45%	35%
Bachelor's degree	14%	38%	48%
Graduate degree	9%	30%	61%

In 1970, almost 60 percent of high school graduates were in the middle class. By 2007, the share had fallen to 45 percent.

Over that same period, people with college degrees (Bachelor's and graduate degrees) have either stayed in the middle class or boarded the escalator upwards to the highest three family income deciles.

The share of people with Bachelor's degrees in the middle class declined from 47 percent to 38 percent, decreasing by 9 percentage points. But the share of people with a Bachelor's degree in the top three income deciles jumped from 37 percent to 48 percent. Meanwhile, the share of people with graduate degrees in the middle class declined from 46 to 30 percent—a decrease of 16 percentage points. But, clearly, they were leaving for greener pastures, as the share of people with graduate degrees in the top three income deciles increased from 41 to 61 percent.

### POSTSECONDARY WAGES ROSE IN THE 1990s, AND THIS PREMIUM STILL REMAINS.

Wage data, not surprisingly, correlate with this movement into and out of the middle class based on access to postsecondary education. This means that the economy is demanding more and more workers with postsecondary education and employers are willing to pay more for them.

Consider that, since 1983, among prime-age workers between the ages of 25 and 54:

- Earnings of high school dropouts have fallen by 2 percent;
- Earnings of high school graduates have increased by 13 percent;
- Earnings of people with some college or an Associate's degree have increased by 15 percent;
- Earnings of people with Bachelor's degrees have increased by 34 percent;
- Earnings of people with graduate degrees have increased by 55 percent.

Clearly, there is a hierarchical relationship between formal education level and annual wages, which reflects the compensation that employers are willing to pay to workers, on average, for the knowledge, skills, and abilities they attained at every consecutive education level. Figure IV shows the persistent wage premium for those who obtain at least some college, a postsecondary certificate, or an Associate's degree, and the growing wage premium for those with Bachelor's degrees or better.

College graduates earn more relative to high school graduates, and continue to do so, which is the most significant signal that the economy is demanding more highly skilled workers.

FIGURE IV

Wage premium by education. Compared to high school graduates, holders of Bachelor's degrees and better have earned a substantial wage premium since the 1990s. (makes no control for full-time or full-year status of workers)

Source: Authors' analysis of March CPS data, various years

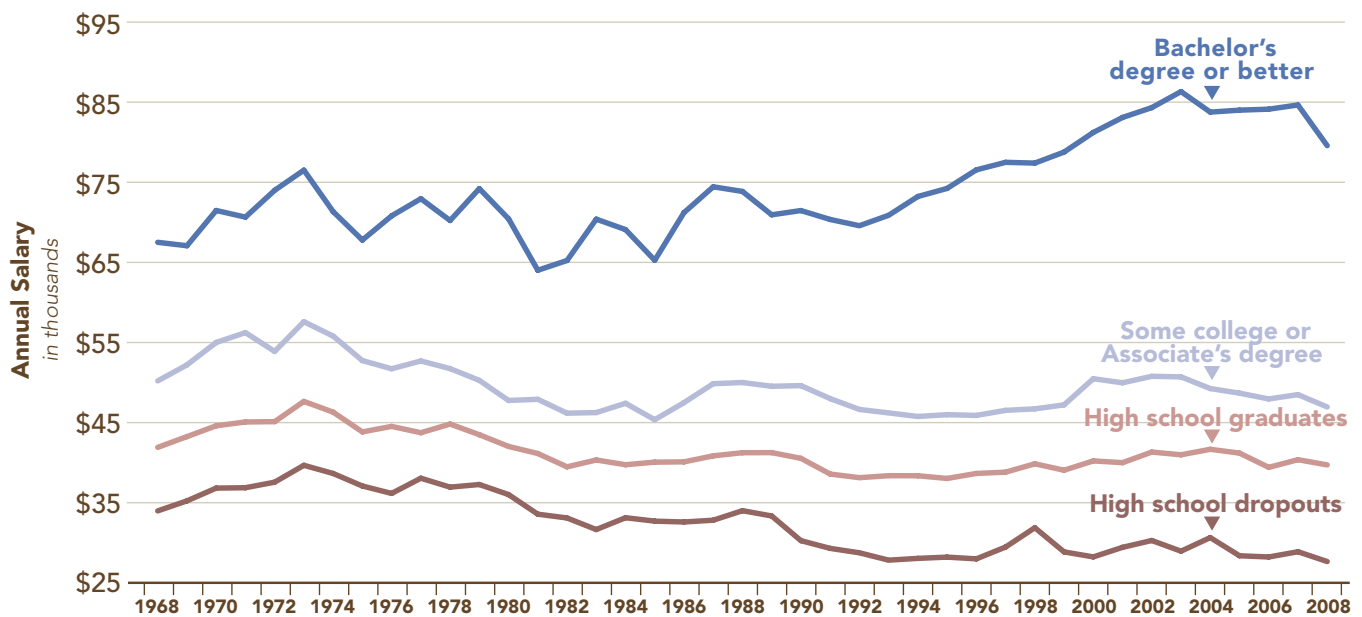
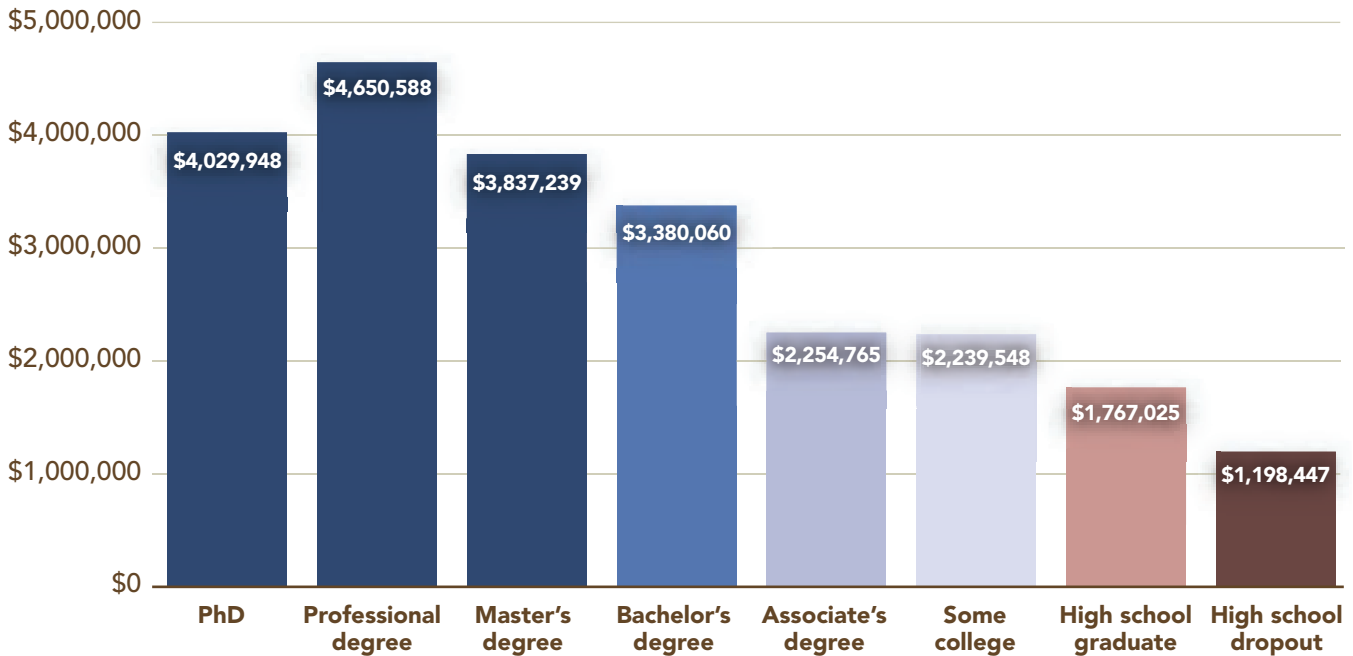


FIGURE V

Estimated average lifetime earnings by education level. (in current dollars)

Source: Authors' analysis of March CPS data, 2008



### POSTSECONDARY EDUCATION GIVES LARGE ACCUMULATED EARNINGS OVER A LIFETIME.

The increased earning power conferred by postsecondary education and training is both tangible and lucrative over a worker's lifetime. Figure V shows just how lucrative, by calculating the *average* career value of educational attainment in 2008 dollars, given the current and projected labor market value of various levels of education.<sup>iii</sup>

Among other things, the chart shows that:

- The range in lifetime earnings by educational attainment is greatest between high school dropouts and professional degrees—a range of \$1,198,000 to \$4,650,000, or a difference of \$3,452,000.
- A high school degree is worth about \$569,000 more than being a dropout.
- Having some college but no degree or a postsecondary certificate is worth about \$473,000 more than a high school degree.
- An Associate's degree is worth about \$15,000 more than some college but no degree.
- A Bachelor's degree is worth about \$1.1 million than an Associate's degree.
- A Master's degree is worth \$457,000 more than a Bachelor's degree.

- A Doctoral degree is worth about \$193,000 more than a Master's degree.
- A Professional degree is worth about \$621,000 more than a Doctoral degree.

### POSTSECONDARY EDUCATION IS YOUR BEST UMBRELLA IN A RECESSION.

Postsecondary education carries with it one more important advantage in today's economy: protection. Workers with college degrees had the lowest unemployment rates over the past three years, thus receiving the best possible shelter from the Great Recession of 2007. They also have the best prospects for getting hired in the recovery. This means that high school dropouts and graduates without some level of postsecondary education or training are at increased risk of being left behind as the economy plods forward in the long march back to normalcy.

A college education does not make one immune, of course. In today's economy, where 59 percent of the people have at least some college, even some of the most highly educated among us have lost their jobs and many college graduates are scrambling for the reduced pool of jobs available to them. Unemployment rates at all education levels have been climbing and have reached 5 percent for workers with Bachelor's or graduate degrees.

In addition, new college graduates face a depressed labor market that probably will not recover its former vitality until 2015. By then, the economy will have recovered enough jobs to replace the 7.8 million we have lost since December 2007 and create an additional 8 million positions to make up for lost growth in the economy and accommodate new job seekers entering the workforce.

Ultimately, when it rains long enough and hard enough, everyone gets a little wet. Recessions are like that too. But postsecondary education and training is still the best umbrella in any economic storm. It is also an excellent safe harbor where workers can wait out the storm and accumulate new knowledge and expertise to position themselves for the surge in skilled jobs that the recovery will bring.

The emphasis of the recovery will be largely on skilled jobs. Many people who lost jobs that required only a high school education or less will find that their relatively low-skill jobs will not come back at all, lost to automation or overseas competitors. Scores of these job seekers will be left behind because the jobs that survived the recession and the jobs created in the recovery will require postsecondary education or training.

The economy that emerges from the recession will be different than the economy that preceded it. This recession, like the previous two, has intensified the underlying engine of economic change that has been evident at least since the 1980–81 recession. The industrial economy of the 20th century has slowly transformed itself into a new services economy that demands more education and different skills of its workers.

TABLE II

The top occupations for job openings by education level.\*

Source: Authors' analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018

	High school or less	Some college, no degree	Associate's degree	Bachelor's degree	Master's degree and better
Management occupations	17%	14%	10%	39%	20%
Business operations specialists	10%	15%	10%	46%	19%
Financial specialists	7%	10%	9%	57%	17%
Computer and mathematical science occupations	6%	11%	10%	51%	22%
Architects and technicians	3%	3%	6%	56%	32%
Engineers and technicians	20%	15%	26%	27%	13%
Life and physical scientists	2%	1%	0%	43%	54%
Social scientists and technicians	5%	6%	6%	30%	53%
Community and social services occupations	8%	11%	9%	39%	33%
Legal occupations	9%	10%	11%	17%	52%
Education occupations	7%	8%	7%	38%	40%
Arts, design, entertainment, sports, and media occupations	9%	12%	11%	56%	11%
Healthcare practitioners and technical occupations	5%	7%	25%	33%	30%
Healthcare support occupations	41%	27%	21%	9%	2%
Protective service occupations	23%	29%	17%	27%	4%
Food preparation and serving occupations	62%	18%	9%	11%	1%
Building and grounds cleaning and maintenance occupations	75%	12%	5%	7%	1%
Personal care and service occupations	43%	21%	16%	17%	2%
Sales and related occupations	34%	20%	11%	29%	5%
Office and administrative support occupations	35%	28%	15%	19%	2%
Farming, fishing, and forestry occupations	91%	3%	3%	2%	0%
Construction and extraction occupations	72%	13%	9%	6%	1%
Installation, maintenance, and repair occupations	51%	19%	21%	9%	1%
Production occupations	62%	18%	11%	8%	1%
Transportation and material moving occupations	67%	19%	7%	7%	1%

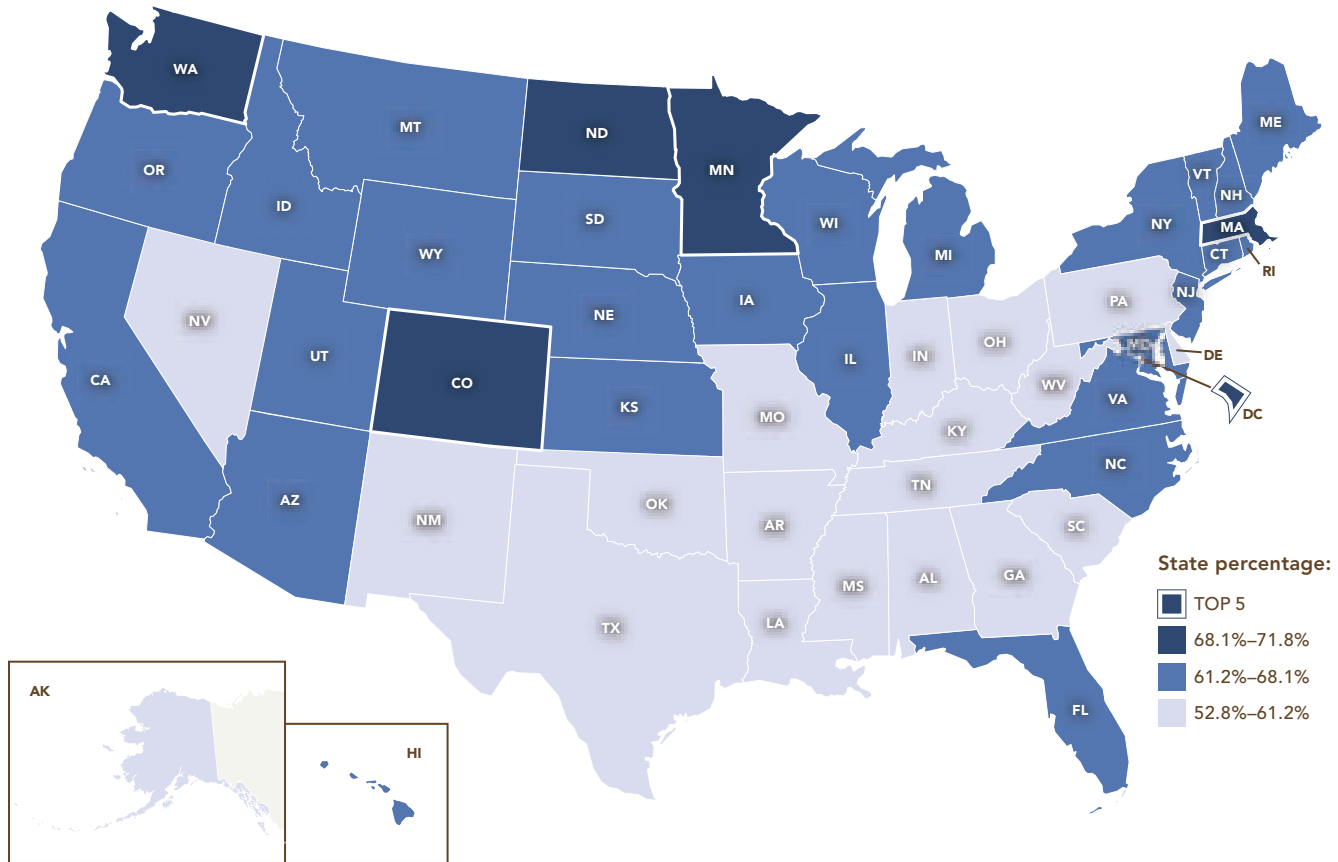
\*These percentages represent the total for each occupation. Row percentages sum to 100%.



FIGURE VI

The top states for postsecondary jobs.

Source: Center on Education and the Workforce forecast of educational demand through 2018



Job losses in this recession have already created suffering that will endure well beyond the recovery. But we will only cause new and unnecessary troubles for ourselves and our children if we remain fixated on regaining the jobs hit hardest in this recession. Many jobs are not coming back—especially the blue collar jobs that required high school education or less.

Table II shows the top job openings by education level from 2008 through 2018. For each occupation, it gives the associated education requirements and therefore provides information on where the jobs are by education level. In 2018, 59 percent of Management occupations, for example, will require a Bachelor’s degree or better. Associate’s degrees are largely concentrated in Engineering and Healthcare practitioners’ occupations.

The outlook from a state perspective is summarized in Figure VI and detailed in our State-Level Analysis report. The District of Columbia, Massachusetts, Colorado, Minnesota and Washington state will lead the nation in job openings requiring postsecondary education.

As long as we remain focused on the economic wreckage in our rearview mirror, we will be hurtling into our economic future unprepared. And we are on this collision course with our future because we are facing an undersupply of workers with postsecondary education.

This report, and the forecast it contains, will be a step toward averting that collision.

**LOOKING AHEAD: A ROAD MAP TO THE REPORT AND ITS CONTENTS.**

This report is divided into five parts that present national forecasts of educational demand from 2008 through 2018 and provide economic context for the findings. These estimates are grounded in occupational and industry forecasts based on a macroeconomic model that generates a cohesive economic outlook for the economy over the next decade.

PART 1 begins by providing an inventory of the current recession. It details job losses and compares this downturn in size

and scope to the previous two recessions and the Great Depression of the 1930s. This chapter also sets the stage for the future of the U.S. economy after the recession ends by showing the pathway out and by relating economic recovery through Gross Domestic Product (GDP), job, and employment growth.

PART 2 provides information on our projections of educational demand by traditional/formal education levels from 2008 by 2018. It gives numbers on the total size of U.S. employment during selected years and provides estimates of the educational demand for job openings by 2018. This chapter makes the case that individual success will require higher education in one form or another by illustrating that nearly two-thirds of the 46.8 million job vacancies between 2008 and 2018 will require some postsecondary education. It also illustrates why the demand for education and training may actually be higher than our forecast suggests.

We offer some historical context for our assertion that we will need increased postsecondary education and training to fill 21st century jobs. This chapter demonstrates that the rise in postsecondary requirements is not a new phenomenon, but one that has existed for quite some time and has accelerated with technological advancement and progress. The chapter defines and discusses the relevance of skill-biased technological change and its role in reshaping job descriptions and the level of knowledge, skills, and abilities required to function in a changing workplace.

Part 2 ends with the estimate that we will under-produce postsecondary graduates by approximately 3 million by 2018. This chapter also outlines all of the assumptions that underlie this general conclusion.

PART 3 describes educational demand by occupation. Demand for workers with postsecondary qualifications is tied tightly to occupations and the skills they require and more loosely to the industries in which they reside. Part 3 fills two roles: first, it presents an occupational forecast by broad categories from 2008 through 2018, and then it gives the educational demand within each occupation from 2008 to 2018. Clear patterns emerge, the most important of which is that the fastest-growing occupations are most often those associated with the highest proportions of jobs that require postsecondary education. Aggregation across occupations by education categories provides national estimates of educational demand. These estimates are presented in terms of sheer size (largest occupations), fastest-growing occupations, and occupations with the highest amounts of postsecondary intensity.

PART 4 describes educational demand by industry. Educa-

tion requirements are most closely tied to occupations, but the economy produces goods and services by organizing occupations into industries. Moreover, it is industrial growth, through its connection to GDP expansion, that provides the basis for occupational growth through staffing patterns. Part 4 also fills two roles: first, it presents an industrial forecast by broad categories from 2008 through 2018, and then it gives the educational demand within each industry from 2008 to 2018. The pattern that becomes clear is similar to that observed in Part 3—the fastest-growing industries are most often those associated with the highest proportions of postsecondary education.

PART 5 bridges the gap between the economic and the social by making the link between access to opportunities, educational attainment, wages, and household income. This section outlines the simple relationships that exist between education and wages, and the more complex ties between education, wages, and occupational choice. Wages are presented to the reader both in a relative context (comparing wages across occupational groups for one year) and in an absolute context (comparing wages for one occupational group or one educational group across various years). The hierarchical relationship between education and wages is demonstrated from a historical perspective. But because these relationships are not absolute and depend on occupational and industry choice, Part 5 also shows how these sub-associations result in disparate wage outcomes. There is no forecast of wages in Part 5.

The SUMMARY AND CONCLUSIONS chapter summarizes the broad outcomes reached in the preceding five chapters.

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<sup>i</sup> With more staffing resources, our method could also be improved substantially in order to give it more predictive power at a more detailed level. Our point here is not that the government should use our method, but that even minor improvements in the current official methods could give much more robust results.

<sup>ii</sup> In 1996, BLS forecast 36 million Associate's degree or better jobs by 2006. But in 2006, there were 50 million Associate's degree or better jobs, leaving them 40% under the true number.

<sup>iii</sup> These figures are obtained by multiplying average earnings of prime-age (25–54 years old) workers by educational attainment over their expected work life of 40 years. Another way to look at lifetime earnings is to consider the present value of these earnings given that a dollar paid in the future is worth less than a dollar today. A similar rationale is used in calculating interest rates. Using this method we discount lifetime earnings as calculated above assuming a discount rate of 1 percent per year. This discounts each lifetime value by 67 percent. This present value calculation results in lifetime earnings total as follows: Doctoral degrees (\$2.7 million); Professional degrees (\$3.1 million); Master's degrees (2.6 million); Bachelor's degrees (\$2.3 million); Associate's degrees (\$1.5 million); some college, no degree (\$1.5 million); high school degree (1.2 million) and dropouts (\$800,000).

# Part 1

## The Recession Is Accelerating the Shift to Jobs Requiring Postsecondary Education.

We are back from the brink, but the tough times are not over.

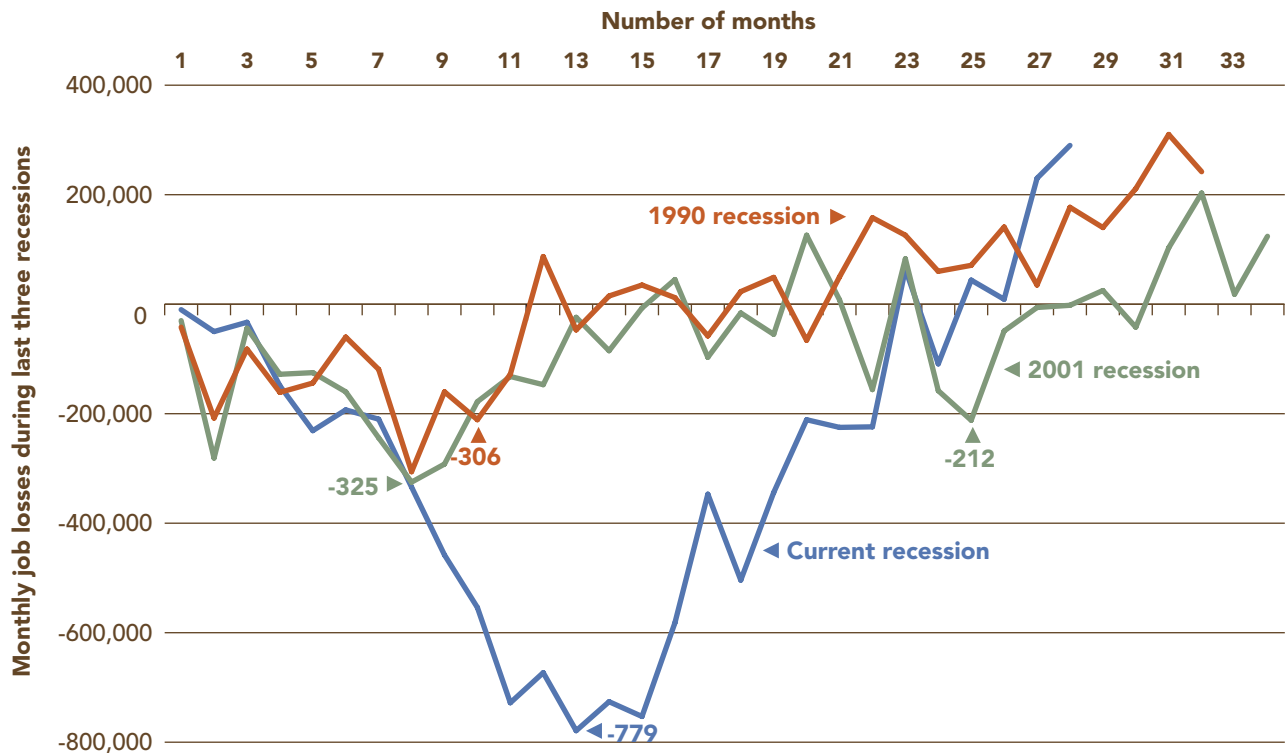
The recession that began in December of 2007 is already 30 months old, but the U.S. economy will not recover its pre-recession employment levels for at least another two years, according to our own forecast and many others. From there, it will take an additional three years to make up for lost growth and create a job market strong enough to accommodate both the casualties of the recession and the millions of new workers who will stream into the workforce from schools across the country. **The economy, as a result, will not be completely back on track until 2015.**

In human terms, the toll of this recession has been staggering. Since it began, more than 7.8 million jobs have been lost. In all, 9.7 percent of the workforce is currently idled, and roughly one-third of the unemployed have been out of work for more than six months. The impact has been especially devastating for minority groups: 12.6 percent of Latinos, 16.5 percent of African Americans, and 26.4 percent of teens are unemployed. By comparison, the unemployment rate for white workers is 8.7 percent. A recent report by the Center for Labor Market Studies at Northeastern University detailed the recession's impact on various income groups and concluded that there is a "true labor market depression fac[ing] those in the bottom...of the income distribution."<sup>1</sup>

FIGURE 1.1

This recession has been much deeper than the two preceding ones.

Source: Bureau of Labor Statistics' employment situation summary, various months



There can be little doubt that this recession is the worst economic downturn since the Great Depression. No matter how long it ultimately lasts, the Great Recession of 2007 has already outlasted the 16-month slumps of 1973 and 1980, which had previously ranked as the longest declines since World War II. Its job losses, too, outstrip those of the two most recent recessions, those of 1990 and 2001. At the height of the current recession, monthly job losses peaked at 779,000 (Figure 1.1), more than double the worst monthly losses of 1990 and 2001: 306,000 and 325,000, respectively.

Many economists predict we will see months of “jobless recovery,” such as we experienced in 1990 and 2001. That means economic output will grow but will not immediately generate job growth. Instead of hiring new workers, employers will ask their existing employees to work longer hours to meet rising demand.<sup>2</sup> Evidence of that phenomenon is mounting already. Gross Domestic Product (GDP) grew by 3.5 percent in the third quarter and 5.7 percent in the fourth quarter of 2009—the fastest pace in six years—but job losses continued, averaging 260,000 and 110,000 over the same period (Figure 1.2). We project that job losses for 2010 will total 300,000, and do not see net gains resuming until 2011.

By then, GDP growth will pick up more steam and the economy will finally start creating more jobs than it loses. The total number of jobs will climb from 142 million to 145 million as employers start hiring again (Figure 1.3). That does not mean everything will be back to normal, however, because the recession not only eliminated 7.8 million jobs, it also stymied job growth, which typically adds an additional 100,000 positions per month to the economy. Once growth resumes, it will take some time for the economy’s job creation engine to catch up to where it should have been. As a result, we do not expect employment to reach pre-recession levels until around 2012. From there, it will take another 26 months to replace positions that would have been created had the recession never occurred.

To reach the employment levels we would have attained without a downturn, the economy will need to create a net total of 11 million jobs: 2.6 million new jobs for people who have been entering the labor market since the recession began, added to the 7.8 million existing jobs that were lost. Mark Zandi of Moodys.com estimates that the recently signed “Hire Act” will create only 250,000 jobs by the end of the year. In other words, the economy will not be “back on track” until 2015, even with this addition to job creation flows (Taylor, 2010).

FIGURE 1.2

Although the real Gross Domestic Product (GDP) growth rate will rise to 3.3 percent in 2010, the economy will not begin adding substantial new jobs until 2011. (*non-farm payroll employment, plus self-employed*)

Source: Authors’ analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018.

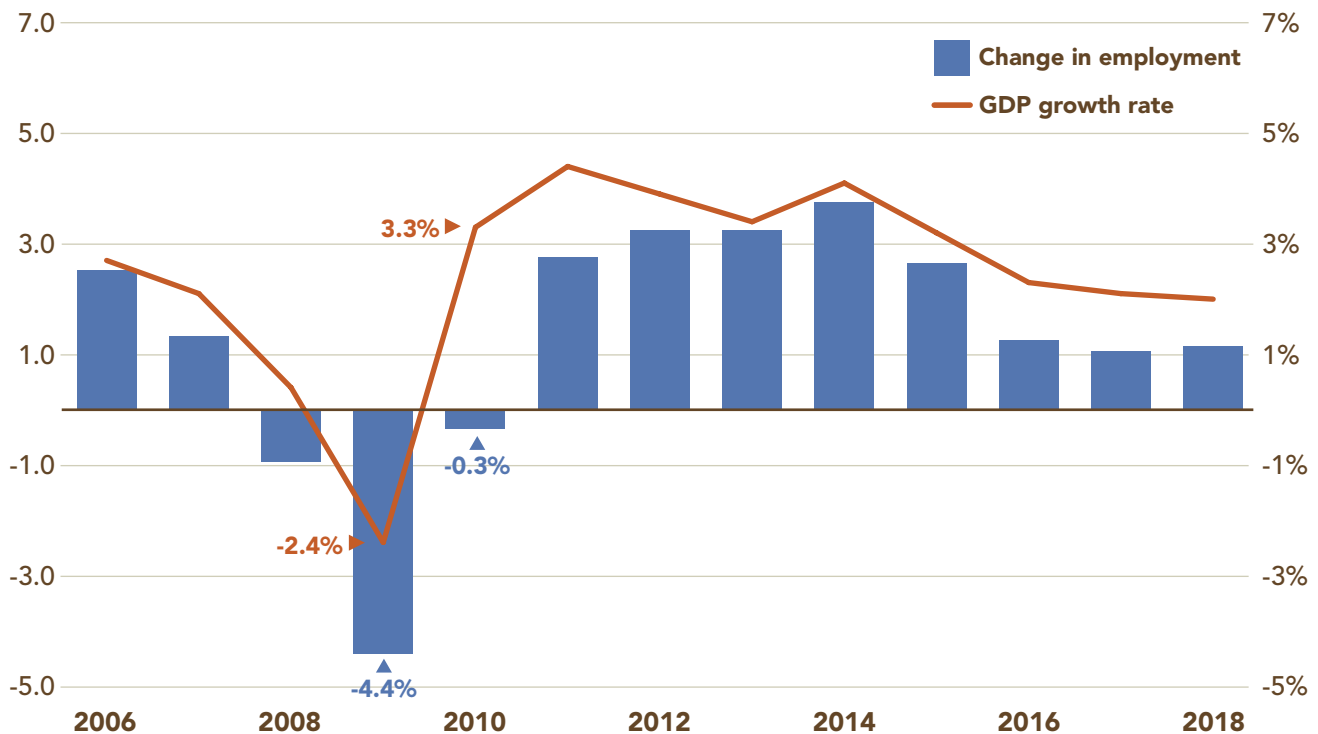
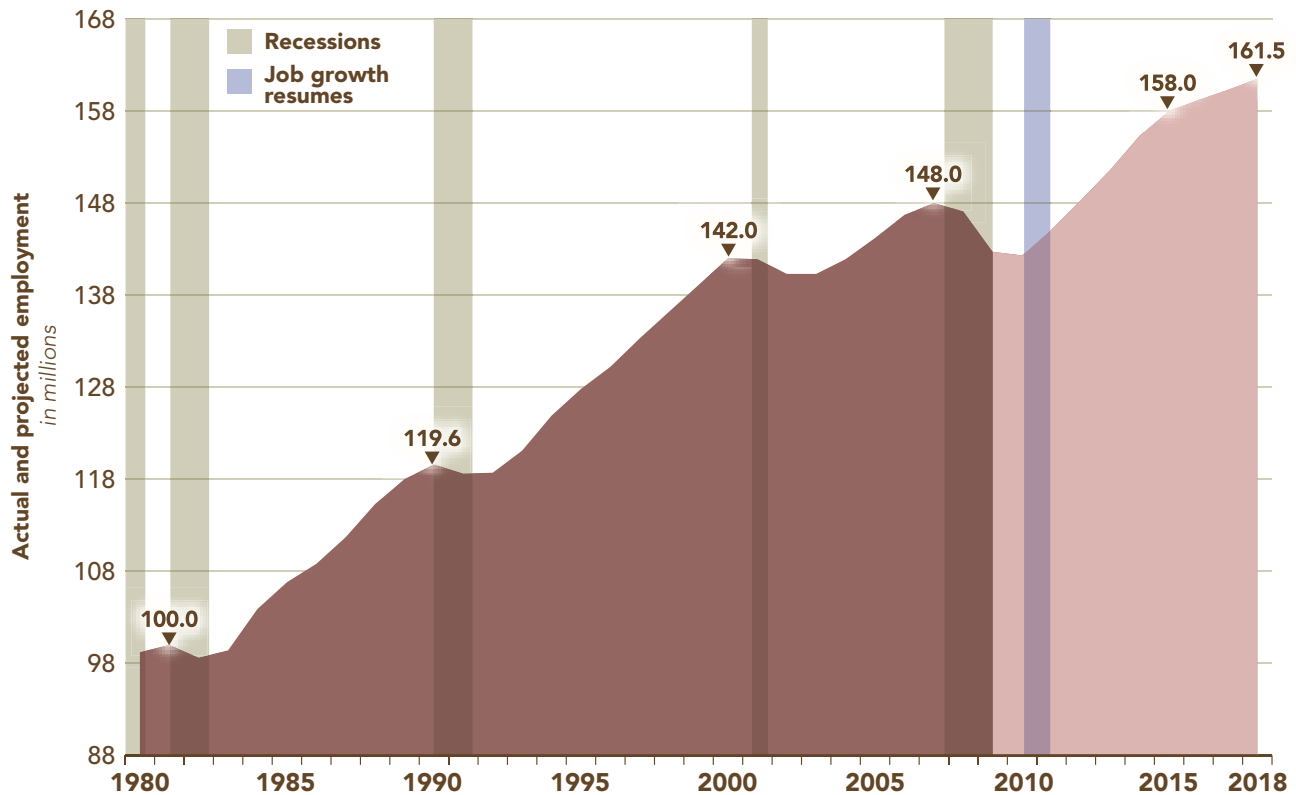


FIGURE 1.3

Employment growth is set to resume in 2011, but the economy will not reach full employment until 2015. (*non-farm payroll employment, plus self-employed*)

Source: Authors' analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018.



For many, a full recovery will be a hollow accomplishment. Hundreds of thousands of low-skill jobs in manufacturing, farming, fishing, and forestry have been permanently destroyed because the recession has further prompted employers to either automate those positions or ship them offshore to take advantage of cheap labor. Overall, we project 637,000 jobs in the Manufacturing and Natural Resources industries will meet such fates by 2018.

**The jobs that replace them will be very different kinds of jobs, requiring very different kinds of workers—and very different kinds of preparation.**

<sup>1</sup> As reported in the *New York Times*, Feb. 10, 2010: “The Worst of the Pain.” Bob Herbert.

<sup>2</sup> Each day that the existing workforce puts in 12 minutes longer per day with a workforce of 141 million people equates to 13,558 full-time, full-year jobs (2,080 hours per year).  $(0.2\text{hr} \times 141,000,000 / 2,080 \text{ hours in full-time year})$



## Part 2

# Our Current Postsecondary System Will Not Meet the Growing Demand for Workers with Postsecondary Education and Training.

The future of employment in the United States boils down to this: success will require higher education, in one form or another.

**By 2018, the economy will create 46.8 million openings—13.8 million brand-new jobs and 33 million “replacement jobs,” positions vacated by workers who have retired or permanently left their occupations. Nearly two-thirds of these 46.8 million jobs—some 63 percent—will require workers with at least some college education.** About 33 percent will require a Bachelor’s degree or better, while 30 percent will require some college or a two-year Associate’s degree. Only 36 percent will require workers with just a high school diploma or less (Figure 2.1).<sup>3</sup>

This growth in demand for postsecondary education dovetails with two major trends. First, the fastest-growing industries—such as computer and data processing services—require workers with disproportionately higher education levels. Second, over time, occupations as a whole are steadily requiring more education.

The implications of this shift represent a sea change in American society. Essentially, postsecondary education or training has become the threshold requirement for access to middle-class status and earnings in good times and in bad. It is no longer the preferred pathway to middle-class jobs—it is, increasingly, the *only* pathway.

FIGURE 2.1

By 2018, 63 percent of job openings will require workers with at least some college education.

Source: Center on Education and the Workforce forecasts of educational demand to 2018

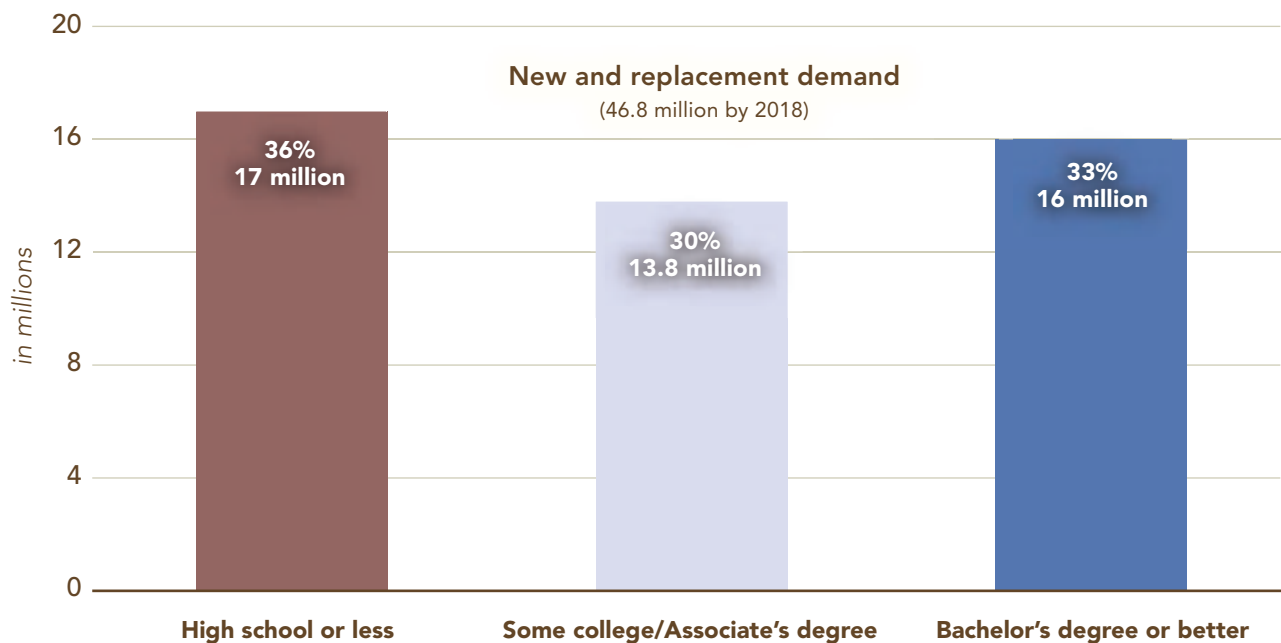
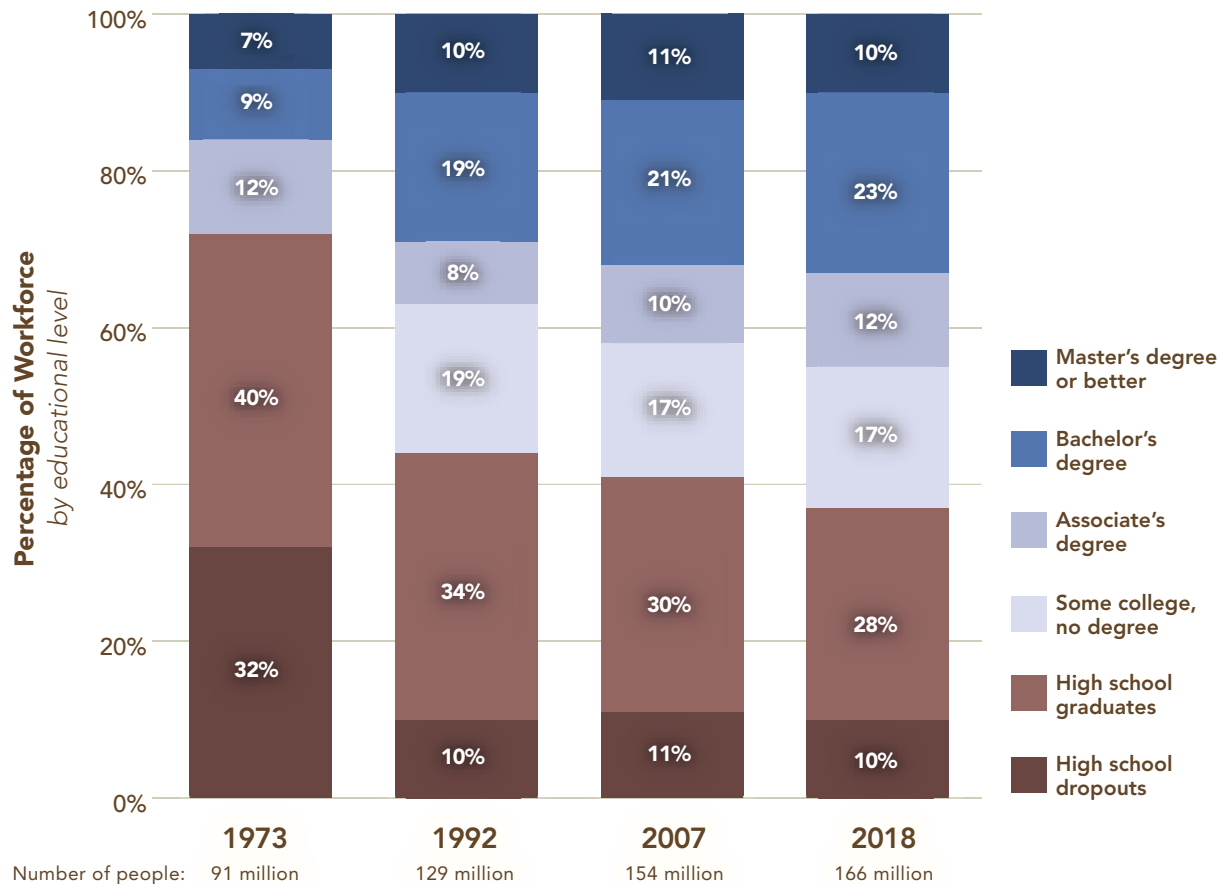


FIGURE 2.2

By 2018, about two-thirds of all employment will require some college education or better.

Source: Authors' analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand to 2018



Nowadays, about 60 percent of Americans go on to some kind of education or formal training after high school. Almost without anyone noticing—and with no real public debate—access to college has become the essential goal for educational reform in the pre-kindergarten to high school years. Middle-class employability, meanwhile, is now the ultimate standard for educational adequacy from kindergarten through college graduation.

Over the past several decades, about 70 percent of the increase in requirements for postsecondary training has stemmed from upgrades in skills demanded by occupational categories that previously did not require higher education. What we called a “foreman” or “manufacturing supervisor” in the 1960s, for example, has since morphed into new occupations that now require postsecondary education, including the modern manufacturing engineer. A significant but smaller share of the increase (about 28 percent) has resulted from the development of entirely new occupations or the expansion of occupations that already required high levels of postsecondary training. What we called a “medical doctor” in the 1950s has

now evolved into a host of new medical specialties that call for a complex set of college-level skill requirements. Middle managers, meanwhile, have divided into a myriad of occupations that now are classified as business services, all requiring significant levels of postsecondary preparation.

For proof of this trend, just look at the statistics. In 1973, there were 25 million jobs that required applicants with at least some college education (Figure 2.2). By 2007, that number had nearly quadrupled to 91 million jobs. Since the early 1970s, the American economy has transformed from one that featured more jobs for high school dropouts than for college graduates, to one where the share of jobs for dropouts has plunged from roughly one-third to 11 percent.

Consider, too, that in 1973 only 28 percent of prime-age workers had any postsecondary education.<sup>4</sup> By 2007 that number had climbed to 59 percent. In fact, the share of workers with an Associate’s degree, certificate, or some college has more than doubled from 12 percent to 27 percent of the workforce. The



percentage of workers with Bachelor's degrees also has more than doubled, from 9 percent in 1973 to 21 percent in 2007. Graduate degree holders have increased at a slightly slower pace, going from 7 percent to 11 percent over the same period.

This trend will only continue. By 2018, more than 63 percent of prime-age workers will need some type of postsecondary instruction. The proportion of workers who will need an Associate's degree, certificate, or some college will increase from 27 percent in 2007 to 29 percent in 2018. The share of workers who must have Bachelor's degrees will climb from 21 percent to 23 percent, while the number who require graduate degrees may decline slightly, from 11 percent to 10 percent over the same period.

These projections are high compared to official Bureau of Labor Statistics (BLS) numbers. Nonetheless, we have every reason to believe both sets of numbers underestimate the true demand for postsecondary education. This is because the official data—for several reasons—underestimate postsecondary educational demand in our country. (See Appendix 4 for details.)

For example, postsecondary training programs that result in certificates and certifications are commonly missed by both education and labor data sources. Education data typically count only people who have passed through educational institutions in pursuit of formal degrees, while labor market data do not include certificates or industry-based certifications. Both sets of data, then, ignore the role played by formal and informal learning outside the traditional education system, including industry and occupational licensure, apprenticeships, and employer-based training. How important is this? **One national data source suggests that close to 60 million people, or 42 percent of the workforce, need some form of occupational certification, registration, or licensure to perform their jobs.** Some 45 million of these certifications are test based.<sup>5</sup>

The official data also understate the importance of postsecondary education and training because they treat all jobs alike. Low-skilled jobs tend to feature an abundance of part-time positions, have high worker turnover, and, as a result, are over-counted in just about everyone's data, including our own. Many of these jobs are transitional in one way or another. Young people commonly take jobs in food services or other low-skill occupations as they work themselves through school or toward better, more skilled jobs they can turn into a career. Such transitional jobs can be found at the other end of the career continuum—retired executives who work as greeters at Wal-Mart, for instance. Jobs data tend to treat openings for such positions the same as openings for long-term career jobs. This exaggerates the significance of low-skilled jobs and,

in turn, underestimates the demand for postsecondary education and training.

In other words, as robust as the demand for postsecondary education and training may seem in our forecast, it may actually be greater.

## Technology Fuels the Growing Demand for Postsecondary Education.

So, let's pause for a quick recap: demand for education and training is on the rise. And jobs, overall, are requiring more and more postsecondary preparation, regardless of industry.

What is driving this transformation of the American economy?

In a word: technology. In the 19th and 20th centuries, electricity and the internal combustion engine drove the rise of manufacturing and America's shift away from an agrarian economy. Today, computers and related inventions are driving the information revolution and transforming the U.S. economic landscape once again. And, just as the industrial revolution was critical to building a mass K–12 education system to feed workers into the manufacturing industries, the information revolution is spurring the development of a mass postsecondary system to fill the needs of sophisticated new industries, such as computer systems design or financial services. **In short, the economic history of the United States is one of lock-step progression between technology and educational attainment.**

Integral to this trend is a concept borrowed from labor economics, known as “skill-biased technological change.” This simply means that technological development and the organizational changes that come with it favor workers with more education because they have the expertise needed to handle more complex tasks and activities. Demand for these workers, in turn, grows across the board as the technology spreads throughout the economy.

In this case, the technology in question is information technology. Like electricity in the industrial age, the computer is a general purpose technology that works across industries and in the larger society.

Computer-based technology adds new kinds of value to goods and services that were simply impossible in previous economic eras. Computers, for instance, allow for built-in quality measurement at every stage of production, and precise, consistent

service delivery. They also allow customized services by involving customers directly through, say, Internet commerce sites or bank machines. Information technology provides convenience because its accessibility is not limited by time and space—consumers can order goods from anywhere in the world, or deposit paychecks in the middle of the night, if they desire.

The penetration of information technology also has fueled a fundamental change in how businesses are organized. The industrial economy featured two dominant organizational formats—the rigid top-down hierarchies of mass production, and the chaotic atomization of professional services, such as health care, education, or business services. The top-down behemoths could deliver standardized goods at low prices, but had little flexibility; service industries provided variety, but little consistency. Now, though, the top-down structure of manufacturing and the fragmented structure of the services sectors are converging in a new format that tries to minimize the weaknesses of each, meld the strengths of both, and add some new twists.

The new format emphasizes flexible networks accountable to common performance standards. As a result, production processes are now just as likely to use goods and services produced by other organizations as those produced in-house. Meanwhile, service and professional industries are often aligned by such standards, pointing everyone toward well-defined outcomes. In medical fields, for instance, health maintenance organizations (HMOs) have helped standardize the delivery of care.

These flexible networks, which now dominate the knowledge economy, require communication and information technologies that allow organizations to connect easily with one another and with their customers. Here, then, is where skill-biased technological change goes to work. Increases in organizational complexity lead to an ever-increasing bias toward skilled and educated workers, because they need more knowledge and training to handle that complexity. Increases in educational attainment, in turn, result in efficiency and productivity gains when better-trained workers are paired with the technologies that make the networks possible. The result is predictable—demand for better-prepared workers goes up.

On the flip side, information technology can depress demand for workers with only high school diplomas or less. Available evidence shows that information technology tends to substitute for the narrow and repetitive work tasks that require low-skilled workers in many industries—which is why many lower-level jobs tend to disappear forever in recessions. Prior to the 1991 recession, roughly one-third of laid-off workers with a high school education or less reclaimed their old—or comparable—positions during recovery periods. In the past two recessions, the numbers were even smaller.

Jobs created in recent recoveries looked nothing like those that were lost, and the people hired for those new positions looked nothing like the people laid off from the old ones. In the past two recessions, the typical job loser was a high school-educated male in a blue collar job, such as manufacturing or construction, working in the middle of the country. In the past two recoveries, the typical job gainer was a female with a postsecondary education who lived on either coast and worked in a service occupation—particularly health care, education, or business services.

That picture is not changing. A recent McKinsey Global Institute report suggests that too few American workers are equipped with the skills required to fill attractive jobs in the economy’s new growth sectors. In fact, the study claims, 71 percent of U.S. workers are in jobs for which there is either low demand from employers, an oversupply of eligible workers, or both.<sup>6</sup>

These numbers suggest that unless we can find a way to educate the American workforce for the complexities of the knowledge economy, we risk leaving hundreds of thousands of workers behind.

## Our Postsecondary System Will Not Produce Enough Graduates.

Economists increasingly worry that America’s postsecondary education system cannot keep up with historic increases in the demand for college-educated workers. To explore that concern, we created a stock and flow model to forecast the supply of such workers through 2018.

