

# Research Report



## Mismatch in the Labor Market: Measuring the Supply of and Demand for Skilled Labor in New England

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Methodology, data appendix, and state tables available at the New England Public Policy Center's web site: <http://www.bos.frb.org/economic/neppc>

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# Mismatch in the Labor Market: Measuring the Supply of and Demand for Skilled Labor in New England

## Introduction

Over the past decade, policymakers and business leaders across New England have been concerned that the region's slower population growth and loss of residents to other parts of the country will lead to a shortage of skilled labor—particularly when the baby boom generation retires.<sup>1</sup> Prior to the Great Recession, the concern was that an inadequate supply of skilled workers would hamper future economic growth by creating barriers for companies looking to locate or expand in New England. More recently, the worry is that the lack of skilled workers will make it difficult to fill jobs that are in high demand as the economy recovers—many of which are likely to require postsecondary education and training—thereby slowing the region's recovery.<sup>2</sup> That means having not only a sufficient *number* of skilled workers but also a workforce with the right *mixture of skills* to meet the diverse needs of the region's economy.

The concern over having a sufficient *number* of skilled workers reflects the apprehension that when workers are in short supply, the rate at which employment can grow is constrained. For employers, slower employment growth means tighter labor markets that may require firms to find innovative ways to increase labor productivity. For policymakers, it means fewer new jobs being added to the New England economy, raising concerns about the types of jobs that will be created and the possibility of lost opportunities for the region's workers.

Given current labor market conditions, it seems hard to imagine that New England could possibly lack a sufficient number of skilled workers in the not-so-distant future. Census projections for 2010 show that the number of individuals aged 15 to 24 years who are slated to enter the labor force in the coming decade

will be 10 percent greater than the number of individuals aged 55 to 64 years who are likely to leave the labor force as they retire. Yet by 2020, that situation will be reversed, as the population entering the labor force will be 15 percent smaller than the population retiring. Moreover, while it is true that this gap is likely to occur in several other U.S. regions, New England is projected to have the largest potential shortfall while some regions will continue to experience a surplus of workers.<sup>3</sup>

Perhaps even more crucial than the potential shortfall in the overall number of workers in New England is whether the region's workforce will have the right mix of skills for the jobs that are likely to be generated in the region. Indeed, a potential mismatch between the level of skill among the population and that which will be demanded by employers over the next two decades may already be under way. The structure of the U.S. economy has changed dramatically over the past few decades, leading to an increase in the demand for more highly educated workers. The reduced role of the manufacturing sector, the increased importance of the professional service and knowledge sectors, advancements in technology, and the spread of globalization are evidence that the ways in which we “do work” have fundamentally changed.<sup>4</sup> As a result, employers are demanding that workers obtain more formal education and training—often requiring some type of postsecondary degree or certificate—in addition to greater technical proficiency and interpersonal skills than in the past.

Recent labor market indicators suggest a potential mismatch already exists between the skills of those looking for work and the needs of employers looking to fill vacant jobs. Typically, as the economy expands, the unemployment rate falls and

the job vacancy rate rises—that is what happened in the years immediately following the 2001 recession.<sup>5</sup> However, between 2004 and 2006, as the economy continued to expand and New England employers were reporting more vacant positions, the unemployment rate hardly budged.<sup>6</sup> The fact that a large number of unemployed workers were actively seeking employment while surveys of employers were indicating that firms had an increasing number of jobs to fill suggests that there may be a potential mismatch between the skills of those looking for work and the needs of employers.

While New England boasts one of the most educated populations in the United States, significant demographic changes suggest that the supply of skilled workers may not keep pace with demand in the future. The retirement of the baby boomers—a well-educated group—will result in large numbers of college-educated workers leaving the labor force—particularly in New England, which has a relatively high share of workers aged 55 to 64 years. In addition, the population of native recent college graduates who are needed to replace those retiring has been growing more slowly in New England than in other parts of the nation.<sup>7</sup> Finally, although immigrants are an increasing source of population and workforce growth in the region, these individuals often lack the formal education and English language skills that employers require. As a result, there is likely to be a potential mismatch between the level of education and skill among the population and that which will be demanded by employers in the coming decades.<sup>8</sup>

However, it is unclear how large this potential labor mismatch might be and whether this issue is unique to New England or is pervasive across the nation. This report provides a framework for analyzing the potential mismatch between the supply of and demand for skilled labor in the region over the next two decades. The goal is to help policymakers and business leaders understand the magnitude of the problem as well as the efficacy of alternative approaches aimed at

addressing the skills gap, including the types of skills in which future investments in education and training may be warranted. Specifically, our research explores several key questions:

- **How has the *skill mix* of New England's workforce compared to demand in the past?** Has the supply of workers at various skill levels kept pace with demand over the past several decades? Can changes in the demand for skilled workers be traced to shifts in employment toward more knowledge-based industries or is it more pervasive throughout the economy? Do chronic or persistent vacancies exist in certain occupations that typically employ skilled labor? Is this situation unique to New England or does it affect other parts of the nation?
- **What are the unique labor supply constraints that New England will face in the future?** How will the educational attainment of future labor force participants change over time as new cohorts enter the labor force and older ones retire? How will the skill levels of the labor force compare to those that are typically found in sectors of the economy that are expected to grow?
- **What role can *public policy* play in addressing the potential gaps in New England's labor force?** What are the implications of a long-term skills mismatch for the region? To what degree might we expect the labor market to adjust in response to a potential mismatch? What policies might be useful in creating a better match between workers and the sectors of the economy where we expect the greatest job growth?

This report seeks to answer these questions by taking a more detailed approach than previous studies, exploring changes in the balance between labor supply and labor demand at multiple skill levels across the New England region and the nation. Drawing on a wide range of data, we examine both historical trends as well as future projections in the supply of and demand for skilled labor. This approach eliminates the effects of the Great

Recession, which involves greater labor market slack than is the case at other points in the business cycle. Assessing whether there is a shortage of skilled labor near the peak of the business cycle, rather than during the recession, provides a better indication of the number of skilled workers that will be needed in the future as the economy recovers.

The evidence presented here indicates that although New England currently has many more workers seeking employment than there are job opportunities, in the long run the supply of skilled workers is not likely to keep pace with demand over the next two decades. Moreover, although these underlying trends are not unique to the region, New England will likely face even greater challenges in maintaining an adequate supply of skilled workers compared to the nation—particularly those required to fill “middle-skill” jobs that require some postsecondary education but less than a bachelor’s degree.

**Our main findings suggest that:**

- Since 1990, the region’s population of working-age adults with any postsecondary education and training has been growing more slowly than that in the rest of the United States due to a combination of slower population growth and greater net domestic out-migration.
- Yet high and rising rates of educational attainment have helped New England increase the percentage of its population with postsecondary training. However, while the region has led the nation in terms of increasing the “high-skill” share of its population (individuals with a bachelor’s degree or higher), it has consistently performed below average in terms of increasing the share of “middle-skill” workers (individuals with some college or an associate’s degree).
- New England employers are willing to pay a premium for workers with any postsecondary education despite there being more of them. Moreover, this premium has been growing over time, indicating that the demand for such workers has continued to outpace their supply. While this situation

is not unique to the region, New England differs from the nation in one important regard: The imbalance between the supply and demand for labor is greatest among “middle-skill” workers—those with some college or an associate’s degree.

- Most of the increased demand for college-educated workers in both New England and the nation comes from greater employment of college-educated workers within industries and occupations, indicating that this trend is not just isolated to a few key sectors of the economy but rather is fairly widespread. Although these trends are not unique to New England, job vacancy rates indicate that the region’s supply of skilled labor may be constrained relative to that of the nation in key sectors of the economy such as management, business and financial operations, computer and mathematical sciences, and healthcare.
- Looking forward, our labor supply projections suggest that New England’s labor force will likely shrink over time while that of the nation is likely to grow. More importantly, shifts in the composition of the population will constrain the educational attainment of future workers in both the region and the nation.
- Our projections of future demand indicate that the supply of skilled workers—particularly those in the middle of the labor market—will not grow fast enough to keep pace with demand once the economy recovers. Simulations of market adjustments such as increased educational attainment, greater in-migration of college-educated workers, and higher labor force participation among older workers do little to change this picture. That said, it is crucial to note that the future path of employment will be determined not only by the demands of employers and the skills of existing workers but also by future adaptations that we cannot anticipate.

Left unchecked, these labor supply constraints may give rise to a mismatch in the region’s labor market in the short run with the potential to limit economic opportunity

and exacerbate income inequality in the longer term. Our demand projections reflect an ongoing trend that was under way before the recession occurred, in which technological change and trade increased the demand for more educated workers. Similarly, our supply projections stem from demographic trends that will continue into the next decade and beyond.

Although any potential mismatch is likely to be alleviated to some degree by a variety of market responses, we argue that there is still a role for public policy. Greater demand for skilled workers will likely result in higher wages that may boost the migration of such workers into the region, increase the incentive for workers to acquire additional education, and alter the location decisions of firms. Yet the magnitude and nature of the mismatch suggest that these market responses may not be enough to fill the gap—particularly in the middle part of the skill distribution. Middle-skill workers often have fewer resources than high-skill workers, constraining their ability to migrate to regions with greater job opportunities or to invest in skill acquisition in response to higher wages. In addition, the type of training required by many middle-skill occupations is more job specific than general in nature, suggesting the need for a more comprehensive and strategic approach to educating these workers than might otherwise occur in the absence of any policy intervention.

The report concludes with a discussion of several policy solutions aimed at addressing the potential skills gap in the region's workforce. Although the replacement of jobs lost during the most recent recession is of the highest priority, in the longer term the key issue will be whether workers have the right mix of skills to fill the jobs being generated by the New England economy. This suggests that our focus should be on providing workers with the skills they need to qualify for occupations that are likely to be in high demand in the future. Despite the labor market's sluggish recovery, we would argue that now is an excellent time to rethink how best to invest in our education and training programs. Keeping

a long-term perspective on the potential consequences of a labor mismatch will be crucial in determining the future welfare of the region and how its citizens will share in it.

## Measuring the imbalance between supply and demand

There are several ways to characterize an imbalance between labor supply and demand, each giving rise to its own definition. In this report, we will use the term “shortage” to refer to a situation where we do not have a sufficient *number* of workers. We will use the term “mismatch” to refer to a situation where we do not have a sufficient number of workers with a *specific set of skills*. In this section we will describe these concepts further and how we plan to measure them.

## Theoretical framework

In the popular press, the terms “shortage” and “mismatch” are often used to describe situations that reflect tight labor market conditions but not actual shortages or mismatches. For example, when labor is plentiful, employers become accustomed to hiring a particular caliber of candidates with specific training or levels of experience. However, when the labor market tightens, the number of job applicants is likely to shrink and employers may have difficulty finding the same caliber of candidates. From the employers' perspective, a shortage or mismatch of workers exists. From the economists' perspective, the existence of a shortage is questionable because the job could be filled by another qualified, if not ideal, worker.

Indeed, there is no universally agreed upon definition of “labor shortage” or “labor mismatch”—even among economists. The most widely used definition identifies such imbalances in a dynamic sense as occurring “when the number of workers available (the supply) increases less rapidly than the number demanded at the salaries paid in the recent past.”<sup>9</sup> Even using this broad definition, economists will argue that most labor imbalances are temporary in nature, as markets will adjust—albeit perhaps slowly—to alleviate the gap. For example, when the demand for

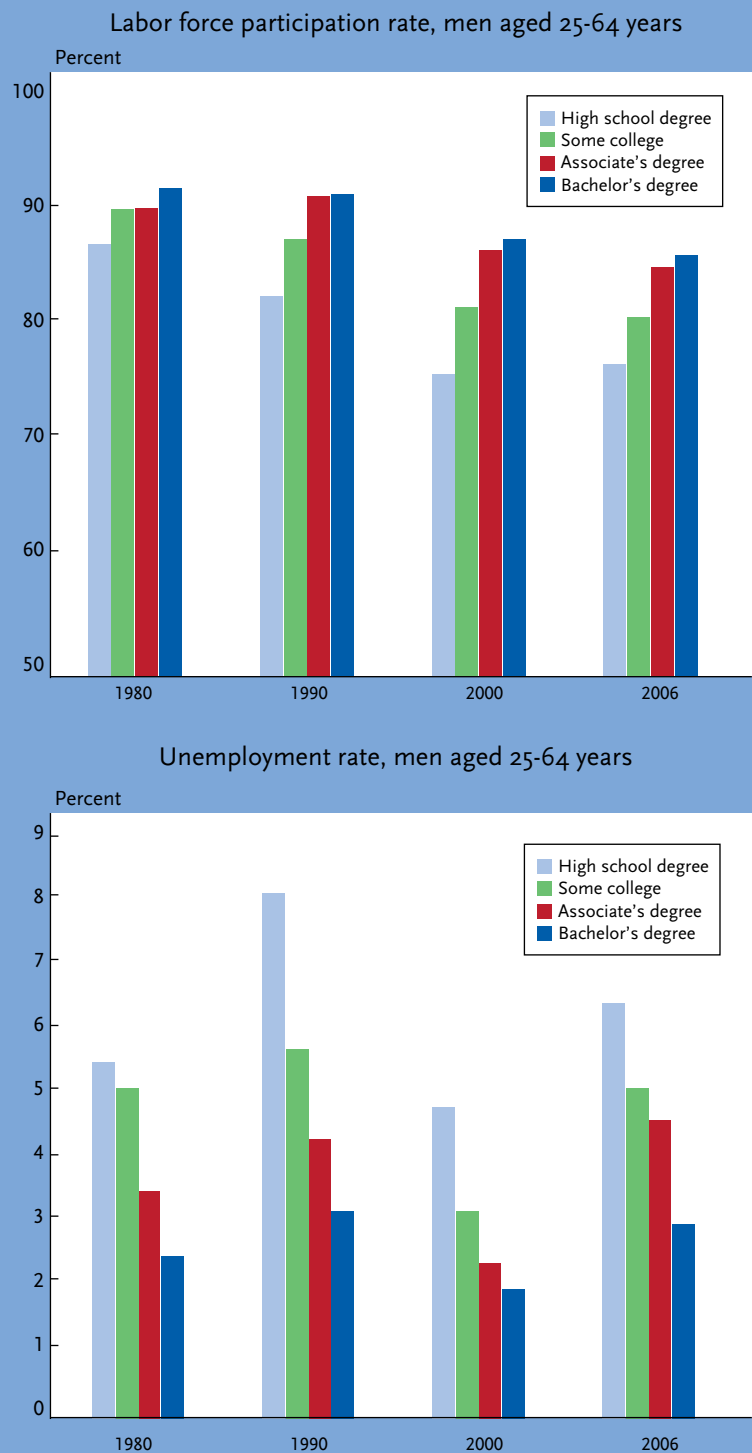


skilled labor exceeds supply, the economy will adjust as the wages of skilled workers increase relative to those of unskilled workers. In the short run, rising wages will encourage greater labor market participation and in-migration on the part of skilled workers to help alleviate the shortage. In the long run, higher returns to skilled labor will encourage individuals to obtain more education and training and create incentives for firms to find innovative ways to increase labor productivity.

However, under some conditions, an imbalance between labor supply and demand may persist for long periods of time. How might this occur? These include situations where demand continually grows more rapidly than supply.<sup>10</sup> For example, technological advancements such as the widespread use of computers have been shown simultaneously to increase the demand for educated workers while replacing those who are less skilled through automation.<sup>11</sup> Globalization has also led to increased demand for goods and services provided by skilled workers in the United States while displacing less-educated workers in production jobs through outsourcing to other countries.<sup>12</sup> Conversely, supply-side constraints such as lengthy training requirements, licensing laws, or demographic shifts (e.g., slower population growth) may restrict the supply of skilled labor for long periods of time in key occupations such as nursing.<sup>13</sup>

In such periods, one would expect to see skilled workers faring better in the labor market than those with less education and training. For example, in 1980, the labor force participation rate of individuals with differing levels of education were fairly equivalent—decades later, sizable gaps have emerged (see Figure 1). As of 2006, roughly 75 percent of adult males in New England with only a high school degree were actively in the labor force compared with 84 percent of those with an associate’s degree and 85 percent of those with a bachelor’s degree. In that same year, the unemployment rate of those with a high school degree was 6.4 percent—significantly higher than those with a college degree. This divergence in the labor market outcomes of

**Figure 1. Since 1980, individuals with any postsecondary education have increasingly fared better in the labor market than those with only a high school degree.**



Source: Author's calculations based on the 1980, 1990, and 2000 decennial Census and the 2005 and 2006 American Community Surveys (combined).  
 Note: The labor force participation rate is the percentage of individuals looking for work or employed in the labor market. The unemployment rate is the percentage of labor force participants who are looking for work.

workers with varying education levels over the past several decades suggests that there may be a persistent imbalance between the supply and demand for skilled labor.

More recently, the delicate balance between the supply and demand for skilled labor has been characterized as a race between education and technology.<sup>14</sup> Over the past century, technological progress has been a steady force for not only increasing average living standards, but also for increasing the demand for skilled workers. In the early part of the 20th century, this skill-based technological change was outpaced by advances in educational attainment as more and more workers earned high school and college degrees—first with the high school movement at the turn of the century and later with the introduction of the G.I. Bill after World War II. However, in recent decades the pace of educational attainment has slowed while technological advances have continued to increase the demand for skilled labor, resulting in increasingly higher wages for skilled workers.

Indeed, it is difficult to tell where we are in terms of this dynamic process given that the forces of supply and demand are in constant motion. Our analysis will focus on an examination of the regional labor economy in terms of a partial equilibrium model, relative to conditions at the national level. Specifically, we will determine whether the shifting equilibrium between labor supply and labor demand produces labor market gaps by skill levels that are larger in New England compared with the nation. We will also examine whether the nature of any such skills gap differs for the region versus the nation by exploring critical job vacancies for detailed occupations. The idea is to highlight areas where the region may face greater labor supply constraints than the nation and where policies at the state or regional level could be most effective in alleviating any potential mismatch.

### **Labor market measures**

It is inherently difficult to measure the imbalance between labor supply and demand as both forces are changing over time and the movement of one affects the movement of the other.<sup>15</sup>

In Section I we track multiple measures of labor

market conditions over time for New England in comparison to the nation to determine whether there are any constraints that are unique to the region. Taken together, these observable trends in educational attainment, earnings differentials, employment, and job vacancies can be used to paint a portrait of relative labor market conditions and highlight areas where greater imbalance exists within the region.

In Section II we measure changes in the supply of skilled workers—defined here as individuals with any postsecondary education—that have occurred in the region over the past several decades. This increase is then compared with recent trends in the demand for these college-educated workers, as indicated by changes in their wages relative to those with only a high school degree. Trends in the share of college-educated workers employed by industry and occupation are then used to indicate whether demand for skilled workers has been isolated to a few key sectors of the economy or has been more widespread. Finally, job vacancy measures are used to indicate which detailed occupations experienced the tightest labor market conditions as of 2006—the most recent “peak” of the business cycle—and whether these conditions have persisted through 2009.

Looking forward in Section III, we make some basic calculations to indicate the size and scope of any potential future imbalance in the New England labor market, recognizing that the market will likely make adjustments to alleviate any shortfall. Specifically, we project the size and educational attainment of New England’s labor force over the coming two decades as new cohorts enter the labor force and older ones retire. We compare these supply simulations to projections of labor demand for the region based on employment growth forecasts made by the U.S. Bureau of Labor Statistics through 2018 and the distribution of educational attainment as of 2009—calculated for each detailed occupation and then aggregated to the economy-wide level.