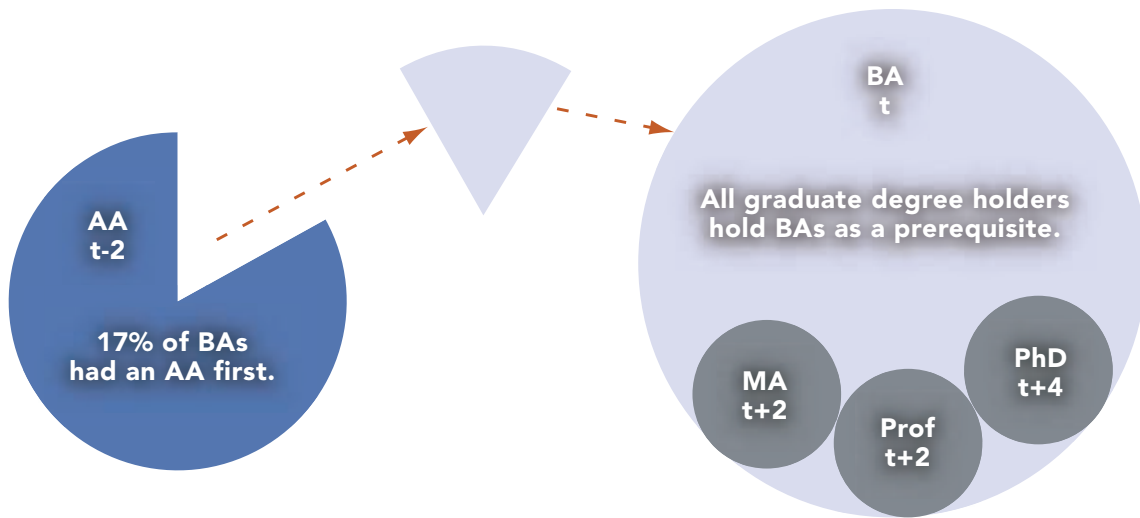
Our findings? The worry is justified. Demand for workers with college educations will outpace supply to the tune of 300,000 per year. **By 2018, the postsecondary system will have produced 3 million fewer college graduates than demanded by the labor market.**

This finding holds despite hints in a key indicator that demand for workers with postsecondary education might actually be slowing. That indicator is known as the “wage premium”—higher wages paid to college graduates compared to those for employees with no higher education. Goldin and Katz (2008) theorize that dramatic increases in this premium in the 1980s and 1990s were due to a supply slow-down in college graduates. From 2002 to 2008, however, the premium shrunk. Real wages for college-educated Americans decreased in absolute terms over that period, but relative declines in the wage premium

FIGURE 2.3

Adjustment to NCES forecast to obtain an estimate of the supply of college degrees. ( $t$ =year)

Source: Center on Education and the Workforce forecasts of educational demand to 2018



compared to the pay for high-school-educated workers have been minimal. Thus, the wage premium still exists, along with an undersupply of college-educated workers.

### SUPPLY CALCULATIONS.

To forecast the supply of degrees in the future, we relied on a combination of data sources looking at labor force characteristics, the growth in labor supply, and growth in the number of degrees conferred.

In 2008, according to the March Current Population Survey (CPS) conducted by the Bureau of Labor Statistics, 42 percent of prime working-age Americans (52.2 million) had an Associate's degree or better. To this base, we added adjusted estimates of new degrees conferred in the next 10 years.

The National Center on Education Statistics (NCES) collects and forecasts estimates of the number of degrees conferred annually. The number of degrees conferred actually exceeds the number of people with those qualifications. That is because, in any given year, if someone attains more than one degree, each is counted. NCES estimates of graduation rates and degrees conferred, therefore, are insufficient to estimate the actual flow of graduates into the U.S. economy.

To address this issue, we used a simple calculation to distinguish between degrees and people with degrees.

Typically, 17 percent of people with an Associate's degree will get a Bachelor's degree.<sup>7</sup> We assume that, on average, these

people will take another two years to complete their Bachelor's. So, we reduced the stock of terminal Associate degrees (AA) by 17 percent in time period  $t-2$ , shown in Figure 2.3.<sup>8</sup> In addition, all advanced degrees require a Bachelor's (BA) as a prerequisite. In time period  $t$ , we reduced Bachelor's degrees by the number of Master's (MA) and professional degrees (Prof) in time period  $t+2$ , and by the number of PhDs in time period  $t+4$ .

Next, we selected 2008 as a base year and found that 52.2 million prime-age Americans had an Associate's degree or better. To this base, we added our adjusted attainment estimate of another 23.4 million workers with Associate's degrees or better by 2018, giving us a preliminary estimate of 75.6 million workers.<sup>9</sup> Then, assuming a labor force outflow of about 25 million workers due to death, disability, and retirement—30 percent of whom had an Associate's degree or better—we cut that total by the appropriate number.<sup>10,11</sup> As a result, our adjusted estimate of the number of Americans with Associate's degrees or better by 2018 was 68.1 million people.

### MATCHING SUPPLY AND DEMAND.

Calculating shortages or surpluses of college workers is more complex than merely subtracting demand and supply forecasts from each other, however. Among the complicating factors: many workers hold more than one job, so the number of jobs could exceed the number of workers. Estimates of the number of jobs and the supply of labor to fill them are created by very different and irreconcilable methods. And many economists

argue that, in the long run, there are no real shortages because the wage rate acts as an equalizing factor: it eliminates short-term shortages with premiums, and short-term oversupplies with cuts to that premium. Other factors include jobs sent offshore, changes to immigration policy, technology in the production process and delayed Baby Boomer retirements.

Everything being equal, however, we estimate that the educational demand requirements of new and replacement jobs will be 21.7 million workers with Associate's degrees or better by 2018. Some 23.4 million additional workers will graduate with those degrees by that date. After adjusting for typical rates of labor force participation, we have a "participating" supply estimate of 17.5 million. Finally, to correct for multiple job holdings we turn to the May Workplace Topics II of the CPS which shows that 5 percent of the employed have more than one job.<sup>12</sup>

Adjusting our numbers for all of those factors, by 2018 we end up with a shortfall of workers with Associate's degrees or better of about 3 million. At current rates, degrees conferred would have to increase by about 10 percent a year to eliminate the shortfall—or the economy would need to slow its demand for higher education in its workers.

And that, as we have seen, simply is not happening.

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<sup>3</sup> Jobs that require only high school or less tend to be over-counted because many of them are in occupations and industries with large shares of part-time jobs or jobs with very high turnover (Lacy and Wright, 2009). Low-wage service jobs account for about 20 percent of the jobs but only 14 percent of the hours worked in the economy (Autor and Dorn, 2009). Many workers are just passing through low-wage/low-skill jobs as part of a natural career progression. Jobs that require postsecondary education or training are more likely to be career jobs. There are many more brain surgeons who used to be cashiers than there are cashiers who used to be brain surgeons, but the statistics tend to treat the two jobs equally. For example, for every new job for cashiers that will open up between 2008 and 2018, there will another 13 job openings to replace people who leave the cashier occupation. By way of contrast, for every new job for physicians there will only be 0.8 job openings to fill the jobs of physicians who leave the occupation. Roughly half the workers in low-skill, low-wage occupations move into higher wage categories within five years. Ultimately about 11 percent of Americans are stuck in low-wage, low-skill jobs in the bottom quartile of the wage distribution (Carnevale and Rose, 2001).

<sup>4</sup> Prime-age workers include those aged 25 to 54.

<sup>5</sup> National Assessment of Adult Literacy (2003)—Authors' calculations

<sup>6</sup> *Changing the Fortunes of America's Workforce: A Human Capital Challenge*. McKinsey Global Institute, June 2009.

<sup>7</sup> Based on a 2003 survey, The National Survey of College Graduates, conducted by the U.S. Census Bureau and National Science Foundation.

<sup>8</sup> For example, we assume that BA's in 2008 will contain some AA's attained in 2006. As a result we decreased 2006 AA's by the amount that will become BA's two years later.

<sup>9</sup> Contrast with unadjusted summation of NCES numbers, which gives an estimate of 36.7 AA's and better between 2008 and 2018.

<sup>10</sup> This assumes that the number of people who retire in 2008 to 2018 will closely follow the number of people who retired in the previous decade (25 million). Dohm (2000) finds that a slightly smaller number of 19 million workers retired during the period 1998 to 2008, which could imply that our static forecast overestimates the retirement number for the decade 2008 to 2018.

<sup>11</sup> Smith and Toder (2005) find that 30 percent of the early Baby Boomer birth cohorts (who will be 62 in 2008–2012) are college graduates. They forecast this proportion to be fairly stable through 2032.

<sup>12</sup> Further, roughly 35 percent of persons with multiple jobs have an Associate's degree or better.

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## Part 3

# Occupation Growth Drives Demand for Postsecondary Education.

**Demand for workers with postsecondary qualifications is tied tightly to occupations and the skills they require and more loosely to the industries in which they reside.**

This concept is critical to understanding the forces that drive educational demand and to understanding what shapes the U.S. job market. The connection between educational demand and occupation makes sense for a couple of reasons. For one thing, occupations have similar requirements regardless of the industry they are in. Accountants perform comparable tasks whether they are working for a mining company or a hospital—and the training required to do the work is virtually the same. If the tasks of a particular job require a high degree of skill, the demand for workers with postsecondary education or training will be high, regardless of industry.

Industries, on the other hand, are made up of all kinds of occupations, some that demand college degrees and some that do not. This tends to dilute the concentration of postsecondary workers found in many industries and, obviously, affects hiring patterns and waters down demand. In sum, education requirements correlate more to occupation than to industry.

This is reflected in our research, which divided occupations into nine major clusters for analysis, ranging from Blue Collar occupations to the STEM Occupations—Science, Technology, Engineering, Mathematics, and Social Sciences.<sup>13</sup>

Postsecondary demand varies substantially by occupation, depending on the sophistication of the tasks required and the training necessary to perform them. Table 3.1 gives a snapshot of that variation, showing occupations grouped in our nine major clusters and ranked by the share of incumbent workers who have some college education or better.

Demand for postsecondary workers in our occupational clusters reflects two simple, interrelated factors:

- The overall size of an occupation;
- The intensity of postsecondary requirements in an occupation.

This means the biggest clusters can produce many postsecondary positions, even if a relatively small percentage of their total jobs require higher education or training. For example, Sales and Office Support is the largest occupational cluster, and will encompass 43.5 million jobs in 2018 (Table 3.2). Even though this cluster ranks only sixth out of our nine for the percentage of workers with postsecondary education, it ranks first for the total number of workers with at least some college education simply because it is so big.

On the other hand, small clusters can produce many postsecondary jobs despite their overall size. That is because virtually every job they produce demands educated workers. Education Occupations is an example—it is only the fifth-largest occupational cluster (Table 3.2), but employs the second-highest share of workers with some college or better in 2018 (Table 3.1).

We break the occupational clusters into three tiers: those where 80 percent or more of the workers have postsecondary education; those where more than half of the workers have such training; and those where postsecondary employees are less than half of the workforce.

The most intense concentrations of postsecondary workers are in the STEM; Education; Healthcare Professional and Technical; Community Services and Arts; and Managerial and Professional Office Occupations. Those five clusters represent more than 30 percent of total occupational employment and about 45 percent of all jobs for postsecondary workers.

TABLE 3.1

Healthcare has the highest rate of growth in postsecondary attainment.

Source: Authors' analysis of March CPS data, 2008; Center on Education and the Workforce forecast of educational demand through 2018

OCCUPATIONS:	Total occupational employment: Some college or better 2008		Total occupational employment: Some college or better 2018		Rate of growth in postsecondary attainment (upskilling)
	Percentage	Rank	Percentage	Rank	
Healthcare Professional and Technical	93%	1	95%	1	22%
Education	93%	2	93%	2	15%
STEM	90%	3	91%	4	19%
Community Services and Arts	89%	4	91%	3	17%
Managerial and Professional Office	83%	5	87%	5	15%
Sales and Office Support	62%	6	65%	6	14%
Healthcare Support	53%	7	59%	7	38%
Food and Personal Services	41%	8	44%	8	23%
Blue Collar	34%	9	35%	9	7%
<b>TOTAL</b>	<b>60%</b>		<b>63%</b>		<b>16%</b>

The second tier of postsecondary intensity includes Sales and Office Support and Healthcare Support Occupations, while the third tier consists of Food and Personal Services and Blue Collar Occupations. Second- and third-tier occupations include almost 80 percent of all workers in the economy and close to 56 percent of all postsecondary workers.

Growth in the number of jobs that demand postsecondary attainment for a particular occupation will depend on a mix of factors, including its share of postsecondary jobs to begin with, its overall size, and its overall growth. Figure 3.1 shows our nine occupational clusters in 2008 and our forecast for growth by 2018.

All nine categories in Figure 3.1 are growing in their total number of jobs and in the number that require postsecondary education. The percentage of jobs that require higher education is also on the rise across the board.

### THE BIGGEST OCCUPATIONAL CLUSTERS INCLUDE THE MOST ENTRY-LEVEL JOBS, DEMAND LESS EDUCATION, AND GROW MORE SLOWLY.

As we examine these clusters a bit more closely, though, certain patterns emerge. The biggest occupational clusters tend to grow slowly and have lower concentrations of postsecondary workers than the smaller, fast-growing clusters. Consider Sales and Office Support, for example. It accounts for the largest share of total jobs, both in 2008 and 2018, but ranks only sixth for postsecondary intensity. About 65 percent of

its workers will require some college or better (Table 3.1) in 2018. Sales and Office Support will gain the largest number of jobs simply because the cluster is so big, but will rank next to last for the speed of its growth (Table 3.2).

Postsecondary intensity in Sales and Office Support is pulled down by retail clerks and cashiers. Those two categories make up more than 20 percent of the cluster's workers, and include large concentrations of people with high school education or less. In addition, employment data tends to overestimate the importance of these jobs in the economy. Clerk and cashier occupations tend to be transitional jobs, as discussed in Part 2, with many part-time workers and high turnover.

The second-largest occupational cluster, Blue Collar Occupations, follows a similar pattern. It is the slowest growing and has the lowest level of postsecondary attainment of all our clusters (Table 3.1). Only 35 percent of the workers in Blue Collar Occupations will have some college or better by 2018. Blue Collar will grow from 33.8 million jobs to 43.6 million jobs during the forecast period. But, like Sales and Office Support Occupations, it is shrinking as a share of all jobs: dropping from 23 percent to 21.4 percent (Figure 3.1).

Blue Collar does break with the pattern for large clusters in one way, though. Not only is it growing slowly, the number of new jobs it creates is small compared to similar clusters. Sales and Office Support Occupations is a comparable cluster: it ranks first in overall size, and grows slowly compared to other occupations. Still, it ranks second in the actual number of new jobs it creates. Blue Collar, meanwhile, is the second largest occupational cluster, but ranks eighth in overall new job creation.

FIGURE 3.1

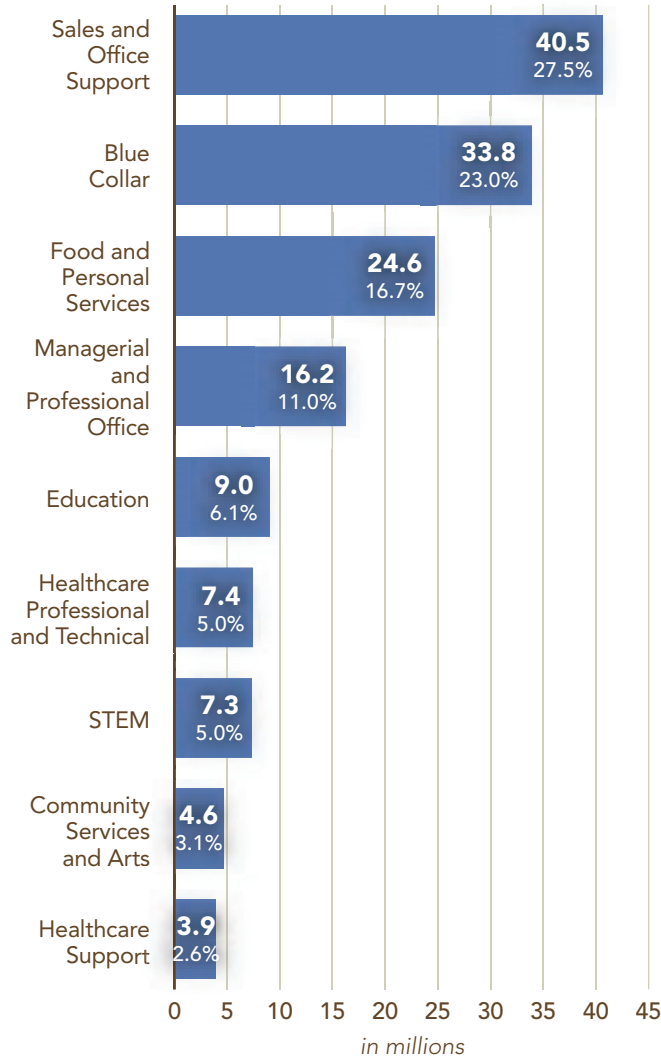
Occupations with lower postsecondary concentration are declining as a share of total employment.\*

Source: Authors' analysis of March CPS data, 2008; Center on Education and the Workforce forecast of educational demand to 2018

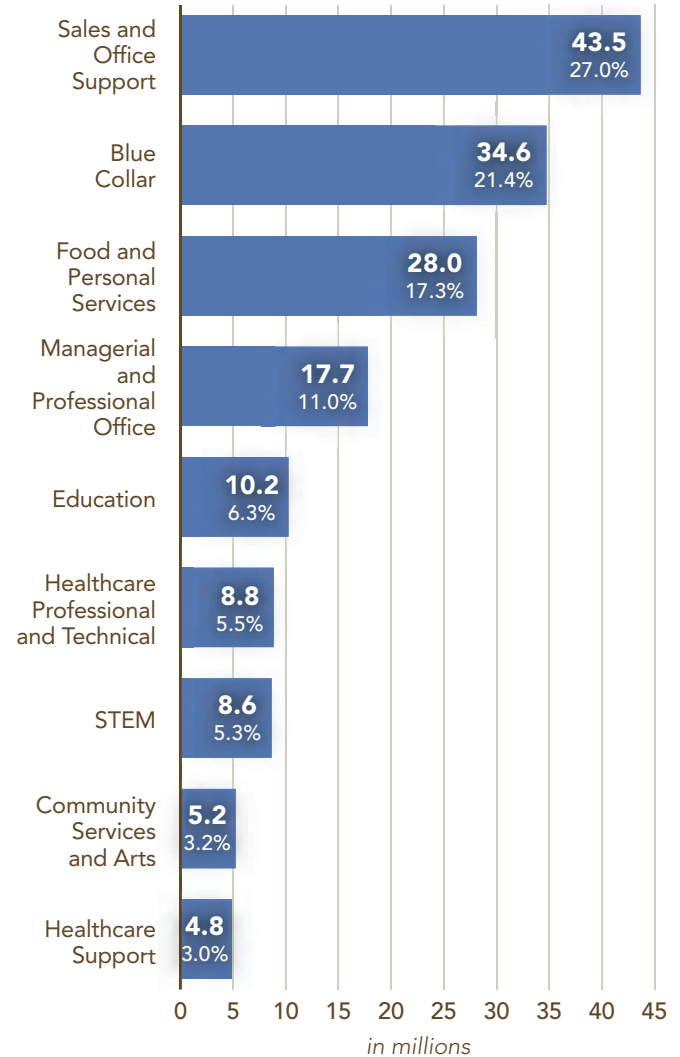
Employment levels: 147 million (2008)

Employment levels: 161.5 million (2018)

**Occupations:**



**Occupations:**



\*Percentages indicate each cluster's share of total employment.

The Blue Collar Occupations include jobs in the Manufacturing; Construction; Natural Resources;<sup>14</sup> Installation and Repair; and Transportation industries. All of these have been hard hit by the Great Recession of 2007. Construction alone accounts for 20 percent of all job losses since the recession began. Because these industries have faced such steep declines in the recession, they will bounce back robustly in the short term as the recovery takes us back to normal levels of economic output.

The prospects for long-term growth among Blue Collar Occupations are not good. Over time these occupations will be significantly affected by automation, industry consolidation, and offshore competition. The effects of these forces will be to automate and send repetitive tasks offshore, and increase the requirements for skill and productivity in the jobs that remain.

## FAST-GROWING OCCUPATIONS REQUIRE MORE WORKERS WITH HIGHER EDUCATION.

In contrast, consider these five occupational clusters:

- Managerial and Professional Office;
- Education;
- Healthcare Professional and Technical;
- Scientific, Technical, Engineering, Mathematic, and Social Sciences (STEM);
- Community Services and Arts.

These occupations, combined, show a strong bias in favor of workers with Bachelor's and Master's degrees or better. By 2018, they will be home to:

- Only 2 percent of the nation's high school dropouts;
- 10 percent of workers with high school diplomas, but no further education;
- 18 percent of workers with some college but no degree;
- 31 percent of workers with Associate' degrees;
- 56 percent of workers with Bachelor's degrees;
- 85 percent of workers with Master's degrees or better.

Although they are smaller overall, they are growing quickly, because virtually all of them tap into the new knowledge economy and are quickly creating new jobs to service it (Table 3.2). These occupations have high concentrations of workers with postsecondary education and training—ranging between 83 percent and 93 percent in 2008, and 87 percent and 95 percent in 2018. These five major clusters had 44.5 million jobs in 2008, a number that will climb to 50.5 million in 2018. Together, these occupations accounted for more than 30 percent of all jobs in 2008 and will account for 31 percent in 2018.

For sheer number of new jobs created, Managerial and Professional Office ranks third among our nine clusters; Healthcare Professional and Technical ranks fourth; Education ranks fifth; and STEM ranks sixth. In the fastest-growing category, Healthcare Professional ranks second; STEM ranks third; Community Services and Arts ranks fourth; and Education ranks fifth.

Table 3.3 shows the effects of occupational size on the number of jobs by different levels of educational attainment in 2018. The three largest occupational clusters produce larger numbers of jobs in every attainment category, except at the

Master's degree level or better. The number of jobs at that level is dominated by the smaller but more postsecondary-intensive occupations.

Table 3.4, then, divides the educational requirements into their occupational shares, while Table 3.5 shows the combined effects of occupational size, growth, and postsecondary educational intensity. The three largest occupations are the Sales and Office Support; Blue Collar; and Food and Personal Services occupations.

The biggest occupational cluster, Sales and Office Support, has a large number of overall jobs and a significant number of postsecondary positions. Because of the combined effects of overall size and postsecondary intensity, Sales and Office Support Occupations rank first in the share of all workers with some college but no degree, Associate's degrees, and Bachelor's degrees.

Blue Collar and Food and Personal Services are the second and third largest occupational clusters (Table 3.3). Because of their size, they produce large numbers of postsecondary workers but have the two lowest *shares* of postsecondary workers.

In combination, by 2018 these three largest occupational clusters will include:

- 95 percent of the nation's high school dropouts;
- 86 percent of workers with high school diplomas, but no further education;
- 76 percent of workers who have some college but no degree;
- 64 percent of workers with Associate's degrees;
- 43 percent of workers with Bachelor's degrees;
- 14 percent of workers with Master's degrees or better.

Healthcare Support Occupations, meanwhile, are a category unto themselves. They contain 3.9 million jobs, which include the lower-skilled occupations in the healthcare industry. They are less than half the size of the larger and more highly educated Healthcare Professional and Technical Occupations and rank seventh overall in postsecondary intensity. But Healthcare Support also is the fastest-growing cluster, going from 3.9 million to 4.8 million jobs between 2008 and 2018. Still, because of its small scale, it will only rank seventh in total number of jobs added.

Figure 3.2 provides a summary of education requirements by occupation as of 2018.



TABLE 3.2

With the exception of Healthcare Support, the fastest-growing occupations have the highest concentration of postsecondary attainment.

Source: Authors' analysis of March CPS data, 2008; Center on Education and the Workforce forecast of educational demand through 2018

OCCUPATIONS:	2008		2018		Difference 2008–2018		Ranking	
	Total employment (thousands)	Rank	Total employment (thousands)	Rank	Change in employment (thousands)	Rate of growth: Percent change in employment	Largest growth	Fastest rate of growth
Sales and Office Support	40,503	1	43,543	1	3,040	8%	2	8
Blue Collar	33,800	2	34,641	2	842	2%	8	9
Food and Personal Services	24,552	3	27,996	3	3,443	14%	1	6
Managerial and Professional Office	16,186	4	17,684	4	1,498	9%	3	7
Education	8,956	5	10,234	5	1,278	14%	5	5
Healthcare Professional and Technical	7,352	6	8,813	6	1,461	20%	4	2
STEM	7,320	7	8,553	7	1,233	17%	6	3
Community Services and Arts	4,552	8	5,209	8	657	14%	9	4
Healthcare Support	3,879	9	4,826	9	947	24%	7	1
<b>TOTAL</b>	<b>147,100</b>		<b>161,500</b>		<b>14,400</b>	<b>10%</b>		

TABLE 3.3

The number of jobs by educational demand in 2018. (in thousands)

Source: Center on Education and the Workforce forecast of educational demand through 2018

OCCUPATIONS:	Total employment		High school dropouts		High school graduates		Some college, no degree		Associate's degree		Bachelor's degree		Master's degree or better	
	#	Rank	#	Rank	#	Rank	#	Rank	#	Rank	#	Rank	#	Rank
Sales and Office Support	43,543	1	2,326	3	12,838	2	10,909	1	5,902	1	10,070	1	1,499	5
Blue Collar	34,641	2	7,123	1	15,323	1	5,805	2	3,665	2	2,388	8	338	8
Food and Personal Services	27,996	3	5,312	2	10,376	3	5,176	3	2,954	3	3,706	4	472	7
Managerial and Professional Office	17,684	4	254	5	2,033	4	2,340	4	1,767	5	7,519	2	3,772	2
Education	10,234	5	60	6	654	7	826	7	675	8	3,906	3	4,113	1
Healthcare Professional and Technical	8,813	6	0	9	450	8	611	8	2,161	4	2,924	6	2,667	3
STEM	8,553	7	28	8	729	6	866	6	1,054	6	3,615	5	2,262	4
Community and Arts	5,209	8	41	7	411	9	584	9	526	9	2,521	7	1,126	6
Healthcare Support	4,826	9	316	4	1,650	5	1,316	5	1,015	7	433	9	95	9

TABLE 3.4

## Educational demand across occupations in 2018.

Source: Center on Education and the Workforce forecast of educational demand through 2018

OCCUPATIONS:	Total employment		High school dropouts		High school graduates		Some college, no degree		Associate's degree		Bachelor's degree		Master's degree or better	
	% in Occ.	Rank	% in Occ.	Rank	% in Occ.	Rank	% in Occ.	Rank	% in Occ.	Rank	% in Occ.	Rank	% in Occ.	Rank
Sales and Office Support	27%	1	15%	3	29%	2	38%	1	30%	1	27%	1	9%	5
Blue Collar	21%	2	46%	1	34%	1	20%	2	19%	2	6%	8	2%	8
Food and Personal Services	17%	3	34%	2	23%	3	18%	3	15%	3	10%	4	3%	7
Managerial and Professional Office	11%	4	2%	5	5%	4	8%	4	9%	5	20%	2	23%	2
Education	6%	5	0%	6	1%	7	3%	7	3%	8	11%	3	25%	1
Healthcare Professional and Technical	5%	6	0%	9	1%	8	2%	8	11%	4	8%	6	16%	3
STEM	5%	7	0%	8	2%	6	3%	6	5%	6	10%	5	14%	4
Community and Arts	3%	8	0%	7	1%	9	2%	9	3%	9	7%	7	7%	6
Healthcare Support	3%	9	2%	4	4%	5	5%	5	5%	7	1%	9	1%	9
<b>TOTAL</b>	<b>100%</b>		<b>100%</b>		<b>100%</b>		<b>100%</b>		<b>100%</b>		<b>100%</b>		<b>100%</b>	

TABLE 3.5

## Educational demand within occupations in 2018.

Source: Center on Education and the Workforce forecast of educational demand through 2018

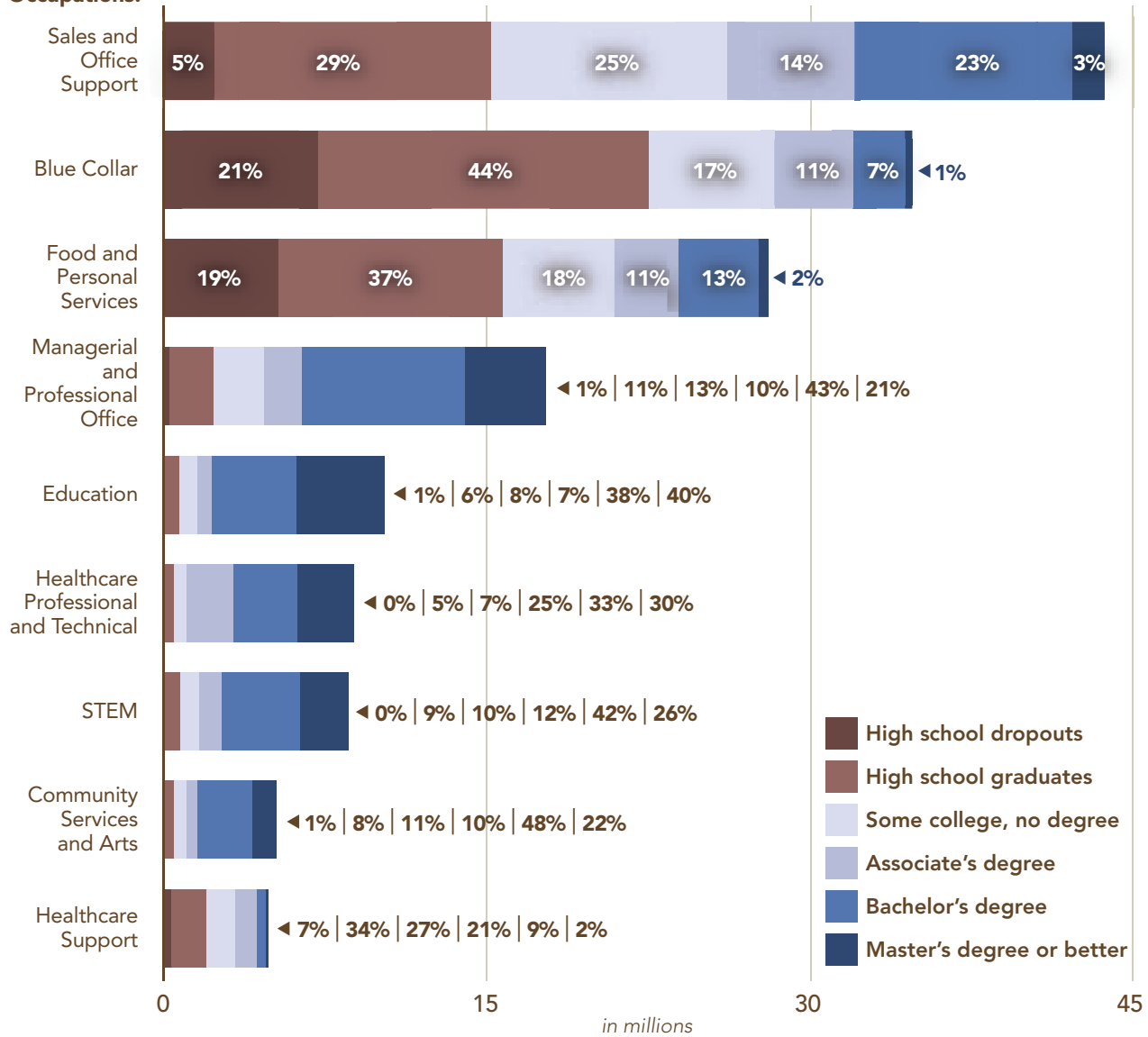
OCCUPATIONS:	High school dropouts		High school graduates		Some college, no degree		Associate's degree		Bachelor's degree		Master's degree or better		Total
	% of Occ.	Rank	% of Occ.	Rank	% of Occ.	Rank	% of Occ.	Rank	% of Occ.	Rank	% of Occ.	Rank	
Blue Collar	21%	1	44%	1	17%	4	11%	5	7%	9	1%	9	100%
Food and Personal Services	19%	2	37%	2	18%	3	11%	6	13%	7	2%	8	100%
Healthcare Support	7%	3	34%	3	27%	1	21%	2	9%	8	2%	7	100%
Sales and Office Support	5%	4	29%	4	25%	2	14%	3	23%	6	3%	6	100%
Managerial and Professional Office	1%	5	11%	5	13%	5	10%	8	43%	2	21%	5	100%
Community and Arts	1%	6	8%	6	11%	6	10%	7	48%	1	22%	4	100%
Education	1%	7	6%	7	8%	8	7%	9	38%	4	40%	1	100%
STEM	0%	8	9%	8	10%	7	12%	4	42%	3	26%	3	100%
Healthcare Professional and Technical	0%	9	5%	9	7%	9	25%	1	33%	5	30%	2	100%
<b>TOTAL</b>	<b>10%</b>		<b>28%</b>		<b>18%</b>		<b>12%</b>		<b>23%</b>		<b>10%</b>		<b>100%</b>

FIGURE 3.2

Occupational employment in 2018 and educational demand within occupations.

Source: Center on Education and the Workforce forecast of educational demand through 2018

**Occupations:**



# Occupations, Education, and Job Openings

As we noted in Part 2 of this report, there are two kinds of job openings. There are brand-new positions created as an occupation grows, and there are pre-existing jobs that people leave behind when they retire or move into other occupations. Together, as both kinds of positions become vacant, they create job openings, which represent the real number of new workers who will be required by a particular occupation.

Between 2008 and 2018 there will be just under 47 million job openings, which will include 14.4 million new and 32.4 million replacement jobs. Some 29.9 million of these openings—63 percent of the total—will require at least some college education (Table 3.6).

Even a cursory glance at the numbers show that the opportunities for workers at the bottom end of the educational attainment spectrum are becoming much more limited. Here is a cumulative look at how the 46.8 million openings will break down:

- 4.4 million, or 9 percent of the total, will be open to high school dropouts;
- 12.5 million, or 27 percent, will be open to workers with

high school diplomas but no further education;

- 8.2 million, or 17 percent, will be open to workers with at least some college but no degree;
- 5.7 million, or 12 percent, will be open to workers with Associate’s degrees;
- 11.1 million, or 24 percent, will be open to workers with Bachelor’s degrees;
- 4.9 million, or 10 percent, will be open to workers with Master’s degrees or better.

A closer look at occupations and job openings (Table 3.7) reveals some patterns. Generally, there are more job openings in the larger occupational categories and in the lower-skilled and lower-wage occupations. That is because most openings occur when workers leave an occupation, not when a new job is created. Occupations that employ large numbers of young workers—such as Retail Sales and Food and Personal Services—generate large numbers of job openings. That is because young people leave low-skilled and low-wage jobs as they gain education and move on in their careers. Replacement job openings diminish as workers move into higher-skilled and higher-wage jobs that they tend to keep until retirement. For example, among lawyers, there will be 1.5 replacement jobs for every new job between 2008 and 2018. In comparison, there will be 13 replacements for every new cashier job.

TABLE 3.6

Job openings for workers with some college or better in 2018. (in thousands)

Source: Center on Education and the Workforce forecast of educational demand through 2018

OCCUPATIONS:	Total job openings requiring Some college or better		Total job openings by 2018	Some college or better share of total job openings	Rank of Some college or better job openings	Growth rate of Some college or better job openings	
	#	Rank				#	%
Sales and Office Support	8,290	1	12,705	65%	6	20%	6
Food and Personal Services	4,559	2	10,211	45%	8	19%	8
Managerial and Professional Office	3,942	3	4,519	87%	5	24%	5
Education	2,793	4	3,003	93%	2	31%	4
Blue Collar	2,686	5	7,745	35%	9	8%	9
Healthcare Professional and Technical	2,635	6	2,777	95%	1	36%	1
STEM	2,611	7	2,831	92%	3	36%	2
Community Services and Arts	1,544	8	1,691	91%	4	34%	3
Healthcare Support	788	9	1,330	59%	7	20%	7
<b>TOTAL</b>	<b>29,848</b>		<b>46,811</b>	<b>63%</b>		<b>20%</b>	

TABLE 3.7

Share of jobs by educational demand in 2018. (in thousands)

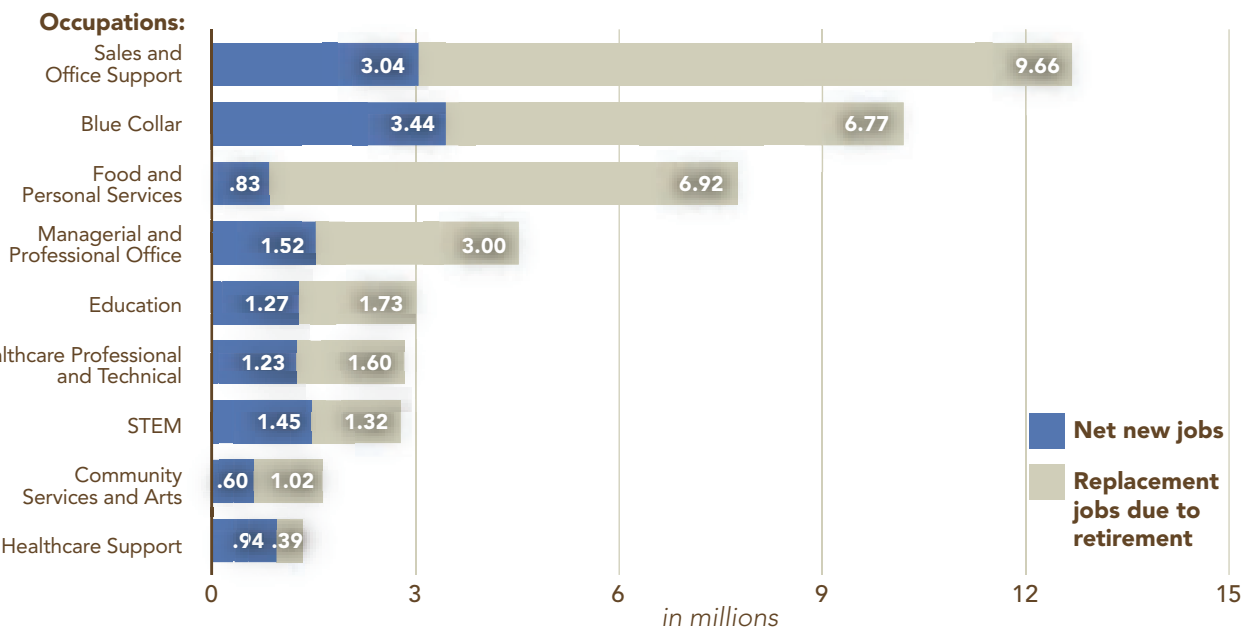
Source: Center on Education and the Workforce forecast of educational demand through 2018

OCCUPATIONS:	Total		High school dropout		High school graduate		Some college, no degree		Associate's degree		Bachelor's degree		Master's degree or better	
	%	Rank	%	Rank	%	Rank	%	Rank	%	Rank	%	Rank	%	Rank
Sales and Office Support	27%	1	16%	3	30%	2	38%	1	30%	1	27%	1	10%	5
Food and Personal Services	22%	2	43%	1	30%	1	23%	2	19%	2	12%	3	4%	7
Blue Collar	17%	3	37%	2	27%	3	16%	3	14%	3	5%	8	2%	8
Managerial and Professional Office	10%	4	1%	5	4%	4	7%	4	8%	5	17%	2	20%	2
Education	6%	5	0%	6	2%	7	3%	7	3%	8	10%	5	25%	1
STEM	6%	6	0%	8	2%	6	3%	6	6%	6	11%	4	16%	4
Healthcare Professional and Technical	6%	7	0%	9	1%	8	2%	8	12%	4	8%	6	17%	3
Community Services and Arts	4%	8	0%	7	1%	9	2%	9	3%	9	7%	7	7%	6
Healthcare Support	3%	9	2%	4	4%	5	4%	5	5%	7	1%	9	1%	9
<b>TOTAL</b>	<b>100%</b>		<b>100%</b>		<b>100%</b>		<b>100%</b>		<b>100%</b>		<b>100%</b>		<b>100%</b>	

FIGURE 3.3

New and replacement job openings and occupational distribution between 2008 and 2018.

Source: Authors' analysis of March CPS data, 2008; Center on Education and the Workforce forecast of educational demand to 2018



Job openings due to replacement needs tend to be important in declining or slow-growing occupations. Production occupations are a good example. Almost 350,000 jobs will disappear by 2018, but retirements and other departures will

create more than 2 million openings. Postal workers are also a case in point. Some 70,000 positions in that category will disappear by 2018, but there will be more than 125,000 job openings to replace departed workers.

FIGURE 3.4

Total job openings and the distribution of educational demand within occupations.

Source: Center on Education and the Workforce forecast of educational demand through 2018

**Occupations:**

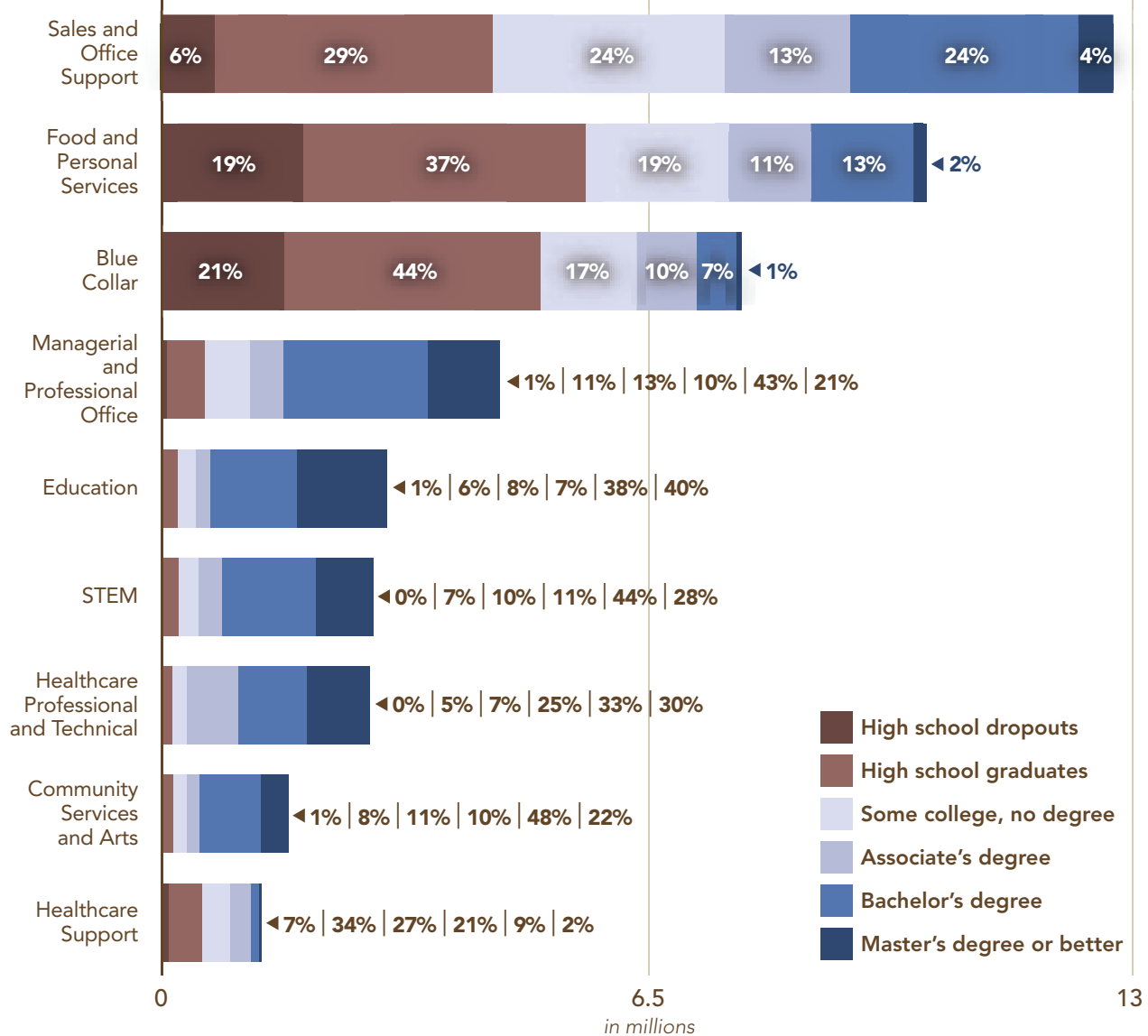


Figure 3.3 offers a graphic look at the importance of net new jobs versus replacement openings for our nine major occupational clusters. Sales and Office Support Occupations account for the largest growth in total job openings, but the ratio of new jobs to replacements is relatively low because of high turnover in cashier and retail clerk jobs. Much the same is true in Food and Personal Services Occupations, which have high concentrations of young people in lower-paid, lower-skilled positions.

In Blue Collar Occupations, too, the vast majority of openings come from replacement jobs. In fact, the ratio of replacement to new jobs is more than eight to one, the highest among the

nine occupational categories. The ratio of new jobs to replacements is much closer in the highly skilled, smaller, and faster-growing occupations. In the two fastest-growing clusters—Healthcare Professional and Technical and Healthcare Support Occupations—new jobs actually exceed replacements.

Keeping the big picture trends in mind, we now will look at how job openings and education requirements will play out in a number of individual occupations. Figure 3.4 shows education requirements, by occupation, for job openings that we forecast will occur by 2018.

## Sales and Office Support Occupations

- **SALES OCCUPATIONS** for example, cashiers, insurance agents, real estate brokers, and retail salespersons
- **OFFICE AND ADMINISTRATIVE SUPPORT OCCUPATIONS** for example, secretaries and administrative assistants, bookkeepers, and customer service representatives

This is the largest cluster of occupations we examined, and it will provide the biggest share of job openings between now and 2018.

The cluster breaks into two groups of occupations: sales positions, and office and administrative support positions. Together, they number about 40.5 million jobs—employing about 27.5 percent of the nation’s 147 million workers—in 2008. By 2018, that number will be 43.5 million, about 27 percent of 162 million total workers. We forecast that Sales and Office Support Occupations will provide 12.7 million job openings between 2008 and 2018. That breaks down to 3 million net new jobs and 9.7 million openings to replace retiring workers.

More than half of all workers in the Sales and Office Support Occupations are concentrated in two industries—Wholesale and Retail Trade Services (38 percent) and Financial Services (14 percent). Between 2008 and 2018, jobs in these occupations will open across a full range of industries, but will again cluster in those two.

**By 2018, Sales and Office Support Occupations will provide 8.3 million openings for people with at least some college education or better.** In total, there will be openings for:

- 707,000 high school dropouts;
- 3.7 million high school graduates;
- 3.1 million workers with some college, but no degree;
- 1.7 million workers with Associate’s degrees;
- 3.0 million workers with Bachelor’s degrees;
- 468,000 workers with Master’s degrees or better.

The share of workers in Sales and Office Support with at least some college or better increased from 47 percent in 1983 to 60 percent in 2008 and is projected to hit 66 percent in 2018. This set of occupations had the sixth-highest concentration of postsecondary workers in 2007 and will hold that overall position in 2018 as well.

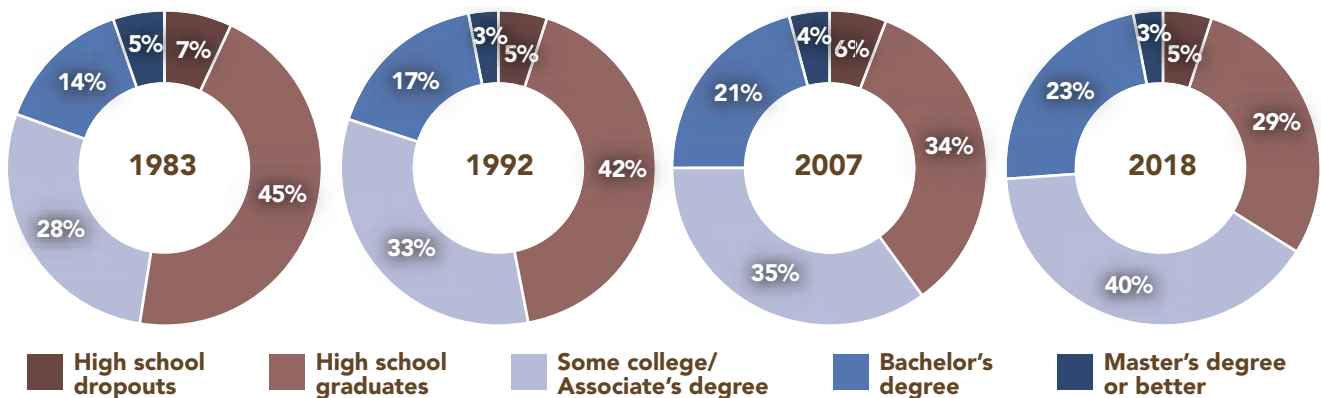
Sales and Office Support includes several positions with concentrations of postsecondary certificates, including:

- Travel Agents, 45 percent;
- Sales Representatives, 45 percent;
- Real Estate Agents, 40 percent;
- Procurement Clerks, 27 percent;
- Medical Secretaries, 21 percent.

FIGURE 3.5

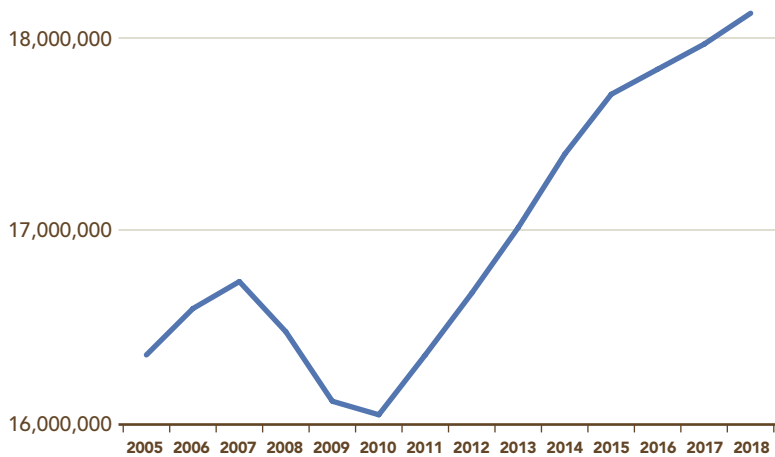
### Educational Attainment in Sales and Office Support Occupations (1983–2018).

Source: Authors’ analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018



## SALES OCCUPATIONS

Sales Occupations (2005–2018)



Education Requirements (2008/2018)

	Education Requirements (2008/2018)			
	2008	Percentage	2018	Percentage
High school dropouts	1,054,304	6%	1,262,629	7%
High school graduates	4,961,210	30%	4,948,653	27%
Some college	3,537,404	21%	3,698,190	20%
Associate's degree	1,609,994	10%	1,973,317	11%
Bachelor's degree	4,473,917	27%	5,307,133	29%
Master's degree	755,351	4.6%	832,121	5%
Professional degree	66,538	0.4%	67,789	0.4%
Doctorate degree	16,823	0.1%	37,627	0.2%

National Employment Trends (2005–2018)

	Sales and related occupations	Total	Percentage
2005	16,359,866	144,200,000	11.3%
2006	16,599,701	146,700,000	11.3%
2007	16,741,425	148,000,000	11.3%
2008	16,475,542	147,100,000	11.2%
2009	16,119,373	142,700,000	11.3%
2010	16,051,309	142,300,000	11.3%
2011	16,359,820	145,100,000	11.3%
2012	16,676,469	148,300,000	11.2%
2013	17,016,901	151,600,000	11.2%
2014	17,403,599	155,300,000	11.2%
2015	17,714,530	158,000,000	11.2%
2016	17,836,239	159,200,000	11.2%
2017	17,965,037	160,300,000	11.2%
2018	18,127,461	161,500,000	11.2%

### [SOC 41-1011–SOC 41-9099]

Source: Authors' analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018

Sales occupations make up 11 percent of all the jobs in the U.S. economy. Employment in these positions follows increases and decreases in Gross Domestic Product (GDP) and consumer spending. Sales occupations were hard hit by the recession, both because of the general GDP decline and because of wealth lost when homes and 401(k) accounts plunged in value. The number of sales positions will grow with the recovery but will be constrained by lower rates of consumer spending for some time to come. In addition, computer technology is automating more and more of these jobs as we move toward e-commerce. New information-based technologies allow consumers to control and customize their interactions with retailers and wholesalers. Consumers can, for example, now perform routine bank transactions at any time of day, or buy products from retailers anywhere in the world through the Internet.<sup>15</sup> Even so, employers will still add sales workers to perform more highly skilled, nonroutine functions and transactions that technology cannot handle.