Although our projections of future labor supply and demand may be an indication of where future investments in human capital may be warranted, it is crucial to note that



the future path of employment will be determined not only by the demands of employers and the skills of existing workers but also by future adaptations that we cannot anticipate. As such, our forecasts of future labor demand will be used only to place bounds on the problem and provide a context for our labor supply forecasts rather than to pinpoint the exact number of workers that will be demanded in the future.

### **How has the skill mix of New England's workforce compared to demand in the past?**

Over the past several decades, New England's working-age population has been growing more slowly than the nation. In the sections that follow, it is apparent that despite the region's slower population growth, the share of working-age adults with any postsecondary education has increased. Yet while the region has led the nation in terms of increasing the "high-skill" share of its population (individuals with a bachelor's degree or higher), it has consistently performed below average in terms of increasing the share of "middle-skill" workers (individuals with some college or an associate's degree).

Over the same period, the evidence presented in the following sections shows that the wages of these college-educated workers in the region grew substantially while those of less-educated workers were relatively stagnant. Thus, New England employers are willing to pay a premium for skilled workers despite there being a relatively larger pool of them. Moreover, this premium has been growing over time, indicating that the demand for such workers has outpaced their supply. This situation is not unique to the region, as evidenced by the increase in the supply of skilled labor in all parts of the United States and the large wage premiums experienced by these workers across the nation. However, New England differs from the nation in one important regard: The imbalance between the supply and demand for labor is greatest among "middle-skill" workers—those with some college or an associate's degree.

In addition, a careful analysis of these trends reveals that most of the increased

demand for college-educated workers in both New England and the nation comes from greater employment of college-educated workers within industries and occupations. These findings suggest that the demand for college-educated workers is not just isolated to a few key sectors of the economy but rather is fairly widespread. However, job vacancy rates by detailed occupations indicate that the region's supply of skilled labor may be constrained relative to that of the nation in key sectors of the economy such as management, business and financial operations, computer and mathematical sciences, and healthcare.

### **The supply of skilled labor: Swimming against the tide of slower population growth**

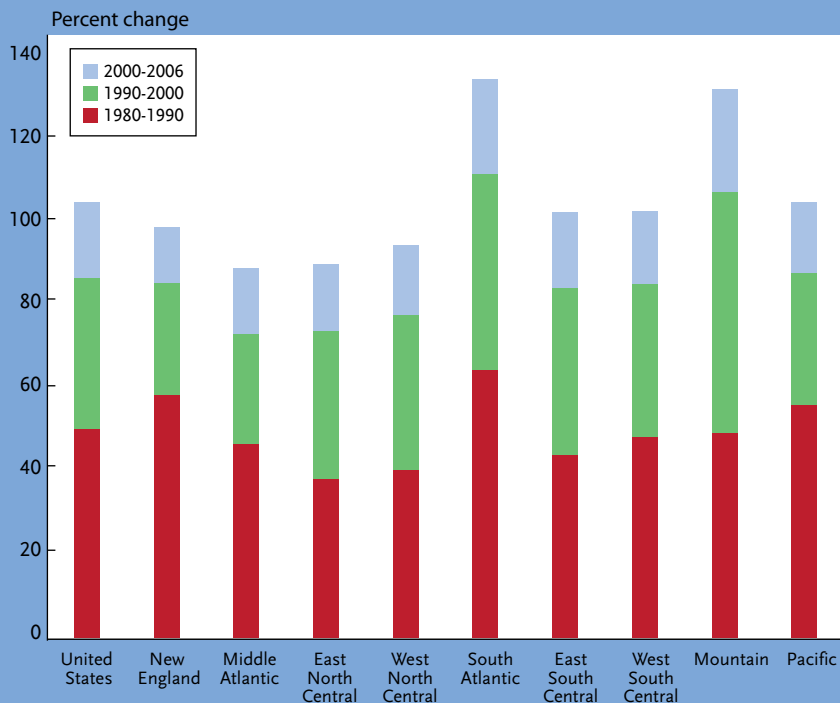
The reason why policymakers and business leaders are so concerned about there being a sufficient *number* of skilled workers in New England is because the region's population of working-age adults with postsecondary education and training has been growing more slowly than that in the rest of the United States. Since 1990, the number of individuals aged 25 to 64 years in the region with any postsecondary education has risen by only 28.7 percent compared with 43.1 percent nationwide, and has been growing more slowly with each passing decade. Moreover, while the rate of growth has slowed across the country, the slowdown has been greater for New England than most other regions (see Figure 2, next page).

The slowdown in the number of college-educated workers also differs by the level of skill. Whereas New England's population of "high-skill" individuals (those with a bachelor's degree or higher) grew at a rate that exceeded the nation during the 1980s, the region's growth rate has slowed in subsequent decades (see Figure 2).<sup>16</sup> Among "middle-skill" individuals (those with some college or an associate's degree), New England's growth rate has consistently been below that of the nation and since 2000 the region has even experienced a small decrease in this population.

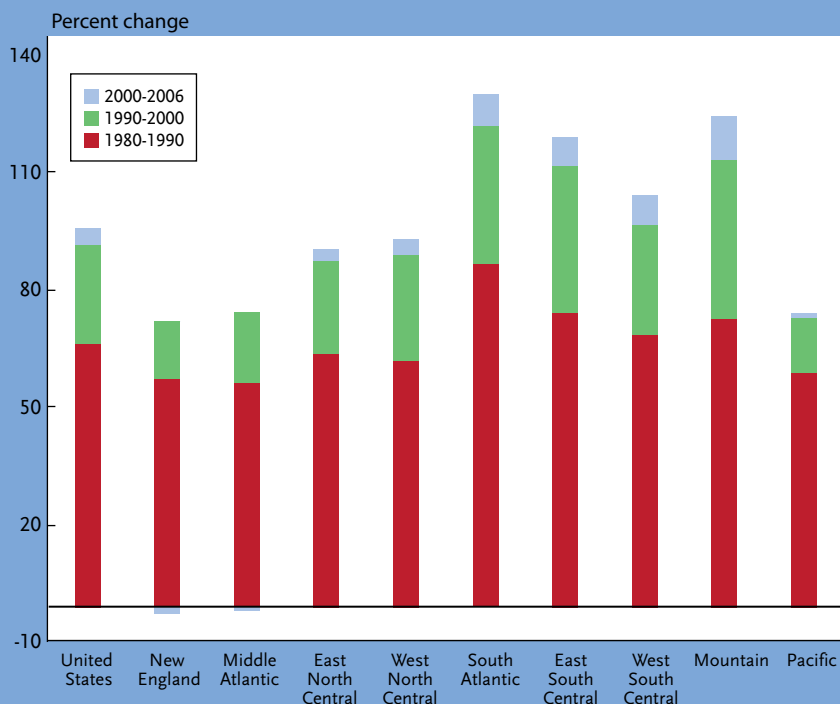
The supply of skilled workers in New England has primarily been constrained by the region's slower population growth over the past several decades. The number of native

**Figure 2. Since 1990, the number of working-age adults in New England with any postsecondary education has been growing more slowly than in most other regions of the country.**

Individuals aged 25-64 years with a Bachelor's degree or higher



Individuals aged 25-64 years with some college or an Associate's degree



Source: Author's calculations based on the 1980, 1990, and 2000 decennial Census and the 2005-07 combined American Community Survey.

Note: Educational attainment in 1980 is defined by number of years of completed education and is not strictly comparable to that in 1990 and later years, which are based on degrees completed.

young adults fell sharply in New England during the 1980s, and has been growing more slowly than the nation since then. This trend primarily reflects a period of low birthrates: During the 1970s, after the baby boom, birthrates fell across the country, but more so in New England. The result is that, some twenty years later, New England had roughly 25 percent fewer native young adults of college age during the 1990s compared with the prior decade (see Figure 3). Since then, the number of young adults of college-going age in the region has grown at a slower rate than in other parts of the country. Moreover, despite a growing number of students coming to the region to attend college from elsewhere in the United States and abroad, the increases from these two groups were just a drop in the bucket compared with the sharp drop in the number of native young adults. Essentially, the region has not been producing enough of the basic input—young adults—to put through the education pipeline.

Migration has also played a role, being both a help and a hindrance to New England. On the one hand, New England attracts a relatively high share of college students from outside the region, with more students arriving to attend college than those leaving to attend college elsewhere. That makes it one of the largest importers of college students in the country. On the other hand, non-native students have a greater propensity to leave the region upon graduation—often to return home to take a job or be closer to family. As such, New England retains a lower share of non-native students compared with other regions. Yet even though the region holds onto only a fraction of those incoming students after they graduate, it still comes out ahead—increasing its stock of college graduates by more than it would have if it had educated only its native population.<sup>17</sup> Overall, migration of college students has been a help to the region, adding to the number of *new* college graduates each year.