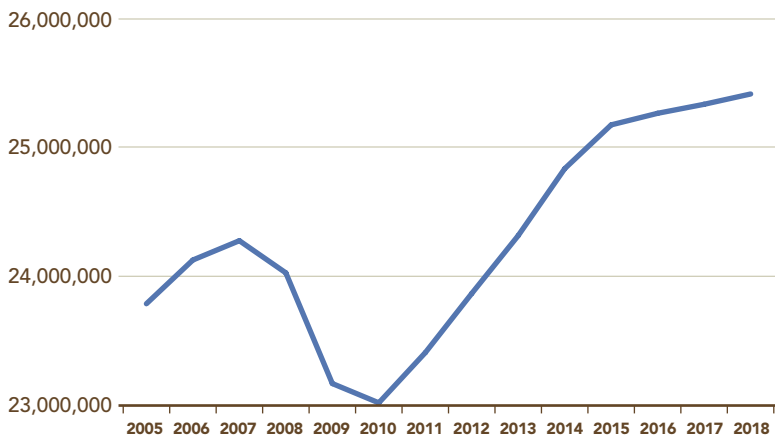
Educational attainment in Sales occupations is diverse and depends on the industry and the goods and services that are being sold. While more than half of the people in Sales occupations are relatively low-skilled cashiers and retail sales workers, the rest of these occupations are diverse in their educational profiles.<sup>16</sup> For example, the share of cashiers with a Bachelor's degree was 6 percent in 2007, with 4 percent having an Associate's degree, and 23 percent having some college education.

Sales occupations will provide 6.3 million total job openings between 2008 and 2018: 1.7 million net new jobs and 4.6 million openings from retirements. Some 4.2 million of these new and replacement jobs will require some college education or more. The largest proportion of workers hired for these positions (29 percent) will require a Bachelor's degree.



## OFFICE AND ADMINISTRATIVE SUPPORT OCCUPATIONS

Office and Administrative Support Occupations (2005–2018)



Education Requirements (2008/2018)

	Education Requirements (2008/2018)			
	2008	Percentage	2018	Percentage
High school dropouts	1,097,282	5%	1,063,847	4%
High school graduates	8,398,588	35%	7,889,573	31%
Some college	6,660,866	28%	7,210,360	28%
Associate's degree	3,065,300	13%	3,928,275	15%
Bachelor's degree	4,205,300	18%	4,762,528	19%
Master's degree	540,186	2.2%	471,802	2%
Professional degree	47,787	0.2%	76,714	0.3%
Doctorate degree	12,765	0.1%	12,557	0.05%

National Employment Trends (2005–2018)

	Office and administrative support occupations	Total	Percentage
2005	23,791,813	144,200,000	16.5%
2006	24,126,027	146,700,000	16.4%
2007	24,281,598	148,000,000	16.4%
2008	24,028,073	147,100,000	16.3%
2009	23,167,812	142,700,000	16.2%
2010	23,022,760	142,300,000	16.2%
2011	23,407,909	145,100,000	16.1%
2012	23,865,786	148,300,000	16.1%
2013	24,323,359	151,600,000	16.0%
2014	24,841,609	155,300,000	16.0%
2015	25,181,373	158,000,000	15.9%
2016	25,274,223	159,200,000	15.9%
2017	25,335,516	160,300,000	15.8%
2018	25,415,657	161,500,000	15.7%

### [SOC 43-1011–SOC 43-9199]

Source: Authors' analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018

Office and Administrative Support occupations make up 16 percent of all jobs. These occupations will continue to grow, especially in healthcare, but will slow in coming years as computer technology takes on more of the information storage and mail tasks that are part of many of these occupations. They will slip to 15.7 percent of the workforce by 2018 in part because of job losses among positions focused on information retrieval, storage, and transmission.

Among Office and Administrative Support occupations, educational attainment is roughly divided into 22 percent with a Bachelor's degree or better; 43 percent with some college or an Associate's degree; and 35 percent with a high school diploma or less. This pattern is driven by industry employment along an educational continuum. At the low end of the continuum are industries such as retail that tend to rely on sales workers with high school or less. At the other end are industries such as finance that rely on sales workers with postsecondary educations.

The education profile among Administrative Support occupations is heavily weighted toward the "high school or less" end of the continuum. More than 60 percent of Administrative Support jobs are held by people with a high school education or less, with some notable exceptions. Some 20 percent of the 24 million office support workers had Bachelor's degrees or higher in 2008. Stereotypes fall when we look closely, for instance, at Secretaries and Administrative Assistants—1.2 million of these workers have postsecondary degrees, and 47 percent have Bachelor's degrees and higher.

Office and Administrative Support occupations will provide 6.4 million total job openings between 2008 and 2018: 1.4 million net new jobs and 5 million retirement openings. Some 4.1 million of these new and replacement jobs will require some college education or more, with the largest proportion (31 percent) requiring only a high school diploma.

# Blue Collar Occupations

- **FARMING, FISHING, AND FORESTRY OCCUPATIONS**
- **CONSTRUCTION AND EXTRACTION OCCUPATIONS** for example, carpenters, laborers, electricians, and miners
- **INSTALLATION, MAINTENANCE, AND REPAIR OCCUPATIONS** for example, mechanics and HVAC technicians
- **PRODUCTION OCCUPATIONS** for example, assembly workers, machinists, welders, and inspectors
- **TRANSPORTATION AND MATERIAL MOVING OCCUPATIONS** for example, bus and truck drivers, taxi drivers, and service station attendants

Blue Collar jobs are the second-largest occupational cluster and will provide the third-largest share of job openings between 2008 and 2018. In 2008, this cluster included 33.8 million jobs, or 23 percent of all positions. Blue Collar’s share of all jobs will decline by about 1.6 percent between 2008 and 2018, but it will still add roughly 800,000 net new positions over the decade.

Blue Collar Occupations are highly concentrated: more than 80 percent are in five industries. Four of these are in goods production and one—Transportation and Utilities—is a service industry. Blue Collar Occupations are distributed among these industries as follows:

- Manufacturing industries, 29.1 percent;
- Construction, 27.6 percent;
- Transportation and Utilities, 12.4 percent;
- Wholesale and Retail Trade, 10 percent;
- Natural Resources, 3.9 percent.

Blue Collar positions are a majority of the jobs in all but one of these industries: Wholesale and Retail Trade. Two of these industries will decline in size, according to our projections: Manufacturing and Natural Resources. With the exception of Wholesale and Retail Trade, industries where Blue Collar Occupations are concentrated tend to rank in the bottom half for growth in total job openings among the 13 industry groups we examined for this forecast.

**Blue Collar Occupations will provide nearly 7.8 million job openings between 2008 and 2018, including roughly 830,000 net new jobs and 6.9 million openings to replace retirees. Those openings will include 2.7 million for people with at least some college or better.** In total, there will be job openings for:

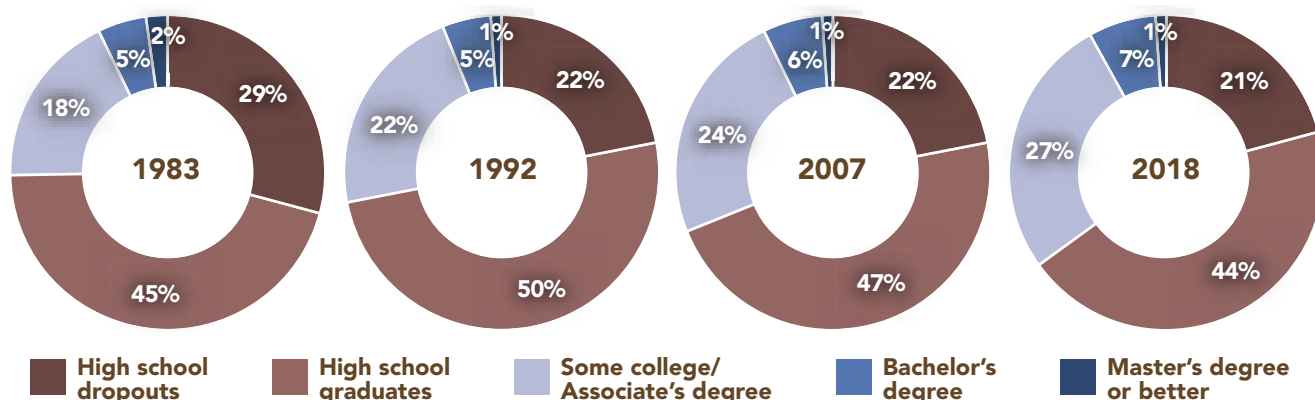
- 1.6 million high school dropouts;
- 3.4 million high school graduates;
- 1.3 million workers with some college but no degree;
- 800,000 workers with Associate’s degrees;
- 526,000 workers with Bachelor’s degrees;
- 74,000 workers with Master’s degrees or better.

Whether or not Blue Collar Occupations require postsecondary education depends to some extent on the industry where they reside. Only 18 percent of the workers in Blue Collar positions in Natural Resources—where most jobs are Blue Collar—have at least some college or better. In the other three industries where most jobs fit the Blue Collar category, the share of workers with at least some college education tops 30 percent—but these shares are still well below the norms of other occupations and industries. On the whole, Blue Collar Occupations are still dominated by positions that require high

FIGURE 3.6

## Educational Attainment in Blue Collar Occupations (1983–2018).

Source: Authors’ analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018

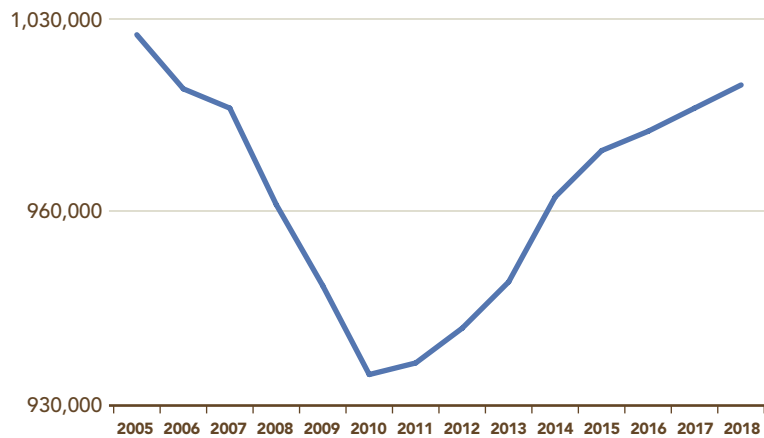


school or less. In 1983, 75 percent of Blue Collar workers had high school educations or less. That number had dropped to 69 percent by 2007, and we project that it will fall to 65 percent by 2018.

Prospects for growth in employment and demand for postsecondary education differ among the various segments of the Blue Collar occupational cluster. In the following pages, we will take a more detailed look at some of those segments.

## FARMING, FISHING, AND FORESTRY OCCUPATIONS

Farming, Fishing, and Forestry Occupations (2005–2018)



National Employment Trends (2005–2018)

	Farming, fishing, and forestry occupations	Total	Percentage
2005	1,026,222	144,200,000	0.7%
2006	1,012,263	146,700,000	0.7%
2007	1,007,047	148,000,000	0.7%
2008	982,193	147,100,000	0.7%
2009	961,523	142,700,000	0.7%
2010	938,389	142,300,000	0.7%
2011	941,136	145,100,000	0.6%
2012	950,150	148,300,000	0.6%
2013	962,490	151,600,000	0.6%
2014	984,090	155,300,000	0.6%
2015	996,622	158,000,000	0.6%
2016	1,001,589	159,200,000	0.6%
2017	1,007,221	160,300,000	0.6%
2018	1,013,951	161,500,000	0.6%

Education Requirements (2008/2018)

	2008	Percentage	2018	Percentage
High school dropouts	482,713	49%	601,762	59%
High school graduates	330,769	34%	319,140	31%
Some college	94,807	10%	34,999	3%
Associate's degree	23,294	2%	32,152	3%
Bachelor's degree	32,845	3%	22,504	2%
Master's degree	4,996	0.5%	-	0%
Professional degree	12,769	1.3%	2,390	0.2%
Doctorate degree	-	0.0%	1,004	0.1%

[SOC 45-1099–SOC 45-4029]

Source: Authors' analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018

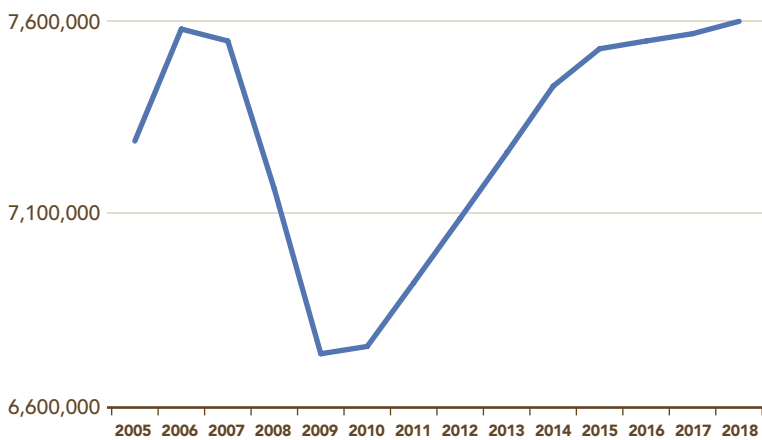
Farming, Fishing, and Forestry occupations represent less than a single percent of all U.S. jobs, roughly 1 million positions. The category's share of the workforce will not grow, either—although it will generate more than 270,000 job openings between 2008 and 2018.

In 2008, 83 percent of Farming, Fishing, and Forestry occupations required no more than a high school education. These occupations employed the highest share of high school dropouts among major occupation groups, and that share will increase to almost 90 percent by 2018. Roughly a third of the jobs in Farming, Fishing, and Forestry will require a high school degree, and less than 10 percent will require some college or better.

Farming, Fishing, and Forestry occupations will provide 272,000 total job openings between 2008 and 2018: 32,000 net new jobs and 240,000 from retirements. About 9 percent of these positions will require some college or more, with the largest proportion (59 percent) not even requiring a high school diploma.

## CONSTRUCTION AND MINING OCCUPATIONS

Construction and Extraction Occupations (2005–2018)



National Employment Trends (2005–2018)

	Construction and extraction occupations	Total	Percentage
2005	7,290,931	144,200,000	5.1%
2006	7,580,931	146,700,000	5.2%
2007	7,549,370	148,000,000	5.1%
2008	7,166,715	147,100,000	4.9%
2009	6,739,863	142,700,000	4.7%
2010	6,758,655	142,300,000	4.7%
2011	6,923,441	145,100,000	4.8%
2012	7,090,679	148,300,000	4.8%
2013	7,259,628	151,600,000	4.8%
2014	7,432,747	155,300,000	4.8%
2015	7,529,505	158,000,000	4.8%
2016	7,549,212	159,200,000	4.7%
2017	7,568,620	160,300,000	4.7%
2018	7,600,333	161,500,000	4.7%

Education Requirements (2008/2018)

	2008	Percentage	2018	Percentage
High school dropouts	1,851,243	26%	2,270,189	30%
High school graduates	3,254,081	45%	3,203,355	42%
Some college	1,031,542	14%	956,306	13%
Associate's degree	558,630	8%	672,387	9%
Bachelor's degree	394,963	6%	422,769	6%
Master's degree	55,176	0.8%	58,563	1%
Professional degree	10,123	0.1%	11,120	0.1%
Doctorate degree	16,823	0.1%	37,627	0.2%

### [SOC 47-1011–SOC 47-5099]

Source: Authors' analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018

Construction and Mining occupations account for about 5 percent of overall U.S. employment. Growth prospects for output and employment in Construction are strong, but much less robust for Mining.

Construction was hard hit by the recession. While the industry accounts for 6 percent of the nation's workers, some 20 percent of the jobs lost during this recession have come from the Construction industry. Because Construction has been particularly hard hit and many projects were canceled or put on hold, there will be growing pent-up demand for new housing and other structures. This backlog, plus demands for new infrastructure, will trigger a strong recovery in the industry.

Employment in Mining occupations, except coal, is expected to decline by more than 10 percent between 2008 and 2018. This forecast is consistent with ongoing trends in the mining industry. With the exception of coal mining, employment in the industry is expected to drop as prices for oil, gas, and

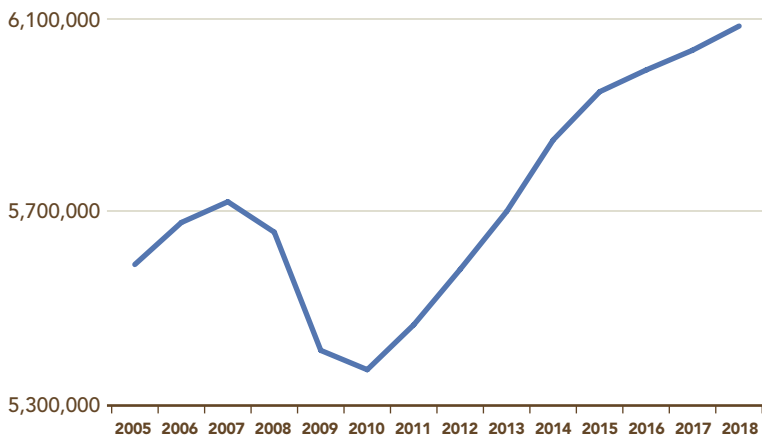
other fuel stabilize over the next decade, barring major supply interruptions. In addition, technology changes will continue to automate mining processes and occupational tasks.

In 2008, a quarter of the jobs in Construction and Mining occupations were open to high school dropouts, and that should increase to almost a third by 2018. More than 40 percent of the jobs in these occupations will be open to high school graduates and roughly a third will go to people with at least some college or better. Only about 6 percent of workers in these occupations have Bachelor's degrees, and they tend to be concentrated in occupations such as Building Inspectors.

Construction and Mining occupations will provide 1.8 million total job openings between 2008 and 2018: 437,000 net new jobs and 1.4 million openings from retirements. Some 517,000 of these new and replacement jobs will require some college or more, with the largest proportion (42 percent) requiring a high school diploma.

## INSTALLATION, MAINTENANCE, AND REPAIR OCCUPATIONS

Installation, Maintenance, and Repair Occupations (2005–2018)



National Employment Trends (2005–2018)

	Installation, maintenance, and repair occupations	Total	Percentage
2005	5,592,705	144,200,000	3.9%
2006	5,679,474	146,700,000	3.9%
2007	5,722,412	148,000,000	3.9%
2008	5,659,795	147,100,000	3.8%
2009	5,414,906	142,700,000	3.8%
2010	5,374,534	142,300,000	3.8%
2011	5,467,942	145,100,000	3.8%
2012	5,582,107	148,300,000	3.8%
2013	5,702,831	151,600,000	3.8%
2014	5,850,706	155,300,000	3.8%
2015	5,950,984	158,000,000	3.8%
2016	5,995,079	159,200,000	3.8%
2017	6,036,395	160,300,000	3.8%
2018	6,086,360	161,500,000	3.8%

Education Requirements (2008/2018)

	2008	Percentage	2018	Percentage
High school dropouts	611,611	10%	594,747	10%
High school graduates	2,459,025	42%	2,494,579	41%
Some college	1,154,468	20%	1,151,003	19%
Associate's degree	1,154,468	20%	1,259,531	21%
Bachelor's degree	422,658	7%	521,128	9%
Master's degree	26,664	0.5%	49,338	1%
Professional degree	7,924	0.1%	12,416	0.2%
Doctorate degree	9,770	0.2%	3,617	0.1%

### [SOC 49-1011–SOC 49-9099]

Source: Authors' analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018

Installation, Maintenance, and Repair occupations account for 3.8 percent of overall U.S. employment. This statistic is constant throughout the forecast horizon as these occupations grow at a steady rate compared to overall job growth. Currently, about 10 percent of people in these occupations are high school dropouts.

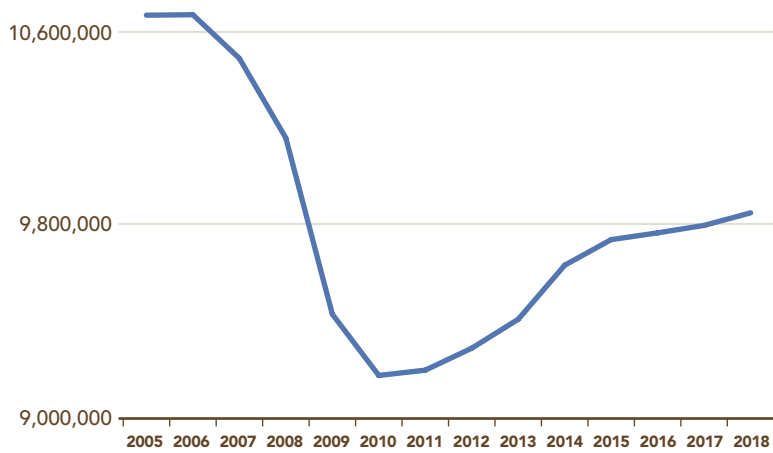
Educational attainment in Installation and Repair is almost equally distributed between high school (42 percent) and some college and Associate's degrees (40 percent), while 7 percent of workers in these jobs have Bachelor's degrees.

These occupations provide about 3 percent of the total new and replacement jobs we forecast. The largest proportion (41 percent) of new and replacement workers in Installation, Maintenance, and Repair occupations will be those with high school diplomas.

Installation, Maintenance, and Repair occupations will provide 1.3 million total job openings between 2008 and 2018: 424,000 net new jobs and 919,000 openings from retirements. About 662,000 of these jobs will require some college or more.

## PRODUCTION OCCUPATIONS

Production Occupations (2005–2018)



National Employment Trends (2005–2018)

	Production occupations	Total	Percentage
2005	10,671,900	144,200,000	7.4%
2006	10,673,845	146,700,000	7.3%
2007	10,492,568	148,000,000	7.1%
2008	10,162,411	147,100,000	6.9%
2009	9,432,569	142,700,000	6.6%
2010	9,178,914	142,300,000	6.5%
2011	9,200,252	145,100,000	6.3%
2012	9,291,796	148,300,000	6.3%
2013	9,411,784	151,600,000	6.2%
2014	9,635,298	155,300,000	6.2%
2015	9,741,229	158,000,000	6.2%
2016	9,769,304	159,200,000	6.1%
2017	9,800,120	160,300,000	6.1%
2018	9,852,642	161,500,000	6.1%

Education Requirements (2008/2018)

	2008	Percentage	2018	Percentage
High school dropouts	1,918,461	19%	1,826,073	19%
High school graduates	4,777,230	47%	4,330,386	44%
Some college	1,846,693	18%	1,790,156	18%
Associate's degree	823,849	8%	1,041,464	11%
Bachelor's degree	679,864	7%	751,142	8%
Master's degree	94,245	1%	95,535	1%
Professional degree	8,725	0.1%	8,988	0.1%
Doctorate degree	13,343	0.1%	8,898	0.1%

### [SOC 51-1011–SOC 51-9199]

Source: Authors' analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018

Production occupations account for 6.9 percent of overall employment, although that will fall to 6.1 percent by 2018, representing a net loss of 300,000 jobs.

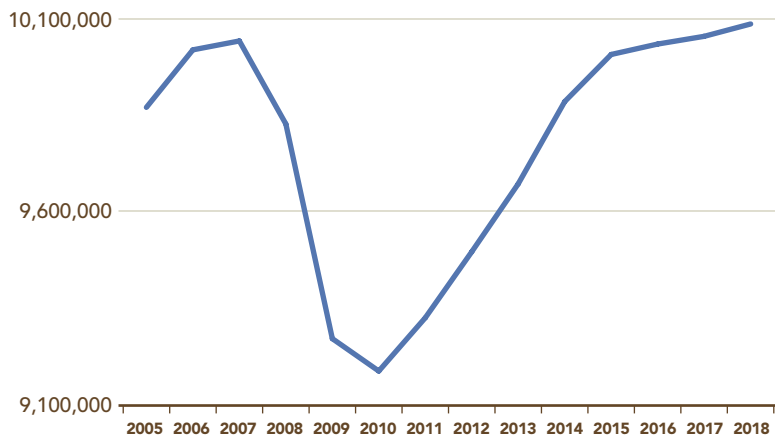
The recession has been catastrophic for this sector. To date, 30 percent of the nation's net job losses have been in Manufacturing, principally in production occupations. The deep impact of the recession on manufacturing will be followed by an initial recovery that will increase production jobs, but growth will then slow as the economy returns to its longer-term declining trend.

Almost 20 percent of jobs in Production occupations go to high school dropouts, while about 47 percent—the largest concentration—goes to high school graduates. An additional 26 percent of workers in these occupations have some college or an Associate's degree, and about 8 percent have a Bachelor's degree.

Production occupations will provide 1.8 million total job openings between 2008 and 2018, a loss of 317,000 net new jobs plus 2.1 million openings from retirements. About 668,000 of those positions will require some college or more, with the largest proportion (44 percent) requiring a high school diploma.

## TRANSPORTATION AND MATERIAL MOVING OCCUPATIONS

Transportation and Material Moving Occupations (2005–2018)



Education Requirements (2008/2018)

	Education Requirements (2008/2018)			
	2008	Percentage	2018	Percentage
High school dropouts	1,893,742	19%	1,829,827	18%
High school graduates	4,784,851	49%	4,975,347	49%
Some college	1,942,884	20%	1,873,010	19%
Associate's degree	535,586	5%	659,410	7%
Bachelor's degree	573,951	6%	670,140	7%
Master's degree	85,530	1%	55,931	1%
Professional degree	7,867	0.1%	19,428	0.2%
Doctorate degree	4,610	0.05%	5,026	0.05%

National Employment Trends (2005–2018)

	Transportation and material moving occupations	Total	Percentage
2005	9,872,217	144,200,000	6.8%
2006	10,021,093	146,700,000	6.8%
2007	10,044,425	148,000,000	6.8%
2008	9,829,021	147,100,000	6.7%
2009	9,273,801	142,700,000	6.5%
2010	9,189,770	142,300,000	6.5%
2011	9,327,780	145,100,000	6.4%
2012	9,498,546	148,300,000	6.4%
2013	9,674,881	151,600,000	6.4%
2014	9,887,129	155,300,000	6.4%
2015	10,009,468	158,000,000	6.3%
2016	10,036,610	159,200,000	6.3%
2017	10,056,331	160,300,000	6.3%
2018	10,088,120	161,500,000	6.2%

### [SOC 53-1011–SOC 53-7199]

Source: Authors' analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018

Transportation and Material Moving occupations tend to rise and fall with economic output and consumption—especially for goods. As the economy grows and demand for goods increases, truck drivers, pilots, and other transport occupations increase employment in order to move products to institutions and consumer outlets. In 2008, these occupations included 9.8 million positions, or 7 percent of all the jobs in the United States. Over the next decade, Transportation and Material Moving will grow by more than 250,000 positions, but decline slightly as a share of all jobs, due to faster growth in other occupations.

Almost 20 percent of jobs in Transportation and Material Moving will be accessible to high school dropouts between 2008 and 2018. Another 49 percent will be accessible to high school graduates, while roughly a quarter will go to workers with some college education or Associate's degrees.

Occupations in this category will provide 2.5 million total job openings between 2008 and 2018: 254,000 net new jobs and 2.2 million openings from retirements. About one-third of these jobs will require some college or more, with the largest proportion (49 percent) requiring a high school diploma.

# Food and Personal Services Occupations

- **FOOD PREPARATION AND SERVING OCCUPATIONS** for example, cooks, waiters, and waitresses
- **PERSONAL CARE OCCUPATIONS** for example, personal and home care aides, child care workers, and hairdressers and cosmetologists
- **BUILDING AND GROUNDS CLEANING AND MAINTENANCE OCCUPATIONS** for example, maids, janitors, and groundskeepers
- **PROTECTIVE SERVICE OCCUPATIONS** for example, firefighters, police officers, correctional officers, and security guards

The Food and Personal Services Occupations are the third-largest of our occupational clusters, and will provide the second-largest share of job openings through 2018. This cluster includes 24.6 million positions, or 16.7 percent of all jobs in the economy. These occupations generally have low educational attainment and, to some extent, are overstated in the data because there is so much turnover and so many are part-time. Many are first jobs that people take while they are in school, or temporary stepping-stones toward better-paying jobs in more skilled occupations. Nonetheless, Food and Personal Services will grow to 28 million jobs by 2018, increasing its number of positions by 3.4 million and its share of all jobs to 17.3 percent.

This cluster is forecast to produce 10.2 million job openings between 2008 and 2018—about 3.4 million net new jobs and an additional 6.8 million replacement openings. About 53 percent of all workers in these occupations are concentrated in the Leisure and Hospitality industry, with an additional 18 percent in Healthcare Services and 15 percent in Personal Services. Job openings in Food and Personal Services Occupations between 2008 and 2018 will provide 4.6 million openings for people with at least some college or better. In total, there will be jobs for:

- 1.9 million high school dropouts;
- 3.8 million high school graduates;
- 1.9 million workers with some college but no degree;
- 1.1 million workers with Associate’s degrees;
- 1.3 million workers with Bachelor’s degrees;
- 173,000 workers with Master’s degrees or better.

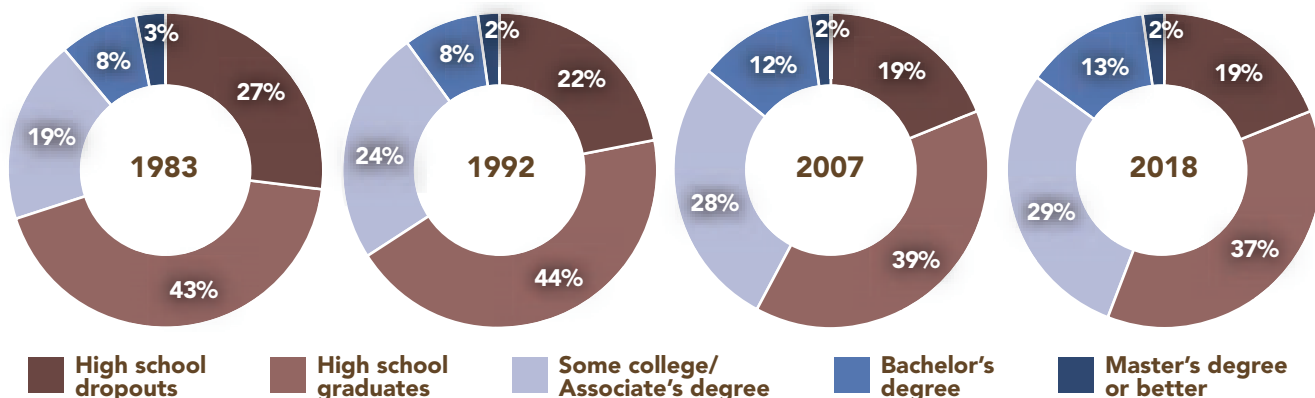
The share of workers with at least some college education or better in these occupations increased from 30 percent in 1983 to 42 percent in 2007 and is projected to increase to 44 percent in 2018. Food and Personal Services had the eighth-highest concentration of postsecondary workers out of nine occupational clusters in 2008, and it will hold that position in 2018.

On the following pages, we will examine some of the specific categories of jobs that make up the Food and Personal Services Occupations cluster.

FIGURE 3.7

## Educational Attainment in Food and Personal Services Occupations (1983–2018).

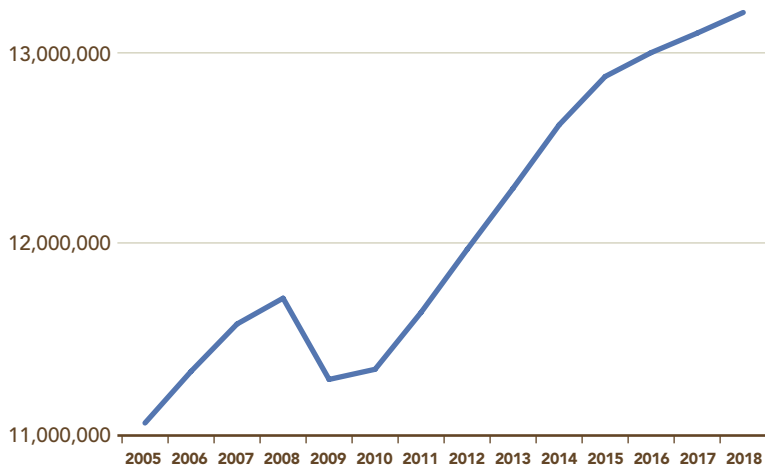
Source: Authors’ analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018





## FOOD PREPARATION AND SERVING OCCUPATIONS

Food Preparation and Serving Occupations (2005–2018)



Education Requirements (2008/2018)

	Education Requirements (2008/2018)			
	2008	Percentage	2018	Percentage
High school dropouts	2,636,232	22%	2,852,248	22%
High school graduates	4,882,079	42%	5,274,378	40%
Some college	2,139,776	18%	2,356,779	18%
Associate's degree	811,118	7%	1,167,538	9%
Bachelor's degree	1,121,891	10%	1,418,252	11%
Master's degree	95,156	1%	84,243	1%
Professional degree	21,751	0.2%	27,939	0.2%
Doctorate degree	10,095	0.1%	31,756	0.2%

National Employment Trends (2005–2018)

	Food preparation and serving occupations	Total	Percentage
2005	11,065,766	144,200,000	7.7%
2006	11,335,863	146,700,000	7.7%
2007	11,583,113	148,000,000	7.8%
2008	11,718,098	147,100,000	8.0%
2009	11,293,777	142,700,000	7.9%
2010	11,346,837	142,300,000	8.0%
2011	11,644,312	145,100,000	8.0%
2012	11,973,361	148,300,000	8.1%
2013	12,294,233	151,600,000	8.1%
2014	12,625,381	155,300,000	8.1%
2015	12,878,944	158,000,000	8.2%
2016	13,003,918	159,200,000	8.2%
2017	13,105,806	160,300,000	8.2%
2018	13,213,133	161,500,000	8.2%

### [SOC 35-1011–SOC 35-9099]

Source: Authors' analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018

During the recession, jobs in this occupational group have been affected in two ways. They have declined overall, and they also shifted from higher-cost restaurants to fast food establishments as people have cut back on spending while they weather the financial crisis. As the recovery gains momentum, however, the ongoing shift from cooking at home to buying prepared foods and eating out will continue to grow.

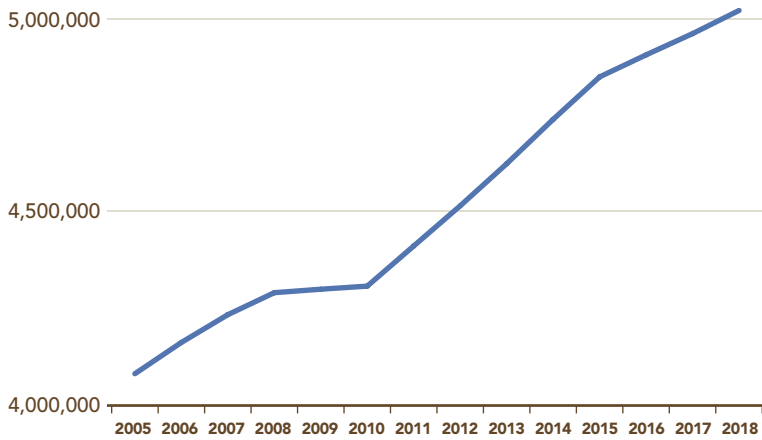
Food Preparation and Serving occupations provide low-wage and low-skilled jobs, and the distribution of postsecondary attainment will remain stable in this group between 2008 and 2018. More than 20 percent of incumbents will continue to

be high school dropouts and another 40 percent will be high school graduates. Slightly less than 20 percent will have some college education, while the number with Associate's degrees will grow a bit, from 7 percent to 9 percent. Employees with Bachelor's degrees or better will stay at roughly 12 percent of the total.

This occupational category will provide 5.3 million total job openings between 2008 and 2018, with 1.5 million net new jobs and 3.8 million openings from retirements. Some 2 million of these jobs will require some college or more, with the largest proportion (40 percent) requiring a high school diploma.

## PERSONAL CARE AND SERVICE OCCUPATIONS

Personal Care and Service Occupations (2005–2018)



Education Requirements (2008/2018)

	Education Requirements (2008/2018)			
	2008	Percentage	2018	Percentage
High school dropouts	472,853	11%	560,528	11%
High school graduates	1,578,380	37%	1,615,320	32%
Some college	913,198	21%	1,030,340	21%
Associate's degree	515,800	12%	824,663	16%
Bachelor's degree	689,683	16%	868,939	17%
Master's degree	114,824	2.7%	107,220	2%
Professional degree	8,218	0.2%	16,717	0.3%
Doctorate degree	-	0%	-	0%

National Employment Trends (2005–2018)

	Personal care and service occupations	Total	Percentage
2005	4,082,320	144,200,000	2.8%
2006	4,163,863	146,700,000	2.8%
2007	4,235,496	148,000,000	2.9%
2008	4,292,956	147,100,000	2.9%
2009	4,301,383	142,700,000	3.0%
2010	4,309,362	142,300,000	3.0%
2011	4,413,258	145,100,000	3.0%
2012	4,517,510	148,300,000	3.0%
2013	4,626,713	151,600,000	3.1%
2014	4,741,420	155,300,000	3.1%
2015	4,851,432	158,000,000	3.1%
2016	4,908,062	159,200,000	3.1%
2017	4,963,027	160,300,000	3.1%
2018	5,023,726	161,500,000	3.1%

[SOC 39-1011–SOC 39-9099]

Source: Authors' analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018

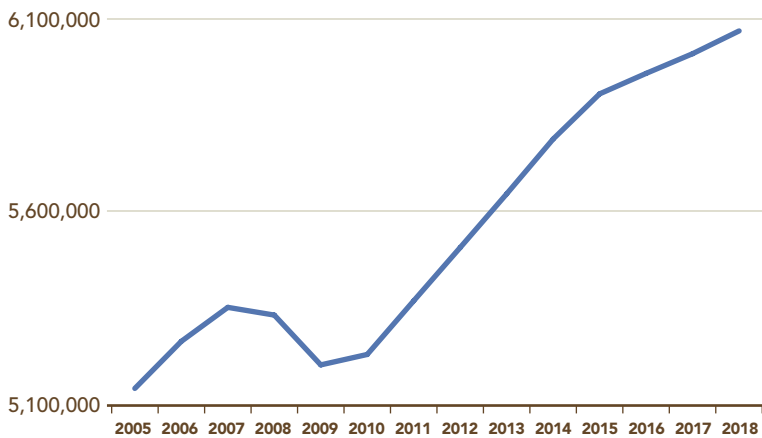
Personal Care occupations account for about 3 percent of overall jobs and will grow by more than 700,000 positions through 2018. Growth in these occupations is influenced by demography, as services for dependent populations increase. Almost 400,000 of the new jobs will come from increases in home care aides as elderly Baby Boomers require more assistance at home. At the other end of the demography spectrum, more than 150,000 jobs will result from the expansion of preschool services for children. The demographic demand for growth in Personal Care occupations has provided some protection against the Great Recession of 2007. The extent of job losses in these occupations has been mild compared to other occupations requiring similar education levels, thus making Personal Care and Services fairly recession proof.

Postsecondary education and training over the forecast period are projected to climb in these occupations. The share of jobs available to people with high school diplomas or less will decline slightly, from 48 percent to 43 percent, while the share with some college or an Associate's degree will increase by 4 percent.

Personal Care will provide 1.9 million total job openings between 2008 and 2018: 735,000 net new jobs and 1.1 million job openings from retirements. Some 1.1 million of these positions will require some college or more, with the largest proportion (32 percent) requiring a high school diploma.

## BUILDING AND GROUNDS CLEANING AND MAINTENANCE OCCUPATIONS

Building and Grounds Cleaning and Maintenance Occupations (2005–2018)



Education Requirements (2008/2018)

	Education Requirements (2008/2018)			
	2008	Percentage	2018	Percentage
High school dropouts	1,598,306	30%	1,864,141	31%
High school graduates	2,405,075	45%	2,687,729	44%
Some college	679,027	13%	735,373	12%
Associate's degree	264,816	5%	317,370	5%
Bachelor's degree	325,414	6%	404,503	7%
Master's degree	51,335	1%	53,629	1%
Professional degree	4,681	0.1%	2,717	0.04%
Doctorate degree	5,958	0.1%	5,156	0.1%

National Employment Trends (2005–2018)

	Building and grounds cleaning and maintenance occupations	Total	Percentage
2005	5,144,407	144,200,000	3.6%
2006	5,266,670	146,700,000	3.6%
2007	5,354,647	148,000,000	3.6%
2008	5,334,612	147,100,000	3.6%
2009	5,205,019	142,700,000	3.6%
2010	5,232,631	142,300,000	3.7%
2011	5,371,565	145,100,000	3.7%
2012	5,509,480	148,300,000	3.7%
2013	5,648,808	151,600,000	3.7%
2014	5,790,195	155,300,000	3.7%
2015	5,907,558	158,000,000	3.7%
2016	5,960,511	159,200,000	3.7%
2017	6,011,563	160,300,000	3.8%
2018	6,070,619	161,500,000	3.8%

### [SOC 37-1011–SOC 37-3019]

Source: Authors' analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018

Building and Grounds Cleaning and Maintenance occupations currently account for 3.6 percent of all jobs, but that percentage will increase to 3.8 percent in 2018 as it adds more than 700,000 new positions. Growth will be driven by increasing public and private construction and the growing tendency for households to contract out building and grounds maintenance.

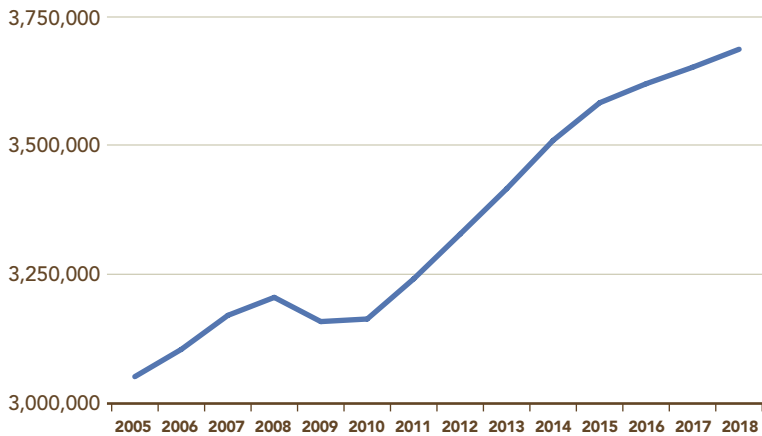
Other than Farming, Fishing, and Forestry, where high school dropouts currently represent 48 percent of the workforce, Building and Grounds Cleaning and Maintenance occupations have the highest share of dropouts, at roughly 30

percent. About 45 percent of the workers in this category will continue to hold high school degrees over the decade; 12 percent will hold Associate's degrees and 7 percent will hold Bachelor's degrees or better.

Building and Grounds Cleaning and Maintenance will provide 1.7 million total job openings between 2008 and 2018: 740,000 net new jobs and 955,000 openings from retirements. Some 424,000 of these new and replacement jobs will require some college or more. The largest proportion (44 percent) will require a high school diploma.

## PROTECTIVE SERVICES OCCUPATIONS

Protective Services Occupations (2005–2018)



Education Requirements (2008/2018)

	Education Requirements (2008/2018)			
	2008	Percentage	2018	Percentage
High school dropouts	64,635	2%	34,689	1%
High school graduates	882,397	28%	798,371	22%
Some college	941,078	29%	1,053,878	29%
Associate's degree	478,449	15%	644,373	17%
Bachelor's degree	732,047	23%	1,013,821	27%
Master's degree	98,367	3%	116,613	3%
Professional degree	4,935	0.2%	14,559	0.4%
Doctorate degree	4,784	0.1%	11,778	0.3%

National Employment Trends (2005–2018)

	Protective services occupations	Total	Percentage
2005	3,052,131	144,200,000	2.1%
2006	3,105,804	146,700,000	2.1%
2007	3,171,237	148,000,000	2.1%
2008	3,206,691	147,100,000	2.2%
2009	3,159,523	142,700,000	2.2%
2010	3,164,998	142,300,000	2.2%
2011	3,242,016	145,100,000	2.2%
2012	3,329,886	148,300,000	2.2%
2013	3,417,134	151,600,000	2.3%
2014	3,511,336	155,300,000	2.3%
2015	3,584,217	158,000,000	2.3%
2016	3,621,972	159,200,000	2.3%
2017	3,653,976	160,300,000	2.3%
2018	3,688,083	161,500,000	2.3%

### [SOC 33-1011–SOC 33-9099]

Source: Authors' analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018

Protective Services require the most highly educated workers of any category in this grouping of occupations. They account for 2.2 percent of all jobs and will add almost 500,000 more by 2018. Job increases will divide between about 400,000 new security guards and 100,000 police and law enforcement jobs. Increasing demand will be driven by population growth and security personnel in a growing number of commercial buildings.

The current proportion of high school dropouts among workers in this field is only 2 percent and will fall to 1 percent by 2018, the lowest level among all Food and Personal Services Occupations. Almost 30 percent of these workers have high school diplomas. This occupational cluster also has the high-

est level of postsecondary participation. In 2008, some 29 percent of workers in these occupations had some college but no degree; 15 percent had Associate's degrees; and 26 percent had Bachelor's degrees or better. The share of those with Associate's degrees or better is projected to grow by 6 percentage points by 2018.

Protective Service occupations will provide 1.3 million total job openings by 2018: 478,000 net new jobs and 849,000 openings from retirements. About 1 million of these jobs will require some college or more. The largest proportion (29 percent) will require some college.

# Managerial and Professional Office Occupations

- **MANAGEMENT OCCUPATIONS**
- **BUSINESS OPERATIONS SPECIALIST OCCUPATIONS** for example, human resources, management analysts, and purchasing agents
- **FINANCIAL SPECIALIST OCCUPATIONS** for example, accountants and auditors, financial advisors, and loan officers
- **LEGAL OCCUPATIONS** for example, lawyers, paralegals, and judges

Managerial and Professional Office Occupations is the fourth-largest of our occupational clusters and will provide the fourth-largest share of job openings over the next decade. These occupations account for 16.2 million jobs, 11 percent of the U.S. total. They will maintain that share and grow to 17.7 million jobs by 2018.

Much of the growth in these occupations will come as a result of the increasing complexity of the business landscape as employers try to function in ever more complicated networks and regulatory environments, while coping with fast-paced economic and technological changes. While businesses will hire much of their managerial, technical, and professional talent as in-house employees, an increasing share will also come from consultants in the Professional and Business Services industry. Employment in management and technical consulting is expected to grow by more than 800,000 employees by 2018. Computer systems design and related services also will drive growth, both in external consulting and internal hiring. Employment services—including human resources professionals hired internally and contracted out to temporary help agencies—will grow, as well.

Almost half of Managerial and Professional Office Occupations (49.6 percent) are concentrated in three industries: About 20 percent are in Professional and Business Services; 18 percent are in Financial and Business Services; and 12 percent are in Manufacturing.

Managerial and Professional Office Occupations constitute a greater share of workers in some industries than others. Financial Services has the largest share of managers and professionals, with more 40 percent of employees falling into those occupations. The Professional and Business Services industry has the second-largest concentration at 36 percent.

The type of industry makes a difference in determining the educational attainment of Managerial and Professional workers. Fewer than 60 percent of managers in Farming, Fishing, and Forestry have at least some college, while more than 90 percent in Professional and Business Services have some college or better.

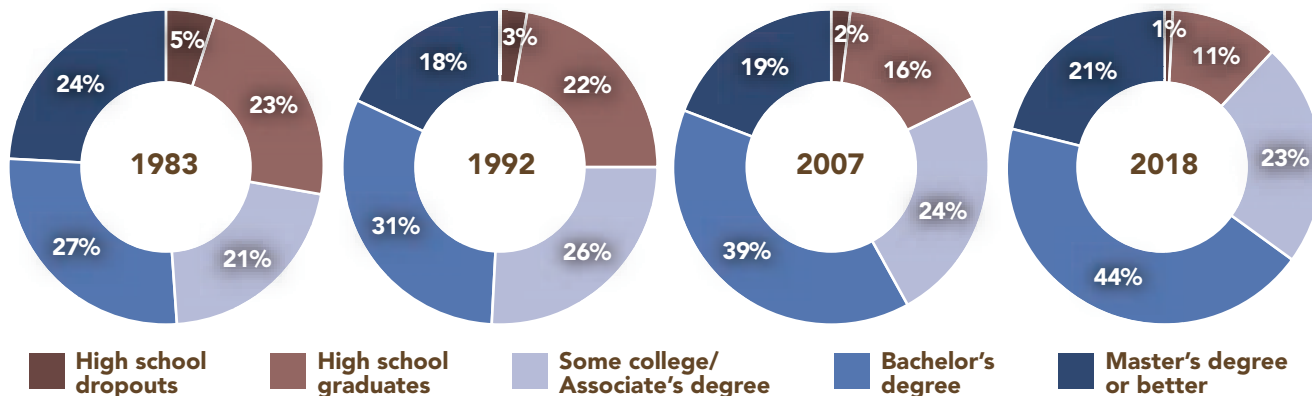
Managerial and Professional Office Occupations will provide the fourth-largest share of job openings through 2018, adding 4.5 million by that year. Some 1.5 million will be net new jobs, while another 3 million will replace retiring workers. **Job openings in this occupational cluster between 2008 and 2018 will provide 1.9 million openings for people with Bachelor's degrees.** In total, there will be openings for:

- 63,000 high school dropouts;
- 514,000 high school graduates;
- 598,000 workers with some college but no degree;
- 452,000 workers with Associate's degrees;
- 1.9 million workers with Bachelor's degrees;
- 967,000 workers with Masters degrees or better.

FIGURE 3.8

Educational Attainment in Managerial and Professional Office Occupations (1983–2018).

Source: Authors' analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018



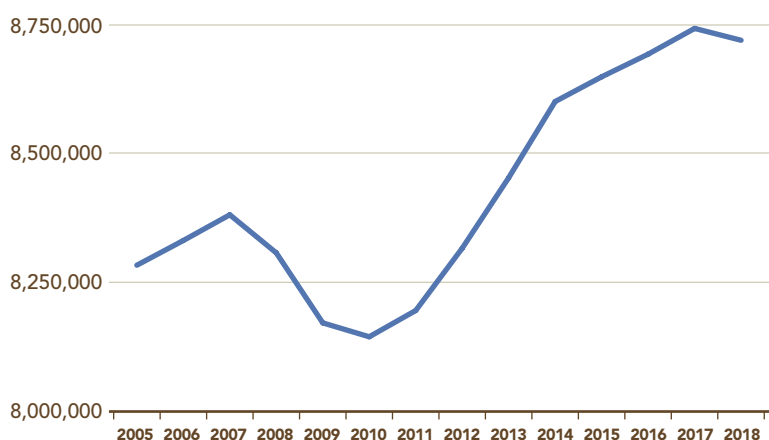
The share of postsecondary workers with at least some college or better in Managerial and Professional Office Occupations has always been relatively high. That share increased from 72 percent in 1983 to 82 percent in 2007 and is projected to climb to 88 percent in 2018. Managerial and Professional Office Occupations had the fourth-highest concentration of postsecondary workers in 2007 and will hold onto that position in 2018.

It will employ 11.3 million people with Bachelor's degrees or better in 2018, making it the fifth-largest occupational cluster for that level of postsecondary attainment.

On the following few pages, we will look at some of the component occupational groups of the Managerial and Professional Office Occupations cluster in more detail.