Yet, migration of *existing* college graduates typically shows net out-migration—meaning that more individuals appear to be leaving than entering the region. During 2006,

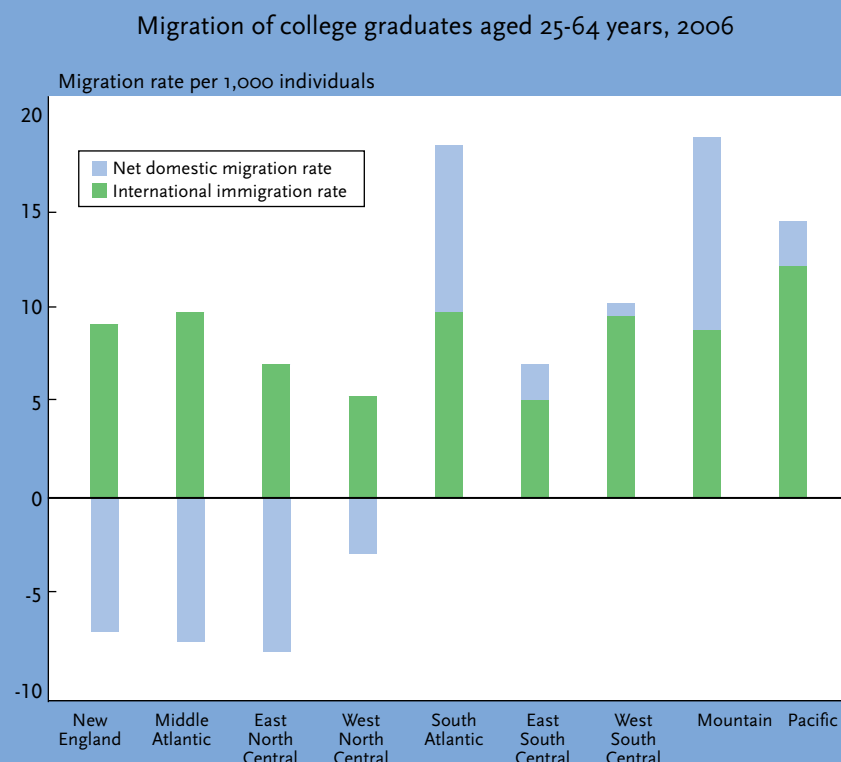
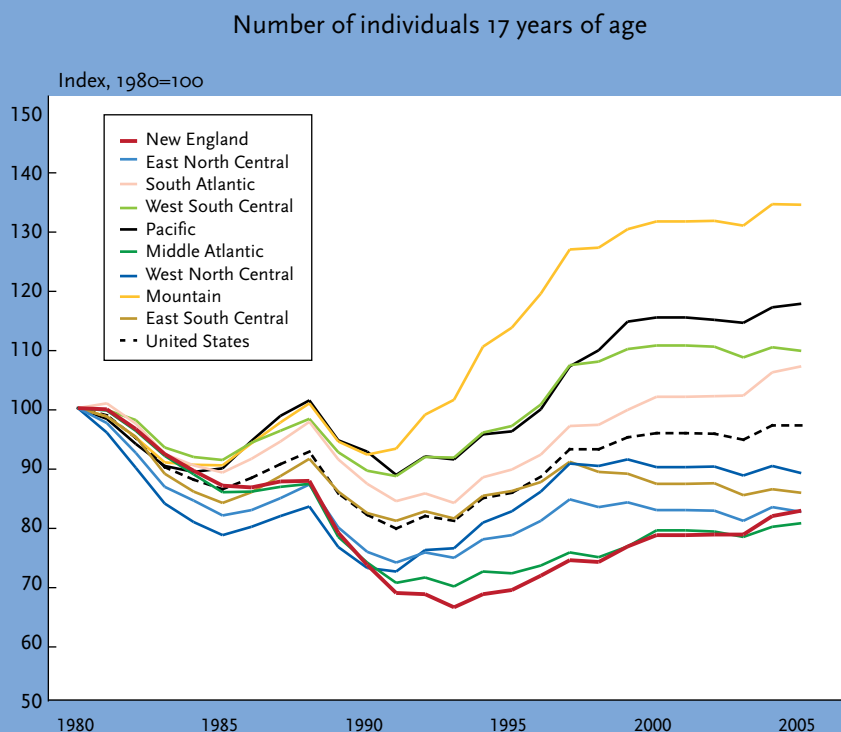
roughly 92,000 college graduates between the ages of 25 and 64 years migrated into New England while approximately 115,000 left, producing a net loss of 23,000 individuals. Compared with the number of working-age college graduates in the region, this means that approximately 6.7 individuals left for every 1,000 residing in the region (see Figure 3). Although this outflow of college graduates is offset to some extent by international immigration, when both domestic and international migrants are combined, most regions attract a higher share of college graduates compared to New England.

How has the distribution of educational attainment in New England—or the region’s *mix of skills*—changed over the past several decades? Despite the region’s slower population growth and greater out-migration, high and rising rates of educational attainment have helped New England increase the fraction of its population with postsecondary training. Between 1980 and 2006, the region’s adult working-age population (individuals aged 25–64 years) grew by 31.4 percent from 5.9 to 6.9 million. Over the same period, the number of working-age adults with a bachelor’s degree or higher more than doubled from 1.3 million in 1980 to 2.9 million in 2006. As a result, the share of the population with a bachelor’s degree grew from 21.7 percent to 36.7 percent between 1980 and 2006—a rate far faster than the rest of the United States (see Figure 4, next page).<sup>18</sup>

Yet this increase in educational attainment was not spread evenly throughout the distribution. Whereas the share of “high-skill” individuals increased more rapidly in New England than in the nation, the share of “middle-skill” individuals has not grown as rapidly and lags behind that of most other regions. Between 1980 and 2006, the share of individuals with some college or an associate’s degree increased from 19.0 percent to 25.8 percent—falling behind the national trend over the past two decades (see Figure 4).

While some might argue that New England has been successful in moving individuals from the middle into the top of the skill distribution, the question remains why the region has

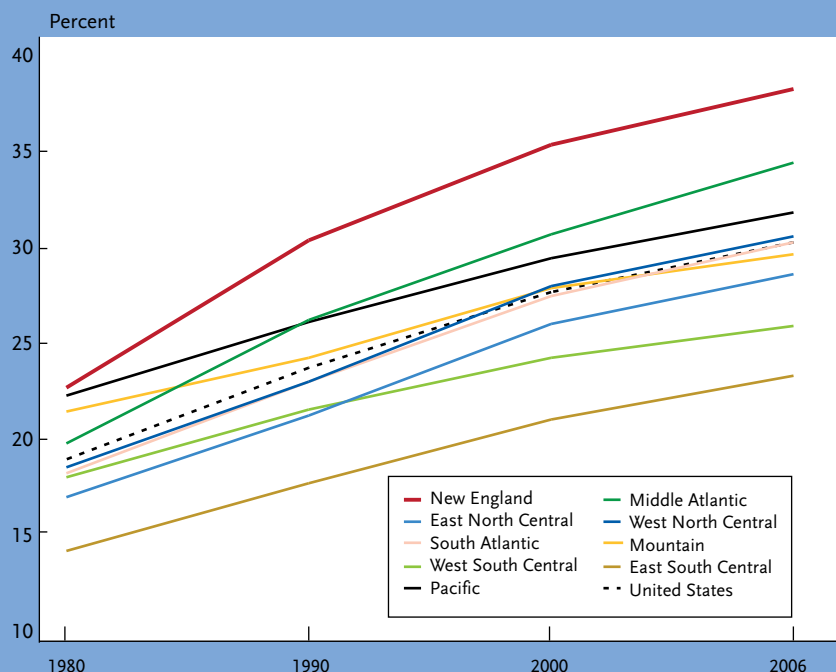
**Figure 3. The supply of skilled labor in New England has been constrained by slower population growth among natives and greater domestic out-migration among college graduates.**



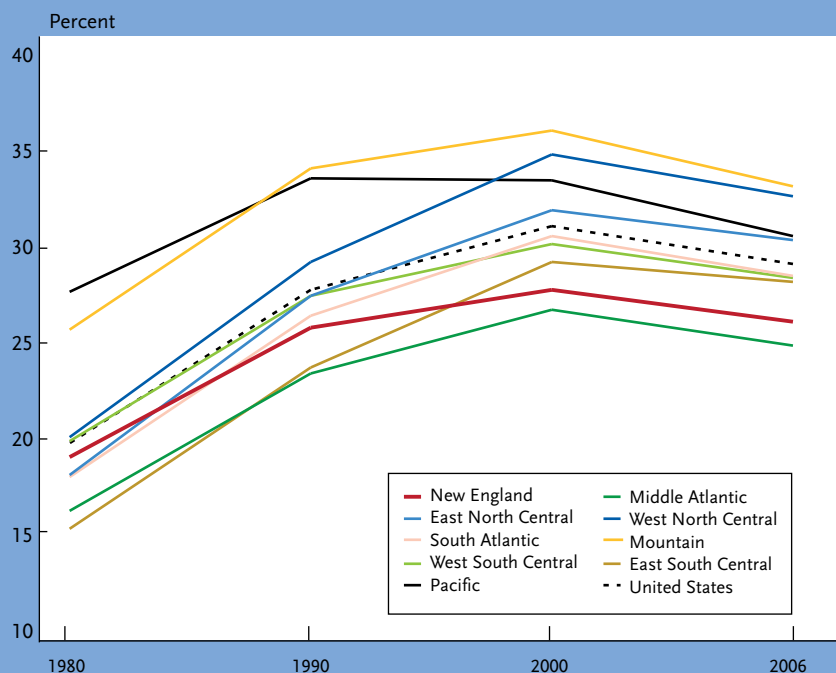
Source: Author’s calculations based on the 1980, 1990, and 2000 decennial Census and the 2005 and 2006 American Community Surveys (combined).  
Note: Migration rates are for division-to-division moves.

**Figure 4. The share of individuals with a Bachelor's degree or higher has increased more rapidly in New England than the nation, yet the share with some college or an Associate's degree lags behind that of most other regions.**

Share of individuals aged 25-64 years with a Bachelor's degree or higher



Share of individuals aged 25-64 years with some college or an Associate's degree



Source: Author's calculations based on the 1980, 1990, and 2000 decennial Census and the 2005-07 combined American Community Survey.