## MANAGEMENT OCCUPATIONS

Management Occupations (2005–2018)



National Employment Trends (2005–2018)

	Managerial occupations	Total	Percentage
2005	8,284,189	144,200,000	5.7%
2006	8,332,663	146,700,000	5.7%
2007	8,382,281	148,000,000	5.7%
2008	8,308,782	147,100,000	5.6%
2009	8,172,600	142,700,000	5.7%
2010	8,145,422	142,300,000	5.7%
2011	8,196,444	145,100,000	5.6%
2012	8,317,053	148,300,000	5.6%
2013	8,454,849	151,600,000	5.6%
2014	8,602,964	155,300,000	5.5%
2015	8,650,492	158,000,000	5.5%
2016	8,694,122	159,200,000	5.5%
2017	8,744,416	160,300,000	5.5%
2018	8,721,208	161,500,000	5.4%

Education Requirements (2008/2018)

	2008	Percentage	2018	Percentage
High school dropouts	200,219	2%	187,650	2%
High school graduates	1,533,020	18%	1,286,929	15%
Some college	1,396,229	17%	1,221,470	14%
Associate's degree	735,558	9%	883,113	10%
Bachelor's degree	2,961,667	36%	3,403,499	39%
Master's degree	1,292,712	16%	1,503,594	17%
Professional degree	84,512	1%	110,485	1%
Doctorate degree	104,866	1.3%	124,469	1%

[SOC 11-1011–SOC 11-9199]

Source: Authors' analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018

Management Occupations include employees with general responsibility for strategic decision making and day-to-day decision-making at a policy level. This category accounts for 5.6 percent of total employment and will grow from 8.3 million jobs in 2008 to 8.7 million jobs in 2018, an increase of about 400,000. Not all managerial jobs will grow, though. They will decline in the Natural Resources industry as its companies continue to consolidate into larger enterprises.

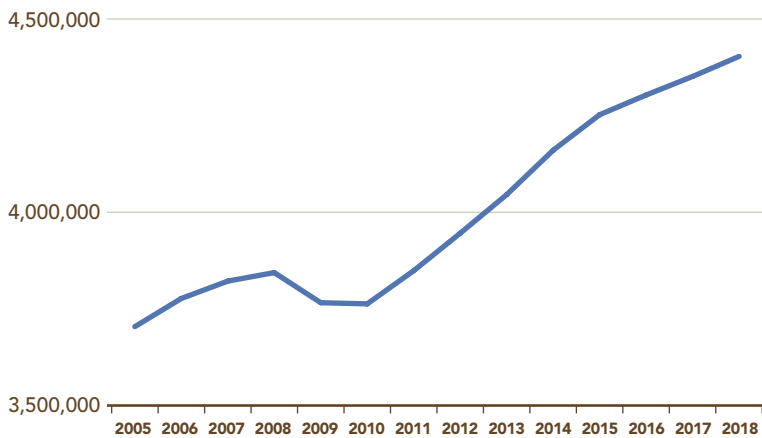
Only 2 percent of those in Management Occupations are high school dropouts. Some 26 percent have some college or an

Associate's degree, and 54 percent have a Bachelor's degree or better. The share of workers with postsecondary education in this category will increase by 4 percentage points over the decade.

Management Occupations will provide 2.1 million total job openings by 2018: 400,000 net new jobs and 1.7 million openings from retirements. About 1.8 million of these positions will require some college or more, with the largest proportion (43 percent) requiring a Bachelor's degree.

## BUSINESS OPERATIONS SPECIALIST OCCUPATIONS

Business Operations Specialist Occupations (2005–2018)



Education Requirements (2008/2018)

	Education Requirements (2008/2018)			
	2008	Percentage	2018	Percentage
High school dropouts	48,729	1%	34,520	1%
High school graduates	618,973	16%	418,731	10%
Some College	574,877	15%	651,662	15%
Associate's degree	341,529	9%	453,076	10%
Bachelor's degree	1,591,779	41%	2,017,243	46%
Master's degree	592,248	15%	734,991	17%
Professional degree	33,827	0.9%	57,594	1%
Doctorate degree	42,449	1.1%	36,532	1%

National Employment Trends (2005–2018)

	Business operations specialist occupations	Total	Percentage
2005	3,704,859	144,200,000	2.6%
2006	3,777,148	146,700,000	2.6%
2007	3,822,879	148,000,000	2.6%
2008	3,844,410	147,100,000	2.6%
2009	3,766,826	142,700,000	2.6%
2010	3,763,146	142,300,000	2.6%
2011	3,849,071	145,100,000	2.7%
2012	3,946,017	148,300,000	2.7%
2013	4,046,427	151,600,000	2.7%
2014	4,161,008	155,300,000	2.7%
2015	4,253,881	158,000,000	2.7%
2016	4,304,549	159,200,000	2.7%
2017	4,352,001	160,300,000	2.7%
2018	4,404,349	161,500,000	2.7%

### [SOC 13-1011–SOC 13-1199]

Source: Authors' analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018

Business Operations Specialist jobs are occupations where individuals have managerial authority over particular functions, such as purchasing, billing, human resources, public relations, and marketing. Business Operations Specialists account for about 2.6 percent of all employment. They are a little more than half the size of Management occupations and will go from 3.8 million jobs in 2008 to 4.4 million in 2018, an increase of about 600,000.

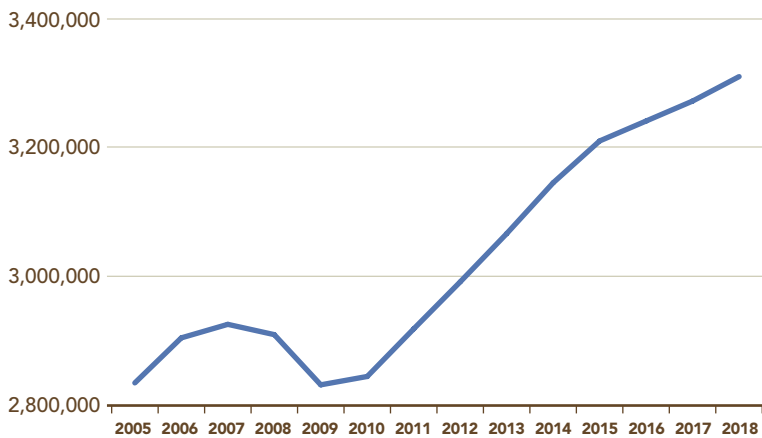
Only 1 percent of workers in these positions are high school dropouts. About 24 percent have some college or an Associ-

ate's degree, while 58 percent have a Bachelor's degree or better. The share with postsecondary education will increase by 8 percentage points over the decade.

Business Operations Specialist occupations will provide 1.2 million total job openings by 2018: 560,000 net new jobs and 649,000 openings from retirements. Some 1.1 million of these new hires will require some college or more, and the largest proportion of them (46 percent) will have a Bachelor's degree.

## FINANCIAL SPECIALIST OCCUPATIONS

Financial Specialist Occupations (2005–2018)



Education Requirements (2008/2018)

	Education Requirements (2008/2018)			
	2008	Percentage	2018	Percentage
High school dropouts	23,443	1%	17,447	1%
High school graduates	268,580	9%	224,936	7%
Some college	333,301	11%	336,907	10%
Associate's degree	297,021	10%	291,685	9%
Bachelor's degree	1,470,955	51%	1,881,309	57%
Master's degree	489,543	17%	511,711	15%
Professional degree	18,195	0.6%	39,160	1%
Doctorate degree	9,398	0.3%	7,868	0.2%

National Employment Trends (2005–2018)

	Financial specialist occupations	Total	Percentage
2005	2,835,064	144,200,000	2.0%
2006	2,905,568	146,700,000	2.0%
2007	2,926,037	148,000,000	2.0%
2008	2,910,438	147,100,000	2.0%
2009	2,832,851	142,700,000	2.0%
2010	2,845,069	142,300,000	2.0%
2011	2,919,561	145,100,000	2.0%
2012	2,992,125	148,300,000	2.0%
2013	3,067,737	151,600,000	2.0%
2014	3,146,441	155,300,000	2.0%
2015	3,211,800	158,000,000	2.0%
2016	3,242,112	159,200,000	2.0%
2017	3,273,677	160,300,000	2.0%
2018	3,311,023	161,500,000	2.1%

[SOC 13-2011–SOC 13-2099]

Source: Authors' analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018

Financial Specialist occupations account for about 2 percent of all jobs and they are concentrated in the Finance, Professional Services, and Real Estate industries.

The Finance industry has been widely blamed for helping to bring on the Great Recession of 2007, and it has paid a price. Some 537,000 financial jobs have been lost since the start of the recession, although the industry has been far from decimated. Financial Specialist occupations include a wide variety of occupations, including appraisers; budget, credit, and financial analysts; loan officers; and tax preparers and examiners. These occupations will grow from 2.9 million jobs in 2008 to 3.3 million by 2018, a net increase of 400,000 jobs.

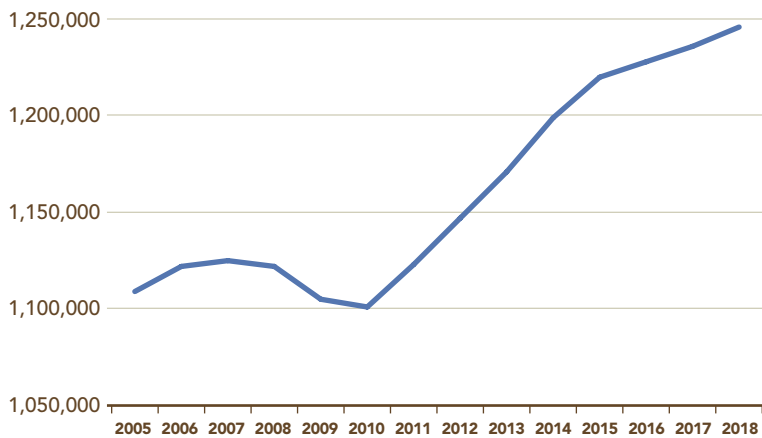
Postsecondary degrees are highly concentrated in this occupation category. Almost 70 percent of current workers have Bachelor's degrees or better. Another 21 percent have some college or an Associate's degree. Less than 10 percent have no formal education beyond high school, and only 1 percent are high school dropouts.

Financial Specialist occupations will provide 854,000 total job openings by 2018: 405,000 net new jobs and 449,000 openings from retirements. Some 791,000 of these positions will require some college or more, and the largest proportion (57 percent) will require a Bachelor's degree.



## LEGAL OCCUPATIONS

Legal Occupations (2005–2018)



National Employment Trends (2005–2018)

	Legal occupations	Total	Percentage
2005	1,109,088	144,200,000	0.8%
2006	1,122,839	146,700,000	0.8%
2007	1,125,915	148,000,000	0.8%
2008	1,122,560	147,100,000	0.8%
2009	1,105,306	142,700,000	0.8%
2010	1,101,623	142,300,000	0.8%
2011	1,123,557	145,100,000	0.8%
2012	1,147,171	148,300,000	0.8%
2013	1,171,841	151,600,000	0.8%
2014	1,199,304	155,300,000	0.8%
2015	1,220,239	158,000,000	0.8%
2016	1,228,566	159,200,000	0.8%
2017	1,236,514	160,300,000	0.8%
2018	1,246,198	161,500,000	0.8%

Education Requirements (2008/2018)

	2008	Percentage	2018	Percentage
High school dropouts	17,427	2%	13,953	1%
High school graduates	87,054	8%	102,290	8%
Some college	90,532	8%	130,165	10%
Associate's degree	104,993	9%	138,664	11%
Bachelor's degree	176,521	16%	216,168	17%
Master's degree	80,918	7%	57,732	5%
Professional degree	466,038	42%	470,419	38%
Doctorate degree	99,078	9%	116,807	9%

### [SOC 23-1011–SOC 23-2099]

Source: Authors' analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018

Legal occupations account for less than 1 percent of the nation's jobs. They include lawyers, judges, arbitrators, and paralegals. Legal occupations will generate 332,000 total job openings between 2008 and 2018, including 124,000 net new jobs and 208,000 openings due to retirement.

This category is heavily weighted toward graduate and professional education. In 2008, 42 percent of incumbent workers had professional degrees, 9 percent had PhDs, and 7 percent had Master's degrees.

Sixteen percent, meanwhile, had Bachelor's degrees and 17 percent had Associate's degrees or some college. Only 10 percent of workers have high school diplomas or less. Between 2008 and 2018, there will be a shift of 4 percentage points from professional degrees to Bachelor's and Associate's degrees, reflecting stronger growth in paralegals and other occupations below the professional degree level.

Some 301,000 of the new and replacement jobs in the category will require some college or more. The largest proportion (38 percent) of new hires will need a professional degree.

# Education Occupations

Education Occupations form the fifth-largest occupational set examined for this report and will provide a commensurate share of job openings between 2008 and 2018. These occupations currently account for 9 million jobs and will grow to 10.2 million by 2018, a net increase of 1.3 million new jobs. Education, Training, and Library Occupations will produce 3 million job openings over the decade, including 1.3 million net new jobs and 1.7 job openings from retirement.

This category includes a wide variety of occupations, but is dominated by preschool and K–16 teachers.

Job openings will include:

- more than 550,000 for postsecondary teachers;

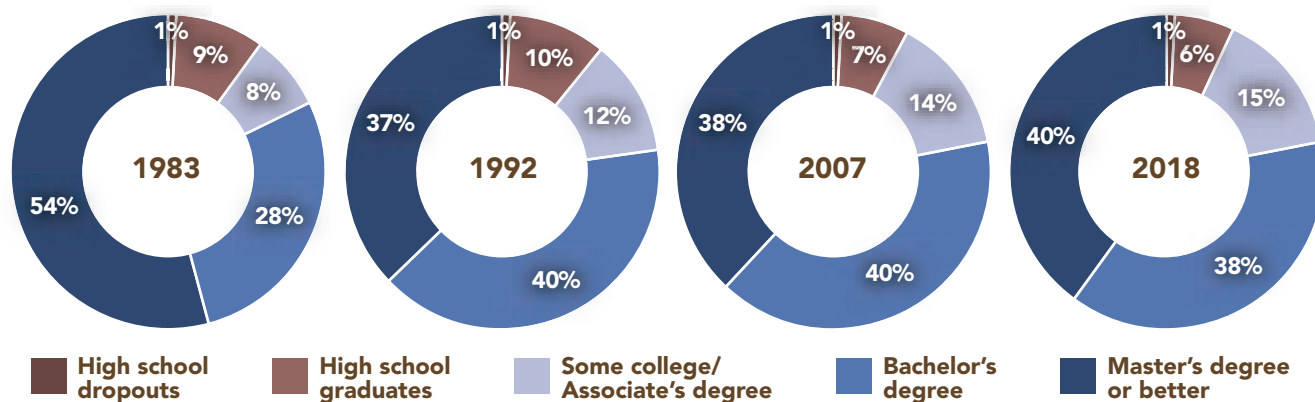
- roughly 450,000 for high school teachers;
- more than 850,000 for elementary and middle school teachers;
- almost 250,000 openings for preschool and kindergarten teachers;
- more than 200,000 openings for special education teachers.

**Education Occupations—along with Science, Technology, Engineering, Mathematics, and Social Sciences Occupations (STEM)—show the highest concentrations of jobs requiring postsecondary education.**

FIGURE 3.9

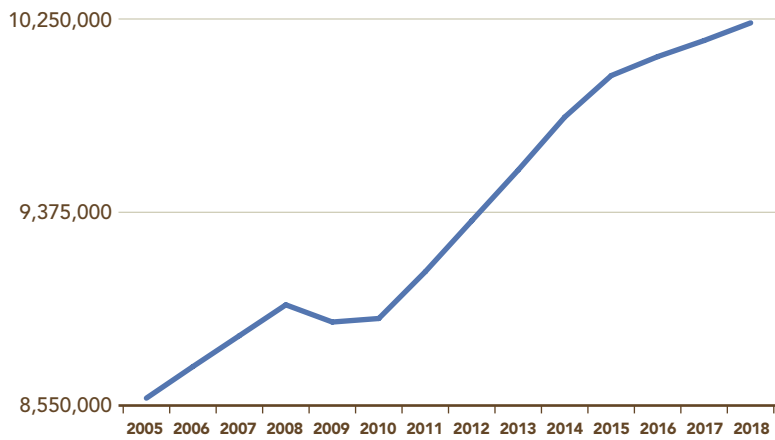
## Educational Attainment in Education Occupations (1983–2018).

Source: Authors' analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018



## EDUCATION OCCUPATIONS

Education Occupations (2005–2018)



Education Requirements (2008/2018)

	2008	Percentage	2018	Percentage
High school dropouts	58,552	1%	60,302	1%
High school graduates	595,458	7%	654,477	6%
Some college	698,385	8%	825,721	8%
Associate's degree	492,910	6%	674,515	7%
Bachelor's degree	3,513,430	39%	3,906,200	38%
Master's degree	3,022,305	34%	3,461,068	34%
Professional degree	135,441	2%	190,260	2%
Doctorate degree	439,732	5%	461,665	5%

National Employment Trends (2005–2018)

	Education occupations	Total	Percentage
2005	8,533,538	144,200,000	5.9%
2006	8,676,164	146,700,000	5.9%
2007	8,816,895	148,000,000	6.0%
2008	8,956,212	147,100,000	6.1%
2009	8,878,388	142,700,000	6.2%
2010	8,894,739	142,300,000	6.3%
2011	9,106,600	145,100,000	6.3%
2012	9,337,838	148,300,000	6.3%
2013	9,567,173	151,600,000	6.3%
2014	9,807,430	155,300,000	6.3%
2015	9,995,547	158,000,000	6.3%
2016	10,081,541	159,200,000	6.3%
2017	10,154,268	160,300,000	6.3%
2018	10,234,209	161,500,000	6.3%

[SOC 25-1099–SOC 25-9099]

Source: Authors' analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018

# Healthcare Professional and Technical Occupations

Healthcare Professional and Technical Occupations rank as the fifth-largest cluster and will provide the seventh-largest share of job openings over the next decade. Growth in healthcare employment is remarkably resilient. As the population ages and as advances in pharmaceuticals, medical technology, and healthcare practices make it possible to treat more diseases, demand for these services will only grow.

Spending on healthcare is estimated at about 16 percent of GDP and growing rapidly. **Demand pressures are so strong that the Healthcare industry has increased employment by almost 650,000 jobs since the recession began.** Healthcare is one of the few sectors that registered employment gains and so stayed relatively insulated during the downturn.

All healthcare occupations will experience robust growth. Registered nurses and health technologists will each grow by more than half a million jobs. These occupations will lead occupational growth over the next decade and account for most of the growth in healthcare.

In 2008, this category had about 7.4 million jobs, around 5 percent of the nation's total of 147 million workers. The number is projected to increase to 8.8 million, or 5.5 percent of the country's 162 million workers, in 2018. Healthcare occupations are forecast to provide 2.8 million job openings by 2018: 1.5 million net new jobs and an additional 1.3 million replacement openings.

These positions are weighted toward postsecondary degrees. In 2008, about 25 percent of healthcare workers had an Associate's degree, making these occupations the most intensive for that category among all major occupations.<sup>17</sup> In addition:

- 9 percent of workers have some college but no degree;
- 31 percent have Bachelor's degrees;
- 11 percent have Master's degrees;
- 13 percent have Professional degrees;
- 5 percent have PhDs.

Here is a breakdown of educational requirements projected for the 2.8 million job openings projected for Healthcare Professional and Technical Occupations by 2018. In total, there will be job openings for:

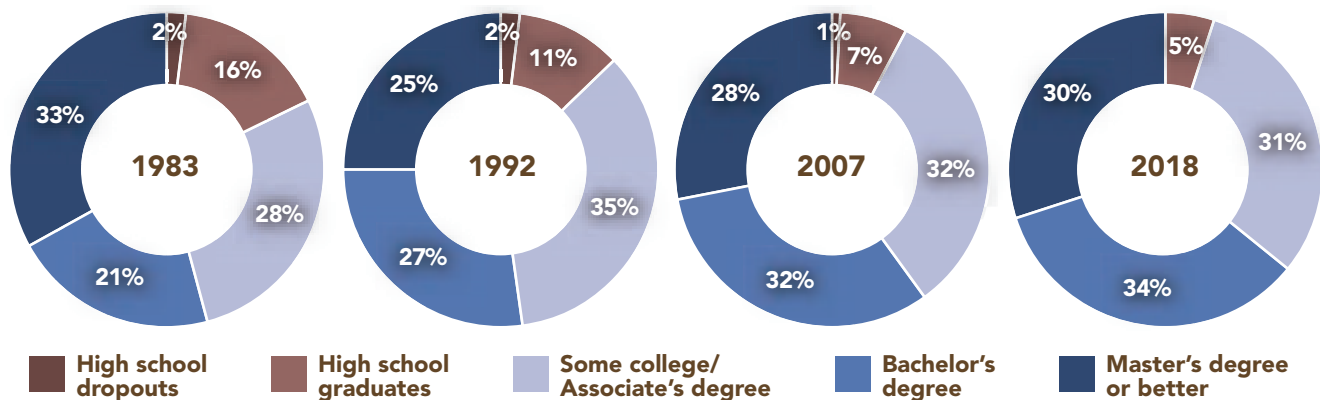
- 0 high school dropouts;
- 142,000 high school graduates;
- 192,000 workers with some college but no degree;
- 681,000 workers with Associate's degrees;
- 921,000 workers with Bachelor's degrees;
- 840,000 workers with Master's degrees or better.

The share of workers with at least some college or better in this occupational category increased from 82 percent in 1983 to 92 percent in 2007 and is projected to increase to 95 percent in 2018. The Healthcare Professional and Technical Occupations; Education Occupations; and Science, Technology, Engineering, Mathematics, and Social Sciences Occupations had the highest concentrations of postsecondary workers in 2008 and will continue through 2018.

FIGURE 3.10

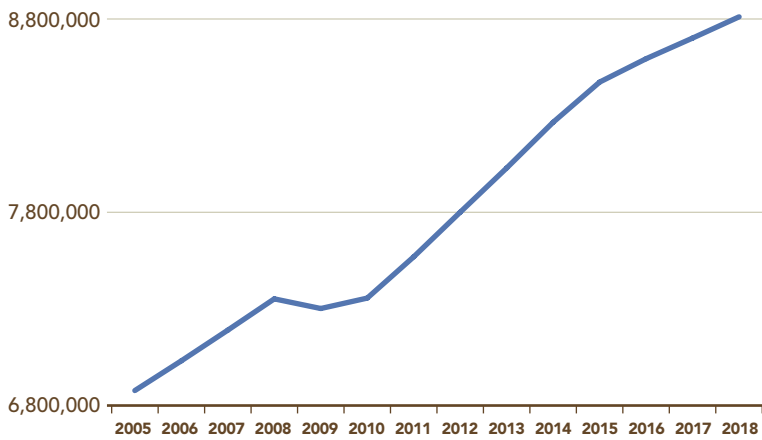
Educational Attainment in Healthcare Professional and Technical Occupations (1983–2018).

Source: Authors' analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018



## HEALTHCARE PROFESSIONAL AND TECHNICAL OCCUPATIONS

Healthcare Professional and Technical Occupations (2005–2018)



Education Requirements (2008/2018)

	Education Requirements (2008/2018)			
	2008	Percentage	2018	Percentage
High school dropouts	25,331	0.3%	-	0%
High school graduates	495,848	7%	450,038	5%
Some college	640,038	9%	610,671	7%
Associate's degree	1,811,139	25%	2,161,139	25%
Bachelor's degree	2,264,542	31%	2,924,180	33%
Master's degree	818,804	11%	1,076,558	12%
Professional degree	963,617	13%	952,263	11%
Doctorate degree	333,127	5%	638,304	7%

National Employment Trends (2005–2018)

	Healthcare professional and technical occupations	Total	Percentage
2005	6,877,443	144,200,000	4.8%
2006	7,031,830	146,700,000	4.8%
2007	7,190,943	148,000,000	4.9%
2008	7,352,445	147,100,000	5.0%
2009	7,302,684	142,700,000	5.1%
2010	7,356,965	142,300,000	5.2%
2011	7,570,269	145,100,000	5.2%
2012	7,801,689	148,300,000	5.3%
2013	8,030,230	151,600,000	5.3%
2014	8,267,083	155,300,000	5.3%
2015	8,475,364	158,000,000	5.4%
2016	8,596,672	159,200,000	5.4%
2017	8,703,162	160,300,000	5.4%
2018	8,813,149	161,500,000	5.5%

[SOC 29-1011–SOC 29-9099]

Source: Authors' analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018

# Scientific, Technology, Engineering, Mathematics, and Social Sciences (STEM) Occupations

- COMPUTER AND MATHEMATICAL SCIENCE OCCUPATIONS
- ARCHITECTS AND TECHNICIANS OCCUPATIONS
- ENGINEERS AND TECHNICIANS OCCUPATIONS
- LIFE AND PHYSICAL SCIENCES OCCUPATIONS
- SOCIAL SCIENCES OCCUPATIONS

STEM, as this group of occupations is known, is the sixth-largest cluster and will also provide the sixth-largest share of job openings in the economy over the next decade. While these occupations are not large in number, they generate the technological changes that shape all other occupations. In 2008, STEM Occupations accounted for about 7.3 million jobs, or about 5 percent of the 147 million in the U.S. economy. By 2018, they are projected to increase to 8.6 million jobs, or 5.3 percent of the nation's 162 million total positions.

The STEM Occupations are broadly represented in all industries, but are most concentrated in the Professional and Business Services (21 percent) and Information Services (14 percent) industries.

This cluster of occupations is forecast to provide 2.8 million job openings through 2018, including 1.2 million net new jobs and an additional 1.6 million replacement openings. Here is a breakdown of projected STEM openings by education requirements. In total, there will be job openings for:

- 9,000 high school dropouts;
- 210,000 high school graduates;
- 274,000 workers with some college but no degree;
- 313,000 workers with Associate's degrees;
- 1.2 million workers with Bachelor's degrees;
- 779,000 workers with Master's degrees or better.

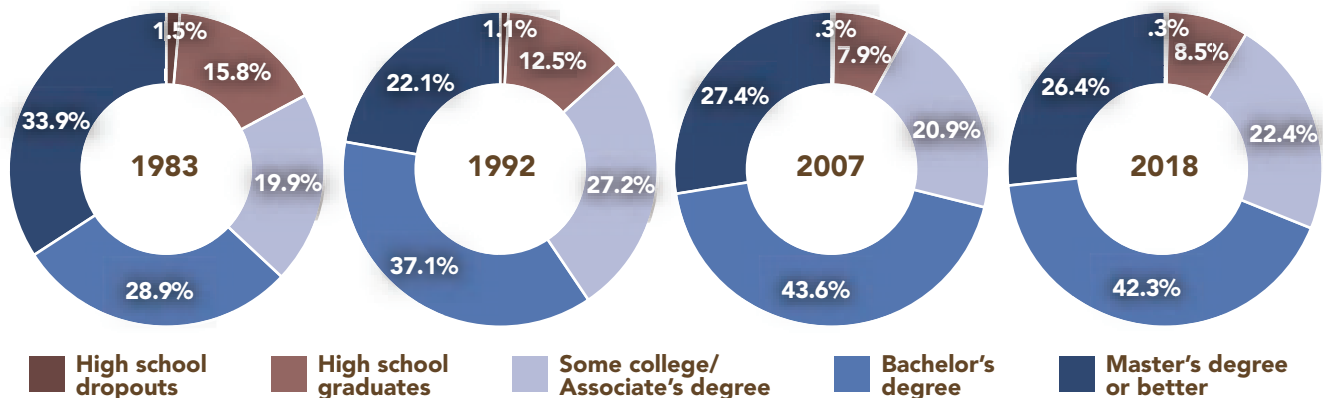
The share of workers with at least some college or better in STEM Occupations has always been high. **Almost 83 percent of STEM employees had at least some postsecondary education in 1983, and that number climbed to 92 percent in 2008 and is projected to remain there through 2018.** STEM Occupations, along with several other occupational clusters, ranked at the top for their concentrations of postsecondary workers in 2007 and will hold onto that ranking in 2018.

The STEM cluster of occupations includes a wide gamut of scientific and technical job categories. We detail some of those in the following pages.

FIGURE 3.11

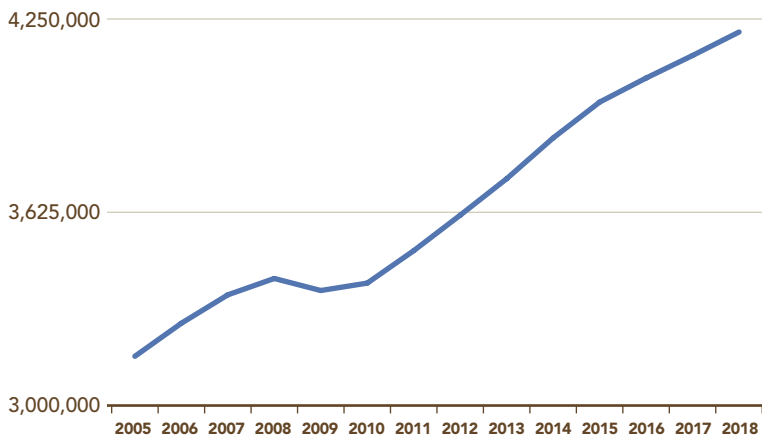
## Educational Attainment in STEM Occupations (1983–2018).

Source: Authors' analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018



## COMPUTER AND MATHEMATICAL SCIENCE OCCUPATIONS

Computer and Mathematical Science Occupations (2005–2018)



Education Requirements (2008/2018)

	Education Requirements (2008/2018)			
	2008	Percentage	2018	Percentage
High school dropouts	18,009	1%	21,406	1%
High school graduates	251,618	7%	229,500	5%
Some college	393,410	12%	476,684	11%
Associate's degree	336,159	10%	408,244	10%
Bachelor's degree	1,658,123	49%	2,127,160	51%
Master's degree	684,770	20%	844,819	20%
Professional degree	22,378	0.7%	39,267	1%
Doctorate degree	46,710	1.4%	62,463	1%

National Employment Trends (2005–2018)

	Computer and mathematical science occupations	Total	Percentage
2005	3,159,691	144,200,000	2.2%
2006	3,266,901	146,700,000	2.2%
2007	3,358,592	148,000,000	2.3%
2008	3,411,177	147,100,000	2.3%
2009	3,372,432	142,700,000	2.4%
2010	3,396,901	142,300,000	2.4%
2011	3,501,083	145,100,000	2.4%
2012	3,616,619	148,300,000	2.4%
2013	3,734,782	151,600,000	2.5%
2014	3,866,375	155,300,000	2.5%
2015	3,982,783	158,000,000	2.5%
2016	4,060,081	159,200,000	2.6%
2017	4,133,008	160,300,000	2.6%
2018	4,209,542	161,500,000	2.6%

### [SOC 15-1011–SOC 15-2099]

Source: Authors' analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018

Computer and Mathematical Science occupations are the largest category in the STEM cluster. They accounted for 3.4 million jobs in 2008, or 2.3 percent of all jobs, and will grow to 4.2 million jobs in 2018, or 2.6 percent of the total.

Education levels for Computer and Mathematical Science occupations are currently concentrated in Bachelor's and Master's degrees (69 percent) and that should increase to 71 percent by 2018. In addition, the demand for workers with some college and Associate's degrees for Computer and Mathematical Science occupations is significant (22 percent), although it should dip to 21 percent by 2018. Some 1.5 million positions will be available in the category through 2018: 798,000 net new jobs and 707,000 replacement openings. This represents about 3 percent of the total new and replacement jobs forecast during that period and reflects a relatively greater demand for highly skilled computer and mathematical sciences workers to replace retirees. About 94 percent of these new and replacement jobs will require some college or more, with the largest proportion (51 percent) requiring a Bachelor's degree.

Computer and Mathematical Science occupations are dominated by Computer occupations, although Mathematical Science occupations will grow by roughly 20 percent from a relatively small base of nearly 120,000 jobs in 2008.

Computer Specialists account for the largest share of growth in this category. People in these occupations help institutions and individuals keep up with the rapid pace of computer technological change and new network applications. Computer Specialists account for more than 700,000 of the 800,000 new jobs that will be created in this category of occupations. The number of computer programmers will decline, however, as programming gives way to the increased use of software interfaces.

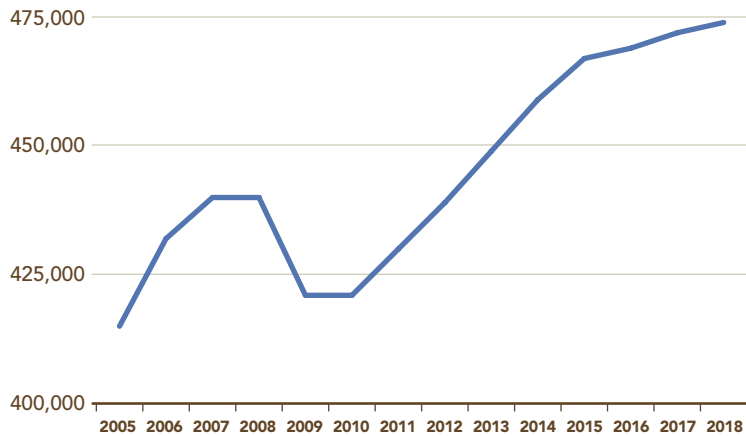
**This occupational category will grow in every industry because of its integral role in broad-based technology change.** Still, almost half of the growth will occur in Professional and Business Services, which houses Computer Systems Design, the economy's fifth-fastest growing industry. It will grow by nearly \$100 billion in output and

almost 700,000 jobs over the decade. Growth will be driven by demand for increasingly sophisticated Internet and intranet capabilities; the need to connect with mobile computer

and communications technologies; the expansion of electronic healthcare records; and increasing demand for computer-related security.

## ARCHITECTURE AND ARCHITECTURAL TECHNICIAN OCCUPATIONS

Architecture and Architectural Technician Occupations (2005–2018)



National Employment Trends (2005–2018)

	Architecture and architectural technician occupations	Total	Percentage
2005	415,146	144,200,000	0.3%
2006	432,743	146,700,000	0.3%
2007	440,064	148,000,000	0.3%
2008	440,656	147,100,000	0.3%
2009	421,233	142,700,000	0.3%
2010	421,013	142,300,000	0.3%
2011	430,072	145,100,000	0.3%
2012	439,687	148,300,000	0.3%
2013	449,341	151,600,000	0.3%
2014	459,486	155,300,000	0.3%
2015	467,087	158,000,000	0.3%
2016	469,815	159,200,000	0.3%
2017	472,136	160,300,000	0.3%
2018	474,926	161,500,000	0.3%

Education Requirements (2008/2018)

	2008	Percentage	2018	Percentage
High school dropouts	242	0.1%	1,053	0.2%
High school graduates	15,208	3%	13,331	3%
Some college	30,350	7%	15,206	3%
Associate's degree	28,949	7%	27,634	6%
Bachelor's degree	230,269	52%	264,399	56%
Master's degree	115,818	26%	133,360	28%
Professional degree	8,080	2%	7,748	2%
Doctorate degree	11,739	3%	12,194	3%

[SOC 17-1011–SOC 17-1022;  
SOC 17-3012–SOC 17-3019;  
SOC 17-3031]

Source: Authors' analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018

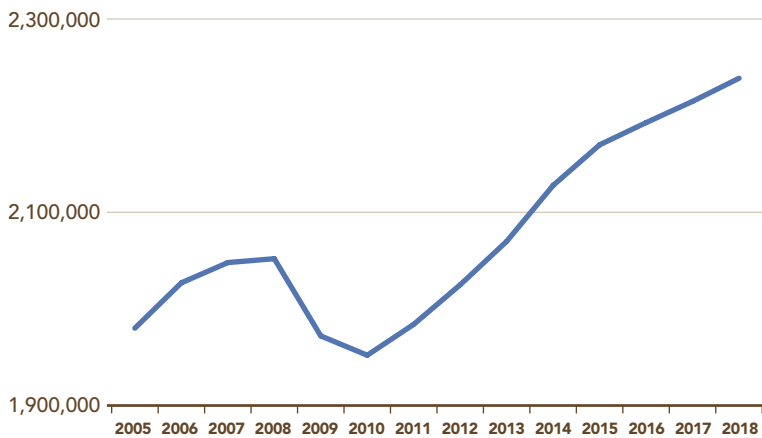
Architects and Architectural Technicians accounted for more than 440,000 jobs in 2008, about 0.3 percent of overall employment. They will increase by roughly 30,000 jobs by 2018 and are concentrated in the Professional and Business Services, Durable Manufacturing, and Construction industries. During the recession, job losses in this category have been severe. Sharp decreases in employment since 2007 reflect the battering taken by the Manufacturing and Construction industries in the recession.

Education levels are currently concentrated in Bachelor's degrees and Master's degrees (78 percent of current workers) and will increase to 84 percent by 2018. This category will provide 266,000 total job openings by 2018: 34,000 net new jobs and 231,000 openings from retirement. About 257,000 of these openings will require some college education, with the largest concentration (56 percent) requiring a Bachelor's degree.



## ENGINEERS AND ENGINEERING TECHNICIAN OCCUPATIONS

Engineers and Engineering Technician Occupations (2005–2018)



Education Requirements (2008/2018)

	Education Requirements (2008/2018)			
	2008	Percentage	2018	Percentage
High school dropouts	71,000	3%	5,246	0.2%
High school graduates	338,594	16%	433,498	19%
Some college	359,624	18%	325,252	15%
Associate's degree	470,703	23%	581,429	26%
Bachelor's degree	526,220	26%	604,506	27%
Master's degree	224,932	11%	240,476	11%
Professional degree	34,984	2%	17,562	1%
Doctorate degree	26,280	1%	31,397	1%

National Employment Trends (2005–2018)

	Engineers and engineering technician occupations	Total	Percentage
2005	1,980,588	144,200,000	1.4%
2006	2,027,266	146,700,000	1.4%
2007	2,048,425	148,000,000	1.4%
2008	2,052,338	147,100,000	1.4%
2009	1,972,149	142,700,000	1.4%
2010	1,952,861	142,300,000	1.4%
2011	1,984,516	145,100,000	1.4%
2012	2,025,906	148,300,000	1.4%
2013	2,070,202	151,600,000	1.4%
2014	2,128,102	155,300,000	1.4%
2015	2,170,895	158,000,000	1.4%
2016	2,193,772	159,200,000	1.4%
2017	2,215,180	160,300,000	1.4%
2018	2,239,368	161,500,000	1.4%

[SOC 17-2011–SOC 17-2199;  
SOC 17-3021–SOC 17-3031]

Source: Authors' analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018

Engineers and Engineering Technicians account for the second-largest share of jobs in STEM Occupations. They accounted for 2 million jobs in 2008, or 1.4 percent of all jobs. This category of occupations will grow by 187,000 jobs through 2018 and maintain its 1.4 percent share.

**The largest growth in this cluster will be for civil engineers, who will be employed in updating the nation's infrastructure.** Openings for civil engineers will increase by more than 100,000 to fill newly created jobs and replace workers projected to retire over the next decade.

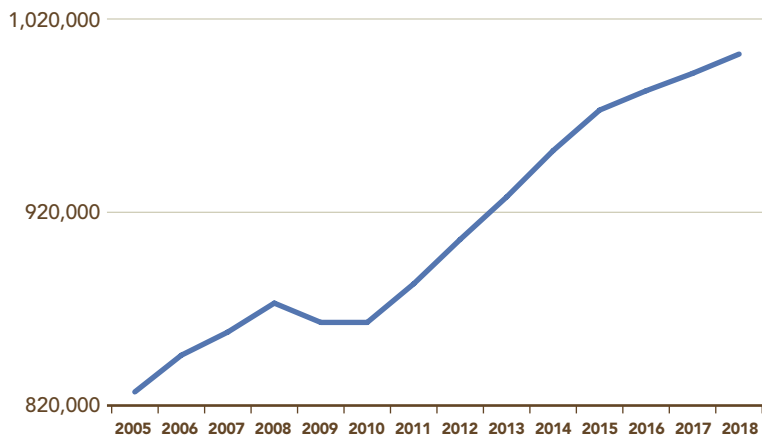
Engineers are concentrated in the Professional and Business Services; Durable Manufactures; Public Administration; and Construction industries. The above graph shows that steep job losses will be followed by a robust return. The sharp

decreases in employment most likely reflect losses connected to construction and infrastructure during the Great Recession.

Educational attainment for this occupational category currently concentrates in Bachelor's and Master's degrees (56 percent), increasing to 63 percent by 2018. There is also significant demand for workers with some college education and Associate's degrees. In 2008, 18 percent of incumbent workers had some college but no degree and another 23 percent had an Associate's degree—a percentage that will increase to 26 percent by 2018. Engineers and related occupations will generate 522,000 total job openings by 2018: 187,000 net new jobs and 335,000 replacement openings. Some 420,000 of these jobs will require at least some college education, with the largest proportion (27 percent) requiring a Bachelor's degree.

## LIFE AND PHYSICAL SCIENCES OCCUPATIONS

Life and Physical Sciences Occupations (2005–2018)



Education Requirements (2008/2018)

	Education Requirements (2008/2018)			
	2008	Percentage	2018	Percentage
High school dropouts	-	0%	-	0%
High school graduates	17,958	2%	20,299	2%
Some college	26,493	3%	11,085	1%
Associate's degree	16,669	2%	-	0%
Bachelor's degree	368,244	42%	430,905	43%
Master's degree	267,649	31%	281,855	28%
Professional degree	24,078	2.8%	28,962	3%
Doctorate degree	152,326	17%	229,590	23%

National Employment Trends (2005–2018)

	Life and physical sciences occupations	Total	Percentage
2005	827,280	144,200,000	0.6%
2006	846,550	146,700,000	0.6%
2007	858,311	148,000,000	0.6%
2008	873,416	147,100,000	0.6%
2009	863,449	142,700,000	0.6%
2010	863,929	142,300,000	0.6%
2011	883,968	145,100,000	0.6%
2012	906,305	148,300,000	0.6%
2013	928,734	151,600,000	0.6%
2014	952,941	155,300,000	0.6%
2015	973,288	158,000,000	0.6%
2016	983,729	159,200,000	0.6%
2017	992,865	160,300,000	0.6%
2018	1,002,696	161,500,000	0.6%

[SOC 19-1011–SOC 19-2099;  
SOC 19-4011–SOC 19-4099]

Source: Authors' analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018

Life and Physical Sciences occupations account for a tiny share (0.6%) of total employment, amounting to about 873,000 jobs in 2008 but are expected to add almost another 130,000 positions by 2018. This occupational category will provide 263,000 total job openings by 2018: 129,000 net new jobs and 134,000 openings from retirements. About 258,000 of these jobs will require some college education or more, with the largest proportion (43 percent) requiring a Bachelor's degree.

The educational attainment of Life and Physical Sciences occupations is concentrated in Bachelor's and Master's degrees (73 percent), but there is a significant demand for Doctoral degree jobs, too—17 percent in 2008, climbing to 23 percent in 2018.

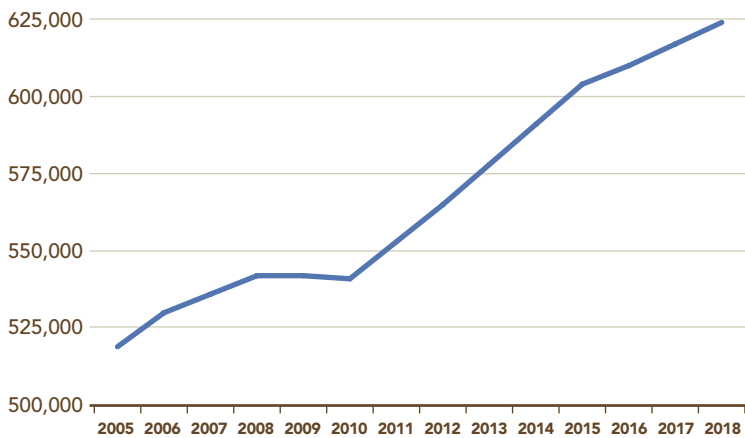
Life Sciences occupations include Biologists, Zoologists, Agricultural and Food Scientists, Conservation Scientists, and

Medical Scientists. Medical Scientists represent the largest share of Life Sciences occupations and will experience the greatest growth between 2008 and 2018, increasing by almost 50,000 over the period. Medical Scientists search for new treatments, and thereby expand the demand for healthcare. With retirements, job openings for Medical Scientists will total more than 70,000.

Physical Sciences occupations include Astronomers, Physicists, Chemists, and Environmental Scientists. Environmental Health Scientists represent the largest share of the Physical Sciences category and will experience the greatest growth by 2018, increasing by almost 25,000 over the period. With retirements, job openings for Environmental Health Scientists will number almost 50,000.

## SOCIAL SCIENCES OCCUPATIONS

Social Sciences Occupations (2005–2018)



Education Requirements (2008/2018)

	Education Requirements (2008/2018)			
	2008	Percentage	2018	Percentage
High school dropouts	6,914	1%	-	0%
High school graduates	39,117	7%	32,398	5%
Some college	36,153	7%	36,859	6%
Associate's degree	27,769	5%	36,285	6%
Bachelor's degree	186,603	34%	186,966	30%
Master's degree	106,752	20%	143,586	23%
Professional degree	46,408	9%	47,880	8%
Doctorate degree	92,576	17%	140,411	22%

National Employment Trends (2005–2018)

	Social sciences occupations	Total	Percentage
2005	519,829	144,200,000	0.4%
2006	530,260	146,700,000	0.4%
2007	536,335	148,000,000	0.4%
2008	542,292	147,100,000	0.4%
2009	542,495	142,700,000	0.4%
2010	541,919	142,300,000	0.4%
2011	553,750	145,100,000	0.4%
2012	565,490	148,300,000	0.4%
2013	578,020	151,600,000	0.4%
2014	591,682	155,300,000	0.4%
2015	604,614	158,000,000	0.4%
2016	610,818	159,200,000	0.4%
2017	617,106	160,300,000	0.4%
2018	624,385	161,500,000	0.4%

### [SOC 19-3011–SOC 19-3099]

Source: Authors' analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018

Social Sciences occupations account for only about 0.4 percent of overall U.S. employment, and are concentrated in the Healthcare, Education, Professional Services, and Public Administration industries. Social Sciences occupations accounted for roughly 550,000 jobs in 2008 and will grow by more than 82,000 jobs by 2018. Between growth and retirements, total job openings may total as high as 275,000 jobs over the decade. More than half the growth in Social Sciences occupations will come from increases in demand for Market and Survey Research workers.

Education levels in this occupational category are concentrated in Bachelor's and Master's degrees (54 percent), although that number is expected to dip slightly to 53 percent by 2018. There also is a significant demand for workers with Doctoral degrees—17 percent of today's jobs require a PhD, and that is expected to reach 22 percent by 2018.

# Community Services and Arts Occupations

- ARTS, DESIGN, ENTERTAINMENT, SPORTS, AND MEDIA OCCUPATIONS
- COMMUNITY AND SOCIAL SERVICES OCCUPATIONS

Community Services and Arts Occupations rank eighth in size out of the nine occupational clusters we studied, accounting for 4.6 million jobs in 2008 or 3.1 percent of all jobs. This category is expected to add almost 700,000 jobs between now and 2018, increasing its workforce to about 5.2 million. Occupations in Community Services and Arts can be found in high concentrations in the Healthcare Services (20 percent), Professional and Business Services (14 percent), Personal Services (13 percent), Information (11 percent), and Leisure and Hospitality (11 percent) industries.

We forecast that Community Services and Arts Occupations will provide 1.7 million job openings between 2008 and 2018, including 700,000 net new jobs and an additional 1 million

openings to replace retiring workers. Job openings in Community Services and Arts Occupations through 2018 will include 1.5 million openings for people with at least some college or better. In total, there will be job openings for:

- 13,000 high school dropouts;
- 133,000 high school graduates;
- 189,000 workers with some college but no degree;
- 171,000 workers with Associate’s degrees;
- 818,000 workers with Bachelor’s degrees;
- 366,000 workers with Master’s degrees or better.

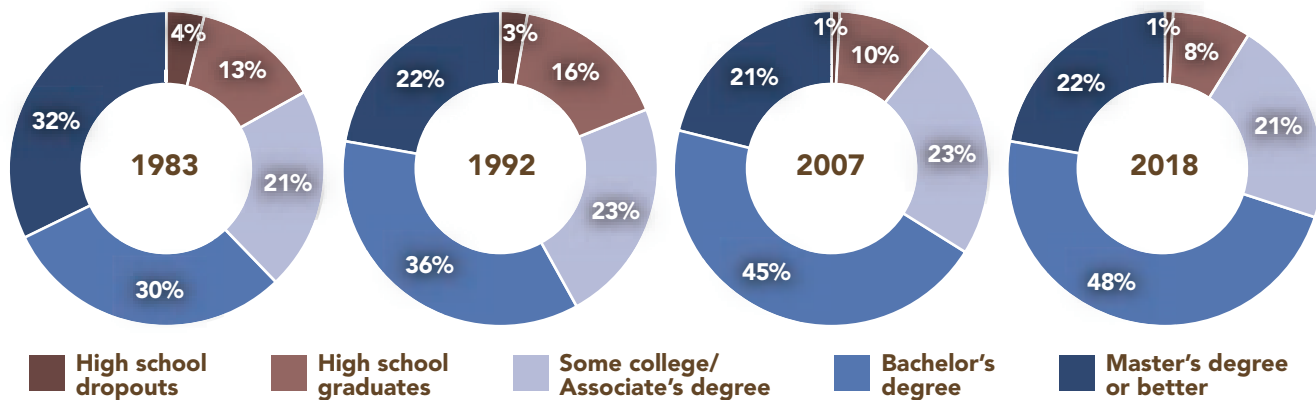
The share of workers with some college education or better in this occupation category has always been relatively high. Almost 83 percent of its occupations required at least some postsecondary education in 1983, increasing to 92 percent in 2007. That figure is projected to dip to 91 percent in 2018, though.

We now will look in more detail at the two significant groups that make up this cluster of occupations.

FIGURE 3.12

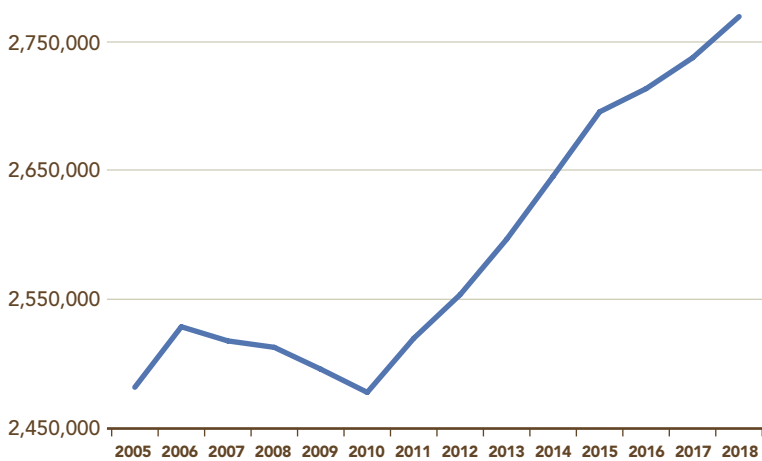
## Educational Attainment in Community Services and Arts Occupations (1983–2018).