Note: Educational attainment in 1980 is defined by number of years of completed education and is not strictly comparable to that in 1990 and later years, which is based on degrees completed.

not been as successful in moving individuals from the bottom into the middle skill level. In 1980, New England had a 3.6 percentage point advantage over the nation in terms of its share of “high-skill” workers—by 2006 that advantage had widened to 7.9 percentage points (see Figure 5). Yet, in terms of its share of “middle-skill” workers, whereas New England’s share was roughly equivalent to that of the United States in 1980, by 2006 the region was at a 2.9 percentage point deficit. If instead the “middle-skill” gap between New England and the nation had not increased during those decades, we would have expected to see a greater decrease in the share of “low-skill” individuals as more people moved up in the education distribution.

Overall, this slowdown in the number of college graduates, while not unique to New England, is more severe in this region than in the rest of the nation. In addition, while the region has led the nation in terms of increasing the “high-skill” share of its population, it has consistently performed below average in terms of increasing the share of “middle-skill” workers. The key question is how these changes in both the number and mix of skilled workers has kept pace with the skills demanded by New England’s employers. We explore that in the next section.

### The demand for skilled labor: Outpacing supply

For the reasons mentioned earlier, it is inherently difficult to measure the demand for skilled workers directly. Yet we can measure movements in the relative supply and wages of skilled workers over time to determine demand. Basic economic principles tell us that when the supply of a good increases relative to demand, the price of that good decreases relative to other goods, all else being equal. However, if the supply of a good increases and the price also increases, then it must be the case that demand is increasing more rapidly than supply. We can apply these same principles to the labor market by examining trends in real hourly wages by education level over time for workers with similar characteristics.<sup>19</sup>

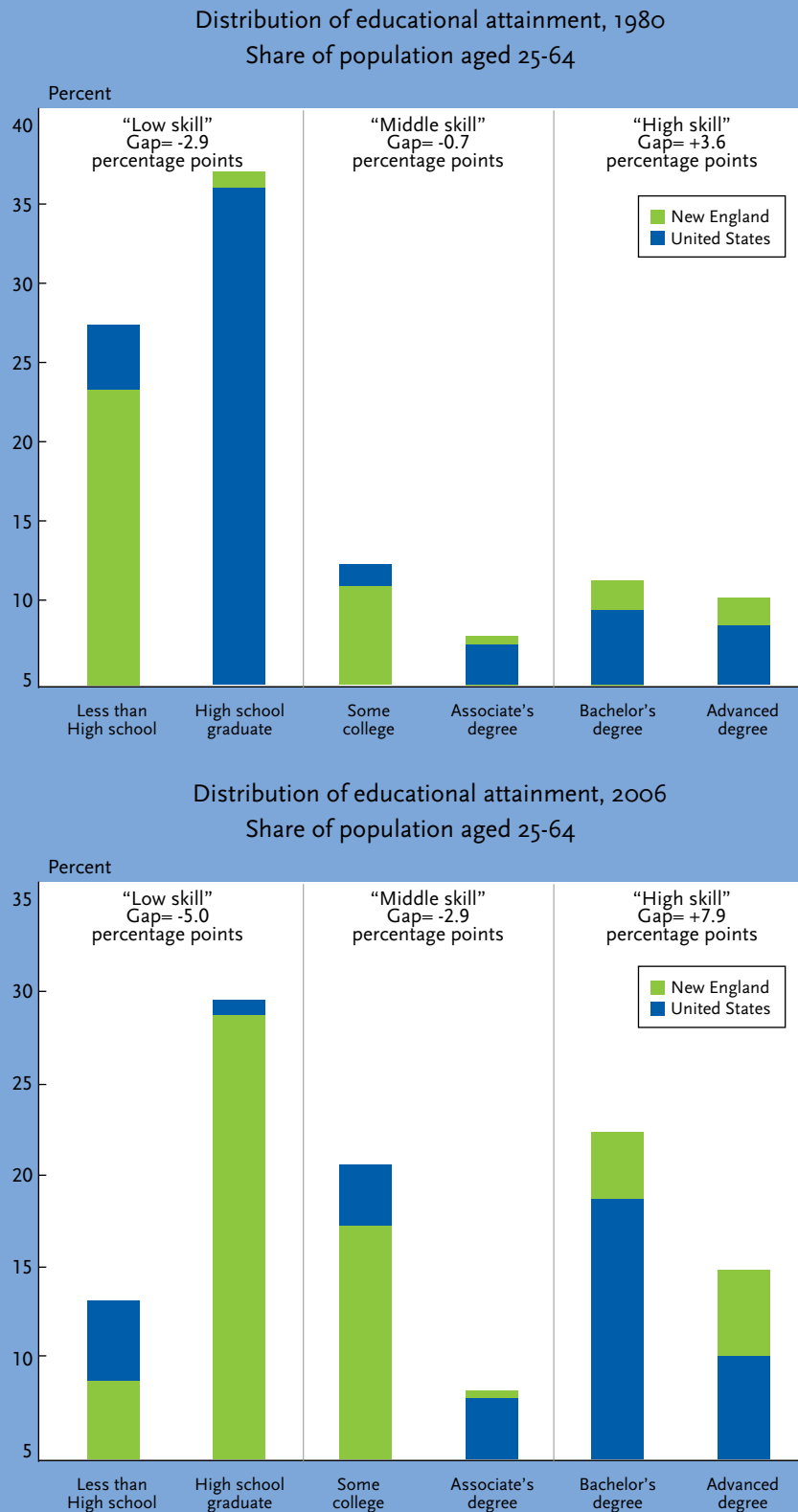
Over the past several decades, the

New England labor market has experienced rising demand for college-educated workers as evidenced by the rapid increase in their earnings relative to those of less-educated workers. Since 1980, even as the share of skilled workers grew in New England, their wages also increased relative to the wages of those with only a high school diploma. For workers with a bachelor's degree, estimates over time show that the greatest increase in real hourly wages occurred during the 1980s, although wages continued to increase for this group throughout the 1990s before leveling off after 2000.<sup>20</sup> For individuals with a graduate degree, wages continued to increase through 2006 while the wages of individuals with an associate's degree have been relatively stable. In contrast, estimates show that real hourly wages of those with a high school degree or less have actually fallen since 1980. These trends are not unique to New England—similar trends in wages by education level have occurred at the national level as well.<sup>21</sup>

As a result, the wage premium for skilled workers grew substantially across both the region and the nation. The wage premium is calculated as the percentage increase in average hourly earnings for individuals with any postsecondary education versus those with only a high school diploma. For example, in 1980, a male worker in New England with a bachelor's degree earned 43.5 percent more than a similar male worker with only a high school diploma (see Figure 6, next page). By 2006, that premium had grown to 74.2 percent.<sup>22</sup> Over this period, the wage premium for those with a bachelor's degree grew in every region of the country—even doubling in some regions—suggesting that demand for such workers outstripped supply across the nation.<sup>23</sup>

Although smaller in magnitude, the premium paid to workers with only an associate's degree or some college in New England has also increased over the past several decades. For example, in 1980, men with an associate's degree earned 12.7 percent more per hour than men with only a high school diploma (see Figure 6). By the year 2006, this premium had more than doubled to 30.2 percent. The increase in the premium for workers with only

**Figure 5. Since 1980, New England has been successful in moving a greater share of individuals from the middle of the distribution to the top, but less successful at moving individuals from the bottom to the middle.**

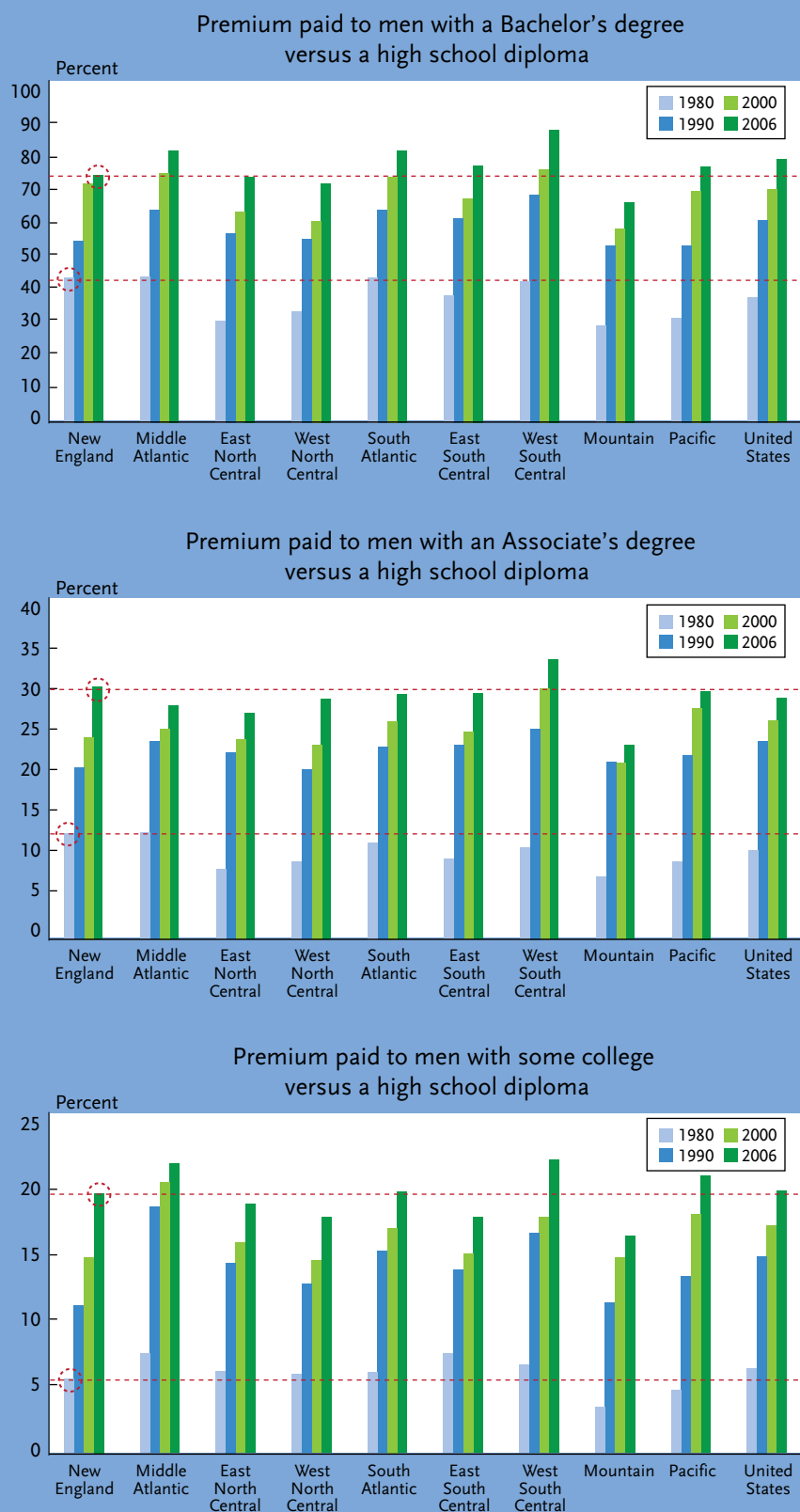


Source: Author's calculations based on the 1980 decennial Census and the 2005-07 combined American Community Survey.