Source: Authors’ analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018



## ARTS, DESIGN, ENTERTAINMENT, SPORTS, AND MEDIA OCCUPATIONS

Arts, Design, Entertainment, Sports, and Media Occupations (2005–2018)



Education Requirements (2008/2018)

	Education Requirements (2008/2018)			
	2008	Percentage	2018	Percentage
High school dropouts	35,617	1%	35,666	1%
High school graduates	258,357	10%	221,909	8%
Some college	344,522	14%	319,207	12%
Associate's degree	260,355	10%	311,387	11%
Bachelor's degree	1,321,774	53%	1,564,233	56%
Master's degree	262,567	10%	277,799	10%
Professional degree	14,926	1%	19,175	1%
Doctorate degree	15,586	1%	21,575	1%

	Arts, design, entertainment, sports, and media occupations	Total	Percentage
2005	2,482,444	144,200,000	1.7%
2006	2,529,836	146,700,000	1.7%
2007	2,518,244	148,000,000	1.7%
2008	2,513,702	147,100,000	1.7%
2009	2,496,212	142,700,000	1.7%
2010	2,478,872	142,300,000	1.7%
2011	2,520,981	145,100,000	1.7%
2012	2,554,690	148,300,000	1.7%
2013	2,597,011	151,600,000	1.7%
2014	2,646,436	155,300,000	1.7%
2015	2,696,508	158,000,000	1.7%
2016	2,714,015	159,200,000	1.7%
2017	2,738,208	160,300,000	1.7%
2018	2,770,951	161,500,000	1.7%

### [SOC 27-1011–SOC 27-4099]

Source: Authors' analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018

Arts, Design, Entertainment, Sports, and Media account for the largest share of occupations in this cluster. The category accounted for 2.5 million jobs in 2008 and should increase to 2.8 million by 2018, an increase of roughly 300,000 jobs.

**Virtually all of the occupations in this cluster will grow except for Radio and Television Announcers and News Analysts, Reporters, and Correspondents, which will only create about 75,000 new job openings to replace retirees.** This cluster will provide 900,000 total job openings between now and 2018: 267,000 net new jobs and 633,000 openings from retirements. About 816,000 of these new and replacement jobs will require some college or more. The largest proportion (56 percent) of new hires will require a Bachelor's degree.

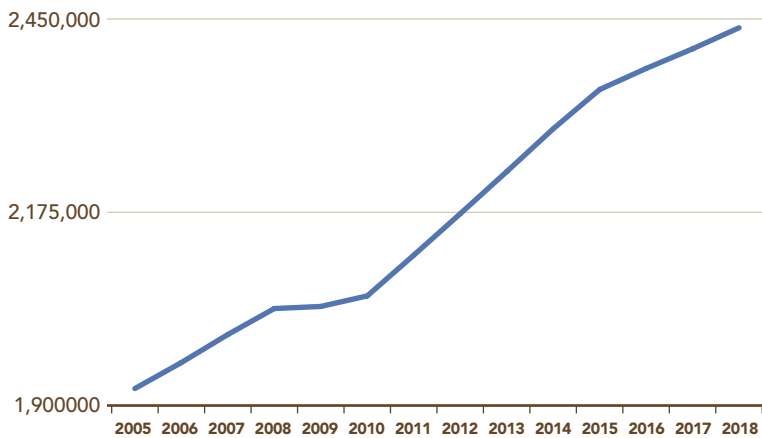
Arts, Design, Entertainment, Sports, and Media occupations divide into three large groups: Art and Design occupations (834,000); Entertainment and Sports occupations (740,000); and Media and Communications occupations (827,000).

Occupations in this cluster concentrate in the Arts, Information, and Professional Services industries. Job creation and losses in this sector traditionally correlate with economic conditions, as consumers shy away from these luxury goods during economic downturns and reward themselves with these activities during a boom.

Education levels in Arts, Design, Entertainment, Sports, and Media occupations are currently concentrated in Bachelor's and Master's degrees (63 percent), which is projected to increase to 66 percent by 2018. Typically, educational demand in these occupations varies. Bachelor's and Master's degrees predominate, but in some occupations—such as athletics—high school education or less is dominant.

## COMMUNITY AND SOCIAL SERVICES OCCUPATIONS

Community and Social Services Occupations (2005–2018)



Education Requirements (2008/2018)

	Education Requirements (2008/2018)			
	2008	Percentage	2018	Percentage
High school dropouts	26,181	1%	5,378	0.2%
High school graduates	172,792	8%	189,323	8%
Some college	220,079	11%	264,309	11%
Associate's degree	131,158	6%	214,988	9%
Bachelor's degree	749,616	37%	956,291	39%
Master's degree	651,721	32%	761,540	31%
Professional degree	52,190	3%	46,238	2%
Doctorate degree	34,510	2%	-	0%

National Employment Trends (2005–2018)

	Community and social services occupations	Total	Percentage
2005	1,924,116	144,200,000	1.3%
2006	1,961,904	146,700,000	1.3%
2007	2,001,965	148,000,000	1.4%
2008	2,038,247	147,100,000	1.4%
2009	2,041,758	142,700,000	1.4%
2010	2,056,083	142,300,000	1.4%
2011	2,114,280	145,100,000	1.5%
2012	2,173,853	148,300,000	1.5%
2013	2,233,685	151,600,000	1.5%
2014	2,294,450	155,300,000	1.5%
2015	2,350,007	158,000,000	1.5%
2016	2,380,203	159,200,000	1.5%
2017	2,408,094	160,300,000	1.5%
2018	2,438,065	161,500,000	1.5%

### [SOC 21-1011–SOC 21-2099]

Source: Authors' analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018

Community and Social Services occupations account for 1.4 percent of the nation's total employment. These occupations provided more than 2 million jobs in 2008 and should grow to more than 2.4 million in 2018, an increase of roughly 400,000 jobs. This cluster's share of the nation's overall employment is expected to go from 1.4 percent to 1.5 percent.

These occupations are concentrated in the Healthcare Services (20 percent); Professional and Business Services (14 percent); Personal Services (13 percent); and Leisure and Hospitality (13 percent) industries.

**Expansion in Community and Social Services is directly related to the growth in healthcare and education and the growing need for counseling and social services among the elderly.** Social Workers account for the largest share of Community and Social Services occupations, totaling some 650,000 jobs. By 2018, they are expected to add another 100,000 positions. Community and Social Services occupations will provide more than 260,000 job openings between 2008 and 2018—100,000 from new jobs

and more than 150,000 to replace retirees.

Counselors of various kinds represent more than 660,000 jobs in this cluster of occupations. Among them: Mental Health Counselors, Substance Abuse Counselors, Rehabilitation Counselors, and Educational and Vocational Counselors. Community and Social Services occupations will provide more than 250,000 job openings between 2008 and 2018.

The broader cluster of Community and Social Services occupations will provide 792,000 jobs by 2018: 400,000 net new jobs and 392,000 openings from retirements. About 729,000 of these positions will require some college or more. The largest proportion (39 percent) will require a Bachelor's degree. Education levels among workers in this category currently concentrate in Bachelor's and Master's degrees (69 percent), and that number will remain stable over the decade. The largest increases will come in jobs requiring Associate's degrees, which will go from 6 percent in 2008 to 9 percent in 2018. Community and Social Services occupations have the fourth-highest concentration of current workers with at least some college or better.

# Healthcare Support Occupations

Healthcare Support Occupations is the smallest of our nine occupational clusters, accounting for 3.9 million jobs in 2008, or 2.6 percent of all jobs. The overall size of this occupational group will increase by 2018, however, climbing to 4.8 million positions, or 3 percent of total U.S. employment. Healthcare Support is forecast to provide 1.9 million job openings by 2018, including 948,000 net new job openings and an additional 390,000 replacement openings.

The largest share of employees in these occupations work as Nursing Aides, Orderlies, and Attendants (1.5 million) and Home Health Aides (921,000). **The Home Health Aide category will grow the fastest as the Baby Boom generation ages and care shifts from institutions to private homes as a cost-containing measure.** There will be more than 550,000 openings for Home Health Aides between now and 2018, including 460,000 new jobs and more than 90,000 replacement positions.

Overall openings in Healthcare Support will provide jobs for:

- 87,000 high school dropouts;
- 455,000 high school graduates;
- 363,000 workers with some college but no degree;
- 280,000 workers with Associate’s degrees;
- 119,000 workers with Bachelor’s degrees;
- 26,000 workers with Master’s degrees or better.

Education levels for workers in Healthcare Support Occupations divide almost evenly between those with high school diplomas or less (47 percent) and those with some college or better (53 percent). That ratio will change over the next several years because the share of workers with at least some postsecondary education is projected to increase to 59 percent by 2018. The percentage of workers with at least some college or better in this occupational cluster traditionally has been relatively low. These occupations currently rank in the bottom three of our nine occupational clusters in the share of current workers with at least some postsecondary education, along with Food and Personal Services Occupations and Blue Collar Occupations.

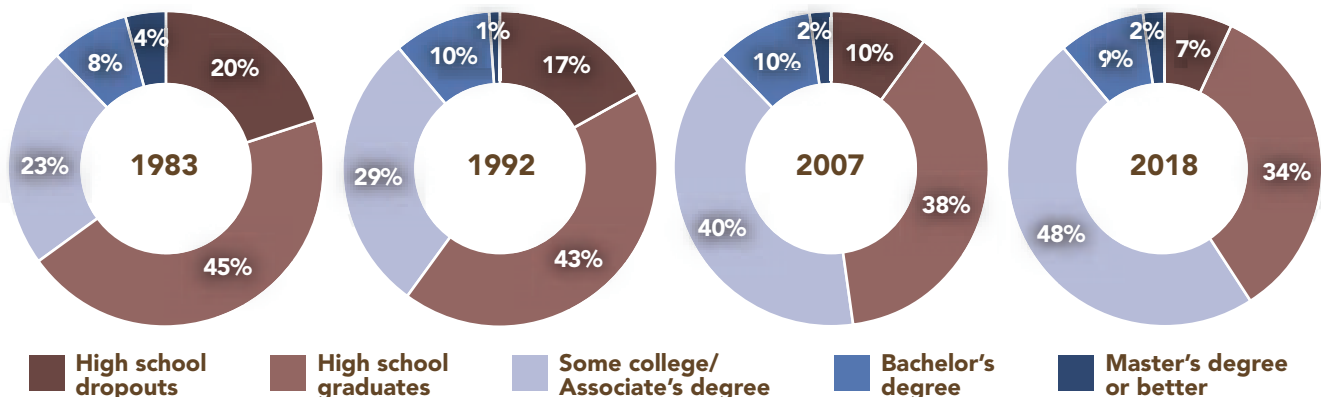
Still, the picture for Healthcare Support has been improving over time. Roughly 35 percent of those workers had at least some postsecondary education in 1983, rising to 52 percent in 2007 and projecting to 59 percent through 2018. The largest increases have come among workers with some college but no degree. Many of these incumbent workers have earned postsecondary certificates. In fact, 46 percent of Nursing Aides and Orderlies and Attendants (the second-largest employment category in this cluster) hold postsecondary certificates (Appendix 6). A significant share of other occupations also holds postsecondary certificates, including:

- Massage Therapists, 57 percent;
- Dental Assistants, 56 percent;
- Medical Transcriptionists, 29 percent;
- Medical Assistants, 23 percent.

FIGURE 3.13

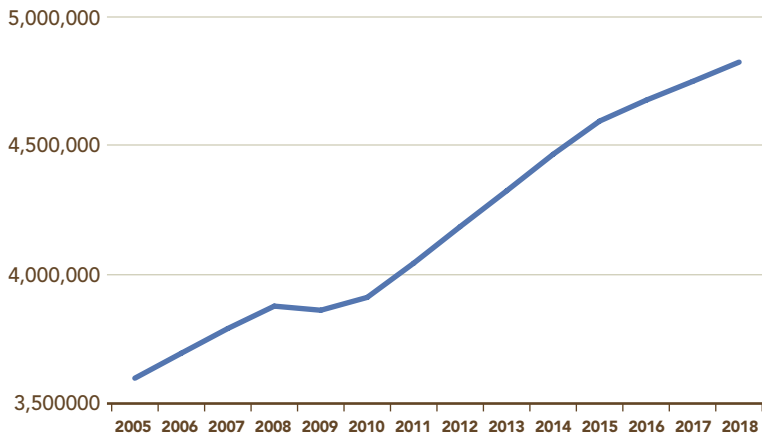
## Educational Attainment in Healthcare Support Occupations (1983–2018).

Source: Authors’ analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018



## HEALTHCARE SUPPORT OCCUPATIONS

Healthcare Support Occupations (2005–2018)



Education Requirements (2008/2018)

	Education Requirements (2008/2018)			
	2008	Percentage	2018	Percentage
High school dropouts	387,239	10%	316,220	7%
High school graduates	1,417,948	37%	1,650,170	34%
Some college	998,108	26%	1,316,377	27%
Associate's degree	658,685	17%	1,015,012	21%
Bachelor's degree	366,924	9%	433,370	9%
Master's degree	38,450	1%	70,863	1%
Professional degree	5,843	0.2%	13,033	0.3%
Doctorate degree	5,728	0.1%	11,191	0.2%

National Employment Trends (2005–2018)

	Healthcare support occupations	Total	Percentage
2005	3,598,454	144,200,000	2.5%
2006	3,695,688	146,700,000	2.5%
2007	3,791,749	148,000,000	2.6%
2008	3,878,925	147,100,000	2.6%
2009	3,862,145	142,700,000	2.7%
2010	3,912,825	142,300,000	2.7%
2011	4,045,710	145,100,000	2.8%
2012	4,187,280	148,300,000	2.8%
2013	4,326,664	151,600,000	2.9%
2014	4,468,050	155,300,000	2.9%
2015	4,597,129	158,000,000	2.9%
2016	4,678,692	159,200,000	2.9%
2017	4,751,713	160,300,000	3.0%
2018	4,826,236	161,500,000	3.0%

[SOC 31-1011–SOC 31-9099]

Source: Authors' analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018

<sup>13</sup>STEM occupations are defined as computer and mathematical science occupations, engineers and technicians and life and physical sciences occupations, and social sciences. We've chosen a more comprehensive definition that includes the social sciences, but are able to exclude it for some analyses.

<sup>14</sup>Natural Resources industries include farming, fishing, forestry, hunting and mining.

<sup>15</sup>As a result, we project a precipitous decline in telemarketers—more than 30,000 jobs—as e-commerce gains market share.

<sup>16</sup>The actual volume and importance of these jobs as careers tend to be overstated in the data. Many more of the workers in the lowest-skilled occupations are part-time and there is usually high turnover compared with higher-skilled jobs. For instance, there is more turnover in part-time work for cashiers and retail service workers than for people with Bachelor's degrees or better in managerial, professional, or STEM occupations. In addition, these low-skilled, high-turnover jobs are often transitional occupations that people take on for short periods in their lives, not long-term career occupations. People who take these lower-tier positions are often passing through on their way to more schooling or better jobs. Sometimes, relatively high-skilled older workers or others in transitional stages of their lives take these jobs. A common example: the former business executive who retires and takes on a job as a greeter at Wal-Mart.

<sup>17</sup>Healthcare Professional and Technical Occupations were the most Associate-intensive in 2008 (25%), followed by Engineers and Technicians Occupations (23%), Healthcare Support Occupations (23%), Installation, Maintenance, and Repair Occupations (20%), and Protective Services (15%).



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# Part 4

## Industry and Education Forecast (2008–2018).

Education requirements are most closely tied to occupations, but the economy produces goods and services by organizing occupations into industries. Demand for postsecondary education within an industry depends on the occupational mix. **The greatest intensity in the demand for workers with postsecondary education occurs in a cluster of fast-growing services industries. They each have workforces dominated—75 percent to 90 percent—by workers with at least some postsecondary education or training.** These include:

- Information Services;
- Professional and Business Services;
- Financial Services;
- Private Education Services;
- Healthcare Services;
- Government and Public Education Services.

The middle tier of postsecondary concentration includes Construction and a set of old-line services industries where the share of workers with higher education hovers around 50 percent. These include:

- Construction;
- Transportation and Utilities Services;
- Wholesale and Retail Trade Services;
- Leisure and Hospitality Services;
- Personal Services.

Figure 4.1 summarizes the distribution of education requirements by industry in 2018.

The bottom tier includes mostly goods production in Manufacturing and Natural Resources, where the share of postsecondary workers ranges between 30 percent and 40 percent of the industry workforces.

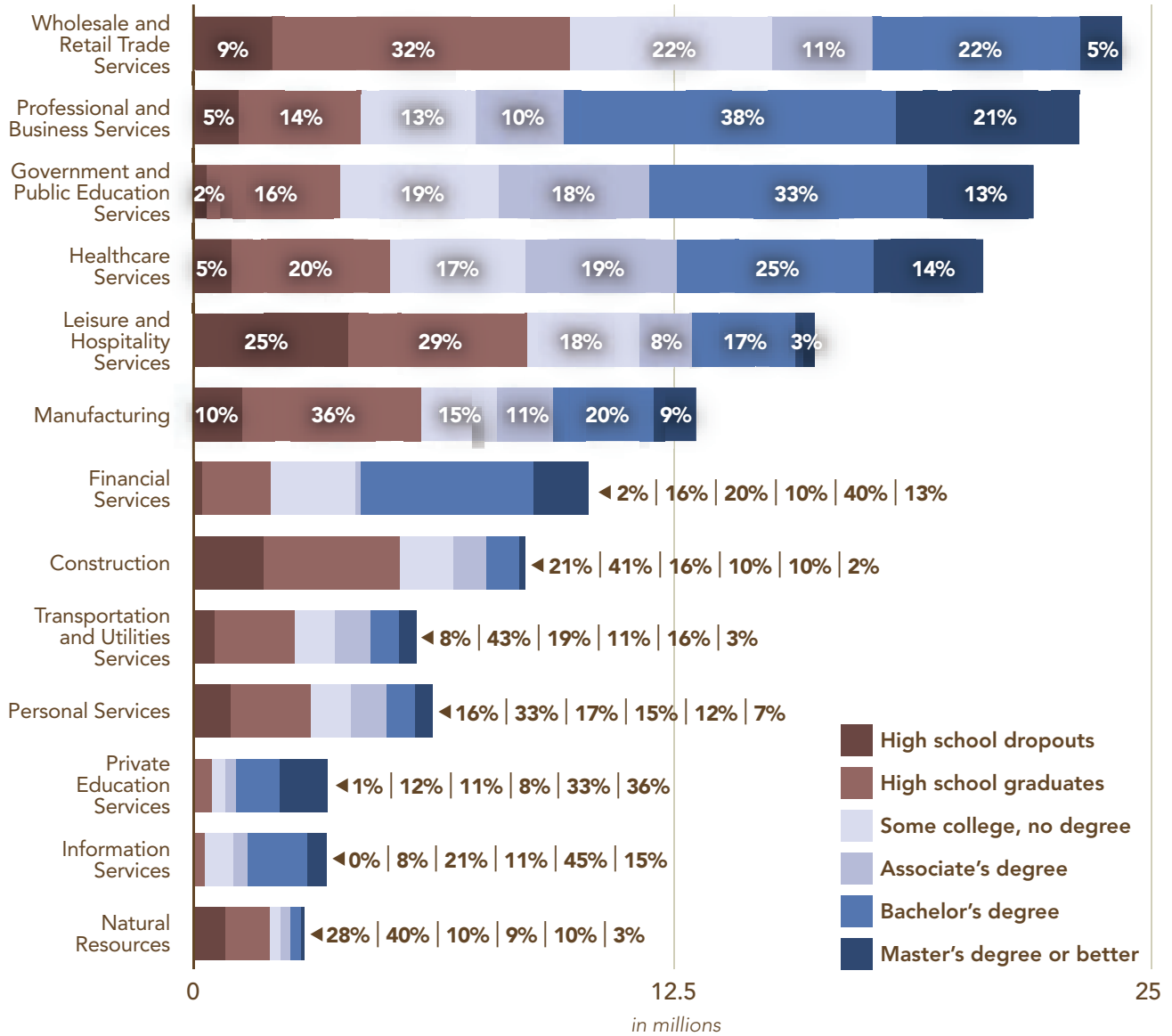
Increasingly, manufacturing and old-line service industries are being replaced by new service industries as those with the most job openings. In Table 4.1, we see Professional and Business Services and Healthcare Services lead in total openings. Other key industries driving employment growth, such as Information Services, have substantial postsecondary education requirements, too. The two industries—Manufacturing and Natural Resources—forecast to decline by 2018 rank eighth (55 percent) and 13th (31 percent) in their requirements for hiring workers with at least some college education or better.

Industry growth drives employment and the rise and fall of different industries leads to changes in the composition of educational demand as the need for different occupations shifts. Industries are defined by the goods and services they produce, not by the diverse occupational and educational characteristics of their employees. For example, everyone who works in manufacturing is part of the manufacturing industry whether they are managers, accountants, computer professionals, janitors, or frontline technicians and operatives. We detailed the link between occupational growth and educational demand in the preceding section of this report.

FIGURE 4.1

Educational demand within industries in 2018.

Source: Center on Education and the Workforce forecast of educational demand through 2018



SERVICES INDUSTRIES DOMINATE THE ECONOMY, PROVIDE MOST U.S. JOBS.

In modern economic systems, industries are divided into three groups depending on whether they extract natural resources from the earth, make material goods, or provide services. Over time, services industries have become dominant players in the U.S. economy. Services generated 65 percent of all jobs in 1973, increasing to 83 percent in 2007. This shift will continue going forward, with Services projected to grow to 85 percent by 2018 (Figure 4.2).

Trends in the demand for workers with postsecondary education and training have aligned with these broad industry shifts. **The slowest-growing industries, in terms of output (Table 4.2), are those where higher education requirements are lowest.** The share of postsecondary workers has grown in the Services and Goods-producing sectors, but not in the Natural Resource industries. Since 1983, the share of workers with at least some college education has increased from 50 percent to 64 percent in Services industries and from 34 percent to 46 percent in Goods-producing industries. In recent history, employment levels in Natural Resources have declined and so has demand for workers with postsecondary educations.

TABLE 4.1

Total job openings for workers with some college or better by industry. (in thousands)

Source: Center on Education and the Workforce forecast of educational demand through 2018

INDUSTRIES:	Total job openings requiring Some College or better		Total job openings 2018	Some college or better share of total job openings by industry	Rank of Some college or better job openings	Largest rate of Some college or better job openings compared to total 2008 employment	
	#	Rank	#	%	Rank	%	Rank
Professional and Business Services	6,404	1	7,895	81%	5	33%	3
Healthcare Services	5,550	2	7,389	75%	6	34%	2
Wholesale and Retail Trade Services	4,374	3	7,363	59%	7	20%	7
Private Education Services	2,969	4	3,435	86%	2	106%	1
Leisure and Hospitality Services	2,826	5	6,095	46%	11	20%	6
Financial Services	2,600	6	3,156	82%	4	26%	5
Government and Public Education Services	1,974	7	2,391	83%	3	9%	11
Manufacturing	1,096	8	2,000	55%	8	8%	12
Personal Services	1,036	9	2,026	51%	9	18%	8
Information Services	902	10	985	92%	1	29%	4
Transportation and Utilities Services	827	11	1,695	49%	10	13%	9
Construction	813	12	2,147	38%	12	10%	10
Natural Resources	105	13	335	31%	13	4%	13

FIGURE 4.2

The composition of the U.S. workforce is increasingly concentrated in Services industries. By 2018, 85% of all workers will be employed in the Services sector.

Source: Authors' analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018

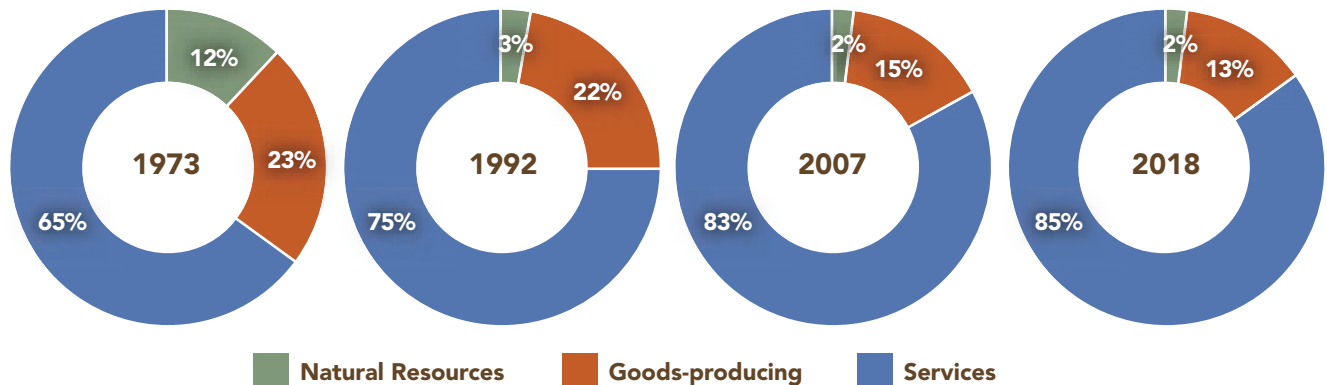


TABLE 4.2

Output growth by industry.

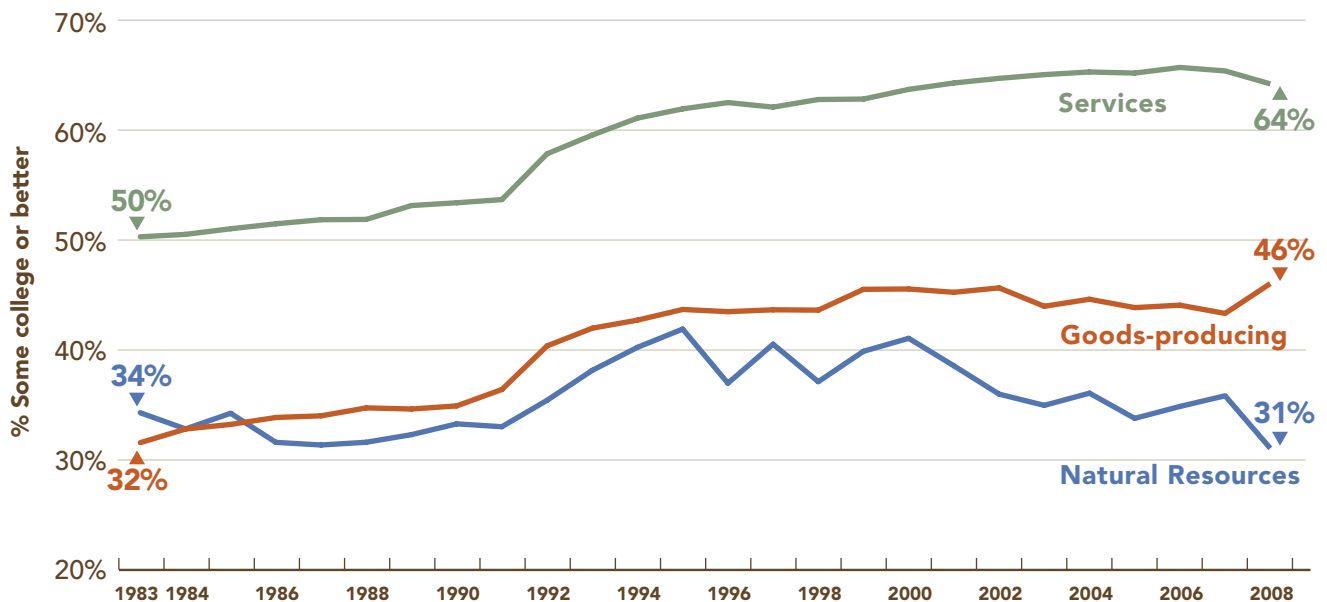
Source: Table 2.7 from the Bureau of Labor Statistics (BLS) Employment Projection Tables available at <http://www.bls.gov/emp/tables.htm>, visited on Jan. 31, 2010.

INDUSTRIES:	2008		2018		Change 2008–2018		Ranking	
	Output in billions \$	Total output rank	Output in billions \$	Total output rank	Change in total output \$	Rate of growth: Percent change in output	Fastest rate of growth	Largest change in output
Manufacturing	3,985	1	4,923	1	938	24%	7	3
Professional and Business Services	2,506	2	3,553	3	1,046	42%	4	2
Wholesale and Retail Trade Services	2,296	3	3,641	2	1,345	59%	2	1
Government and Public Education Services	2,264	4	2,595	4	332	15%	11	7
Healthcare Services	1,302	5	1,861	6	560	43%	3	5
Financial Services	1,256	6	1,775	7	519	41%	5	6
Information Services	1,106	7	1,865	5	759	69%	1	4
Construction	861	8	1,141	8	280	33%	6	8
Leisure and Hospitality Services	748	9	884	9	136	18%	8	9
Natural Resources	524	10	546	10	22	4%	13	13
Personal Services	463	11	539	11	77	17%	10	10
Transportation and Utilities Services	319	12	349	12	30	9%	12	11
Private Education Services	156	13	184	13	28	18%	9	12

FIGURE 4.3

The Services and Goods-producing industries show increasing demand for postsecondary education over time, but the demand for postsecondary workers in Natural Resources industries has declined.

Source: Authors' analysis of March CPS data, various years



Some of the declines in employment are due to increased productivity. For instance, both Manufacturing and Natural Resources are forecast to increase output by \$938 billion (24 percent) and \$22 billion (4 percent) even as their workforces shrink (Table 4.2). Other employment shifts reflect changes in the relative economic importance of various industries. Information Services, Wholesale and Retail Trade Services, and Healthcare Services are the three fastest-growing industry sectors, while Manufacturing and Natural Resources rank seventh and 13th. Overall, industries with the fastest-growing output have the highest education requirements (Figure 4.3).

## DIVIDING THE ECONOMY INTO 13 INDUSTRIES.

We have grouped the results from our detailed industry forecasting model into 13 industries, including 10 Services industries, two Goods-producing industries, and a single category where we grouped Natural Resources industries. Table 4.3 details employment in these Industries and shows how our forecast projects them to change by 2018.

Natural Resources industries include:

- Agriculture, forestry, fishing, hunting, and mining.

Goods-producing industries include:

- Manufacturing;
- Construction.

Services industries include:

- Wholesale and Retail Trade Services;
- Transportation and Utilities Services;
- Information Services;
- Financial Services;
- Professional and Business Services;
- Private Education Services;
- Healthcare Services;
- Leisure and Hospitality Services;
- Personal Services;
- Government and Public Education Services.

TABLE 4.3

Employment growth and decline by industry in 2008/2018. (in thousands)

Source: Authors' analysis of March CPS data, 2008; Center on Education and the Workforce forecast of educational demand through 2018

INDUSTRIES:	2008		2018		Difference 2008–2018		Ranking	
	Total employment	Rank	Total employment	Rank	Change in employment	Rate of growth: Percent change in employment	Largest change #	Fastest rate of growth
Wholesale and Retail Trade Services	22,405	1	24,145	1	1,740	8%	4	9
Government and Public Education Services	21,735	2	21,860	3	125	1%	11	11
Professional and Business Services	19,682	3	23,058	2	3,375	17%	2	3
Healthcare Services	16,440	4	20,554	4	4,114	25%	1	1
Leisure and Hospitality Services	14,186	5	16,155	5	1,968	14%	3	4
Manufacturing	13,646	6	13,080	6	-566	-4%	13	13
Financial Services	10,096	7	11,344	7	1,248	12%	5	5
Construction	8,124	8	8,629	8	505	6%	9	10
Transportation and Utilities Services	6,167	9	6,687	9	520	8%	8	8
Personal Services	5,647	10	6,212	10	566	10%	7	7
Information Services	3,137	11	3,461	12	324	10%	10	6
Natural Resources	2,953	12	2,883	13	-70	-2%	12	12
Private Education Services	2,798	13	3,482	11	684	24%	6	2

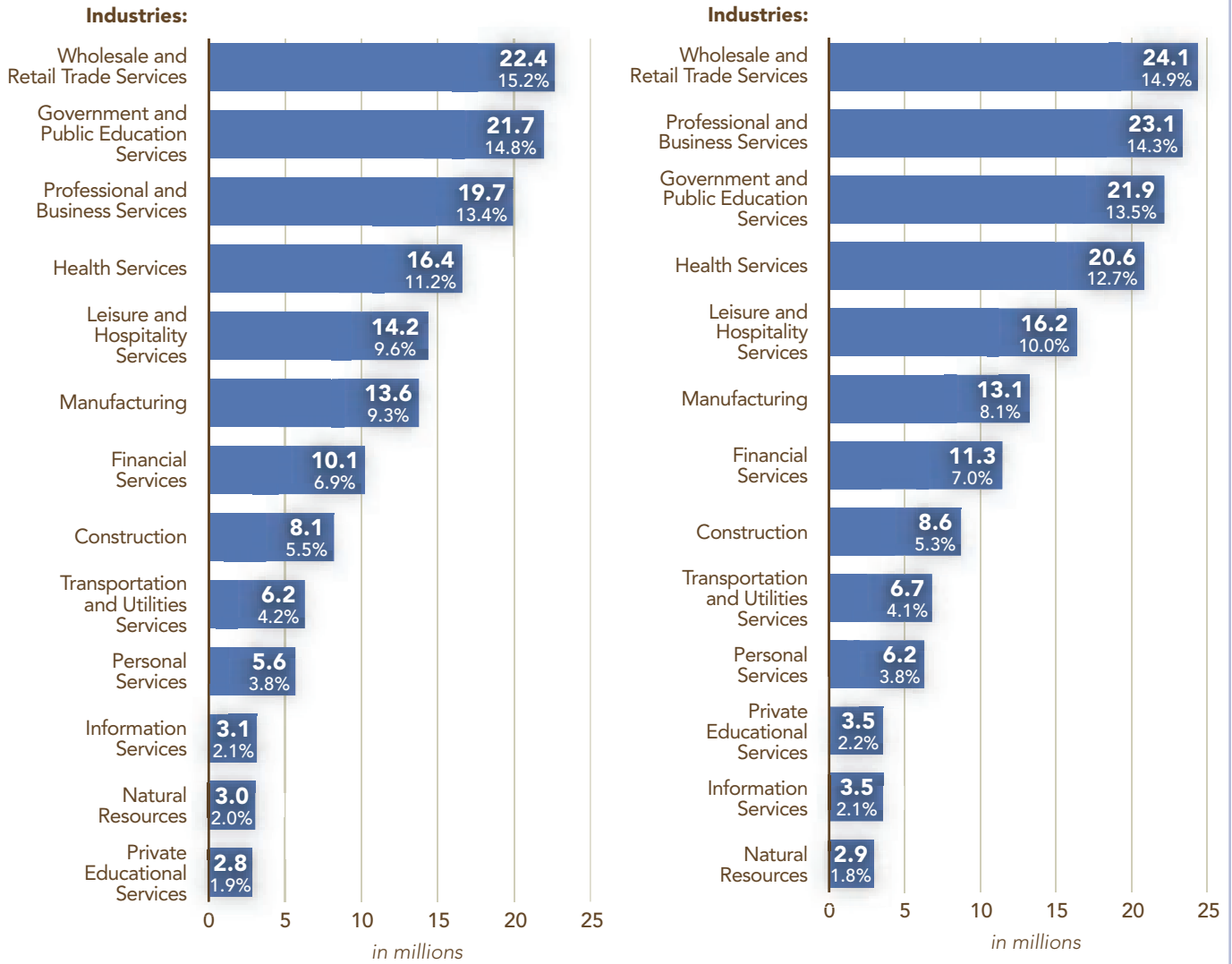
FIGURE 4.4

Industrial distribution of total employment in 2008/2018.

Source: Authors' analysis of March CPS data, 2008; Center on Education and the Workforce forecast of educational demand through 2018

Employment levels: 147 million (2008)

Employment levels: 161.5 million (2018)



\*Percentages indicate each industry's share of total employment.

In our base year, 2008, the industry mix was heavily weighted in favor of services rather than goods production. The top five industries ranked by total employment in 2008 make up 64 percent of the total workforce. They are Wholesale and Retail Trade Services, Government and Public Education Services, Professional and Business Services, Healthcare Services, and Leisure and Hospitality Services. Our projections show a continuing shift as Goods-producing and Natural Resources industries decline and Services industries increase

as a share of total employment. The decline in Manufacturing and Natural Resources is not a new phenomenon. In fact, permanent loss of employment opportunities in these sectors defines the structural change that characterized the recessions of 1991 and 2001. So does the growing opportunity in the Services industries—a phenomenon that will continue unabated through 2018. Figure 4.4 describes the distribution of industry employment in both 2008 and 2018.

## INDUSTRY OUTPUT AND EMPLOYMENT GROWTH.

Change in industry output is not always the best predictor of demand for education and employment. Rising output can signal increased productivity and increased contributions to national wealth. That can mean growth in some kinds of jobs but declines in others that at first glance are difficult to balance out.

In Manufacturing, for instance, new computer-based technologies, new work processes, and more complex global production networks allow the industry to achieve higher and higher levels of output with fewer and fewer workers (Table 4.2). Many workers who perform routine tasks lose their jobs, as employers either automate those processes or send them offshore to take advantage of lower labor costs. This has reduced the overall number of jobs in domestic manufacturing, but the jobs that remain are those that demand non-routine work and, therefore, require higher skill.<sup>18</sup> As a result, in Manufacturing as well as in Natural Resources industries, when output increases, jobs do not increase commensurately—or actually decline.

Truly declining industries are rare. They are characterized by drops in both industry output and employment. These tend to be in the old-line Manufacturing and Natural Resources sectors. They include industries such as tobacco, apparel, textile, paper products, and newspapers. In many cases, these industries have been moved offshore.

### Most job decline comes from technology change and automation, not from declining demand for products or services.

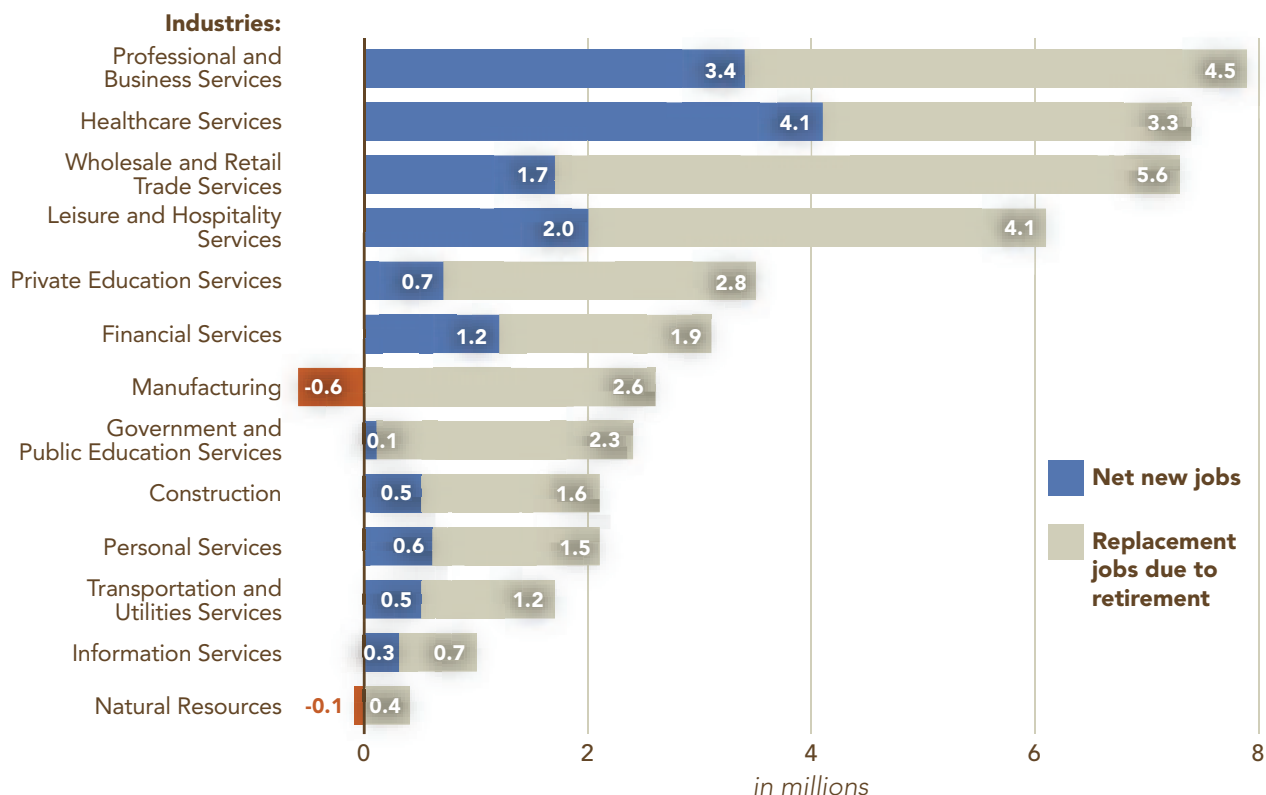
Technology, especially computer-based technology, makes it possible to create higher productivity—more output with fewer people. The ability of computer-based technologies to increase output without increasing employment can be striking. Some examples are the following:

- The computer and peripheral equipment manufacturing industry is projected to increase output almost fivefold, from about \$200 billion to almost \$1 trillion dollars between 2008 and 2018. At the same time, the industry will shed nearly 60,000 jobs, dropping from more than 180,000 to less than 125,000 positions.
- The Semiconductor and Electronic Component Manufacturing industry is projected to increase output by more than

FIGURE 4.5

Industrial distribution of net new and replacement jobs through 2018. Healthcare Services has the largest proportion of net new jobs and the second largest fraction of job openings through 2018.

Source: Center on Education and the Workforce forecast of educational demand through 2018



175 percent, growing from about \$170 billion to more than \$300 billion in output. Over the same period, employment in the industry will decline by some 145,000, going from 432,000 jobs in 2008 to 287,000 in 2018.

- Output in Telecommunications Services will increase by 170 percent, from almost \$500 billion in 2008 to more than \$800 billion in 2018. Over the same period, the industry will lose almost 100,000 jobs.
- Insurance Services will lose as many as 60,000 jobs, even as the industry's output increases by more than \$60 billion.

Because of technology improvements, output tends to grow faster than jobs in virtually every industry, although it can vary considerably. The effect of technology tends to be more powerful in Goods production than in Services, but its effects on Services industries are still powerful. Over the next decade, output in Services is expected to increase by roughly 25 percent, almost \$5 trillion. Over the same period, Services employment is expected to increase by about half that rate—roughly 12 percent, or some 14 million jobs.

## DECLINING INDUSTRIES STILL HAVE JOB OPENINGS.

There will be jobs following the recession; job openings exist even now. That is because industry growth only tells part of the story—replacement jobs due to retirement are the other part.<sup>19</sup> Figure 4.5 details these openings by industry by 2018.

We forecast 46.8 million job openings between 2008 and 2018 and there will be many openings for workers with a postsecondary education in both declining industries and in those that will grow. Service industries provide virtually all of the net new jobs over the decade, since Manufacturing and Natural Resources will decline over that time. The Healthcare Services industry leads in job creation and will post 4.1 million net new jobs between 2008 and 2018 (Figure 4.5). Other Services industries with high net new job creation include Professional and Business Services (3.4 million net new jobs); Leisure and Hospitality (2 million net new jobs); Wholesale and Retail Trade Services (1.7 million net new jobs); Financial Services (1.2 million net new jobs); Private Education Services (683,000 net new jobs); and Government and Public Education (123,000 net new jobs). Because of their huge productivity gains, Information Services only provide 294,000 net new jobs in spite of an increase in output of more than \$700 billion. Transportation Services and Utilities follow a similar pattern, creating only 520,000 net new jobs as it increases output by more than \$250 billion. While Manufacturing and Natural Resources lose jobs, there is one exception in the Goods-production sector: Construction. That industry

tends to rise in good times and fall in bad. So, although it was hammered during the recession, construction will bounce back during the recovery, creating 505,000 net new jobs between 2008 and 2018.

The largest source of openings always comes from replacement jobs. In fact, these often occur at triple the number of openings due to growth. Replacement job growth will be particularly large over the next decade as the Baby Boom generation retires. Even assuming that Baby Boomers stay in the labor force beyond age 55 at unusually high rates, we still forecast a total of 32.4 million replacement job openings over the next decade. As with new jobs, the lion's share of these replacement positions will come in the Services industries.

Wholesale and Retail Trade Services will have the highest replacement job levels, totaling 5.6 million over the coming decade. Much the same is true in the Leisure and Hospitality Services industry, the third-largest source of replacement jobs, at 4.1 million. With the exception of Information Services, because of its unusually high productivity rates, replacement jobs are robust in all of the remaining services industries. Professional and Business Services will have the second-largest replacement rate at 4.5 million jobs over the decade, followed by:

- Healthcare Services, 3.3 million replacement jobs;
- Private Education Services, 2.8 million;
- Government and Public Education Services, 2.3 million;
- Financial Services, 1.9 million;
- Personal Services, 1.5 million;
- Transportation and Utilities Services, 1.2 million.

Except for the Construction industry, replacement jobs will be the only source of openings over the next decade in the Goods-production and Natural Resources industries. Construction produces 1.6 million replacement jobs along with its 505,000 new posts. Manufacturing is projected to decline in total jobs but will still produce 2.6 million replacement positions—more than half of the 10 Services industries. There will be no new jobs created in the Natural Resources sector, but 406,000 replacement jobs will open up there by 2018.

## NEW JOBS DEMAND POSTSECONDARY EDUCATION.

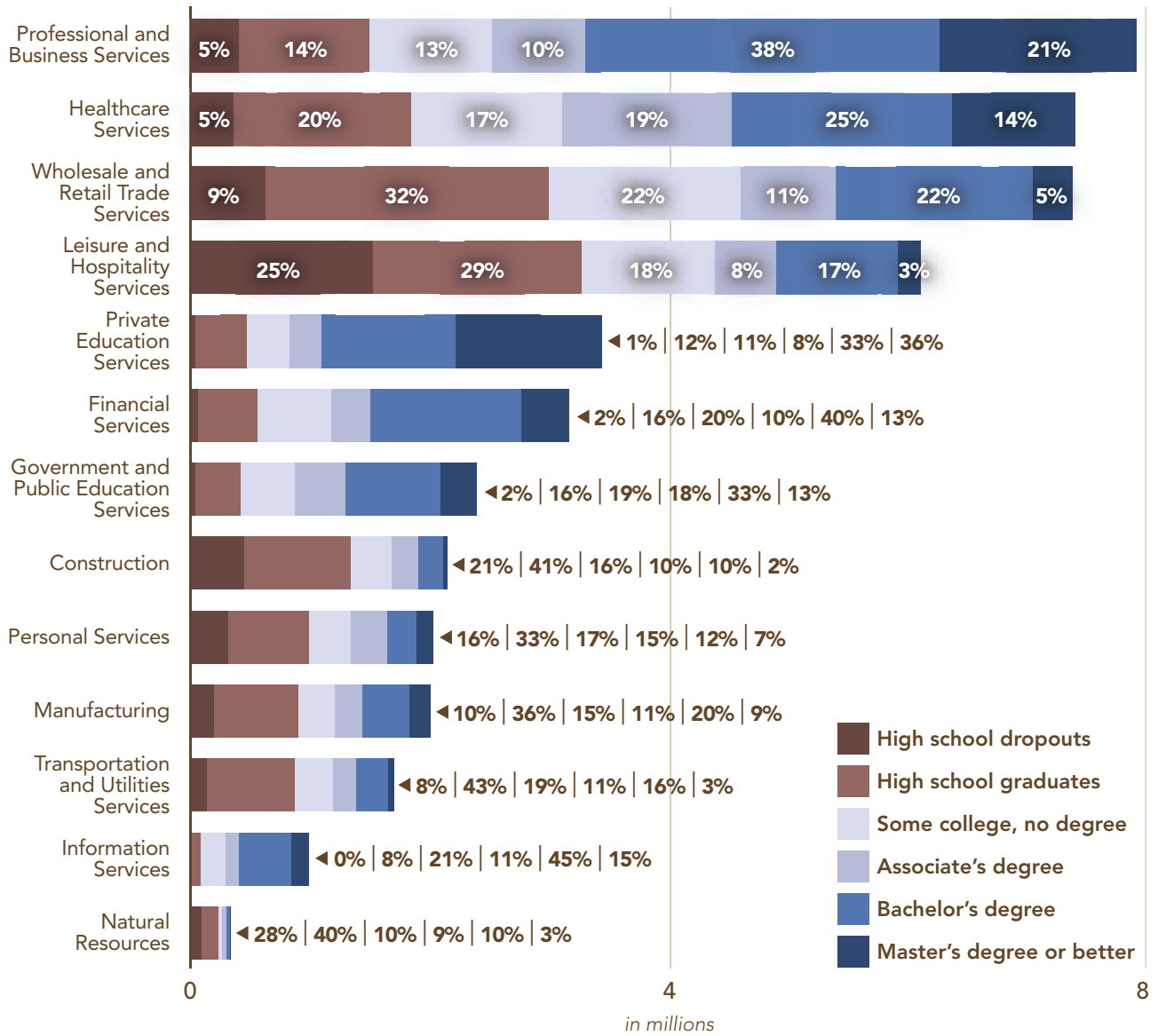
The 14.4 million newly created jobs through 2018 will overwhelmingly require secondary education. Overall, the ratio of new to replacement jobs is about 0.3:1, while for positions requiring a Master's degree and better this ratio is 0.69:1 (1.77 million/2.93 million). The ratio of new to replacement jobs grows between high school and Master's level jobs.



FIGURE 4.6

Total job openings and educational demand by industry in 2018.

Source: Center on Education and the Workforce forecast of educational demand through 2018



Much of this distribution of job openings reflects an economy that is shifting toward industries that are growing and requiring more education of their workers. This, combined with the retirement of highly educated Baby Boomers, is a driver behind the ever-increasing demand for higher education in the labor market.

The economy is continuously in flux, but increasing educational requirements is a thread that runs throughout. As we have explained in previous sections, this is not a new trend. Some of the increasing demand comes about because employment gains are most robust in industries that require more education of its workers. This is fairly clear in the data. But

another important, albeit less visible, driver is skill-biased technological change, or shifts in an industry's technology that favor more skilled workers. This pattern is picked up by our forecasting method (Appendix 4), and it contributes to a significant share of the educational demand observed in Figure 4.6.

Table 4.4, meanwhile, details how projected employment in 2018 will reinforce postsecondary educational demand and how the distribution of total employment works against people with high school diplomas or less. Wholesale and Retail Trade Services is forecast as the top-ranked industry, providing employment for many less-educated workers.

TABLE 4.4

## Employment and educational demand in 2018 by industry. (in thousands)

Source: Center on Education and the Workforce forecast of educational demand through 2018

INDUSTRIES:	Total		High school dropouts		High school graduates		Some college, no degree		Associate's degree		Bachelor's degree		Master's degree or better	
	#	Rank	#	Rank	#	Rank	#	Rank	#	Rank	#	Rank	#	Rank
Wholesale and Retail Trade Services	24,145	1	2,054	2	7,747	1	5,241	1	2,629	3	5,384	3	1,090	7
Professional and Business Services	23,058	2	1,172	5	3,181	7	2,995	4	2,265	4	8,649	1	4,795	1
Government and Public Education Services	21,860	3	347	10	3,466	6	4,127	2	3,909	2	7,246	2	2,764	3
Healthcare Services	20,554	4	991	6	4,124	4	3,519	3	3,936	1	5,116	4	2,866	2
Leisure and Hospitality Services	16,155	5	4,030	1	4,636	3	2,937	5	1,351	6	2,691	6	510	8
Manufacturing	13,080	6	1,262	4	4,646	2	1,984	7	1,459	5	2,612	7	1,116	6
Financial Services	11,344	7	218	11	1,781	10	2,220	6	1,177	7	4,506	5	1,442	4
Construction	8,629	8	1,809	3	3,554	5	1,387	8	878	9	837	11	163	12
Transportation and Utilities Services	6,687	9	553	9	2,872	8	1,263	9	768	10	1,050	10	181	11
Personal Services	6,212	10	970	7	2,065	9	1,064	10	914	8	750	12	448	10
Private Education Services	3,482	11	40	12	432	12	366	12	263	12	1,142	9	1,238	5
Information Services	3,461	12	-	13	292	13	736	11	382	11	1,548	8	504	9
Natural Resources	2,883	13	818	8	1,159	11	281	13	258	13	276	13	92	13

The second- (Professional and Business Services) and third- (Government and Public Education Services) largest industries, however, rank fifth and 10th (out of 13) for jobs with less-than-high school requirements and seventh and sixth for positions requiring high school diplomas. On the other hand, these same two industries rank first and second for Bachelor's

degree requirements and first and third, respectively, for graduate level requirements.

On the following few pages, we look in more detail at what lies ahead for job seekers, broken down by industry and levels of education.