Note: Educational attainment in 1980 is defined by number of years of completed education and is not strictly comparable to that in 2006, which is based on actual degrees completed.



**Figure 6. Since 1980, the premium which employers are willing to pay workers with any postsecondary education versus those with only a high school degree has been increasing.**



Source: Author's calculations based on the 1980, 1990, and 2000 decennial Census and the 2005 and 2006 American Community Surveys (combined).

Note: The college wage premium is defined as the percentage increase in average hourly wages for an individual with a Bachelor's degree relative to an individual with only a high school diploma. Wages are estimated from OLS regressions for each year. Please see the data appendix on the New England Public Policy Center's website for details.

some college was even greater, increasing more than threefold from 5.5 percent to 19.4 percent.

While the premium for “middle-skill” workers with some college or an associate's degree has accelerated relative to the nation, the premium for bachelor's degree recipients in the region has tapered off. For example, in 1980, the region boasted the second-highest wage premium for bachelor's recipients (see Figure 6). Yet by 2006 these workers earned a smaller premium than their counterparts in most other regions. This suggests that as New England has expanded the share of workers with a bachelor's degree more rapidly than elsewhere in the country, the imbalance between supply and demand has become less severe. Yet the opposite is true for “middle-skill” workers. Although the share of workers with some college or an associate's degree has risen in New England, the increase has lagged behind that of other regions. As a result, the wage premium for such workers has been rising more rapidly in the region than across the nation.

The trends described here demonstrate a continued increase in the demand for skilled workers in both New England and the nation, suggesting that the imbalance between the supply of and demand for skilled labor is not unique to the region. The wage premium for both high- and middle-skill workers has been increasing over time, suggesting that even though they now represent a greater share of the population, the supply of these workers has not kept pace with demand. Indeed, a large literature has documented increasing skill-wage premiums at the national level, noting several potential causes that are not easily reversed, such as increasing technological change that favors more educated workers, growth in international trade that has displaced work done by less-educated workers, and declining labor market institutions (e.g., unions and minimum wage laws) that have traditionally protected employment and wages of workers without a college education.<sup>24</sup>

Although these demand-side trends are not unique to New England, there is one key difference. Whereas wage premiums at the national level have increased steadily across the education spectrum, in New England the increase in the wage premium since 2000 has been greater

for middle-skill workers than for high-skill workers. That suggests that while an imbalance between supply and demand within the region exists for all skilled workers, the mismatch is greater among those with only some college or an associate's degree. Certainly the supply of such workers in New England has lagged behind that of other regions, yet the question remains whether this mismatch is isolated to a few key areas or is spread more broadly throughout the economy. We turn to that question in the next section as we explore changes in employment and wages by industry and occupation.

### **Mismatch: Exploring the imbalance between supply and demand by industry and occupation**

The structure of the New England economy can be characterized by the share of employment accounted for by either industries or occupations. An industry is a group of firms that produce similar products or provide similar services (e.g., manufacturing, transportation, education services). An occupation is a set of activities or tasks that employees are paid to perform (e.g., administrative support, sales, farming). Employees who perform essentially the same tasks are in the same occupation, whether or not they work in the same industry. Although industries and occupations often overlap, they are two distinct groupings of jobs where a given industry may employ workers in a variety of occupations.<sup>25</sup>

This section describes the changing industrial and occupational composition of both the regional and national economy since 1990, with a particular focus on the employment of college-educated workers. Increasing demand for college-educated workers can result from economic shifts if industries or occupations that require more college-educated labor are growing faster than those that require fewer such workers. Demand can also increase without a change in industrial or occupational structure if more college-educated labor is used within industries and occupations as firms adopt new technologies or alter production to take advantage of opportunities for international trade.

Interestingly, we find that little of the

increased demand for college-educated workers in both New England and the nation comes from a shift in employment across industries or occupations and toward those that have higher shares of workers with college degrees. Instead, most of the increase comes from greater demand for college-educated workers within industries and occupations. In addition, job vacancy rates by detailed occupations indicate that the region's supply of skilled labor may be constrained relative to that of the nation in key sectors of the economy such as management, business and financial operations, computer and mathematical sciences, and healthcare.

**Demand for college-educated workers has increased within most industries.** Compared with the nation, New England's employment is more highly concentrated in knowledge-based industries such as healthcare, education services, finance and insurance, and professional and scientific services and less concentrated in blue-collar industries such as construction, agriculture, and transportation and warehousing (see Figure 7, next page). As of 2006, healthcare and social assistance (14.0 percent) and manufacturing (12.4 percent) were the largest industries, followed closely by retail trade (10.6 percent) and education services (9.2 percent).

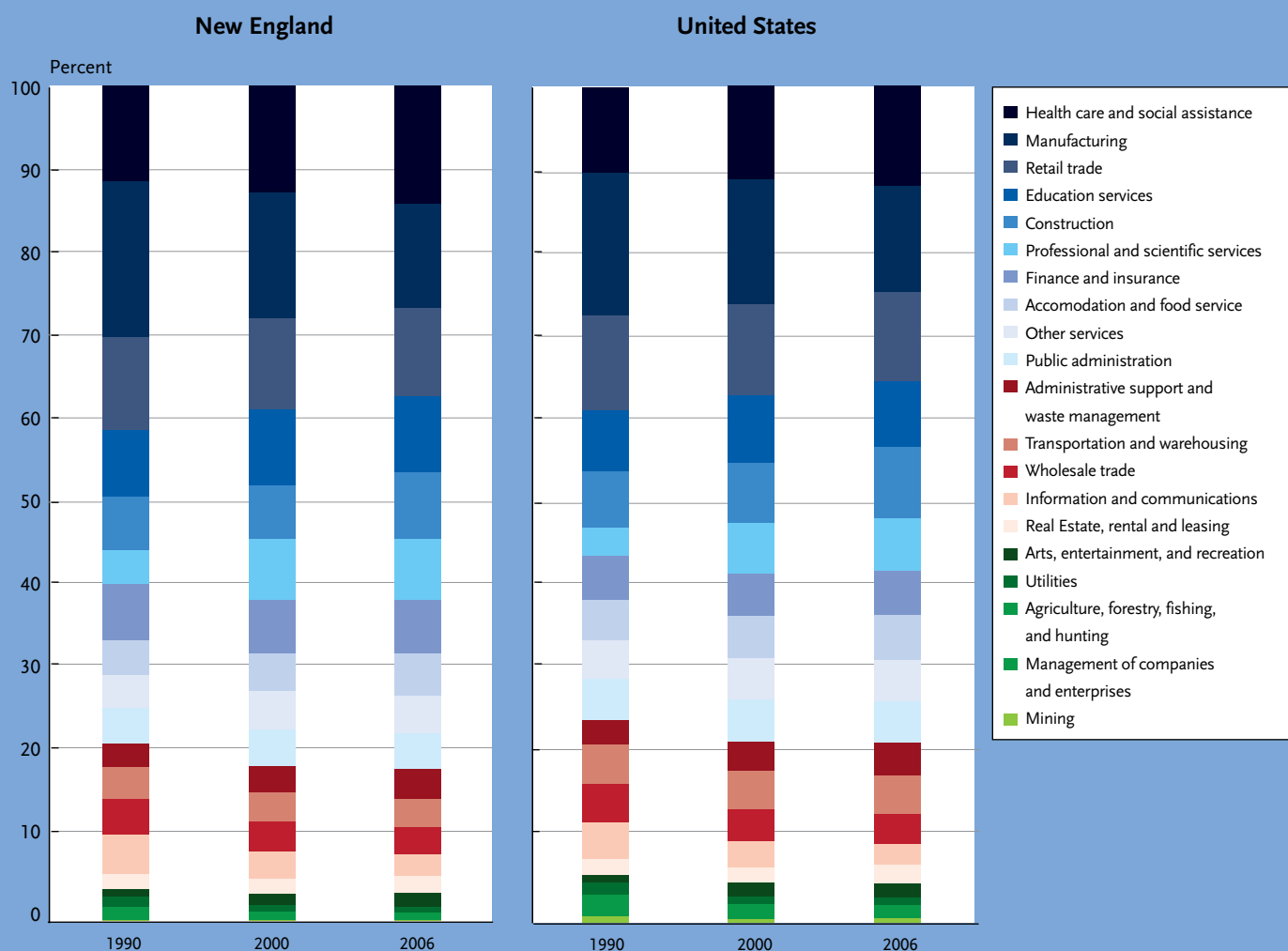
Since 1990, the share of employment accounted for by the various industries has shifted over time in both the region and the nation, although these movements have been more pronounced in New England. Key industries that have grown as a share of employment include large sectors such as healthcare and social assistance and education services (see Figure 7).<sup>26</sup> Other industries such as professional and scientific services, while not as large, have nearly doubled their share of employment since 1990. In contrast, industries such as manufacturing have declined as a share of the region's overall employment.