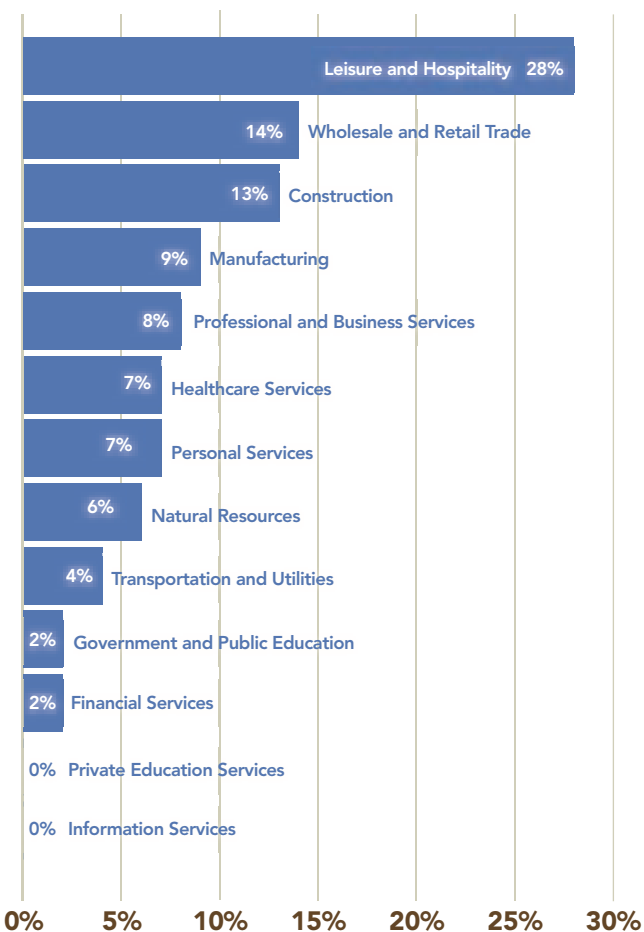
## High School Dropouts

Workers without high school diplomas will be concentrated in the Leisure and Hospitality (28 percent); Wholesale and Retail Trade (14 percent); and Construction (13 percent) industries. Those sectors will account for 55 percent of less-than-high school employment (Figure 4.7). Job openings for these workers follow the same pattern—nearly twice as many openings will occur in Leisure and Hospitality as in Wholesale and Retail Trade Services. Openings in Construction will rank just beneath those in Wholesale and Retail. Typically, replacement jobs drive openings for the low-skilled workforce, and that will be true going forward, too. In the case of Manufacturing and Natural Resources, all of the openings will be replacements.

FIGURE 4.7

Distribution of high school dropouts employed by industry in 2018.

Source: Center on Education and the Workforce forecast of educational demand to 2018



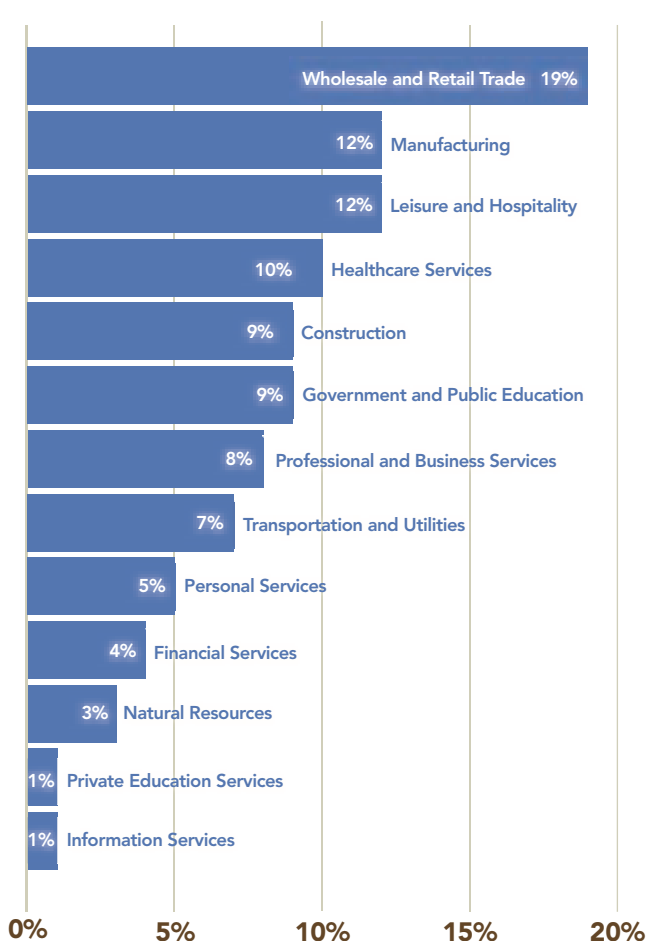
## High School Graduates

Employment of high school graduates will be concentrated in Wholesale and Retail Trade Services (19 percent), with an additional 34 percent spread across Manufacturing (12 percent), Leisure and Hospitality (12 percent), and Healthcare Services (10 percent). Openings will be strong for high school graduates in these industries (Figure 4.8). Overall growth in Healthcare Services will benefit workers with high school educations, as will replacement demand across the economy.

FIGURE 4.8

Distribution of high school graduates employed by industry in 2018.

Source: Center on Education and the Workforce forecast of educational demand to 2018



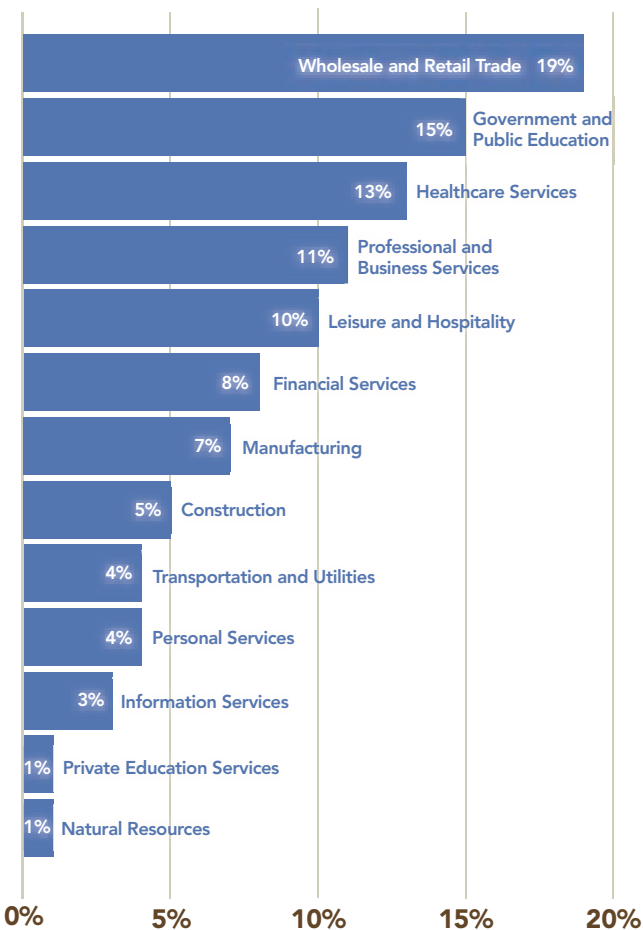
## Some College Education

Workers with some college education will find a third of their employment in Wholesale and Retail Trade (19 percent) and Government and Public Education (15 percent), with another third of employment spread across Healthcare Services (13 percent), Professional and Business Services (11 percent), and Leisure and Hospitality (10 percent). Workers with some college will benefit from growth in Healthcare Services, but will find their strong hold on employment in Government and Public Education supported almost entirely by replacement demand (Figure 4.9).

FIGURE 4.9

Distribution of workers with some college education but no degree employed by industry in 2018.

Source: Center on Education and the Workforce forecast of educational demand to 2018



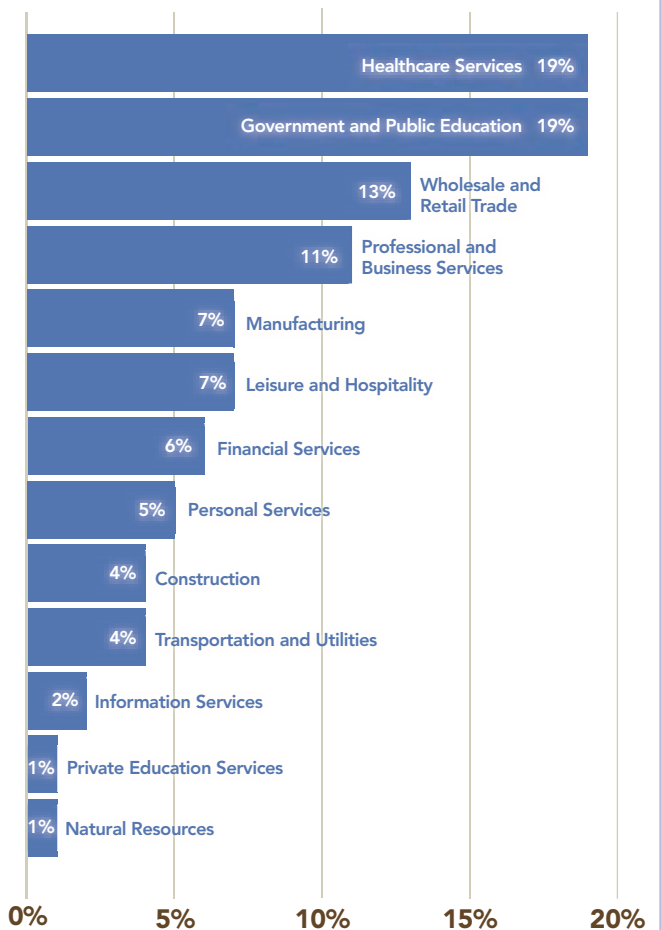
## Associate's Degree

Demand for Associate's degrees will be concentrated in Healthcare Services (19 percent) and Government and Public Education (19 percent). These workers will also have a strong presence in Wholesale and Retail (13 percent) and Professional and Business Services (11 percent). Job openings will be strongest in Healthcare Services, where specific Associate-level jobs will be dominated by openings from growth. New job openings will also be plentiful in Professional and Business Services. Overall, a large number of openings will occur in Wholesale and Retail Trade, although most of these will be derived from retirement (Figure 4.10).

FIGURE 4.10

Distribution of Associate's degree holders employed by industry in 2018.

Source: Center on Education and the Workforce forecast of educational demand to 2018



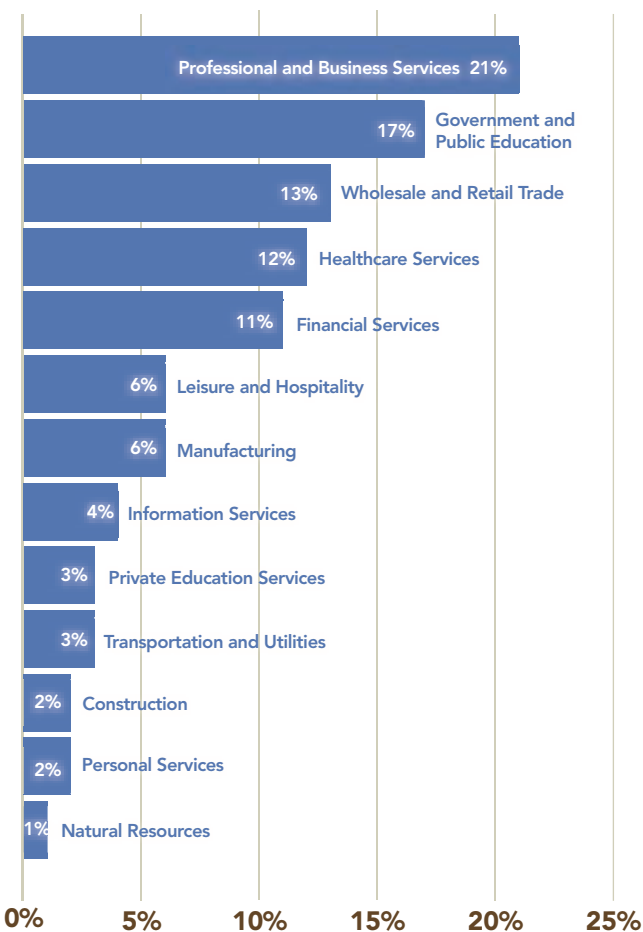
## Bachelor's Degrees

Seventy-four percent of workers with Bachelor's degrees will be employed in Professional and Business Services (21 percent), Government and Public Education (17 percent), Wholesale and Retail Trade (13 percent), Healthcare Services (13 percent), and Financial Services (11 percent). New job openings will be strong in Professional and Business Services and Financial Services. Overall openings will be largest in Professional and Business Services, Healthcare Services, and Wholesale and Retail Trade. Openings will be robust, but slightly fewer in number, in Financial Services, Private Education Services, Leisure and Hospitality, and Government and Public Education (Figure 4.11).

FIGURE 4.11

Distribution of Bachelor's degree holders employed by industry in 2018.

Source: Center on Education and the Workforce forecast of educational demand to 2018



## Master's Degrees and Better

While graduate-level workers will be spread across the 2018 economy, they will concentrate quite heavily in Professional and Business Services (28 percent). Another third will be employed in Healthcare Services (17 percent) and Government and Public Education (16 percent). Many of the opportunities for workers with graduate degrees in Professional and Business Services and Healthcare Services will stem from growth in those industries, where new openings will exceed those from replacement. Overall openings will also be high in Private Education Services (Figure 4.12).

FIGURE 4.12

Distribution of graduate degree holders employed by industry in 2018.

Source: Center on Education and the Workforce forecast of educational demand to 2018

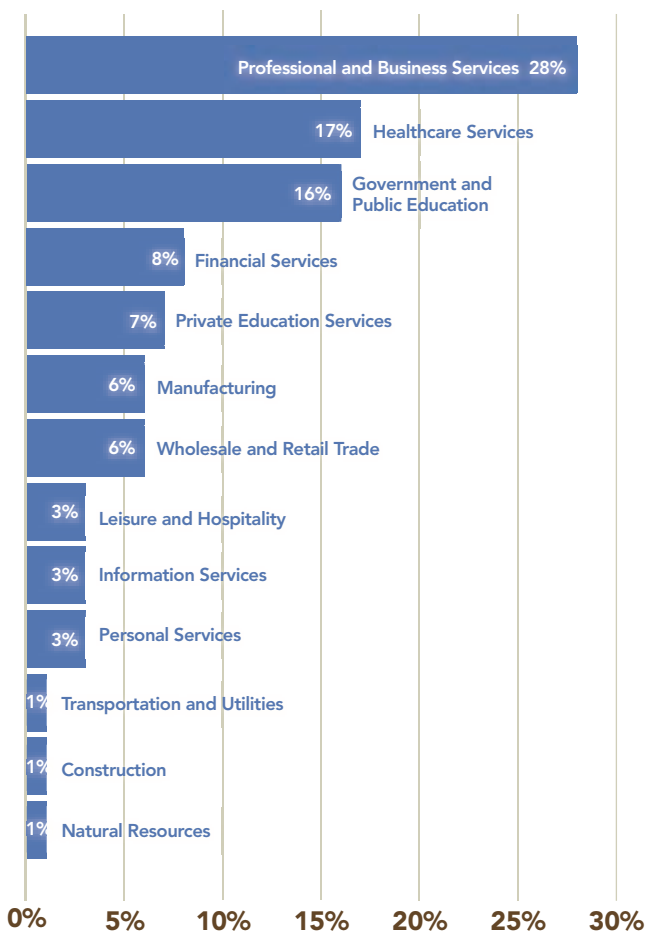


TABLE 4.5

## Employment and educational demand in 2018 by industry.

Source: Center on Education and the Workforce forecast of educational demand to 2018

INDUSTRIES:	High school dropouts		High school graduates		Some college, no degree		Associate's degree		Bachelor's degree		Master's degree or better		Total
	% of industry	Rank	% of industry	Rank	% of industry	Rank	% of industry	Rank	% of industry	Rank	% of industry	Rank	
Natural Resources	28%	1	40%	3	10%	13	9%	11	10%	13	3%	10	100%
Leisure and Hospitality Services	25%	2	29%	7	18%	6	8%	12	17%	9	3%	11	100%
Construction	21%	3	41%	2	16%	9	10%	9	10%	12	2%	13	100%
Personal Services	16%	4	33%	5	17%	7	15%	3	12%	11	7%	8	100%
Manufacturing	10%	5	36%	4	15%	10	11%	5	20%	8	9%	7	100%
Wholesale and Retail Trade Services	9%	6	32%	6	22%	1	11%	7	22%	7	5%	9	100%
Transportation and Utilities Services	8%	7	43%	1	19%	4	11%	4	16%	10	3%	12	100%
Professional and Business Services	5%	8	14%	11	13%	11	10%	10	38%	3	21%	2	100%
Healthcare Services	5%	9	20%	8	17%	8	19%	1	25%	6	14%	4	100%
Financial Services	2%	10	16%	10	20%	3	10%	8	40%	2	13%	5	100%
Government and Public Education Services	2%	11	16%	9	19%	5	18%	2	33%	4	13%	6	100%
Private Education Services	1%	12	12%	12	11%	12	8%	13	33%	5	36%	1	100%
Information Services	0%	13	8%	13	21%	2	11%	6	45%	1	15%	3	100%
<b>TOTAL</b>	<b>9%</b>		<b>25%</b>		<b>17%</b>		<b>12%</b>		<b>26%</b>		<b>11%</b>		<b>100%</b>

Overall, the importance of education in the 2018 economy can be seen in how it is used across industries. The top three industries expected to employ high school dropouts—Natural Resources, Leisure and Hospitality Services, and Construction—rank 10th, ninth, and eighth in terms of their forecasted 2018 output. They will increase their output by 13, 8, and 6 percent, respectively. These same industries are 13th, ninth, and 12th in their relative requirements for workers with Bachelor's degrees, and 10th, 11th, and 13th in their relative demand for graduate-level employees. **Bottom line: Industries with lower education requirements will grow more slowly than sectors that require more educational attainment** (Table 4.5).

Table 4.6, meanwhile, shows the industries that are important drivers of demand within the workforce for workers at each education level. Wholesale and Retail Trade Services will support 15 percent of total projected 2018 employment; Professional and Business Services will generate 14 percent; and Government and Public Education Services will employ 14 percent. Combined, these three industries will employ 24 percent of high school dropouts, 36 percent of high

school graduates, 45 percent of workers with some college, 43 percent of workers with Associate's degrees, 51 percent with Bachelor's degrees, and 50 percent of the graduate-level workforce. Leisure and Hospitality Services will provide the most jobs for the less-than-high-school labor force, while Wholesale and Retail Trade Services will rank highest for high school graduates and for workers with some college education. Associate's degree requirements are highest in the Healthcare Services industry, and Professional and Business Services provide the most jobs for the Bachelor's and better workforce (Table 4.6).

We forecast the 2018 economy to be one with significant postsecondary requirements—a continuation of trends already working in the 2008 economy. Table 4.7 details the requirement of some-college-or-better workers by industry, ranked by share of this postsecondary requirement, and demonstrates how this demand will change by industry by 2018. Our forecast shows some of the strongest demand will be in industries requiring the most intense concentrations of workers with at least some college or better.

TABLE 4.6

## Concentration of educational demand within industries in 2018.

Source: Center on Education and the Workforce forecast of educational demand to 2018

INDUSTRIES:	Total		High school dropouts		High school graduates		Some college, no degree		Associate's degree		Bachelor's degree		Master's degree or better	
	%	Rank	%	Rank	%	Rank	%	Rank	%	Rank	%	Rank	%	Rank
Wholesale and Retail Trade Services	15%	1	14%	2	19%	1	19%	1	13%	3	13%	3	6%	7
Professional and Business Services	14%	2	8%	5	8%	7	11%	4	11%	4	21%	1	28%	1
Government and Public Education Services	14%	3	2%	10	9%	6	15%	2	19%	2	17%	2	16%	3
Healthcare Services	13%	4	7%	6	10%	4	13%	3	19%	1	12%	4	17%	2
Leisure and Hospitality Services	10%	5	28%	1	12%	3	10%	5	7%	6	6%	6	3%	8
Manufacturing	8%	6	9%	4	12%	2	7%	7	7%	5	6%	7	6%	6
Financial Services	7%	7	2%	11	4%	10	8%	6	6%	7	11%	5	8%	4
Construction	5%	8	13%	3	9%	5	5%	8	4%	9	2%	11	1%	12
Transportation and Utilities Services	4%	9	4%	9	7%	8	4%	9	4%	10	3%	10	1%	11
Personal Services	4%	10	7%	7	5%	9	4%	10	5%	8	2%	12	3%	10
Private Education Services	2%	11	0%	12	1%	12	1%	12	1%	12	3%	9	7%	5
Information Services	2%	12	0%	13	1%	13	3%	11	2%	11	4%	8	3%	9
Natural Resources	2%	13	6%	8	3%	11	1%	13	1%	13	1%	13	1%	13
<b>TOTAL</b>	<b>100%</b>		<b>100%</b>		<b>100%</b>		<b>100%</b>		<b>100%</b>		<b>100%</b>		<b>100%</b>	

TABLE 4.7

## Share of industry employees with some college education or better in 2008.

Source: Authors' analysis of March CPS data, 2008; Center on Education and the Workforce forecast of educational demand to 2018

INDUSTRIES:	Some college or better 2008*	% of total industry employment 2008	Change 2008–2018		Rank	
			#*	%	Fastest (%)	Largest (#)
Government and Public Education Services	16,502	76%	1,545	9%	5	10
Professional and Business Services	14,060	71%	4,645	33%	1	2
Healthcare Services	11,808	72%	3,630	31%	2	3
Wholesale and Retail Trade Services	11,728	52%	2,616	22%	3	6
Financial Services	7,588	75%	1,758	23%	4	5
Manufacturing	6,660	49%	511	8%	9	11
Leisure and Hospitality Services	6,446	45%	1,044	16%	6	7
Construction	3,317	41%	-51	-2%	13	13
Transportation and Utilities Services	2,901	47%	361	12%	10	8
Personal Services	2,883	51%	293	10%	11	9
Information Services	2,364	75%	805	34%	7	1
Private Education Services	2,306	82%	703	30%	8	4
Natural Resources	919	31%	-13	-1%	12	12

\*(in thousands)

# Demand for Education by Industry: A More Detailed Discussion.

As we have seen, the demand for workers with a postsecondary education has been growing and will continue to grow, especially with the expansion of Services industries. Postsecondary demand has also been growing—and will continue to do so—in Manufacturing, Construction, and other Goods-producing industries. The sole exception to the trend is Natural Resources. The concentration of postsecondary workers has not grown in that group of industries and will not grow significantly over the next decade.

If we look across the entire economy, we find that one-third of all job openings will require a Bachelor’s degree or better. A slightly smaller proportion of workers (30 percent) will require some postsecondary education—such as a certificate, certification, or an Associate’s degree—and another 37 percent will be high school graduates or dropouts (Figure 4.13).

Natural Resources (69 percent), Construction (62 percent), and Leisure and Hospitality Services (54 percent) will have

the most jobs requiring workers with high school educations or less (Table 4.8). At the other end of the spectrum, Private Education Services (68 percent), Information Services (59 percent), and Professional and Business Services (58 percent) will have the largest volume of total job openings requiring a Bachelor’s degree or more.

Four industries drive openings for workers at all education levels. Those industries are Professional and Business Services (17 percent), Healthcare Services (16 percent), Wholesale and Retail Trade Services (16 percent), and Leisure and Hospitality Services (13 percent). Private Education Services is an outlier, in that it will have the third-largest set of openings requiring workers with Bachelor’s degrees or higher.

Table 4.9 details how openings from growth compare to replacement openings as drivers of educational demand. As shown, the distribution of educational attainment among openings will include jobs for:

- 15.2 million workers with high school diplomas or less;
- 8 million workers with some college education, but no degree;
- 5.6 million workers with Associate’s degrees;
- Nearly 18 million workers with Bachelor’s degrees or better.

FIGURE 4.13

By 2018, 30 million new and replacement jobs will require some college or better.

Source: Center on Education and the Workforce forecast of educational demand through 2018

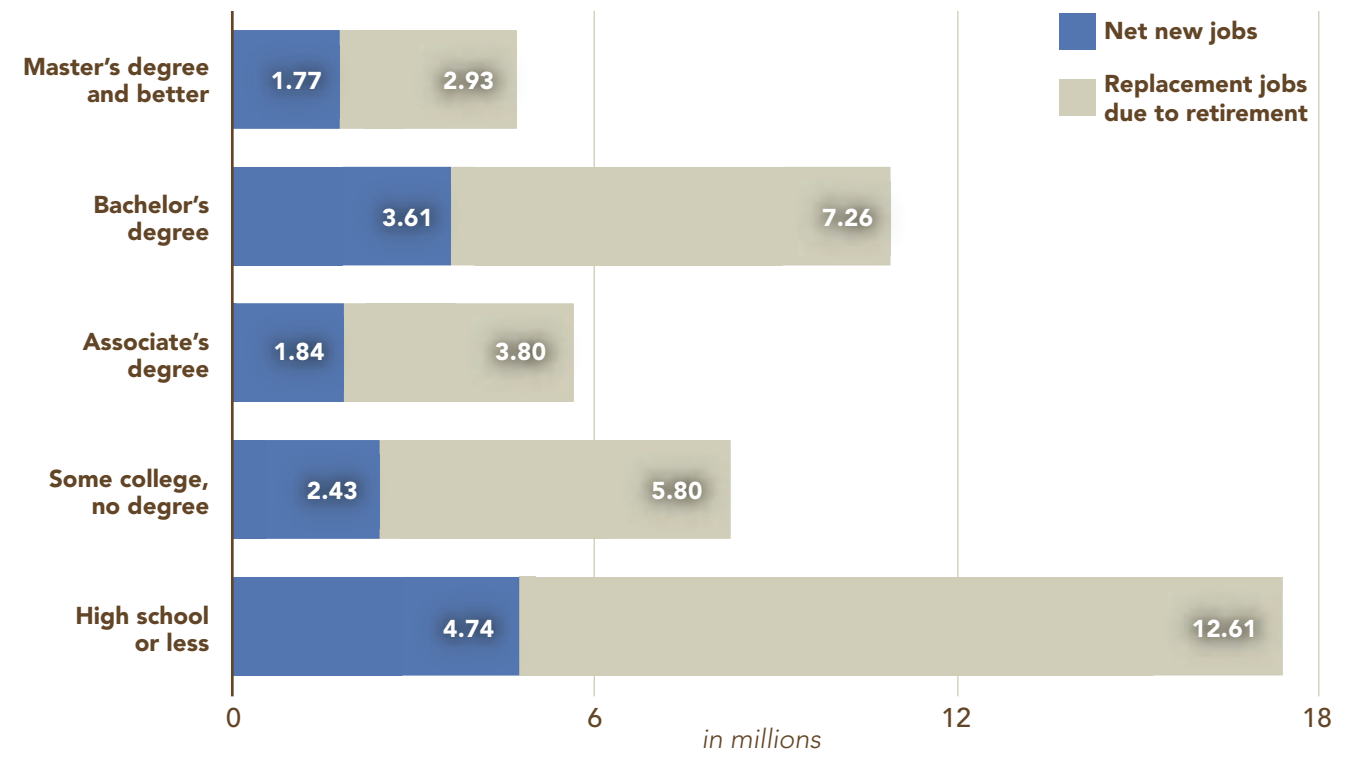




TABLE 4.8

Educational concentration of total job openings across industries in 2018.

Source: Center on Education and the Workforce forecast of educational demand through 2018

INDUSTRIES:	High school or less		Some college, no degree		Associate's degree		Bachelor's degree or better		Total
	% of industry	Rank	% of industry	Rank	% of industry	Rank	% of industry	Rank	
Natural Resources	69%	1	10%	13	9%	11	13%	12	100%
Construction	62%	2	16%	9	10%	9	12%	13	100%
Leisure and Hospitality Services	54%	3	18%	6	8%	12	20%	9	100%
Transportation and Utilities Services	51%	4	19%	4	11%	4	18%	11	100%
Personal Services	49%	5	17%	7	15%	3	19%	10	100%
Manufacturing	45%	6	15%	10	11%	5	29%	7	100%
Wholesale and Retail Trade Services	41%	7	22%	1	11%	7	27%	8	100%
Healthcare Services	25%	8	17%	8	19%	1	39%	6	100%
Professional and Business Services	19%	9	13%	11	10%	10	58%	3	100%
Financial Services	18%	10	20%	3	10%	8	52%	4	100%
Government and Public Education Services	17%	11	19%	5	18%	2	46%	5	100%
Private Education Services	14%	12	11%	12	8%	13	68%	1	100%
Information Services	8%	13	21%	2	11%	6	59%	2	100%

TABLE 4.9

Educational demand for new and replacement jobs through 2018. (in thousands)

Source: Center on Education and the Workforce forecast of educational demand through 2018

INDUSTRIES:	High school dropouts		High school graduates		Some college, no degree		Associate's degree		Bachelor's degree		Master's degree or better	
	New	Repl	New	Repl	New	Repl	New	Repl	New	Repl	New	Repl
Construction	106	344	208	676	81	264	51	167	49	159	10	31
Financial Services	24	37	196	300	244	374	129	198	496	758	159	243
Government and Public Education Services	2	36	20	359	23	428	22	405	41	752	16	287
Healthcare Services	198	158	825	658	704	561	787	628	1,023	816	573	457
Information Services	0	0	25	58	62	147	32	76	131	309	43	101
Leisure and Hospitality Services	491	1,030	565	1,185	358	751	165	345	328	687	62	130
Manufacturing	-55	248	-201	911	-86	389	-63	286	-113	512	-48	219
Natural Resources	-20	115	-29	163	-7	40	-6	36	-7	39	-2	13
Other Services	88	228	188	486	97	251	83	215	68	177	41	105
Private Education Services	8	32	85	342	72	290	52	208	224	902	243	978
Professional and Business Services	172	230	466	624	438	587	331	444	1,266	1,696	702	940
Transport and Utilities Services	43	97	223	504	98	222	60	135	82	184	14	32
Wholesale and Retail Trade Services	148	478	559	1,804	378	1,220	190	612	388	1,254	79	254
TOTAL	1,205	3,033	3,130	8,070	2,462	5,524	1,833	3,755	3,976	8,245	1,892	3,790

Except for Construction, the Goods-producing industries all have lower levels of employees with postsecondary training or education than the Services industries. This is especially evident in Manufacturing and Natural Resources, where there is no net job growth. Only about one-third of workers in the Manufacturing and Natural Resources industries have at least some postsecondary education or training—a level of postsecondary workers that is exceeded in every services industry.

Construction, as noted, is the exception in Goods production. It is growing, and almost half of its employees had at least some postsecondary education or training in 2008. This level exceeds the share of postsecondary workers in the Services industries with the lowest shares of postsecondary workers. Only 45 percent of workers in Leisure and Hospitality Services, for example, have postsecondary training.

## Natural Resources

- For example, farming, fishing, forestry, hunting, and mining

They are what remains of the extractive economy that dominated the United States until after the Civil War. They are now among the nation’s smallest industries, both in output and employment. In 2008, Natural Resources industries employed about 3 million workers, or some 2 percent of the workforce. Overall employment in this sector will decline by 2018 to 2.9 million workers, or 1.8 percent of the workforce.

With the exception of coal mining, where there is some small job growth because of the overwhelming demand for domestic energy sources, Natural Resources industries will increase their output but not the number of jobs. All 300,000 job openings we forecast for Natural Resources in 2018 will come from the retirement of existing workers, ranking it at bottom of the 13 industries we examined for the number of job openings.

**Natural Resources has the lowest level of postsecondary employment of all industry categories.** The total number of jobs has been declining in this industry over time, although the occupations that remain increasingly have required postsecondary education. In 1983, the Natural Resources industries employed only 22 percent of U.S. workers with at least some college education. That share had increased to 34 percent by 1992 and stayed at that level through 2008. Our projections show continued increase by 2018, from 34 percent to 38 percent.

Of the 300,000 job openings in the Natural Resources industries, 105,000 will require at least some college.

Natural Resources industries will have openings for:

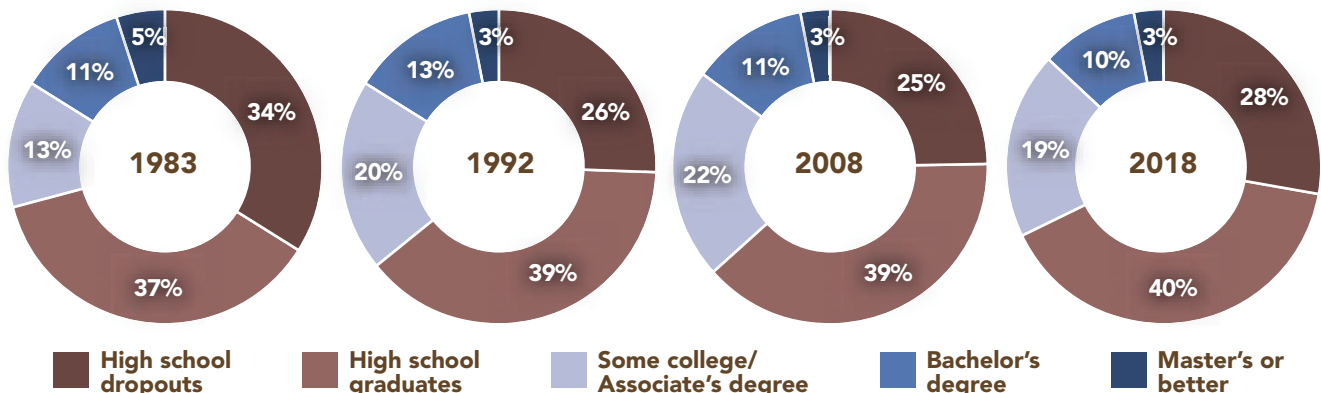
- 95,000 workers who dropped out of high school;
- 135,000 high school graduates;
- 32,000 workers with some college, but no degree;
- 30,000 workers with Associate’s degrees;
- 32,000 workers with Bachelor’s degrees;
- 11,000 workers with Master’s degrees or better.

Figure 4.14 shows that education requirements have been relatively constant in this industry, with some shifting away from high school dropouts. The level of workers with high school diplomas was 37 percent in 1983 and will be 40 percent in 2018, while dropouts will decline from 34 percent in 1983 to 28 percent in 2018.

FIGURE 4.14

### Educational Attainment in Natural Resources (1983–2018).

Source: Authors’ analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018



# Goods-producing Industries

- Includes Manufacturing and Construction

The Goods-producing industries provided more than 20 million jobs in 2008, roughly 15 percent of total positions. These industries produced more than \$5 trillion in output in 2008, which means they provided almost 25 percent of national output using only 15 percent of the nation’s workers. Goods production will grow more than \$1 trillion and provide 4.7 million job openings between 2008 and 2018, including 505,000 net new jobs and 4.2 million replacement jobs.

**Employment levels in Goods-producing industries have been most affected by computer-based technologies that automate routine tasks.** More routine Goods-production functions have been outsourced and moved off-shore to less costly and lower skilled workers.

The share of postsecondary workers in Goods-production has increased as technology has automated routine functions, leaving behind more challenging tasks that require postsecondary skill or training. Goods-production workers with at least some postsecondary education or training constituted 46 percent of the industry’s workforce in 2008, a figure that will grow to 48 percent in 2018. Those levels compare to 60 percent of all workers in the economy as a whole for 2008, and 63 percent projected for 2018.

## Manufacturing

Manufacturing includes makers of nondurable goods that are quickly used up, such as cosmetics or office supplies, and durable goods, such as cars, that are used for several years. For many years, Manufacturing was the nation’s largest

employer, although that peaked in 1979. In 2008, Manufacturing was still our largest industry as measured by the value of its output, but ranked sixth for employment with some 13.6 million workers or about 9 percent of the nation’s workforce. Manufacturing is expected to remain our largest industry as measured by output, but employment is expected to decline by 4 percent between 2008 and 2018. It will increase its output by almost \$1 trillion by 2018, yet Manufacturing’s share of total output, its share of total employment, and its actual employment level all are expected to decline over the next decade.

As a result of the industry’s ability to increase output with fewer employees, all job openings in manufacturing will come from retirement and other replacement needs. The Manufacturing industry will provide 2 million job openings between 2008 and 2018. Although we project that the industry will have some 2.6 million openings to replace retiring workers, about 565,000 of those jobs will be lost permanently, shrinking the number of actual openings. The industry will rank eighth in total jobs openings, all from replacement of retiring workers.

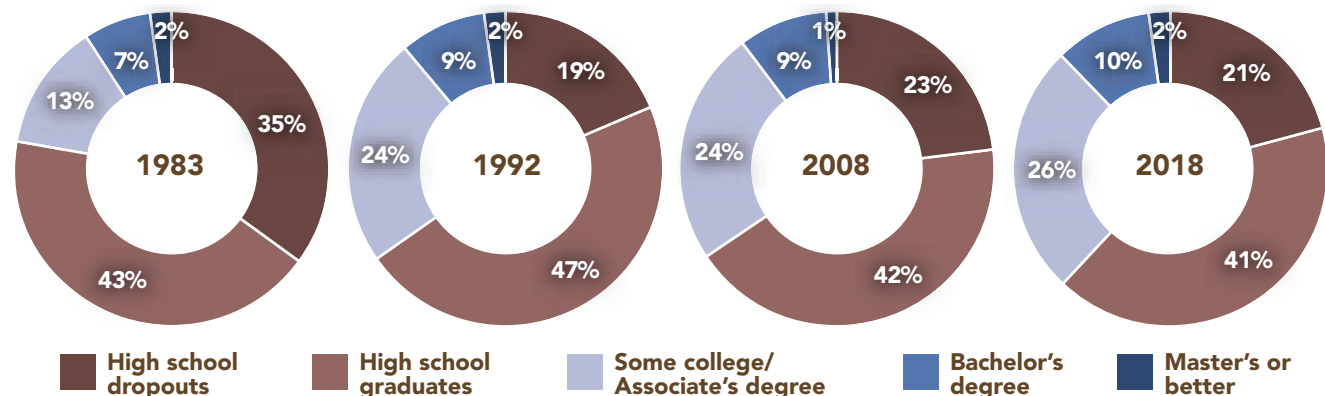
By 2018 we project Manufacturing industry jobs will fall to about 13 million from its 2008 level of 13.6 million. Increasing automation and global trade are the primary causes of Manufacturing decline. Employment declines will occur both in traditional Manufacturing and in newer industries. The fastest decline occurs in apparel, textile, and leather goods, but the largest declines will occur in electronics, transportation equipment, and metal products.

Output growth will be led by the manufacture of computer and information technologies—the technologies at the heart of structural change and increasing demand for postsecondary education throughout the economy. Ironically, though, the information technology manufacturing industries are victims of

FIGURE 4.15

### Educational Attainment in Manufacturing (1983–2018).

Source: Authors’ analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018



their own revolution. They experience the most intense productivity increases from automation, which results in falling employment. As a case in point, the computer and peripheral equipment manufacturing industry will grow by almost \$800 billion in output—while its employment is expected to decline by almost 60 percent.

In contrast, as employment plunges in the manufacturing of computers and peripheral equipment, it will explode in a related Services industry field. Computer systems design and related services—part of Professional and Business Services—are expected to add some 650,000 jobs by 2018.

Some quick Manufacturing facts:

- Manufacturing jobs, as noted earlier, have been declining for decades but the jobs that remain require more postsecondary education to perform. In 1983, the industry employed just 22 percent of the nation’s workers with at least some college education. The share increased to 34 percent by 1992 and has remained at the same level through 2008. Our projections show a small increase in the share of Manufacturing workers with at least some college from 34 percent to 38 percent.
- Manufacturing, along with Natural Resources industries, has the lowest shares of workers with postsecondary education or training among our 13 industry designations now and in our forecast for 2018.
- Postsecondary workers are underrepresented in the Manufacturing industry workforce. Manufacturing employs 9 percent of the total workforce, but just 7 percent of all postsecondary workers.

By 2018, Manufacturing will have openings for:

- 192,000 workers who dropped out of high school;

- 710,000 high school graduates;
- 303,000 workers with some college but no degree;
- 223,000 workers with Associate’s degrees;
- 400,000 workers with Bachelor’s degrees;
- 179,000 workers with Master’s degrees or better.

High school graduates and dropouts have lost employment share in Manufacturing since 1983 when they captured 43 and 35 percent of employment. Combined, they are projected to employ 62 percent in 2018. Over the same period, requirements for workers with some college and Associate’s degrees double from 13 percent to 26 percent (Figure 4.15).

## Construction

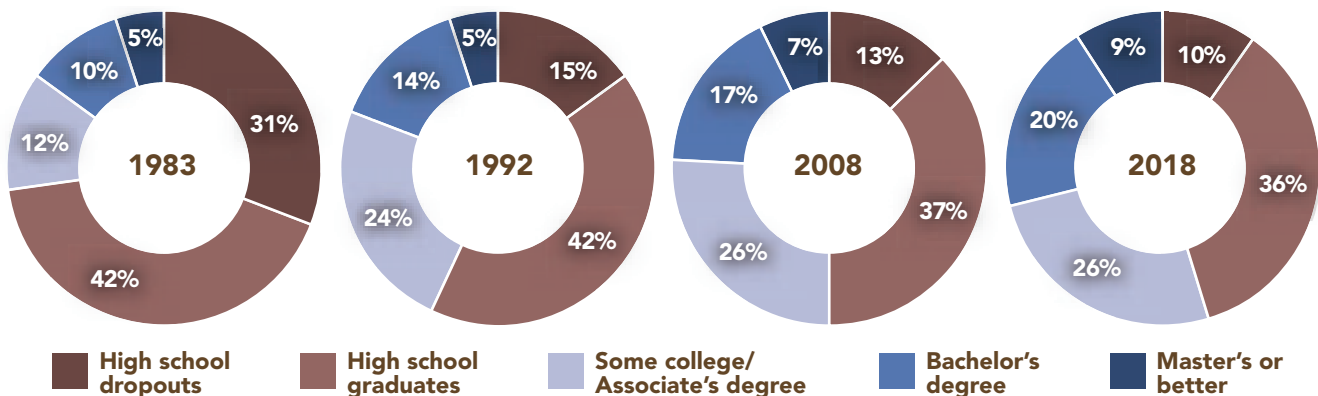
Construction is the nation’s ninth-largest industry as measured by output and our eighth-largest industry employer, with 8.1 million workers, or 6 percent of the nation’s workforce. In our forecast, employment will increase in this industry by 500,000 workers, but because of even larger growth in other industries, Construction’s share of the workforce will decline from 6 percent to 5 percent. Because of its growth, Construction is the exception to the rule among Goods-producing industries. Construction is expected to add 505,000 new jobs over the next decade, plus an additional 1.6 million openings to replace retiring workers.

As with other industries hard hit by the recession, the forecast growth reflects a low starting point in 2008, caused by the virtual halt in construction after the economic crisis hit. Investment in residential housing will increase substantially, though, as housing starts race to catch up with pent-up demand that has been growing since the housing collapse.

FIGURE 4.16

### Educational Attainment in Construction (1983–2018).

Source: Authors’ analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018



An aging Baby Boom generation will add to the residential construction demand as the building of retirement communities and remodeling of existing structures surge with retirements. Baby Boomers also will add to nonresidential construction through increased demand for medical facilities and nursing homes. A substantial share of nonresidential construction will be driven by demographic shifts between geographic regions, creating demand for new infrastructure ranging from schools to retirement homes. Infrastructure investments that were put on hold in the recession and replacement or modernization of existing structures also will add to the coming surge in construction as the recovery gains momentum

Some quick Construction facts:

- The Construction industry has the highest share of postsecondary jobs among all the Goods-producing industries. Construction ranks eighth in the share of workers with at least some postsecondary education in 2008 and in our 2018 projections.
  - The share of postsecondary workers in Construction has grown from 17 percent in 1983 to 50 percent in 2008, and we project that share will grow to 54 percent by 2018.
  - Postsecondary workers are underrepresented in the Construction industry workforce. The industry employs 6 percent of all workers, but includes just 3 percent of all postsecondary workers.
- In 2008, postsecondary workers in Construction were divided between those with some college or an Associate's degree (26 percent), those with Bachelor's degrees (17 percent), and those with Master's or other graduate degrees (7 percent). The other 50 percent are divided between workers with high school diplomas and those who dropped out.

The Construction industry will provide 2.1 million job openings between 2008 and 2018, and 800,000 of those will require at least some college education.

Construction will have openings for:

- 450,000 workers who dropped out of high school;
- 885,000 high school graduates;
- 345,000 workers with some college but no degree;
- 219,000 workers with Associate's degrees;
- 208,000 workers with Bachelor's degrees;
- 41,000 workers with Master's degrees or better.

The industry is projected to move away from employing large numbers of high school dropouts toward requiring substantial postsecondary education. The demand for high school graduates will decline from 42 percent in 1983 to 36 percent of employment in 2018, while the requirement for at least some college or better doubles from 27 percent in 1983 to 54 percent in 2018 (Figure 4.16).

# Services Industries

Services industries, a broad category consisting of 10 of the 13 major industries, accounted for almost 117 million jobs in 2008, and we forecast that number will swell to more than 131 million jobs in 2018. That means Services jobs will go from 73 percent of the total jobs in the economy to almost 80 percent. Economic output will grow explosively, too. Over the same period, output in Services industries will increase from \$11 trillion to \$20 trillion, boosting their share of total output from 65 percent to 73 percent.

Consider this contrast: Only one of the Goods-producing industries—Construction—is expected to grow in overall size. The reverse is true for Service Industries. Only one—Utilities—is expected to decline in overall size by 2018.

Services industries will provide some 42 million job openings between 2008 and 2018, including all 14 million of the economy's new jobs and 28 million openings to replace retiring workers. About 63 percent of these openings will require at least some college education.

Services industries will have openings for:

- 3.5 million workers who have dropped out of high school;
- 9.5 million high school graduates;
- 7.3 million workers with some college but no degree;
- 5.1 million workers with Associate's degrees;
- 11.5 million workers with Bachelor's degrees;
- 5.4 million workers with Master's degrees or better.

Services industries have been the primary source of value added, of Gross Domestic Product, growth, and of postsecondary demand—all of which is characteristic of the nation's shift from an industrial to a postindustrial economy. Service tasks often require interaction with other people and are not always routine. Services industries include many sectors that require robust knowledge, skills, and abilities. For example, doctors, lawyers, financial analysts, and teachers constantly deal with diverse problems and people, and they require both skill and knowledge to solve a constant stream of diverse problems. Heightened requirements for advanced knowledge, skill, and abilities make Services a natural seedbed for increasing postsecondary demand.

Many in the Services industries are college-educated, white collar workers who are responsible for deploying new technical capabilities throughout the economy. Many also are increasingly skilled technical and nonmanagerial workers who provide a growing share of value added to products and services in the postindus-

trial economy. In many ways, this dynamic has created a strong link between skill-biased technology change and growth in Services—both of which result in strong demand for workers with postsecondary educations. These workers do not make consumer goods or new technologies like manufacturers do, grow things like farmers, or wrest and refine natural resources like miners and loggers do. But they are, nonetheless, on the frontlines of the new postindustrial economy because they have their own skills: they can bend to their wills the new computer and communications technologies that have revolutionized modern economic activity.

In the pages that follow, we will look at some of the specific industries in this group and their employment prospects.

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## Information Services

- for example, newspaper publishers, libraries and archives, Internet service providers, the motion picture and videos industry, plus all other broadcast industries

This is the signature services industry in the new knowledge economy. Because of its extraordinary productivity, Information Services is distinguished by its output growth and the intensity of its demand for postsecondary education more than for its employment share. Information Services produced \$769 billion in output in 1998, grew to \$1.1 trillion in 2008, and is projected to grow to \$1.9 trillion in 2018. Information Services moved from our ninth-largest industry in overall output in 1989, to seventh in 2008, and is projected to move into sixth by 2018.

Information Services employs only about 2 percent of the workforce, which ranked it among the three smallest industry employers in 2008, and it won't grow substantially between now and 2018. Information Services accounted for 3.1 million jobs in 2008, and we forecast that it will employ 3.4 million workers in 2018—an increase of about 290,000. The industry will create 985,000 total job openings by 2018 and will rank 12th out of our 13 industries in job openings. Still, Information Services is a core asset, producing the computing services, communications technology, and media that are at the core of the nation's postindustrial transformation. Industry employment boomed in the 1990s as part of the tsunami wave at the start of the computer revolution, but it has grown at a slow and steady pace ever since.

Because it sits at the heart of the economy's computer and communications technology change, the Information Services industry is a mixed bag of rapid growth and decline. Telecommunications and publishing are expected to lose more than 200,000 jobs over the next decade. Demand for non-electronic publishing is expected to continue to decline. And

while demand for telecommunications is expected to rise by more than \$340 billion as homes and businesses invest in an expanding range of communications services, increasing automation will reduce new job growth. As a result, job openings in publications and telecommunications will come entirely from the replacement of retirees. The strongest employment growth in this sector will come from software publishing, Internet publishing, the development of Web search and service portals, and associated customer services as electronic media capture market share from more traditional media.

The relatively slow growth in Information Services employment is due to the technology shift between paper and electronic publishing. Paper-based newspaper, periodical, book, reference, and directory publishers are projected to lose jobs over the decade as those functions shift to electronic media. Moreover, net job growth relative to output in these functions is expected to decline because electronic media is less labor-intensive.

The share of postsecondary workers in Information Services has increased dramatically over time. From 1983 to 2008, the share of workers with at least some postsecondary education or training rose from 33 percent to 78 percent, and we project it will rise to 91 percent by 2018. Information Services had the second-highest share of postsecondary workers in 2008 at 79 percent. We project that trend will continue through 2018 as that share goes even higher, to 91 percent.

Workers with postsecondary education or training are overrepresented in the Information Services workforce. The industry employs just 2 percent of the nation's workers but 3 percent of its postsecondary workers. Information Services will provide 985,000 job openings between 2008 and 2018, and 902,000 of those will require at least some college.

Information Services will have openings for:

- 0 high school dropouts;
- 83,000 high school graduates;
- 209,000 workers with some college but no degree;
- 109,000 workers with Associate's degrees;
- 440,000 workers with Bachelor's degrees;
- 143,000 workers with Master's degrees or better.

Change in the Information Services industry has been profound. In 1983, the industry supported significant employment for workers with high school degrees or less, but now has virtually no opportunity for workers with that level of education. Sixty-seven percent of the industry's jobs in 1983 required a high school diploma or less, but this will shrink to 9 percent for high school graduates in 2018, with no jobs for high school dropouts (Figure 4.17).

## Financial Services

- For example, finance, insurance, and real estate, as well as leasing and rental activities

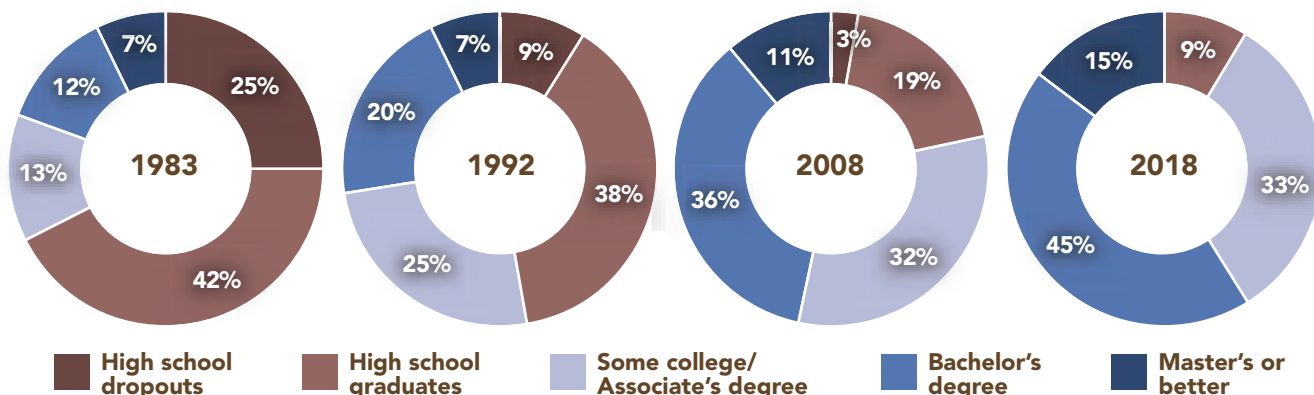
As measured by economic output, Financial Services is the second-largest industry in the economy and will remain so through 2018. It will grow from \$3 trillion to almost \$4 trillion over the next decade.