Most of the industries that have been growing rapidly in New England employ a high share of college-educated workers. As of 2006, more than half of the labor force in growing industries such as professional and scientific services, education services, finance and



**Figure 7. Since 1990, the industrial composition of employment in New England has shifted away from manufacturing and towards healthcare, education, and professional and scientific services, even to a greater degree than the nation.**

Industry employment as a share of overall employment



Source: Author's calculations based on the 1990 and 2000 decennial Census and the 2005 and 2006 American Community Surveys (combined).

Notes: Employment shares are calculated as the percentage of workers aged 25-64 years employed in each industry. Industries are listed in order of 2006 employment share for New England. Industry categories may not be strictly comparable between 1990 and later years due to classification changes. See data appendix at the New England Public Policy Center's web site for a complete listing of employment shares by industry for each year.

insurance, healthcare and social assistance, public administration, and administrative support had either an associate's or a bachelor's degree (see Figure 8). Industry employment at the national level exhibited similar trends, although the share of college-educated workers was lower than that of New England in almost every industry. For example, 40 percent of workers in New England's manufacturing industry have a college degree compared with only 31.5 percent

nationwide, indicating that the region relies more heavily on skilled labor within comparable industrial sectors.

In addition, the share of college-educated workers has increased within most industrial sectors in both the region and the nation—even within industries that have not typically employed a high fraction of skilled workers. Since 1990, the share of workers who hold a college degree has increased in

16 of the 20 major industrial sectors in New England (see Figure 8).<sup>27</sup> For example, the most rapid increase in the share of workers with a bachelor's degree occurred in finance and insurance, manufacturing, and information and communication. For workers with an associate's degree, the most rapid increase was in administrative support, utilities, and management. This suggests that the demand for college-educated labor is more broad-based than simply requiring a four-year degree, yet varies by skill level across

industries. Compared with the nation, the employment of bachelor degree recipients within industries has expanded more rapidly in New England while that of associate's degree recipients has been slower.

So what is driving the demand for skilled labor—shifts in employment *across* industries toward those that employ a greater share of college-educated labor or greater use of college-educated workers *within* industries? We can decompose the change in the overall share of workers with a college degree

**Figure 8. The share of college-educated workers has increased within most industrial sectors in both New England and the nation since 1990.**

Percentage point change in share of workers with any college degree, 1990-2006



Source: Author's calculations based on the 1990 and 2000 decennial Census and the 2005 and 2006 American Community Surveys (combined). Notes: College shares are calculated as the percentage of workers age 25-64 years who are college educated in each industry. Industries are listed in order of 2006 college-educated share for New England. Industry categories may not be strictly comparable between 1990 and later years due to classification changes. Please see the data appendix on the New England Public Policy Center's website for a complete listing of college educated shares by industry for each year.

**Table 1. Increased employment of college workers reflects increasing shares of college-educated workers within industries.**

Share of workers with an Associate's degree or higher under various scenarios

	New England				United States			
	1990	2000	2006	Increase (percentage points)	1990	2000	2006	Increase (percentage points)
<b>Overall share of workers with any college degree</b>								
Actual	40.7	46.5	48.3	7.6	34.6	39.2	40.9	6.3
Holding constant share of college workers within each industry	40.7	42.2	42.4	1.8	34.6	35.7	35.9	1.4
Holding constant employment share of industry within the economy	40.7	44.9	46.9	6.2	34.6	38.1	39.7	5.1
Percent of increase due to:								
Changing employment share across industries	—	—	—	18.0	—	—	—	18.6
Changing share of college workers within industry	—	—	—	82.0	—	—	—	81.4
<b>Overall share of workers with a Bachelor's degree</b>								
Actual	32.7	38.3	39.5	6.8	27.5	31.9	32.5	5.0
Holding constant share of college workers within each industry	32.7	34.1	34.2	1.5	27.5	28.5	28.7	1.2
Holding constant employment share of industry within the economy	32.7	36.8	38.2	5.5	27.5	30.9	31.5	4.0
Percent of increase due to:								
Changing employment share across industries	—	—	—	19.1	—	—	—	20.8
Changing share of college workers within industry	—	—	—	80.9	—	—	—	79.2
<b>Overall share of workers with an Associate's degree</b>								
Actual	8.0	8.2	8.8	0.7	7.1	7.3	8.4	1.3
Holding constant share of college workers within each industry	8.0	8.2	8.2	0.2	7.1	7.2	7.3	0.1
Holding constant employment share of industry within the economy	8.0	8.1	8.7	0.7	7.1	7.2	8.2	1.1
Percent of increase due to:								
Changing employment share across industries	—	—	—	7.4	—	—	—	9.7
Changing share of college workers within industry	—	—	—	92.6	—	—	—	90.3

Source: Author's calculations based on the 1990 and 2000 decennial Census and the 2005 and 2006 American Community Surveys (combined).

Notes: Actual shares in each year are calculated as the percentage of workers aged 25-64 that have a college degree in each industry multiplied by that industry's employment share and summed over all industries. Shares holding constant the share of college workers in each year are calculated as the percentage of workers age 25-64 that have a college degree in 1990 in each industry multiplied by that industry's employment share for each year and summed over all industries. Shares holding constant the employment share in each year are calculated as the percentage of workers age 25-64 that have a college degree in each year in each industry multiplied by that industry's employment share for 1990 and summed over all industries.

that occurred between 1990 and 2006 into two parts. The first part is the increase that occurred due to shifts in the economy's industrial structure, holding constant the share of college-educated workers employed within each industry. The second part is the increase that occurred due to the greater employment of college-educated workers *within* industries, holding constant the employment shares across industries.

The decomposition shows that most of the increase in the overall share of workers with a college degree is due to greater employment of college-educated workers *within* industries over time in both New England and the nation. If the share of college-educated workers within each industry had not increased, the overall share of such workers would have risen by only 1.8 percentage points in New England as industries

that employed more college-educated workers grew more quickly than those that did not (see Table 1). If instead the industry employment shares had not shifted, the overall share of workers with a college degree would have jumped by 6.2 percentage points—accounting for over 80 percent of the actual increase that was observed.

Interesting differences emerge when we do the decomposition separately for the overall share of employment with a bachelor's degree versus an associate's degree. Whereas most of the increase in the share of workers with a bachelor's degree occurred between 1990 and 2000, almost all of the increase in the share of workers with an associate's degree occurred between 2000 and 2006 (see Table 1). Moreover, a greater share of the overall increase in the employment of associate's degree recipients was due to their employment within industries over time compared with that of bachelor degree recipients. The differing trends by skill level are slightly more pronounced for New England compared with the nation.

Additional evidence points to increased demand for college-educated workers occurring within industries. Between 1990 and 2000, the college wage premium increased within most industries—despite there being more workers who were college graduates—even within industries with relatively low shares of college-educated workers (see Figure 9, next page). In addition, the increase in the wage premium in New England exceeded that of the nation in 14 out of the 20 major industrial sectors, suggesting that the imbalance between the supply of and demand for skilled labor was greater in the region. As of 2000, industries such as management of companies and enterprises, finance and insurance, and manufacturing had wage premiums that exceeded that of the nation and of the overall New England economy. That suggests that employers in the region place a greater premium on college-educated workers in these industries than their counterparts nationwide.

What is driving the increased demand for college workers *within* industries? Recent research has shown that within industries,

technological advancements over the past several decades is associated with automating routine manual or cognitive tasks, reducing the demand for such workers while increasing the demand for workers performing non-routine cognitive tasks that are not so easily automated. Research has shown that this trend explains the majority of the estimated relative demand shift within industries that has favored college-educated workers since 1970.<sup>28</sup> Thus, much of the increased demand for skilled labor within industries is due to changes in the nature of work—or put another way—changes in the occupational structure of the economy.

Indeed, occupations that employ a high share of college-educated labor account for a large percentage of employment in the New England economy. These are “high-skill” occupations where the majority of workers have a college degree such as educators, healthcare practitioners, business/finance professionals, and computer personnel (see Figure 10, page 21). Not surprisingly, industries that employ a high share of college-educated workers and have a high college wage premium—such as professional and scientific services, education, management, finance and insurance, information and communications, and healthcare—employ more than half of their workforce in these “high-skill” occupations.<sup>29</sup> Thus, understanding the shifts in demand for college-educated workers by occupation is crucial to understanding the changing skill requirements within industries.

**Demand for college-educated workers has increased within occupations.** Relative to the nation, New England's employment is more highly concentrated in knowledge-based occupations such as education, training, and library; management; healthcare practitioner and technical; and business and financial operations and less concentrated in blue-collar industries such as transportation and material moving; production; construction and extraction; and installation, maintenance, and repair (see Figure 10, page 21). As of 2006, office

**Figure 9. The college wage premium increased within most industries between 1990 and 2000 in both the region and the nation.**

Percentage point change in the college wage premium, for those with a Bachelor's degree 1990-2000



Source: Author's calculations based on the 1990 and 2000 decennial Census.

Notes: College wage premium is the percentage difference in hourly wages for male workers with only a Bachelor's degree over that for male workers with only a high school degree. In each industry. Industries are listed in order of 2006 college-educated share for New England. Industry categories may not be strictly comparable between 1990 and later years due to classification changes.

and administrative support (13.9 percent), management (10.9 percent), and sales related (10.9 percent) were the largest occupations.