While Financial Services ranks second as measured by economic output, it was seventh in overall employment in 2008 and will keep that ranking in 2018. The industry employed 7 percent of all workers in 2008. Although its share of employment will remain stable, the Financial Services industry will increase its

FIGURE 4.17

### Educational Attainment in Information Services (1983–2018).

Source: Authors' analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018





actual employment by 1.2 million workers over the decade, growing from 10 million jobs to 11.2 million. The industry will rank eighth in overall job openings between 2008 and 2018, creating 3.1 million job openings that will include 1.2 million net new jobs and 1.9 million jobs to replace retiring workers.

Financial Services has grown markedly over recent decades as a result of several factors. Among them are the shift from defined benefit to defined contribution retirement plans; increasing consumer debt for mortgages, postsecondary education, and consumer durables such as automobiles; and the globalization of Financial Services. **Workers in this sector have been hit hard by the Great Recession of 2007, largely because the crisis was triggered by a financial and housing market collapse. But because of their pervasive role in modern economic institutions and because of the steep loss of jobs in the recession, they will grow back rapidly as the recovery proceeds.** The industry should go from 3 million jobs in 2008 to almost 4 million by 2018.

The share of postsecondary workers in Financial Services has increased from 48 percent in 1983 to 76 percent in 2008 and is projected to increase to 82 percent by 2018. Financial Services had the third-highest share of workers with postsecondary education or training in 2008, with 76 percent attaining at least some college or better. It will hold onto that ranking in 2018, we project, increasing to 82 percent. Postsecondary workers are overrepresented in the Financial Services workforce. In 2008, Financial Services employed 7 percent of the nation's workers but 8 percent of its postsecondary workers.

Of the industry's 3.1 million job openings 2008 and 2018, some 2.6 million will require at least some college education.

Financial Services will have openings for:

- 60,000 high school dropouts;
- 495,000 high school graduates;
- 617,000 workers with some college, but no degree;
- 327,000 workers with Associate's degrees;
- 1.3 million workers with Bachelor's degrees;
- 401,000 workers with Master's degrees or better.

The Financial Services industry, like Information Services, once relied on significant employment for workers with no postsecondary education. In 1983, 42 percent of employment in these jobs required no postsecondary education, but this share will shrink drastically to 18 percent in 2018 (Figure 4.18).

## Professional and Business Services

- For example, legal, accounting, tax preparation, bookkeeping and payroll, advertising and related services, professional consulting, architectural, and engineering

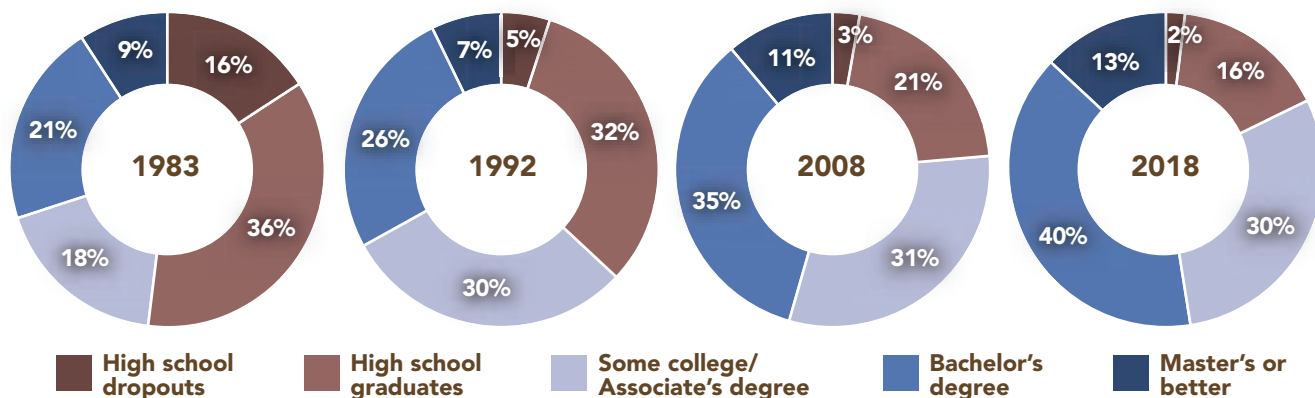
This sector employs workers who provide consulting, temporary help, technical support, and network computing and communications support to the complex organizational networks that typify the postindustrial economy.

The industry employed 19.7 million workers in 2008—13 percent of the workforce. We project it will add 1.4 million new jobs by 2018, making it second only to Wholesale and Retail Trade Services as the largest growth industry. Professional and Business Services is the nation's third-largest industry, producing more than \$2.5 billion in economic output in 2008 and projected to increase by another \$1 billion by 2018.

FIGURE 4.18

### Educational Attainment in Financial Services (1983–2018).

Source: Authors' analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018



Between 2008 and 2018, Professional and Business Services will generate 7.9 million job openings, including 3.4 million net new jobs and 4.5 million to replace retiring workers.

Growth in this industry is a result of the increasing pace of change as employers struggle to retain and expand market shares in rapidly shifting environments.

The Professional and Business Services industry has grown apace with the increasing complexity of far-flung institutional networks that rely on multiple companies or institutions to produce final products or services. Such networks have become commonplace in the postindustrial economy. Workers in Professional and Business Services enable such networks by providing highly skilled professional and managerial expertise—skills that tend to cut across traditional industry, geographic, and occupational boundaries.

Consulting and contracting for basic services and expert work accounts for a growing share of Professional and Business Services employment. Strong growth in the future will be driven by the need for consultants and contractors to help companies with everything from running cafeterias to ensuring regulatory compliance to providing marketing, design, and logistics help.

Computer systems design is another fast growth area in this sector. Growth here is driven by a variety of factors, including demand for Internet and intranet design; the need for integration of fixed and mobile technologies; movement toward electronic records in healthcare and other industries; and the need for information security.

Increased use of temporary help and human resources firms will increase demand in employment services. The ongoing shift to

temporary help services is projected to continue, especially in high-demand and specialized services such as healthcare. In addition, companies will increasingly shift human resource management functions to contractors in order to reduce costs and risk as they operate in complex regulatory and benefits environments.

Professional and Business Services had the fourth-highest share of postsecondary workers in 2008, with 76 percent attaining at least some college education or better. The share of postsecondary workers in the industry increased from 43 percent in 1983 to 71 percent in 2008 and is projected to hit 81 percent by 2018. Postsecondary workers are overrepresented in the Professional and Business Services workforce. In 2008, the industry employed 13 percent of the nation’s workers, but 16 percent of its postsecondary workers. The industry will provide 7.9 million job openings between 2008 and 2018, with 6.4 million requiring at least some college education.

Professional and Business Services will have openings for:

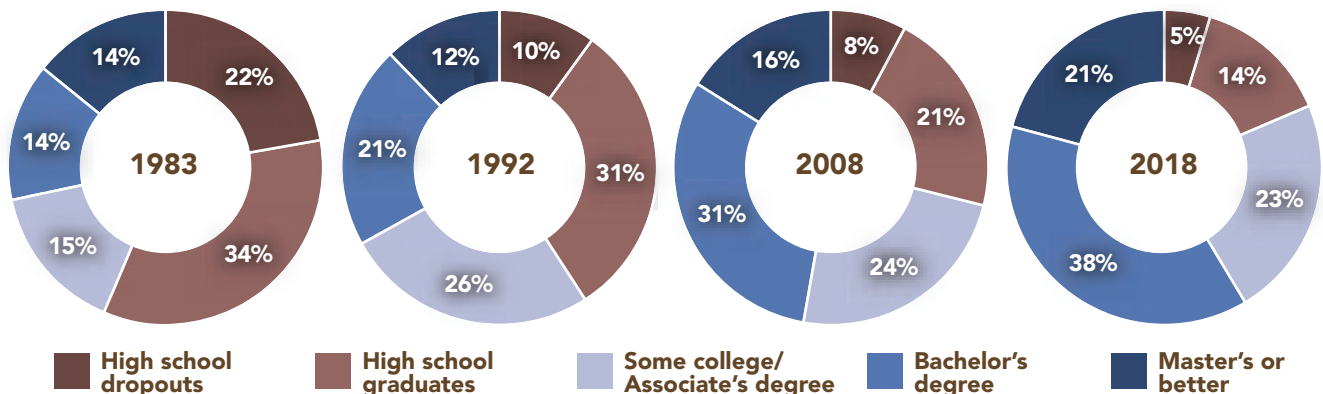
- 401,000 high school dropouts;
- 1.1 million high school graduates;
- 1 million workers with some college but no degree;
- 775,000 workers with Associate’s degrees;
- 3 million workers with Bachelor’s degrees;
- 1.6 million workers with Master’s degrees or better.

The growth of the Professional and Business Services industry includes a shift toward increasing postsecondary requirements. In 1983, 56 percent of employment in the sector required no postsecondary education, but that will drop to 19 percent in 2018 (Figure 4.19).

FIGURE 4.19

Educational Attainment in Professional and Business Services (1983–2018).

Source: Authors’ analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018



## Education Services

- For example, elementary and secondary schools, colleges and universities, business and technical schools and professional services training institutions

**Education Services is the core institution for providing entry-level workforce development in the postindustrial economy.** Not surprisingly, education is the most postsecondary-intensive industry. The increasing importance of education in workforce preparation begins with a deep-seated education bias in technology change.

Because technology change requires workers with more skill, it naturally increases the demand for learning on the job and ultimately fuels increasing educational requirements in three respects:

- The flow of new skill requirements increases entry-level qualifications and these often require postsecondary education or training.
- Because technology automates repetitive functions, it increases the value of general skills required to perform nonrepetitive tasks and activities. Higher skill levels are necessary because employees are constantly dealing with a flow of unique problems to be solved. In addition, as technology takes on routine tasks, people in every industry spend more time interacting with coworkers, customers, and others. This is especially true in service industries, where human interactions are most pervasive and intense.
- The rate of change that has come with the new computer technology in its various guises means that employers want workers who can learn fast and innovate on the job. This further intensifies the need for more robust entry-level skills and increases demand for postsecondary learning.

This is why, combined, Public and Private Education Services have risen to become the nation’s seventh-largest industry and will surpass Manufacturing to become our sixth-largest industry in 2018. We forecast that employment growth in these combined industries will increase from 13.4 million to 15.1 million over the period.

While Education Services have grown dramatically, they have not kept up with the demand for workers with postsecondary education. The result has been a rising wage premium for college-educated workers and increasing inequality between postsecondary-haves and postsecondary have-nots (Goldin and Katz, 2008). As we discussed in Part 2, our projections suggest that demand will continue to outstrip postsecondary education supply in the future, maintaining wage premiums for college-educated workers and increasing inequality.

Education Services divide into two distinct industry groupings: Private Education Services and Public Education. Public Education is by far the larger of the two. Altogether, Public and Private Education Services accounted for almost 14 million jobs in 2008 and will add more than 1.5 million more by 2018, with the public share growing most and the private share slipping slightly.

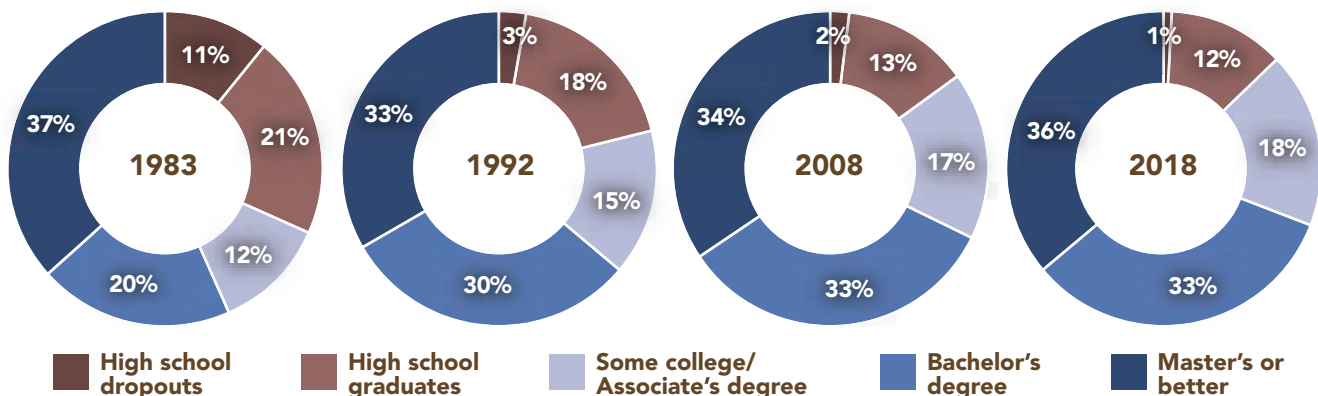
Private Education Services, which we will examine first, is the smallest industry in our projections. It produced \$166 billion in output in 2008 and is projected to produce another \$28 billion in output by 2018. The industry generated 2.8 million jobs in 2008—2 percent of the workforce. We project it will grow to 3.5 million jobs by 2018, an increase of nearly 700,000 jobs. Between 2008 and 2018, Private Education Services will generate 3.4 million job openings, including 683,000 new jobs and 2.7 million replacement jobs.

A significant part of this industry’s growth will be due to increasing numbers of 18–24-year-olds, and older adults, who

FIGURE 4.20

### Educational Attainment in Private Education Services (1983–2018).

Source: Authors’ analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018



seek training and education to qualify for entry-level jobs and to upgrade their skills to adapt to changing job requirements. In addition, because many jobs that required high school diplomas or less were permanently lost in the recession, experienced workers will need to be retrained for new jobs.

Growth in Private Education Services will be fastest at the postsecondary level. Private elementary schools will add more than 200,000 jobs, increasing their workforce to over 1 million workers. But private community colleges, universities, and professional schools will add more than 250,000 jobs, increasing their total employment to more than 1.9 million workers. And private educational institutions that specialize in business, computer, and management training, as well as technical and trade schools, will add more than 300,000 jobs.

Postsecondary workers are overrepresented in the Private Education Services workforce. In 2008, the industry employed 2 percent of the nation's workers but 3 percent of its postsecondary workers. The industry will provide 3.4 million job openings between 2008 and 2018, with 3 million requiring at least some college education.

Private Education Services will have openings for:

- 39,000 high school dropouts;
- 427,000 high school graduates;
- 362,000 workers with some college but no degree;
- 260,000 workers with Associate's degrees;
- 1.1 million workers with Bachelor's degrees;
- 1.2 million workers with Master's degrees or better.

Even though the Private Education Services Industry historically has had high educational requirements, there was room for workers without postsecondary education. In the economy of 2018, this will not be the case. In 1983, 33 percent of

the jobs in the industry required no postsecondary education, but by 2018 that figure will be 13 percent (Figure 4.20).

## Government and Public Education Services

- For example, public school systems, plus government executive offices and legislative bodies; public finance activities; and public administration

Government and Public Education Services generates \$2.3 trillion in economic output—\$760 billion from the federal government and \$1.5 trillion from the state and local governments. Taken together, the federal, state, and local governments generate the fourth-largest share of output.

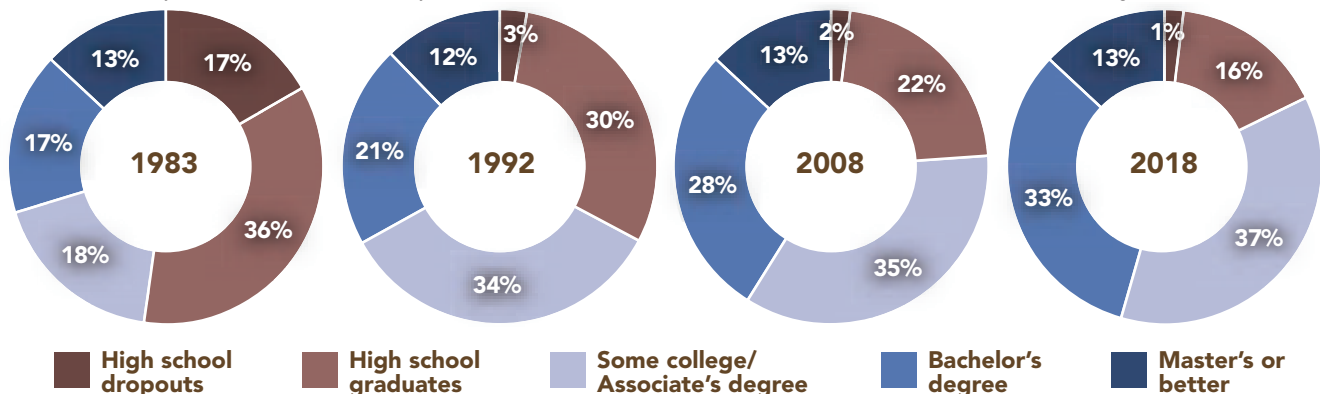
**Government and Public Education generated 22 million jobs in 2008, making Government the nation's second-largest employer with 15 percent of the workforce.** The Government and Public Education Services industry will grow by 125,000 jobs between 2008 and 2018, reducing its share of the workforce from 15 percent to 14 percent. In 2018, Government and Public Education Services will fall from the second-largest industry employer to third, behind Wholesale and Retail Trade and Professional and Business Services. Between 2008 and 2018, the Government and Public Education Services industry will generate 2.4 million job openings, including 125,000 net new jobs and 2.3 million to replace retiring workers.

In 1983, 48 percent of workers in Government and Public Education Services had at least some postsecondary education or training. That share increased to 69 percent in 1992. By 2008, Government and Public Education Services, along with Financial Services, had the third-highest concentration of postsecondary workers. Both industry workforces included 76 percent of workers with at least some postsecondary education or training.

FIGURE 4.21

### Educational Attainment in Government and Public Education Services (1983–2018).

Source: Authors' analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018



Postsecondary workers are overrepresented in the Government and Public Education Services workforce. In 2008, Government and Public Education Services employed 15 percent of the nation's workers but 18 percent of its postsecondary workers. The industry will produce 2.4 million job openings between 2008 and 2018, with 1.9 million requiring at least some college.

Government and Public Education Services will have openings for:

- 38,000 high school dropouts;
- 380,000 high school graduates;
- 451,000 workers with some college but no degree;
- 427,000 workers with Associate's degrees;
- 792,000 workers with Bachelor's degrees;
- 302,000 workers with Master's degrees or better.

Government and Public Education Services is just like the other service industries. Jobs requiring less than a high school education virtually disappear, those requiring high school diplomas are reduced by half, and all of the gains in employment share go to jobs requiring some college education or better (Figure 4.21)

## Healthcare Services

- For example, doctors' offices to hospitals to nursing and residential care facilities

We project that Healthcare Services will increase its economic output from \$1.3 trillion to \$1.9 trillion between 2008 and 2018, making it the fifth-largest industry as measured by economic output. Over that same period, it will increase its employment levels from 16.4 million workers to 20.6 million, an increase of 4.2 million jobs. Healthcare will remain the nation's fourth-largest industry as measured by employment, although its share of workers will increase from 11 percent to 13 percent.

Healthcare Services ranks fifth in its concentration of workers with postsecondary education or training. Growth in Healthcare Services is driven by an aging population and the rapid advance of health technologies. The number of people over age 65 will increase by 13 million between 2008 and 2018, driven by the aging Baby Boom generation. New technologies and drugs will allow people to live into advanced ages where care needs are higher than normal. Technology advances will also ensure increased survival rates from major diseases but will trigger increased costs of critical recovery care. Indeed, such cost pressures will affect growth—as well as the distribution of growth—shifting treatment from hospitals to less expensive outpatient settings in practitioners' offices, home healthcare, and nursing and residential facilities.

Healthcare Services has grown steadily in its use of workers with postsecondary education and training. In 1983, 52 percent of workers in Healthcare Services had at least some postsecondary education or training. The share had increased to 72 percent by 2008, and we project it will increase slightly more by 2018. Postsecondary workers are overrepresented in the Healthcare Services workforce. In 2008, Healthcare Services employed 11 percent of the nation's total workers, but 13 percent of its postsecondary workers. Healthcare Services will produce 7.4 million job openings between 2008 and 2018, with 4.4 million requiring at least some college (Figure 4.22).

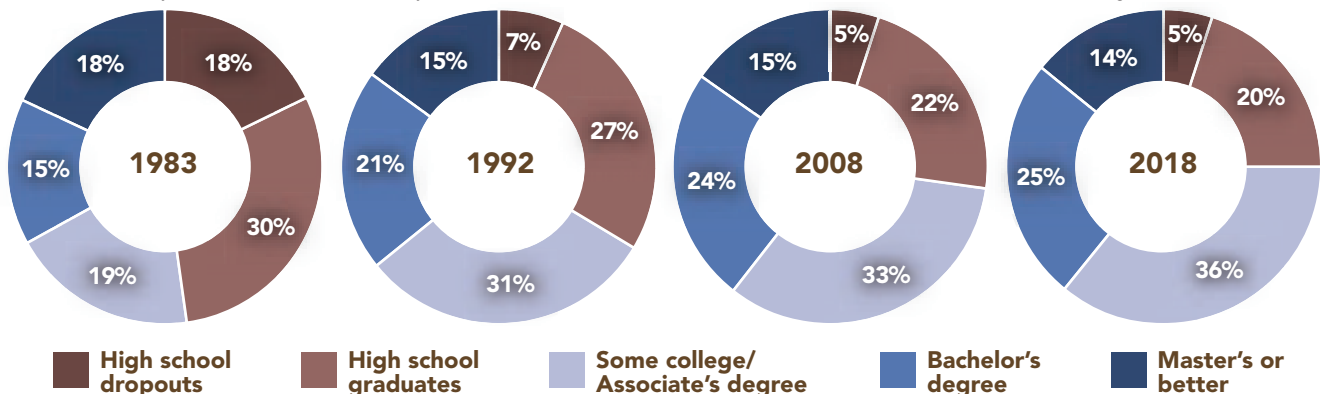
Healthcare Services will have openings for:

- 357,000 high school dropouts;
- 1.5 million high school graduates;
- 1.3 million workers with some college but no degree;
- 1.4 million workers with Associate's degrees;
- 1.8 million workers with Bachelor's degrees;
- 1 million workers with Master's Degrees or better.

FIGURE 4.22

### Educational Attainment in Healthcare Services (1983–2018).

Source: Authors' analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018



## Wholesale and Retail Trade Services

This is an industry that sits at the intersection between the producers of goods and services and their customers. It has already been powerfully affected by computer-based technology. Among the revolutionary developments: technology that allows complex data interchange, radio tracking of products, and electronic commerce that cuts out wholesale and retail establishments and likely will force more consolidation.

The industry also is under enormous pressure from the nation's economic situation. The unusual draw-down on home equity and the free-spending psychology, fueled by inflated housing values and 401(k) balances in the 1990s, were decimated by the recession. As a result, there is likely to be a decline in consumer spending in favor of savings and debt retirement, especially as the Baby Boom ages. A general decline in consumer spending will affect demand and job creation in Wholesale and Retail Trade Services. In spite of pressures for restructuring and a curb on consumer demand—which are assumed in the forecasting model—the industry will grow with the economic recovery.

Our projections show Wholesale and Retail Trade Services growing from \$2.3 trillion to \$3.7 trillion over the decade, an increase of \$1.4 trillion. This makes Wholesale and Retail Trade one of the nation's four largest industries. Wholesale and Retail Trade Services remains the largest industry in overall employment throughout the decade. In 2008 Wholesale and Retail Trade Services employed 15 percent of the workforce, or 22.4 million workers. In 2018 it will still employ 15 percent at 24.1 million workers, an increase of 1.7 million employees.

The industry has grown steadily in its use of workers with postsecondary education and training. In 1983, 32 percent

of workers in Wholesale and Retail Trade had at least some higher education. That share increased to 53 percent in 2008, and we project that it will increase to 60 percent by 2018. Postsecondary workers are underrepresented in the industry's workforce. In 2008, Wholesale and Retail Trade employed 15 percent of the nation's workers, but 13 percent of its workers with higher education (Figure 4.23). Wholesale and Retail Trade will provide 7.4 million job openings between 2008 and 2018, with 2.8 million of those requiring at least some college.

Wholesale and Retail Trade Services will provide openings for:

- 626,000 high school dropouts;
- 2.4 million high school graduates;
- 2.6 million workers with some college but no degree;
- 801,000 workers with Associate's degrees;
- 1.6 million workers with Bachelor's degrees;
- 332,000 workers with Master's degrees or better.

## Transportation and Utilities Services

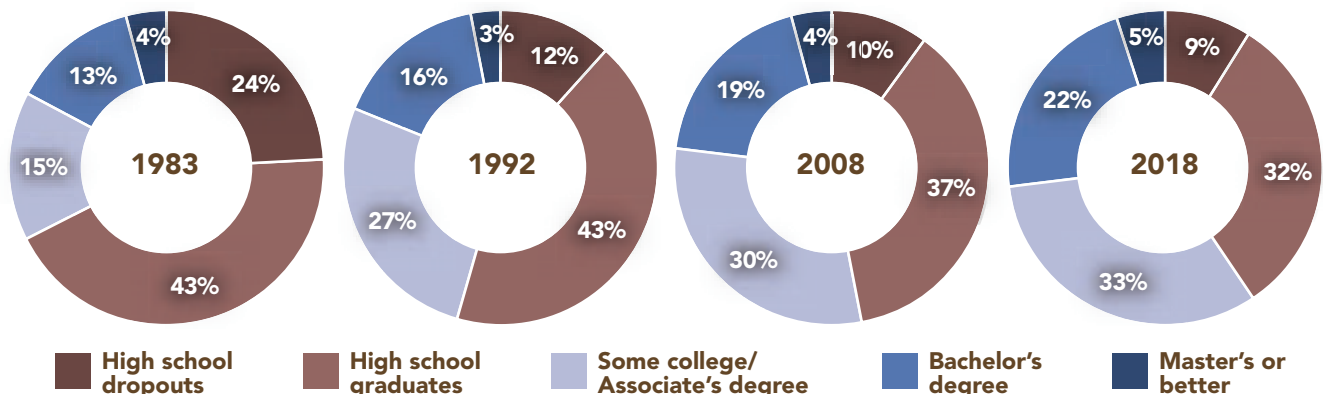
Transportation and Utilities Services produced almost \$1 trillion in economic output in 2008, and our forecast shows it will grow to more than \$1.3 trillion by 2018. This was our 12th-largest industry as measured by output, and will remain so in 2018. The industry employed 6.2 million workers in 2008 and will employ 6.7 million workers in 2018, with all the increases coming in Transportation Services. At that level, Transportation and Utilities Services will remain our ninth largest industry employer.

Over the next decade, the industry will generate 1.7 million job openings: 520,000 new jobs and 1.2 million job openings necessary to replace retiring workers. Transportation and Utilities Services ranks 11th in job openings.

FIGURE 4.23

### Educational Attainment in Wholesale and Retail Trade Services (1983–2018).

Source: Authors' analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018



An overall decline in Utilities employment, much like the decline in many Goods-producing industries, is occurring despite increased production. The largest projected decline is in electric power generation—despite almost \$50 billion in increased output. Technology changes and deregulation have spurred industry consolidation and other trends that have affected the use of personnel.

The share of postsecondary workers in Transportation and Utilities Services has increased from 28 percent in 1983 to almost 50 percent in 2008, where it is projected to remain until 2018 (Figure 4.24). Transportation and Utilities Services had the seventh-highest concentration of postsecondary workers in 2008. The industry will produce 1.7 million job openings between 2008 and 2018, with 826,000 requiring at least some college education.

Transportation and Utilities Services will have openings for:

- 140,000 high school dropouts;
- 728,000 high school graduates;
- 320,000 workers with some college but no degree;

- 195,000 workers with Associate’s degrees;
- 266,000 workers with Bachelor’s degrees;
- 46,000 workers with Master’s degrees or better.

## Leisure and Hospitality Services

This industry is projected to grow from \$748 billion in output to \$884 billion between 2008 and 2018, an increase of \$136 billion. Over the same period, it is expected to grow from 14.2 to 16.2 million jobs, and will continue to employ 10 percent of all U.S. workers. Over half the increase in jobs comes from expanded demand for food services, which is principally driven by population growth—especially growth in the elderly population. The remainder of the growth will come in arts, entertainment, and accommodations. Over the next decade, Leisure and Hospitality Services will generate 6.1 million job openings—2 million net new jobs, and 4.1 million openings necessary to replace retiring workers.

FIGURE 4.24

### Educational Attainment in Transportation and Utilities Services (1983–2018).

Source: Authors’ analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018

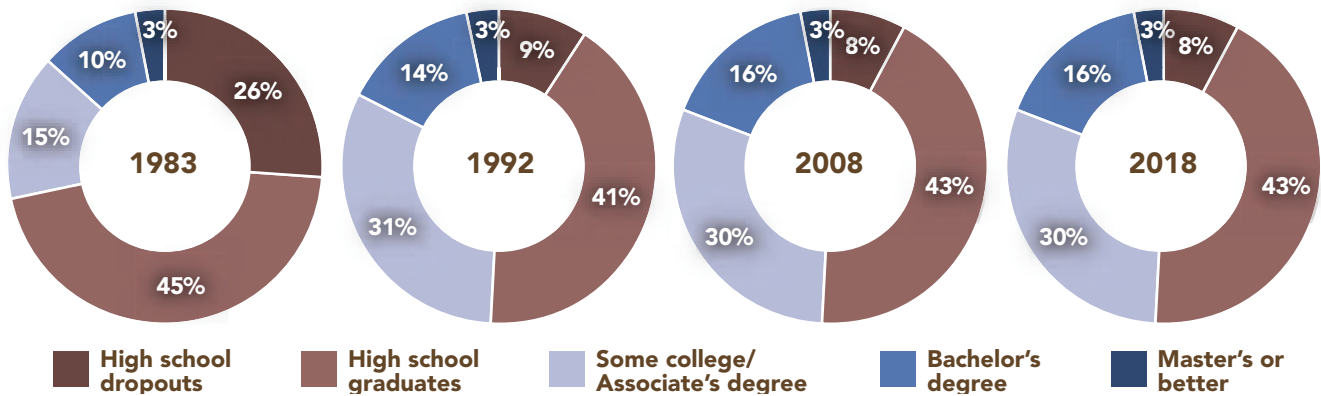
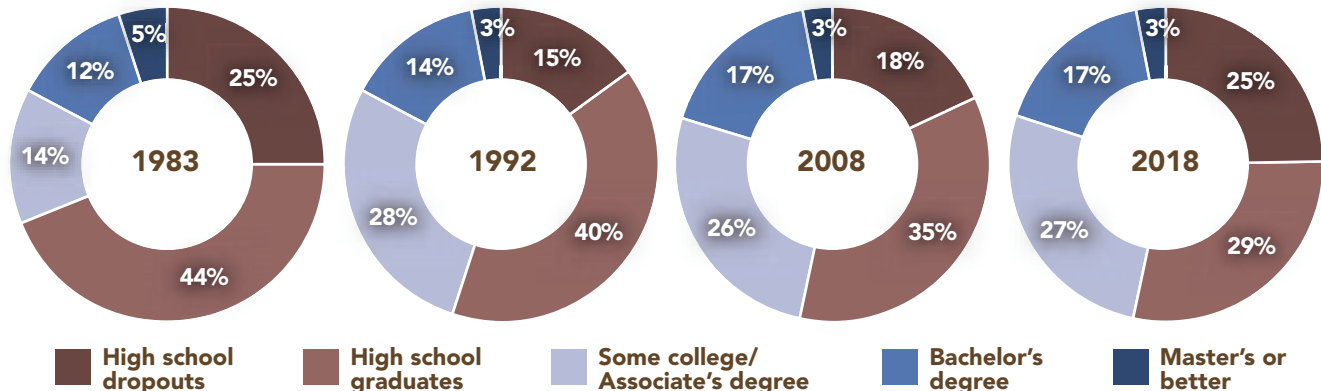


FIGURE 4.25

### Educational Attainment in Leisure and Hospitality Services (1983–2018).

Source: Authors’ analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018



The share of postsecondary workers in Leisure and Hospitality Services has increased from 31 percent in 1983 to 46 percent in 2007, where it is projected to remain until 2018 (Figure 4.25). Leisure and Hospitality Services ranked 10th in the concentration of postsecondary workers in 2008, but it will move up to seventh by 2018. The industry will produce 6.1 million job openings between 2008 and 2018, with 3 million requiring at least some college. The industry will rank fourth in overall job openings.

Leisure and Hospitality Services will include openings for:

- 1.5 million high school dropouts;
- 1.7 million high school graduates;
- 1.1 million workers with some college but no degree;
- 509,000 workers with Associate’s degrees;
- 1 million workers with Bachelor’s degrees;
- 192,000 workers with Master’s degrees or better.

## Personal Services

- For example, automotive repair and maintenance, car washes, nail salons and other grooming services, labor unions, and religious organizations

The sector produced almost \$1 trillion in economic output in 2008, and our forecast shows it will grow to more than \$1.3 trillion by 2018. Personal Services ranked 11th among our 13 industry groups as measured by output and will rank there in 2018, as well.

The industry employed 5.6 million workers in 2008 and will grow to 6.2 million by 2018. The Personal Services industry was our 10th-largest employer in 2008 and will keep that ranking in 2018.

Over the next decade, Personal Services will generate 2 million job openings: 564,000 net new jobs and 1.4 million openings necessary to replace retiring workers. This industry ranks ninth in its volume of job openings through 2018. The share of postsecondary workers in Personal Services has grown from 36 percent in 1983 to almost 47 percent in 2008 and will nudge up to 48 percent by 2018 (Figure 4.26). Personal Services had the 11th-highest concentration of postsecondary workers in 2008. About half of the industry’s job openings between now and 2018 will require at least some college education.

Personal Services will have openings for:

- 317,000 high school dropouts;
- 673,000 high school graduates;
- 347,000 workers with some college but no degree;
- 298,000 workers with Associate’s degrees;
- 244,000 workers with Bachelor’s degrees;
- 146,000 workers with Master’s or other graduate degrees.

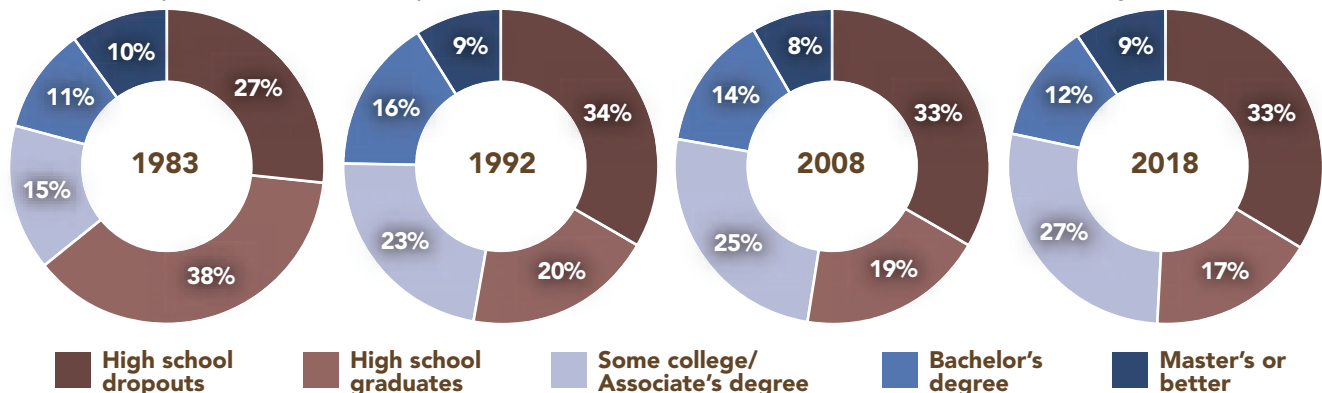
<sup>18</sup>Autor, Katz, and Kearney, 2006

<sup>19</sup>Replacement jobs include openings due to retirement, death, or cases when someone leaves an industry altogether. Retirements are the single largest source of replacement needs. The high rate at which people leave lower-wage and lower-skill jobs, as well as high levels of part-time employment biases the count of job openings toward lower-wage, lower-skill jobs in industries such as Wholesale and Retail Trade Services. These biases in the data lead to an understatement of the demand for postsecondary education.

FIGURE 4.26

### Educational Attainment in Personal Services (1983–2018).

Source: Authors’ analysis of March CPS data, various years; Center on Education and the Workforce forecast of educational demand through 2018





# Part 5

## Education and Earning Power.

The best thing workers who want job security in the U.S. economy can do for themselves is to get an education: earn a high school diploma, and go on to college. But there is one more critical advantage we have not yet touched on: earning power. Simply put, education helps workers find, keep, and advance in good-paying jobs.

Research shows there is a direct correlation between formal education levels and annual wages, which reflect what employers are willing to pay for the knowledge, skills, and abilities that workers attain at every consecutive education level. Figure 5.1 clearly illustrates that point. By obtaining a high school diploma, a worker contributes the greatest percentage jump to his or her earning power—82 percent over high school dropouts. For the great majority of Americans, it is necessary to obtain at least some college—a postsecondary certificate or

an Associate's degree—to earn wages above the median for the entire country.

### WAGES AS AN INDICATOR OF RELATIVE DEMAND FOR SKILLED LABOR.

Wages reflect the interaction between relative supply and demand for labor. Employers may pay higher wages to guarantee a worker's tenure or as a premium for special skills or training in tight labor markets. Rising wages can indicate excess demand or a short-term inability of supply to meet demand for a particular skill. To illustrate this concept, think of the labor market as consisting of two big, largely independent categories of workers: those with a Bachelor's degree or better and those without a Bachelor's degree. Workers in each

FIGURE 5.1

On average, people with higher educational attainment have higher earnings.

Source: Authors' analysis of March CPS data, various years

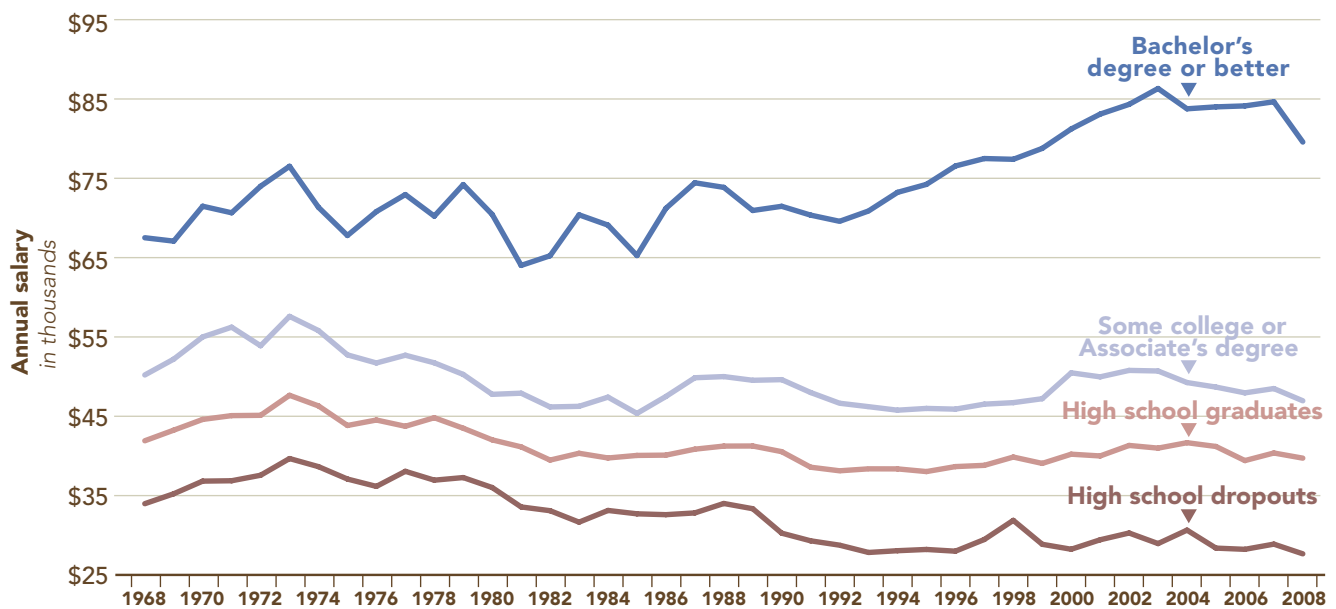
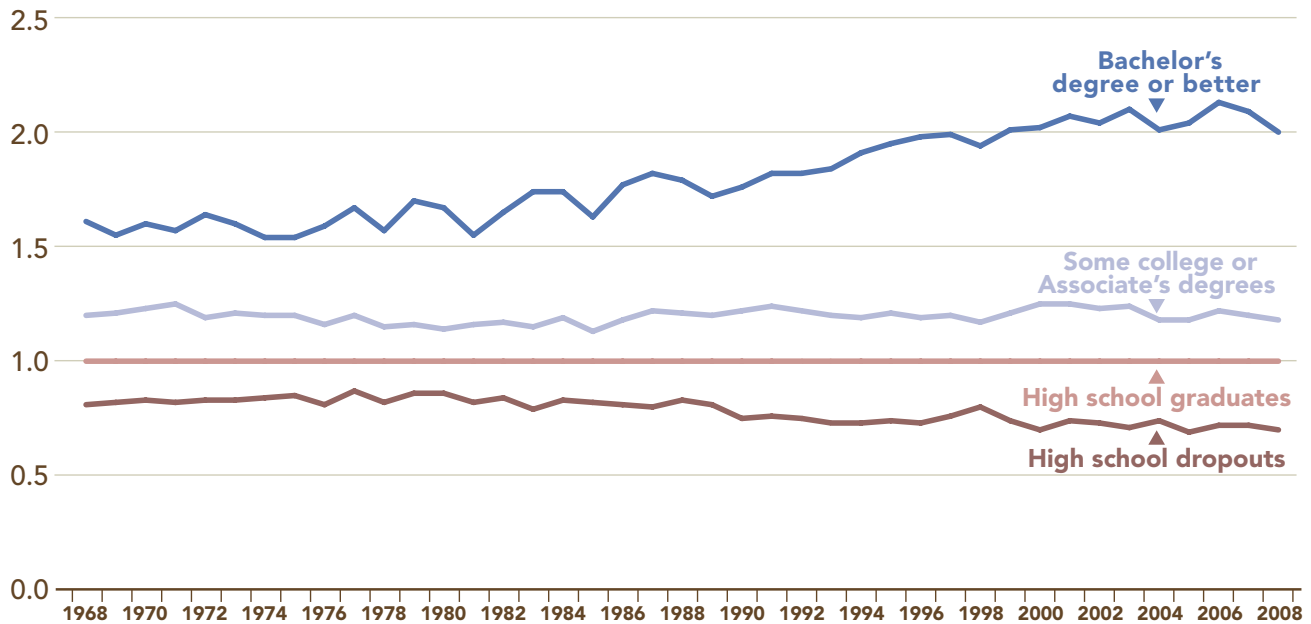


FIGURE 5.2

Wage differentials by education level relative to high school graduates.

Source: Authors' analysis of March CPS data, various years



category are not generally good substitutes for each other because of their differing knowledge and skill sets. **Even within specific occupations increases in attainment commonly lead to significantly higher earnings. This means that employers who want workers with college-level skill sets are willing to pay extra to get them.** Higher wages for workers with a Bachelor's degree or better, then, suggest they are in relatively greater demand than workers with less education.

We have examined the average earnings of prime-age (25–54 years old)<sup>20</sup> Americans with Bachelor's degrees or better in recent decades and focused on the premium paid to college graduates relative to those workers without a degree.<sup>21</sup> Those earnings fell from the early 1970s up to the 1980s and then rose dramatically through most of the 1990s (Figure 5.2). Since 2000, the wages for workers with Bachelor's degrees or better have declined, but the relative wage differentials over workers with lower levels of education have remained stable. The value of “some college” and Associate's degrees over high school diplomas has also been relatively stable, while the relative wage status of high school dropouts has continued to decline.

On average, high school graduates earned 68 percent more than high school dropouts, while workers who attended some college or attained an Associate's degree earned 26 percent more than high school graduates. Bachelor's degree holders

earned 45 percent more than Associate's; and Master's degree holders earned 37 percent more than Bachelor's. Figure 5.2 shows that holders of college degrees, on average, earned twice as much as high school graduates in 2008—even while the real wages of college degree holders declined over several years. That is because wages for high school graduates and dropouts either stagnated or fell during the same period.

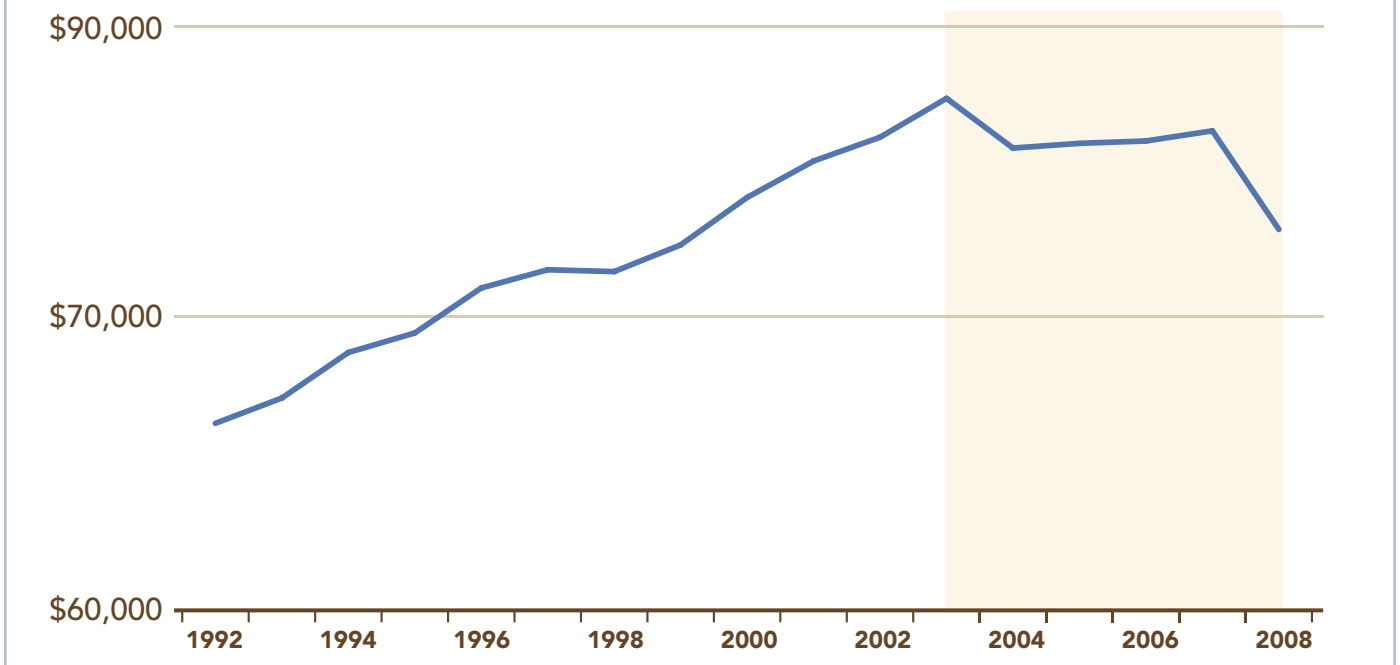
We use this relative wage premium as an indicator of the relative demand for workers with Bachelor's degrees and better versus non-degree holders.<sup>22</sup> Wages by education level traditionally behave as human capital theory predicts: higher education levels correlate with higher wages, a pattern that has remained unchanged over the past eight years.

In the 1970s, the relative premium for college-educated workers declined as the supply of these workers grew dramatically with a surge in college attainment; this resulted in the supply exceeding the demand for college-educated workers. The pattern was quickly reversed in the 1980s as information technology began to transform the economy from industrial to services-based. Skills-biased technological change increased the demand for more educated workers, leading employers to bid up the price. This trend peaked in the 1990s as the real wage premium for college-educated workers spiked dramatically; it has been decreasing since roughly 2002.

FIGURE 5.3

Real wages of prime-age, college-educated American workers since 2002. (in 2008 dollars)

Source: Authors' analysis of March CPS data, various years



### WHAT DOES THE DECLINE IN REAL WAGES REALLY MEAN?

Much emphasis has been placed on the dip in real wages; some have argued, incorrectly we believe, that this implies the advantages of earning a college degree are also in decline. Understanding the difference between supply and demand for college workers and wage premiums for college degrees helps to clarify why college education is valuable. Demand for college-educated workers can be rising dramatically, but if supply keeps up, “college wages” will not increase. The real issue for individuals trying to decide whether to attend college is not whether college wages are going up or down. The real issue is not the wage level, but rather the relative wage advantage of college degrees over lower attainment levels. As we show later, while the absolute real wages of college-educated workers have declined since 2002, such fluctuations are not unusual. Overall, the relative advantages of college degrees have grown dramatically since the 1980s and declined only slightly since 2002.

Figure 5.3 shows the average real wages of American prime-age college-educated workers from 1992 to 2008.<sup>23</sup> Note that college wages peaked in 2002, then declined through 2003. They began rising again after 2003—but declined dramatically with the 2007 recession.

Inspection of the wage differential for workers with Bachelor’s degrees or better reveals three turning points in the data that correspond to the time periods 1968–1981, 1982–2003, and 2004–2008. In Figure 5.4, we more closely examine the wage premium for college-educated Americans during these time periods.

### WHAT DOES THIS MEAN FOR RECENT COLLEGE GRADUATES?

When we limit our observations to recent college graduates between the ages of 25–34, real wages of males and females fluctuated between 2001 to 2008, but ended up roughly where they began.

But both young women and young men are still better off than their less-educated counterparts. Although young women earn less, on average, than young men, they earned 1.6 times as much as young women without college degrees. Young college-educated men, meanwhile, earned 1.7 times as much as young high school-educated men.

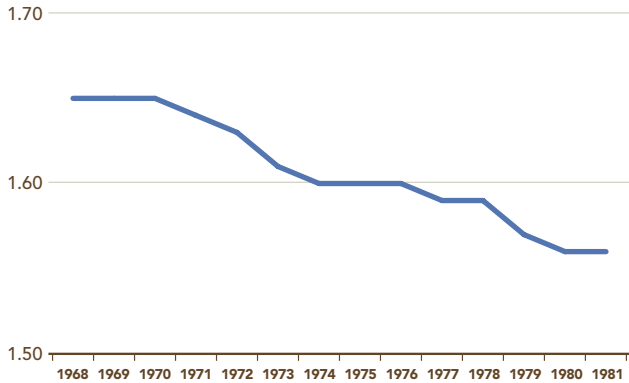
Given trends in wage premiums over the last three decades, we believe it is irresponsible to argue against the pursuit of a college degree solely because real returns have fallen

FIGURE 5.4

A closer look at the college wage premium.

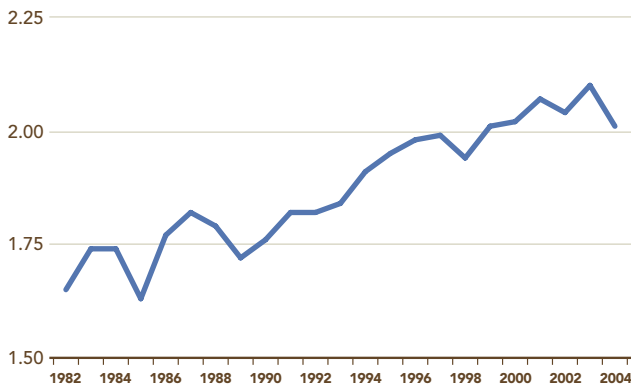
Source: Authors' analysis of March CPS data, various years

PANEL 1 (College wage premium, 1968 to 1981)



Panel 1 shows a decline in the relative real wage premium for holders of college degrees through most of the 1970s. Goldin and Katz (2008) explain this by the sudden surge in college-educated Baby Boomers that created a temporary oversupply of college graduates and reduced the wage premium. They find that the demand for college graduates grew at an average rate of 2.14 to 2.16 percent per year, while the supply grew at a faster rate of 3.19 percent per year, resulting in an oversupply of college workers and a resultant decline in their wage premium relative to high school graduates.

PANEL 2 (College wage premium, 1982 to 2004)



Panel 2 shows a steep increase in the relative real wage premium for college degrees from the 1980s up to the early 2000s. Here, Goldin and Katz (2008) show that a supply slow-down in college graduates dramatically increased the wage premium of workers with Bachelor's degrees and better compared to high school graduates. The supply of college graduates increased by 3.19 percent per year in the 1970s but fell to 2.00 percent per year in the 1980s and 1990s. In the 1970s, demand increased by an average of 2.15 percent, but accelerated in the 1980s to between 3.27 and 3.66 percent per year. Therefore, increasing demand and declining supply guaranteed a rise in the college wage premium. The relative increase in the wage premium during this period was quite remarkable and increased at far greater rates than the premium had declined during the previous decade. At its peak, college graduates earned more than twice as much, on average, as high school graduates.

PANEL 3 (College wage premium, 2005 to 2008)



Panel 3 shows the most recent period of earnings fluctuation. While this period of decline in the wage premium for higher education is apparent, college graduates of all ages still earned twice as much in 2008 as high school graduates, down from a peak of 2.13 in 2006. The explanation for the dip is straightforward: the economy is in a recession and everyone bears some of the burden. Less-educated workers, however, shoulder a relatively greater share. In April 2010, 4.9 percent of the unemployed had a Bachelor's degree or better; 10.6 percent were high school graduates; and 14.7 percent were high school dropouts.<sup>24</sup>

compared to the most recent past. This is especially true when, even given that decline, college graduates can still expect to earn almost twice as much as their non-college-educated competitors. Furthermore, as this report has already demonstrated, college-level jobs continue to grow at faster rates than middle- or lower-skill-level jobs. Our forecast of educational demand through 2018 estimates that 63 percent of new and replacement jobs in the future will require some college or better, while 72 percent of this subset will require a Bachelor's degree or better.

Ultimately, if we continue to incorrectly downplay the value of postsecondary attainment—and discourage young Americans from pursuing college degrees because real wages have dipped in this decade—this discouragement will lead to low-skill, low-wage work over the next 10 years. Further, while the American system is more forgiving than most, young students who decide not to attend college are unlikely to get a second chance. Enrollment and graduation rates in postsecondary institutions decline geometrically with age, dropping from 70 percent (for those under age 23) to 16 percent (for those over 30) in four-year institutions.<sup>25</sup> Bottom line: a decision to forgo or postpone a college degree now will make it significantly tougher to get one later.

## ESTIMATING THE VALUE OF A COLLEGE DEGREE

What is a degree worth over a lifetime? In the spirit of the Census Bureau's 2002 report on the value of a college education, we calculate that the average value of a college degree—compared to a high school diploma—is about \$1.6 million in additional earnings.<sup>26</sup> This figure is based on 2008 earnings projected over a typical work life (25 through 64 year olds) for full-time, full-year workers.

The real payoff today of this total benefit over 40 years would be lower. So, to adjust for that, we calculate the net present value (NPV) and present a hypothetical cost benefit analysis of attending college in light of recent reductions in the wage premium. If we start today and look forward to earning \$1.6 million in additional pay over 40 years, then the present value tells us today how much money is required at an assumed interest rate to yield that amount in the future. Assuming an interest rate of 1 percent (average Federal Funds rate in 2008), then a conservative estimate of the net present value of the lifetime average marginal return from a Bachelor's degree over a high school diploma is \$1 million. To determine if a college degree is worth it, we must simply ensure that the discounted cost of the degree is at most \$1 million expressed in today's dollars.<sup>27</sup>

FIGURE 5.5

Wage premiums by sex for recent college graduates.

Source: Authors' analysis of March CPS data, various years



The economic costs of attending college should include the indirect cost of forgone income while students are in school, plus the direct costs of tuition, books, and other necessities.<sup>28</sup> According to the College Board, “about 56 percent of students enrolled at four-year colleges or universities attend institutions that charge tuition and fees of less than \$9,000 per year.” The average annual tuition at public four-year colleges and universities was about \$5,685 for in-state residents during 2006–2007 according to the National Center for Education Statistics, U.S. Department of Education. For argument’s sake, we have taken the larger of those estimates into consideration for our calculations. Our conclusion: over the length of a four-year degree, the estimated cost is around \$50,000.

Is a degree worth it? If one does the math, there is just one answer: a resounding yes.

### DEBATING THE DISAPPEARANCE OF THE MIDDLE CLASS

Another debate swirling through economic circles today is whether middle-income jobs are disappearing from the American economy, signaling the decline of the middle class. This

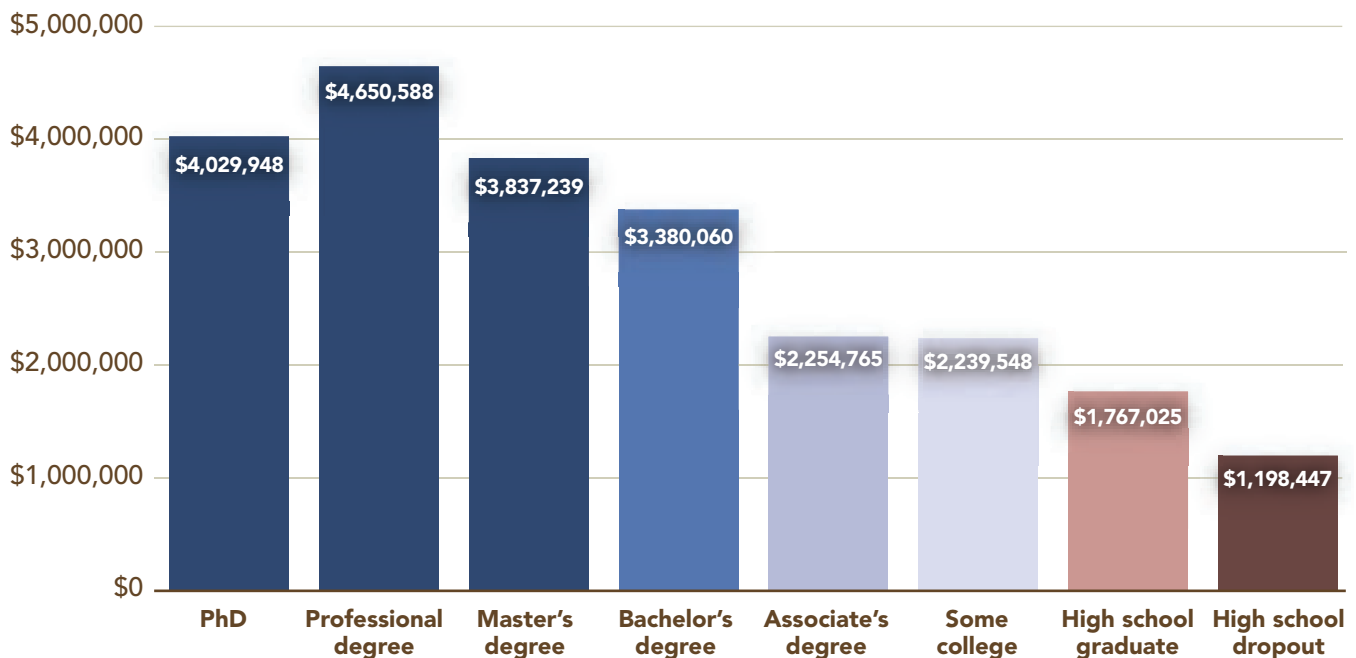
idea first surfaced in the 1980s. Theorists cited the increasing movement of wealth toward the top 10 percent of wage earners relative to those at the bottom as an indication that the middle class was beginning to dwindle. During the prosperous 1990s, analysis of the movement of people from one social class to another pointed to upward mobility—people moving from the middle into the wealthier income categories, which was interpreted as a positive. Now, though, we are closing this decade with the most severe economic decline since the Great Depression, and people are sliding from the middle onto the lower-wage rungs. Speculations about an hourglass economy—concentrations of people at the top and bottom of wage categories with a slender middle—are rampant.

The concepts of declining middle class, declining middle-wage jobs, and an hourglass economy are related—and relevant in this report for what they mean for the jobs that will be created as part of the recovery. Will the jobs of the next decade lead to middle-class wages? Is there, indeed, polarization of the job market toward the top and bottom with a decline in middle-wage or middle-skill jobs? Are middle-wage and middle-skill jobs the same? We approach these questions by analyzing the available literature on wage growth in America

FIGURE 5.6

Estimated average lifetime earnings by educational level. (in 2008 dollars)

Source: Authors’ analysis of March CPS data, 2008



and presenting the evidence on historical wage changes by education and occupation.

There is a growing body of literature that discusses the polarization of American jobs into high-wage and low-wage opportunities, with a consequent decline in the number of jobs offering middle wages. A 2003 study by Autor, Levy, and Murnane notes that this phenomenon results in a U-shaped growth pattern—with jobs increasing at either end of the pay scale and dipping in the middle. The study found that one factor driving this phenomenon is the computerization of routine tasks.

*The first-order impact of computerization is to displace “middle skilled,” routine cognitive and manual tasks, such as bookkeeping and repetitive production work.*

This phenomenon affects the demand for workers who do such work and, of course, the wages they earn.

Two decades of experience with such U-shaped growth does suggest that middle-income jobs are indeed becoming scarcer—and significantly harder to land without a postsecondary education.

## DISTRIBUTION OF WORKERS BY WAGE AND EDUCATION CATEGORIES

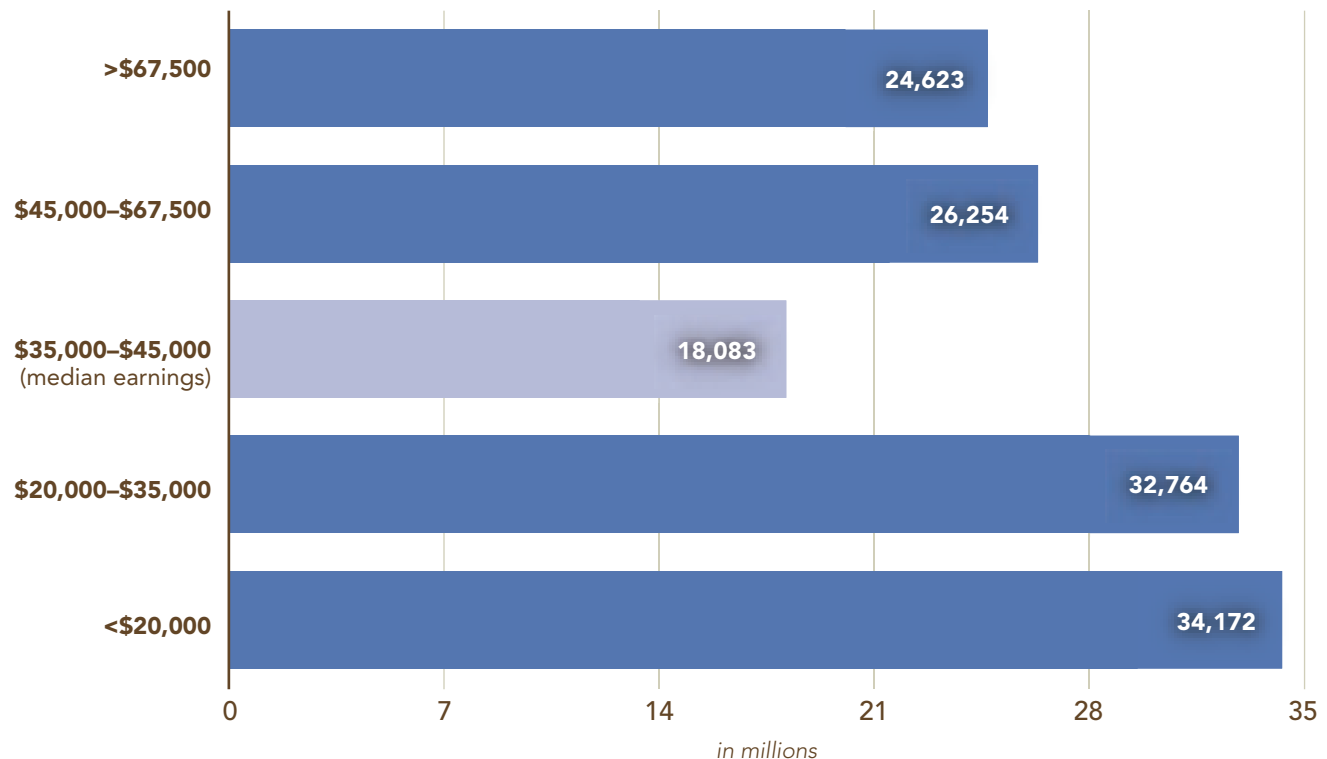
Analysis of the U.S. workforce by educational attainment shows a clear and predictable bias: higher education levels are associated with higher income levels. In Figure 5.8, we sort each of the income classifications according to the average educational attainment of the workers and demonstrate the relative sizes of five income groupings for the U.S. population in 2008. The quintiles were based on a definition of wages drawn from national poverty measurements. The lowest income category is essentially the average weighted poverty threshold for a family of four. Thus, one in four American workers (over 34 million) has a job that pays poverty level wages. Fifty percent make less than \$35,000 per year, or 175 percent of the poverty level.

Middle America earns between \$35,000 and \$68,000, which represents one-third of the working population (18 million workers). Upper-income Americans earn more than \$68,000, which is close to 20 percent of the population. Of course, there are many assumptions that cloud these definitions. For example, location in a metropolitan area might imply that larger wages are required to

FIGURE 5.7

More workers are at the top and bottom of the wage spectrum than in the middle. (in 2008 dollars)

Source: Authors' analysis of March CPS data, 2008



meet one's basic needs, meaning someone earning upper-income wages might not be living an upper-income lifestyle.

**Reading Figure 5.8 horizontally**

The lowest-income categories have the highest proportions of high school dropouts and high school graduates (more than 54 percent). The second earnings category has a similar pattern of attainment, where close to 50 percent of its workers have high school diplomas or less. The upper-income category, meanwhile, has the greatest proportion of highly educated workers—32 percent have a Master's degree or better. Overall, workers with Bachelor's degrees or better have a higher probability of working in the highest-income categories.

**Reading Figure 5.8 vertically**

Here, we can see the proportions of Americans within each educational category. About 34 percent of Americans have a Bachelor's degree or better, and more than 60 percent of these highly educated workers have wages in the upper two income

categories. About 28 percent of workers (38 million) have some college or an Associate's degree.<sup>29</sup> About 51 percent of these middle-skills people are in the lower two income categories, while 33 percent are in the upper two. Thus, if we look at the subgroup of some college workers only, there are greater numbers in the lower two earnings categories than in the upper two. The odds worsen for high school dropouts and holders of high school diplomas: 67 percent of Americans with a high school diploma or less earn wages in the lowest two categories, while only 20 percent are in the upper two. As expected, just 9 percent of high school dropouts earn \$45,000 or more, while 23 percent of high school graduates earn \$45,000 or more. Overall, then, there is a hierarchical relationship between mean wages earned and educational attainment.

**WAGES BY OCCUPATION**

The previous section outlined average wages of prime-age workers for the entire economy, broken down by formal education level. While average education is a useful tool for

**FIGURE 5.8**

Those with the most postsecondary attainment have the highest wages. (in 2008 dollars)

Source: U.S. Census Bureau, Current Population Survey, 2009 Annual Social and Economic Supplement

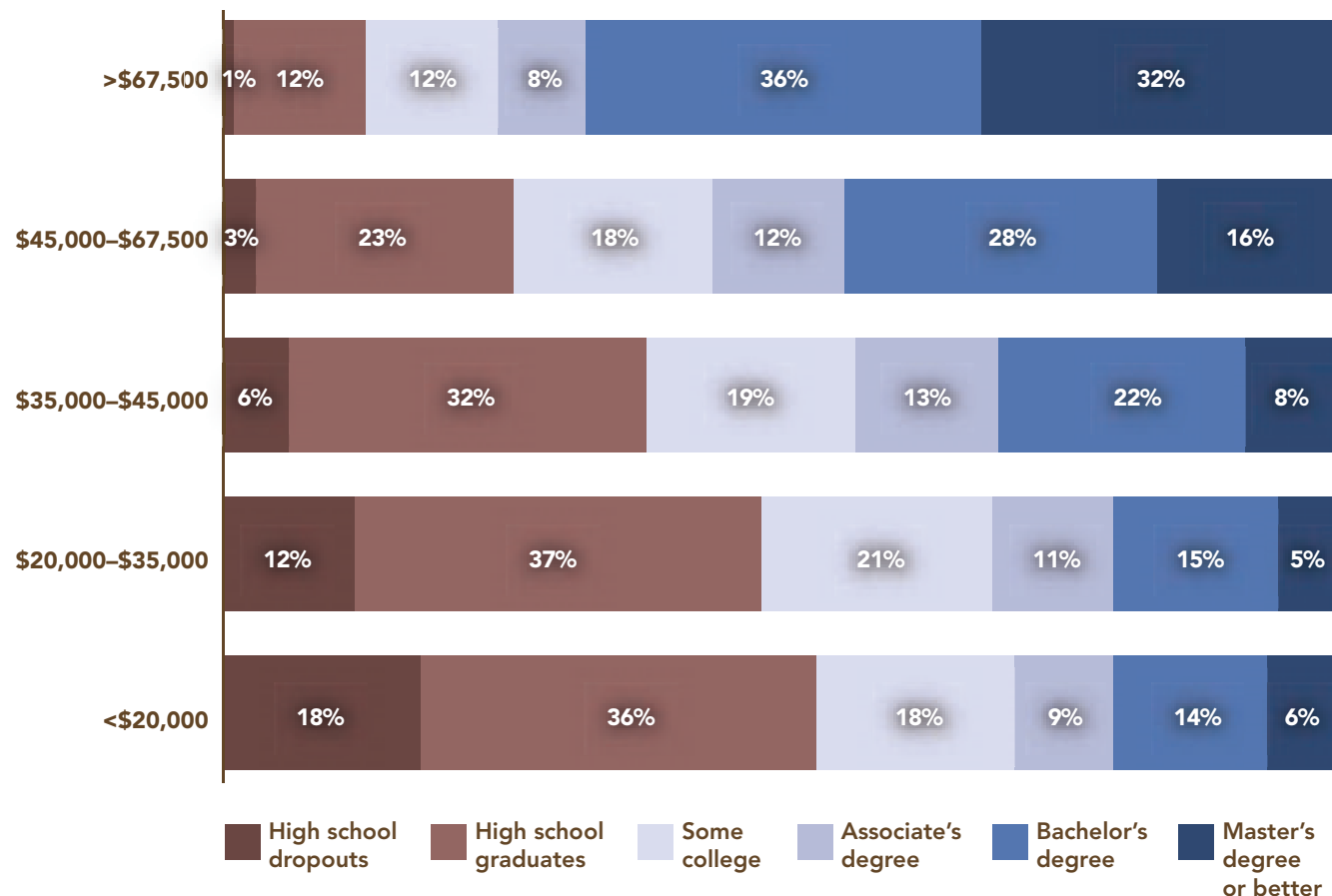


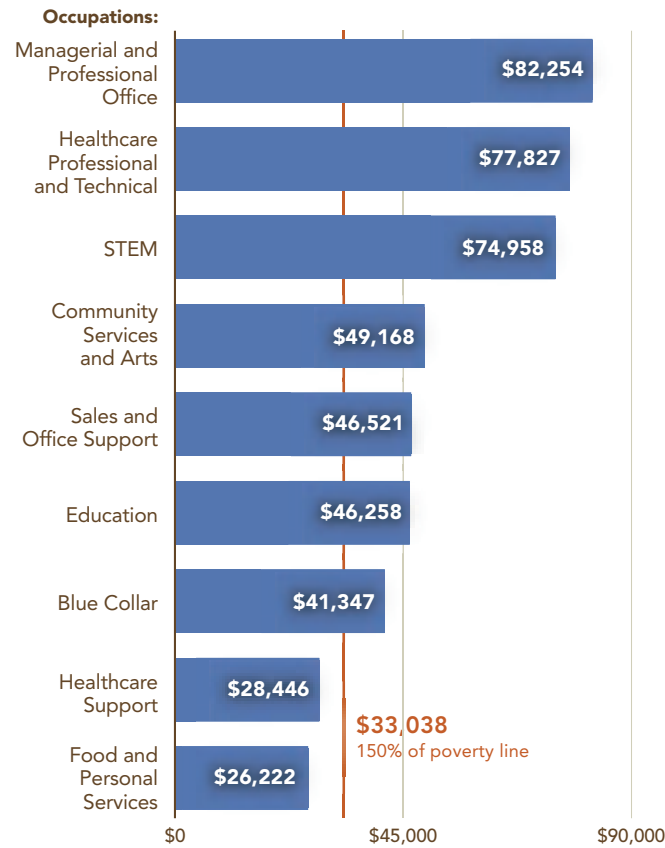


FIGURE 5.9

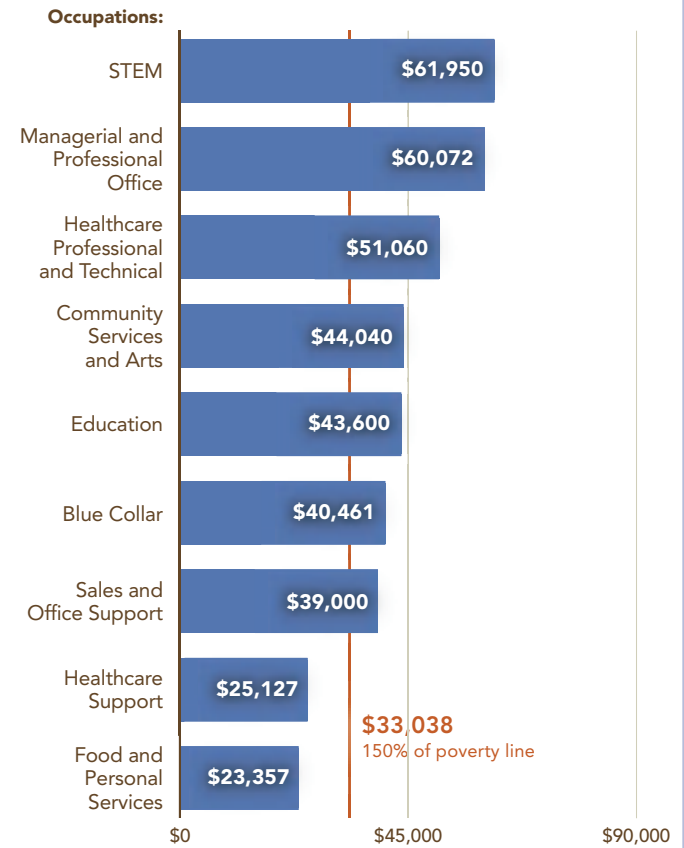
On average, Healthcare Support and Food and Personal Services jobs provide insufficient annual earnings to support a family of four at 150% of the poverty line.

Source: Authors' analysis of March CPS data, various years

Average wage by occupation  
(full-time, full-year workers; pooled data, 2005–2008)



Average real wage by occupation  
(full-time, full-year workers; pooled data, 1983–1985)



gauging one's location on the payroll totem pole, average wages conceal complex relationships between wages and degree choice or wages and occupational choice. In other words, while education level is highly associated with one's earnings, other factors are gaining importance, too: the type of degree one selects, the occupation one pursues within a particular industry; and a variety of personal traits also influence the average wages one can expect. In this section, we discuss average wage trends by occupation and education level.

Figure 5.9 shows average real earnings by broad occupational categories for two time periods: the mid-1980s and the late 2000s. Over time, the hierarchical distribution of earnings has changed. Managerial and Professional Office jobs have overtaken STEM jobs for the highest current real average earnings, and Healthcare Professional and Technical Occupations are now the second highest-paying category. The wage increase for Healthcare Professionals is more than \$26,000

per year over the time period, an impressive 52 percent increase. Managerial and Professional Office jobs have grown by more than \$22,000, while STEM jobs have grown by more than \$13,000 in real terms over the time period.

Blue Collar jobs had the lowest increase—less than \$1,000 in real earnings—followed by Education jobs and low-skill Food and Personal Services. Wages of Blue Collar workers have grown by a meager 2 percent, while those of Education workers grew by 6 percent. Wages for Healthcare Support and Food and Personal Services, meanwhile, have grown by 13 and 12 percent, respectively. Despite this increase, however, Healthcare Support and Food and Personal Services jobs still, on average, fail to earn employees at least 150 percent of the poverty threshold for a family of four.

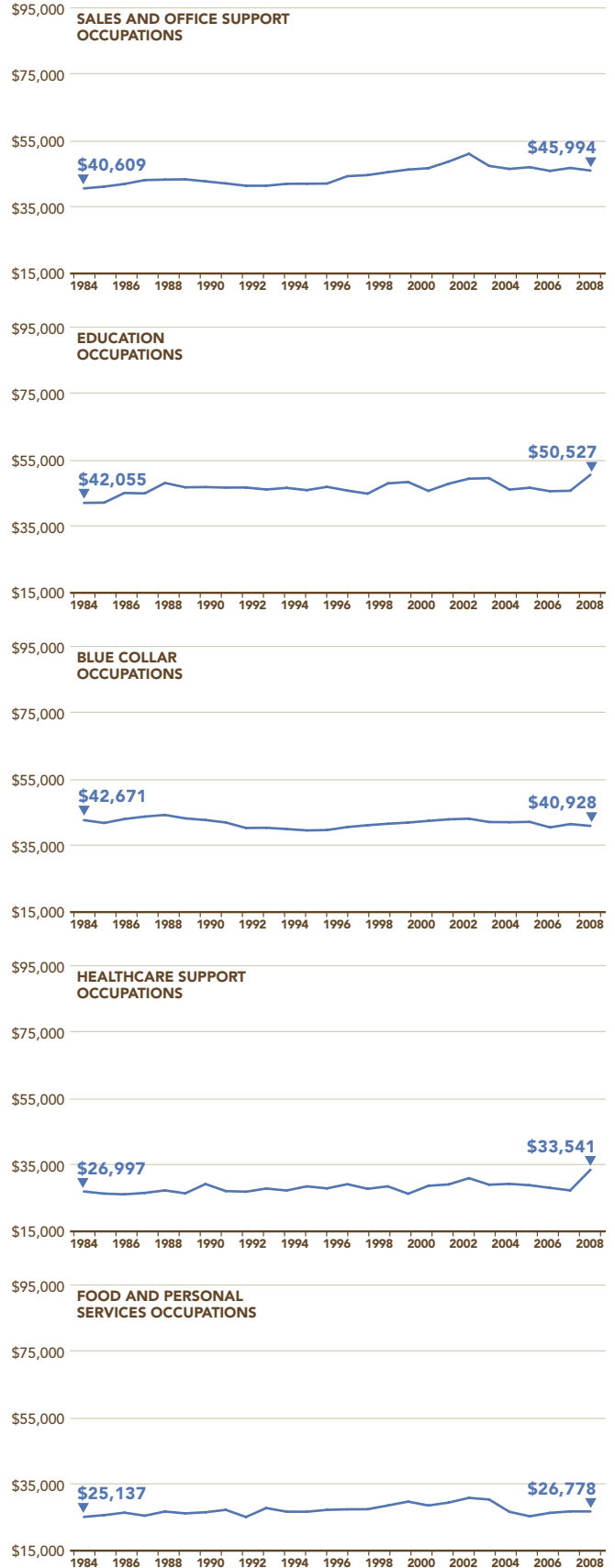
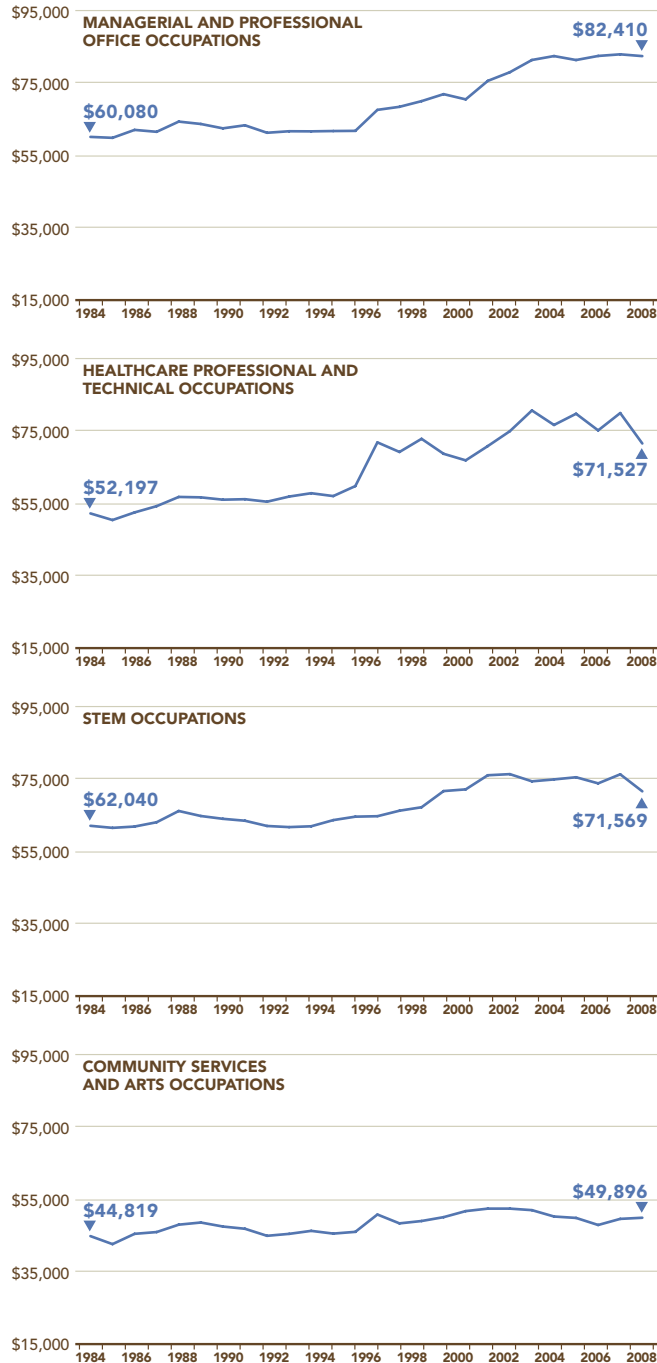
Figure 5.10 takes each of the broadly defined occupations and plots their average earnings across time. A flat graph across time for Blue Collar, Healthcare Support, and Food

**FIGURE 5.10**

**Average wage by occupation through time.**  
*(full-time, full-year workers)*

Growing occupations with higher levels of education also show growth in real wages over time.

Source: Authors' analysis of March CPS data, various years



and Personal Services jobs emphasizes the low-wage growth capacity of these occupations. Indeed, the fact that these occupations are in predominantly declining industries may contribute to this particular trend. Blue Collar Occupations, for example, are found in Manufacturing and Natural Resources industries, both of which are in decline.

In Figure 5.11, we show average wages for broad education levels in each of our nine occupational groupings for two

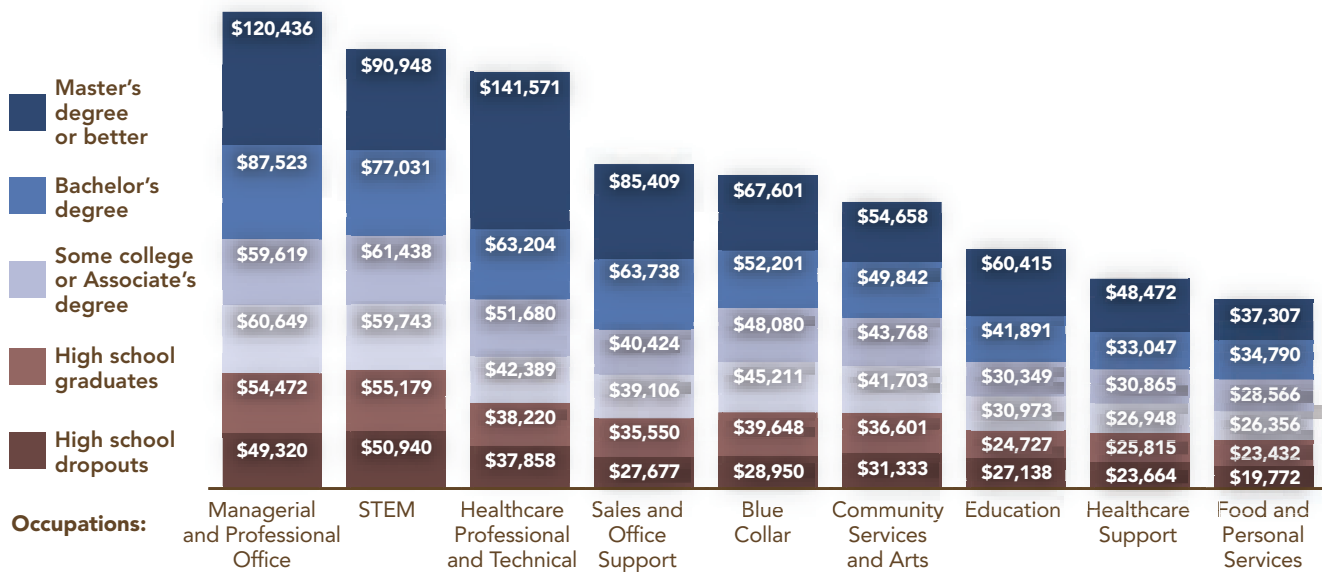
periods, the 1980s and the 2000s, to see whether there have been any substantial changes over time. The tallest bars are in jobs that pay well at every level of the educational food chain. For example, in 2005–2008, holders of a Bachelor’s degree or better working in Managerial and Professional Office Occupations earned, on average, at least \$87,000, while high school dropouts and graduates earned at least \$49,000—a figure far above the national mean and median wages at the time of \$35,000 and \$40,000, respectively. The best-paying

FIGURE 5.11

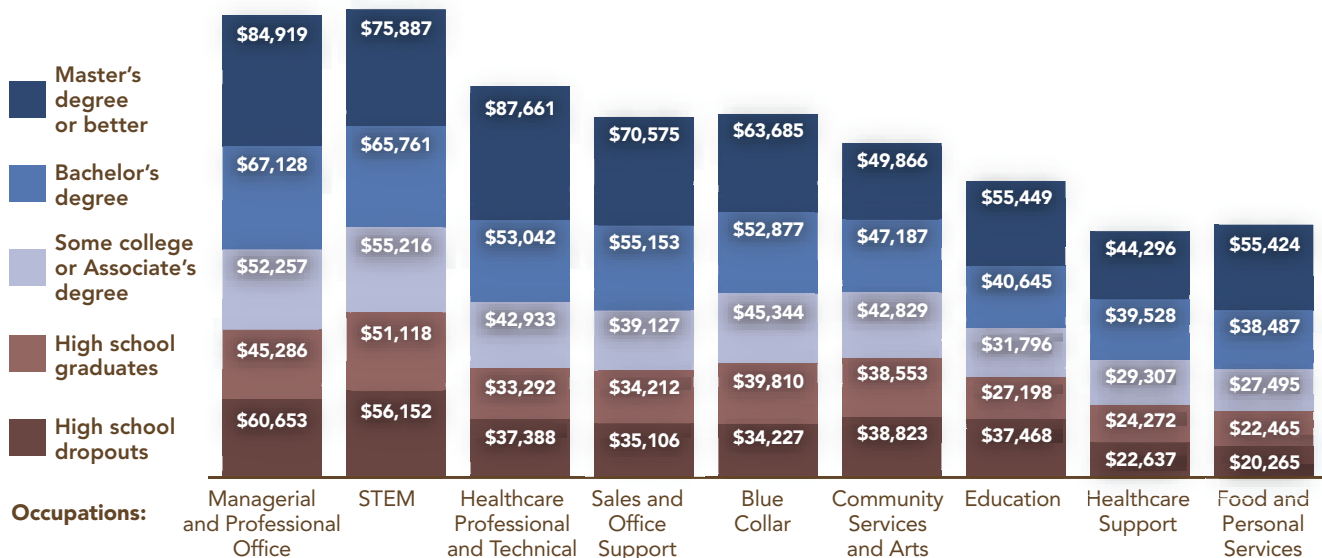
People with the same educational attainment levels can have different wages depending on their occupation. (in 2008 dollars)

Source: Authors’ analysis of March CPS data, various years

2005–2008 pooled data



1983–1986 pooled data



jobs at the top of the educational distribution overall are still doctors and nurses in the Healthcare Professional and Technical occupations, while managers and CEOs in Managerial and Professional Office jobs rank second for the size of their wage premiums. STEM jobs also pay well at every level of the educational distribution, a trend that remains consistent across time.

Although middle-skills jobs correlate with middle wages, the relationship is not absolute—there is also a distribution of earnings associated with education levels. If we define middle skills as some college or an Associate’s degree (knowing that the “some college” category includes postsecondary certificates, certifications, and college dropouts), then the best jobs for these workers are in Managerial and Professional Office, STEM, and Blue Collar Occupations.

While better education correlates to better pay across the board, this dynamic is especially significant in low-earning jobs. Workers with some college, for instance, receive a 13 percent bump in salary over high school graduates in Food and Personal Services occupations and a 10 percent increase in Healthcare Support occupations. Occupations that require the least amount of education for its workers still pay low wages, however—even at the top of that educational distribution. For example, college graduates earn only about \$33,000 in Healthcare Support and \$35,000 in Food and Personal Services occupations. Although there are benefits to more training in these occupational groupings, there are still wage ceilings that make it impossible to climb comfortably into the middle class. The average wages of the lowest-educated workers in Food and Personal Services actually declined in real terms over the time period.

Occupational choice also matters at the highest education levels. A graduate degree in Healthcare Professional, Managerial, and STEM Occupations gives workers a vastly superior wage premium than a comparable degree for workers in Food and Personal Services Occupations. Ultimately, occupation-specific human capital ties people to their occupations and can result in substantial wage premiums for specialized tasks. Occupational choice is highly correlated to earnings, regardless of educational attainment levels. High school dropouts in Managerial and Professional Office and STEM jobs, for instance, still earned twice as much as high school dropouts in Healthcare Support or Food and Personal Services jobs.

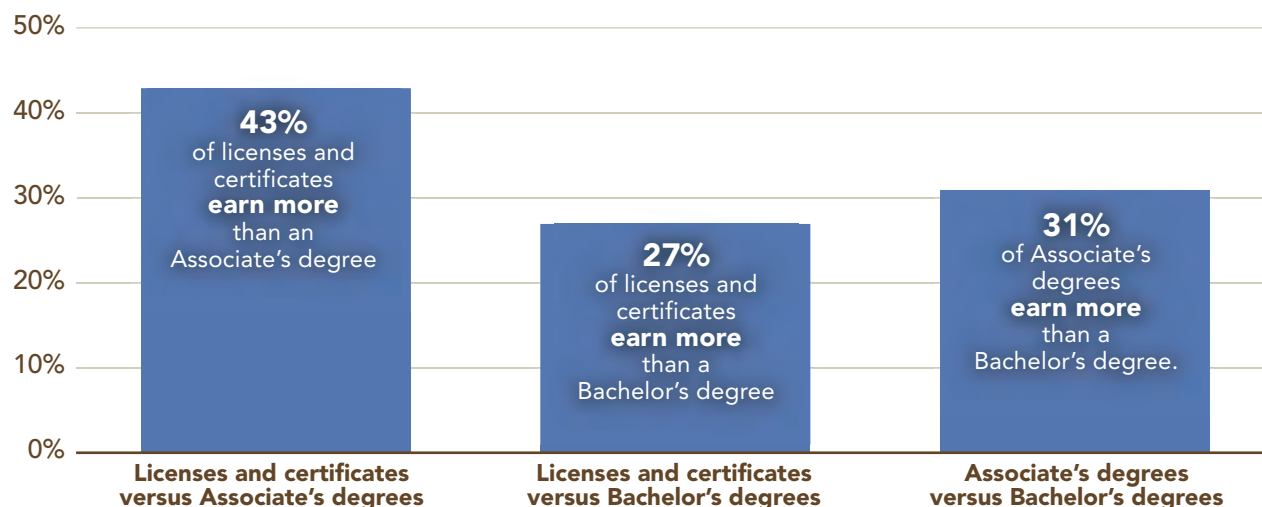
Further, workers with Bachelor’s degrees in Managerial and Professional Office or STEM Occupations earned more than employees with graduate degrees in Blue Collar, Community Services and Arts, Education, Healthcare Support, and Personal Services Occupations, on average. In general, there are greater rewards to higher education levels in the STEM, Managerial, and Healthcare Professional Occupations than there are in the Education, Healthcare Support, and Food and Personal Services Occupations.

Figure 5.12 demonstrates that, depending on industry and occupational choice, the link between education and higher wages can sometimes break down. For instance, 43 percent of workers with licenses and certificates earn more than their colleagues with an Associate’s degree. About 27 percent of workers with licenses and certificates earn more than employees with a Bachelor’s degree, and 31 percent of those with Associate’s degrees earn more than their counterparts with a Bachelor’s degree.

FIGURE 5.12

Earnings are not just a function of postsecondary attainment. Occupational choice also influences earnings potential.

Source: National Education Longitudinal Study 2000



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<sup>20</sup>Prime-age workers have most commonly left the education system and have had enough time in the labor market to be on a career track and are entering the prime of their earnings years, which makes this group the most appropriate for the study of the relationship between earnings and education.

<sup>21</sup>Essentially, relative demand and changes in relative demand is best understood viewed through this lens.

<sup>22</sup>This argument is fully developed in Goldin and Katz (2008).

<sup>23</sup>For privacy purposes, anyone today who earns an annual salary of \$200,000 and above is recorded as having earned the mean amount of persons with similar socioeconomic characteristics in the CPS public use file. This practice is called topcoding and amounts to a censoring of information on wage data for the small portion of people at this level of the earnings distribution. How we treat topcoded data is particularly important for relative earnings analysis between disparate groups of people. About 1–2 percent of Americans are topcoded in the CPS surveys: 83 percent are male, 45 years old on average, and predominantly White, while 73 percent have a Bachelor's degree and above. According to the Internal Revenue Service (IRS), the top 1 percent of earners in the nation made \$388,806 on average, and the top 10 percent made \$108,904 in 2006.

<sup>24</sup>The unemployment rate overall was 9.8 percent at the time of this writing.

<sup>25</sup>Enrollment by students under 23 years old and over 30 years old was 70 percent and 16 percent, respectively, in 2004. Source: U.S. Department of Education, National Center for Education Statistics, 2003–04 National Post-secondary Student Aid Study (NPSAS:04).

<sup>26</sup>We've updated the original Census data and limit our sample to prime-age, full-time, full-year workers (25–54). The Census Bureau's 2002 report on the average value of a college degree over one's lifetime estimates that high school graduates can expect to earn \$1.2 million; holders of Bachelor's degrees, \$2.1 million; and holders of Master's degrees, \$2.5 million. This implies that the average value of a four-year degree is increased earnings income of \$900,000 over a period of about 40 years.

<sup>27</sup>At the following interest rates, the NPV of \$1.6 million today, 40 years into the future, is \$1 million (1 percent), \$725,000 (2 percent) or \$490,000 (3 percent).

<sup>28</sup>Tuition and fees, \$9,000 per year; books, \$1,500 per year; trips and extra costs, \$1,500 per year. Rent and food are excluded from these calculations since these are costs that one would have incurred regardless of whether one was attending college or working.

<sup>29</sup>This is usually a difficult group of workers to connect human capital and earnings to, since the group contains some college dropouts as well as those with a recognizable degree.



# Summary and Conclusions

## Recession and economic change are reshaping the U.S. job and education landscapes.

The recession that began in December of 2007 is already 30 months old, but the U.S. economy will not recover its pre-recession employment levels for at least another two years. From there, it will take an additional three years to make up for lost growth and create a job market strong enough to employ both the casualties of the recession and the millions of new workers who will stream into the workforce from schools across the country.

In the preceding chapters we have looked at the current state of the economy, assessed the prospects for job creation through 2018, and detailed what employers will be looking for once hiring resumes.

Among other things, we found that:

- There is a growing mismatch between the jobs that will be created over the next decade and the education and training of our adult workers. More than 60 million of our prime-age workforce who are 25–54 years old are still working in jobs that require high school or less. That economy is receding fast and those workers will be left behind: unemployed, underemployed, or likely stuck in jobs that don't provide middle-class wages.
- The postsecondary education and training system will fall short by 3 million or more postsecondary degrees. Economic demand will not be met, denying numerous Americans access to middle-class career pathways.
- Hundreds of thousands of Manufacturing and Natural Resources jobs in farming, fishing, and forestry have been destroyed in the recession and will not be coming back. And we will lose another 1.4 million jobs in these industries over the next decade. The new jobs that replace them will look nothing like the old ones and will require employees with postsecondary skills and preparation.

- The U.S. economy will create 46.8 million job openings by 2018, including 13.8 newly created jobs and 33 million “replacement” positions produced when workers retire.
- Employers filling these jobs, overwhelmingly, will require college degrees or other postsecondary preparation of 63 percent of their new hires.
- Postsecondary education and training is quickly becoming the only viable path to the American middle class.
- Education and training connects directly to occupations and less directly to industries, which can complicate economic development efforts.

In the immediate future we likely will see months of “jobless recovery,” such as we experienced during the recessions of 1990 and 2001. That means economic output will grow but will not immediately generate job growth. Instead of hiring new workers, businesses will ask current employees to work longer hours to meet rising demand. Evidence suggests this is already happening. Gross Domestic Product grew by 3.5 percent in the third quarter and 5.7 percent in the fourth quarter of 2009—the fastest pace in six years—but job losses continued, averaging 260,000 and 110,000 respectively over that period.

By then, GDP growth will pick up more steam and the economy will finally start creating more jobs than it loses. That does not mean everything will be back to normal, however. Here's why: The recession eliminated 7.8 million jobs and also stymied job growth, which typically adds an additional 100,000 positions per month to the economy. Once growth resumes next year, it will take until 2015 for the economy's job creation engine to catch up to where it should have been.

## TECHNOLOGY FUELS A RESTRUCTURING ECONOMY.

For many, though, that will be a hollow accomplishment. Hundreds of thousands of low-skill jobs in manufacturing, farming, fishing, and forestry have been permanently destroyed because the recession has prompted employers to either automate those positions or ship them offshore to reduce labor costs.

They are casualties of more than just the recession, though, for such jobs have been steadily disappearing for years as part of a fundamental restructuring of the American economy. And the forces behind that restructuring have not been slowed by the recession—if anything, they have sped up.

Foremost among those forces: technology. In the 19th and 20th centuries, electricity and the internal combustion engine drove the rise of manufacturing and America's shift away from an agrarian economy. In the 21st century, computers and related inventions are transforming the U.S. economic landscape—boosting productivity so companies can produce more with less and spurring an economic shift from Manufacturing to Services. That is why, when old-line Manufacturing and Natural Resources jobs disappear, they often don't come back.

Their replacements tend to be very different kinds of jobs, requiring very different kinds of employees—and very different kinds of preparation. Just as the industrial revolution was critical to building a mass K–12 educational system to feed workers into the Manufacturing industries, the information revolution is spurring the development of a mass postsecondary system to fill the needs of sophisticated new industries, such as Computer Systems Design or Financial Services.

Integral to this trend is skill-biased technological change. This simply means that technological development and the organizational changes that come with it favor workers with more education, because they have the expertise needed to handle more intricate tasks. Demand for these workers, in turn, grows across the board as the technology spreads throughout the economy.

Education and training requirements change, too. Instead of looking for narrow, industry-specific skills in their new hires, employers instead tend to look for employees with advanced general education and skills. Once employed, then, the new workers receive more specialized on-the-job training.

## POSTSECONDARY EDUCATION AND TRAINING IS THE ROAD TO THE MIDDLE CLASS.

And so, the jobs report finds, the future of employment in the United States comes down to this: success will require postsecondary education, in one form or another. By 2018, our forecasts show the economy will create 46.8 million openings—13.8 million brand new jobs and 33 million replacement jobs, positions vacated by workers who have retired.

**Nearly two-thirds of these 46.8 million jobs—some 63 percent—will require workers with at least some college education.** About 34 percent will require a Bachelor's degree or better, while 30 percent will require at least some college or a two-year Associate's degree. Only 36 percent of total jobs will require workers with just a high school diploma or less, and those will be clustered toward the low end of the wage scale.

The implications of this shift represent a sea of change in American society. Essentially, postsecondary education or training has become the threshold requirement for access to middle-class status and earnings in good times and bad. It is no longer the preferred pathway to middle-class jobs—it is, increasingly, the only pathway.

Obtaining a good job—one capable of providing a family-sustaining wage—has become the ultimate standard for educational adequacy. The mass postsecondary educational system has arrived, leaving academics the debate over “college for all.” Experts might contest whether everyone needs some college education—but the labor market clearly has linked middle-class employability to postsecondary education and training.

The reasons are not hard to understand. College education is critical not only to the initial hire, but also to better wages and access to on-the-job training. There is a clear relationship between formal education level and annual earnings. Consider that, in 2008, high school dropouts earned an average of \$14,318 per year, according to Department of Labor statistics. High school graduates earned \$26,001; Bachelor's degree holders earned \$49,435; and advanced degree holders earned \$71,895.

That college graduates earn more than high school graduates or dropouts is an indication that they are in relatively greater demand in the labor force. Essentially, employers are paying a premium to hire workers with more education and have been for decades. Recently, some emphasis has been placed on a decline in the growth rate of real wages for holders of Bach-



elor's degrees and better since 2002. But the relative wage premium for workers with postsecondary degrees over those with high school educations or worse has essentially held steady—which means there are still overwhelming advantages for college degrees in the workplace.

Among them: access to further training. College graduates are almost twice as likely as high school graduates to receive formal training from their employers, which can increase employee wages by 3 to 11 percent.

## TODAY'S CAREER PATHWAYS ARE IN OCCUPATIONS, NOT WITHIN INDUSTRIES.

All of this leads to some dilemmas for federal, state, and local governments as they try to formulate economic development strategies. The emphasis on postsecondary preparation for new hires means that workers will tend to be attached more to the occupations they will be filling than to the specialized industries in which they work. The day when people left high school to go to work in the local industry and then worked their way up is disappearing. Starting out, straight from high school, on the loading dock or in the mail room and climbing to the CEO's corner office is no longer an option. People do not go work in industries any more. They get educated or trained, go to work in occupations, and progress in an occupational hierarchy. Some occupations are tied tightly to particular industries, Healthcare occupations for example, but more and more occupations are dispersed broadly across industries. And industries vary widely in how many jobs they create: old-line Manufacturing, clearly, is in decline. But even some new industries, such as Information Services, have only limited hiring potential because they are tech-heavy and can achieve high levels of productivity with relatively few workers. This means governments will need to be selective about how they approach industries and where they deploy scarce development resources.

In addition, education and training must be made available to individuals outside the usual college-age population to serve workers whose old-economy jobs have disappeared. To do otherwise risks leaving hundreds of thousands of workers behind as the economy recovers and builds for the future.

And that would be a dismal recovery, indeed.

Help Wanted: Projections of Jobs and Education Requirements Through 2018

*is comprised of an executive summary, a national report and a state-level analysis.*

*It provides comprehensive industrial and occupational forecasts of where jobs will be  
and what kinds of preparation they will demand of their workers.*

*The report is available online at <http://cew.georgetown.edu/>, or hard copies can be obtained  
by contacting the Center at [cewgeorgetown@georgetown.edu](mailto:cewgeorgetown@georgetown.edu).*

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