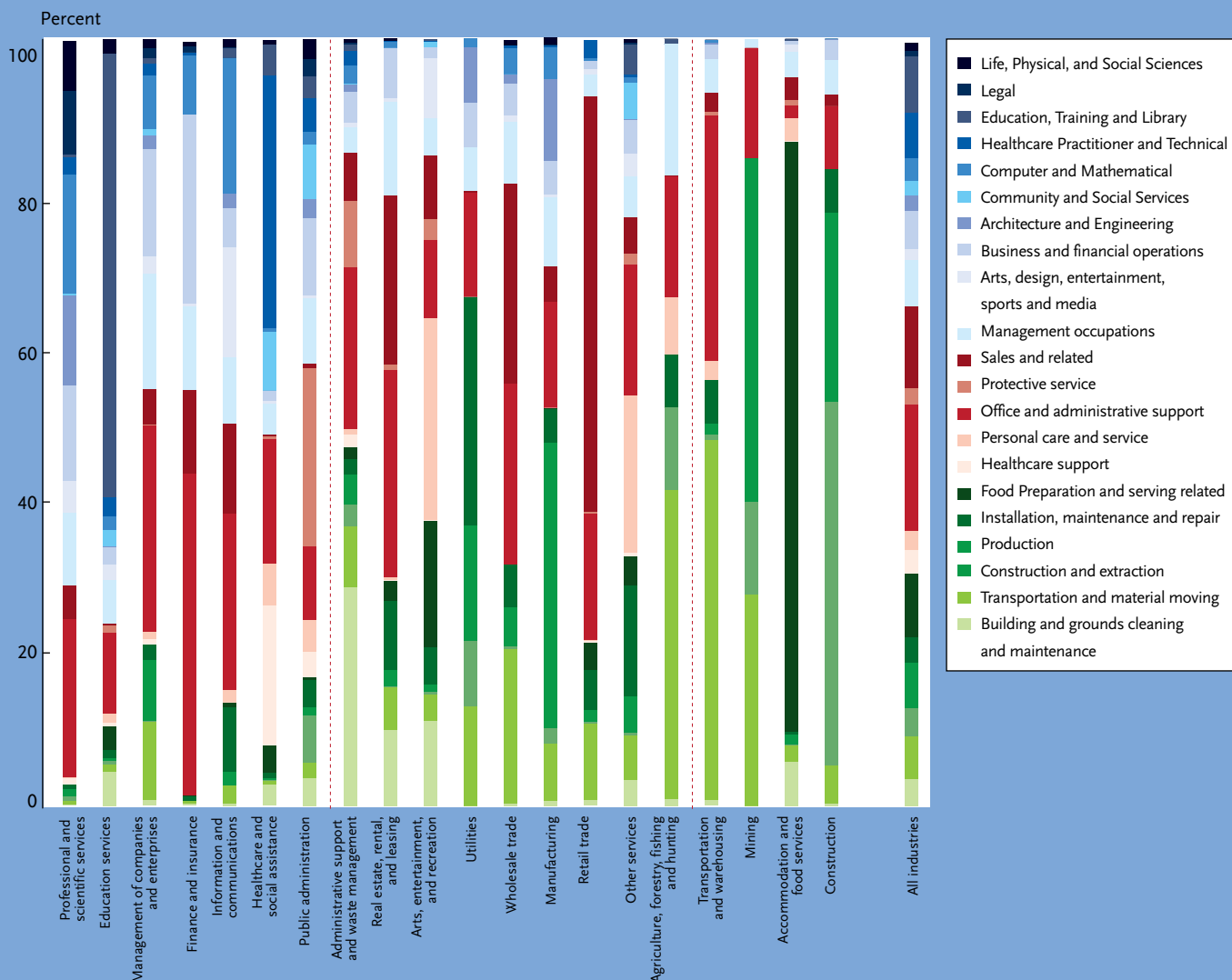
As with the industrial structure of the economy, the share of employment accounted for by the various occupations has shifted since 1990. Again, these movements have been more pronounced in New England. Key occupations that have grown as a share of employment include management, education, healthcare, and business and financial operations (see Figure 11, page 22).<sup>30</sup> Other occupations such as computer and mathematical, while not as large, have nearly doubled their share of employment since 1990. In contrast, industries such as office

and administrative support and production have declined considerably as a share of the region's overall employment.

Most of the occupations that have been growing rapidly in New England employ a high share of college-educated workers. As of 2006, more than three-quarters of the labor force in growing occupations such as life, physical, and social sciences; legal; education, training, and library; healthcare practitioner and technical; and business and financial operations had either an associate's or a bachelor's degree (see Figure 12, page 23). Employment at the national level exhibited similar trends, although the share of

**Figure 10. Industry demand for college educated workers in New England is driven by occupations that typically employ a high share of skilled workers.**

Share of industry employment by occupation group, 2006



Source: Connecticut, Maine, Massachusetts, and New Hampshire Departments of Labor.

Note: Occupations and industries are listed in order of share of college-educated share for New England.

See data appendix at the New England Public Policy Center's website for a complete listing of occupations by industry.

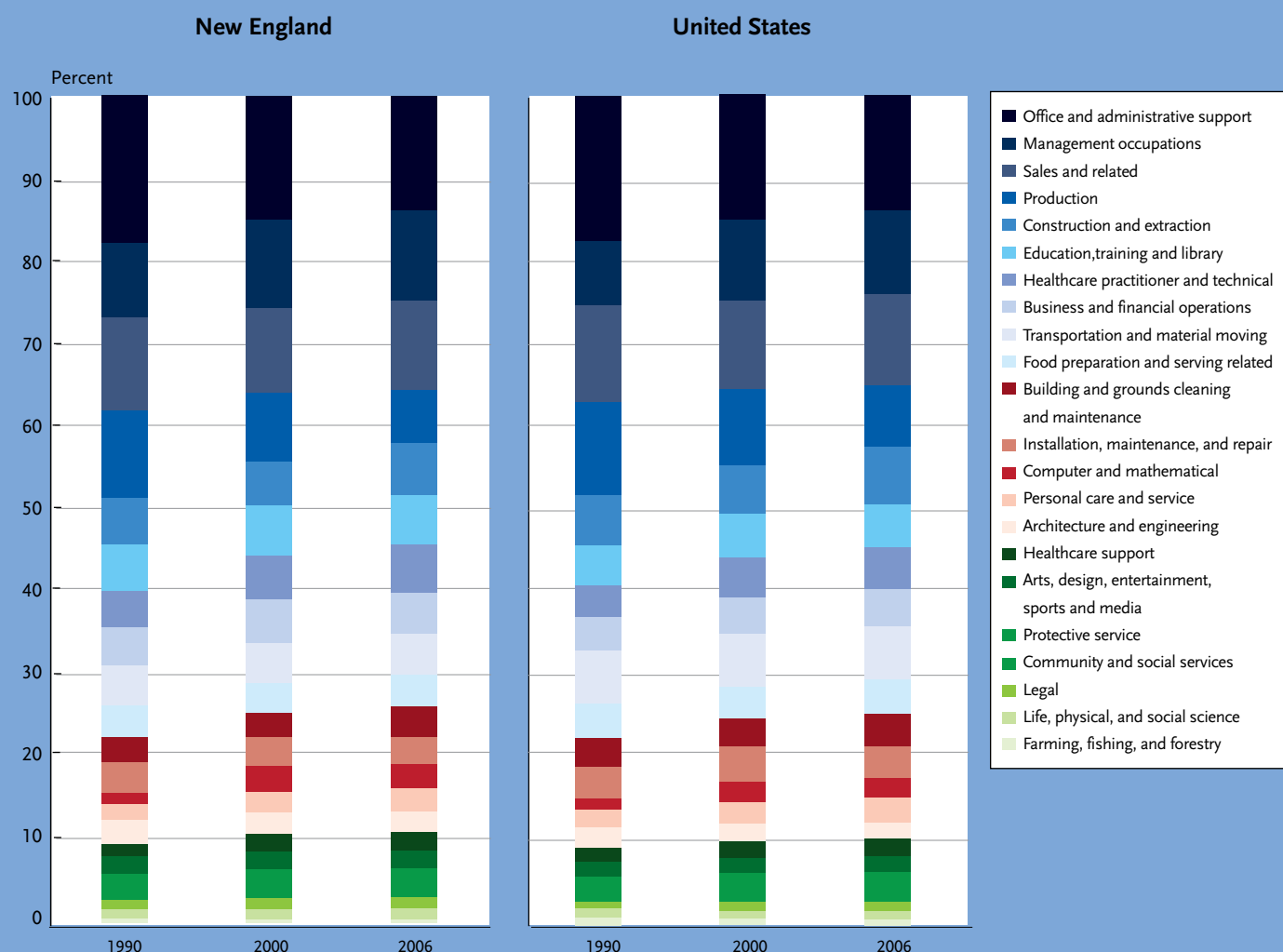
college-educated workers was lower than that of New England in almost every occupation. For example, 68.3 percent of managers in the region have a college degree compared with only 58.5 percent nationwide, indicating that the region relies more heavily on skilled labor within comparable occupation groups.

In addition, more college-educated labor is being used within occupations over time in both New England and the nation—even within occupations that have not typically employed a high fraction of skilled workers.

Since 1990, the share of workers who hold a college degree has increased in 18 of the 22 major occupation groupings (see Figure 12). For example, the most rapid increase in the share of workers with a bachelor's degree occurred in life, physical, and social science jobs; legal positions; and business and financial professions. For workers with an associate's degree, the most rapid increase was among healthcare practitioners; installation, maintenance, and repair workers; personal care services; and protective services. As with

**Figure 11. Since 1990, the mix of occupations in New England has shifted away from production and office support and towards management, education, healthcare and business and financial operations.**

Occupation employment as a share of overall employment



Source: Author's calculations based on the 1990 and 2000 decennial Census and the 2005 and 2006 American Community Surveys (combined).

Note: Employment shares are calculated as the percentage of workers aged 25-64 years employed in each occupation. Occupations are listed in order of 2006 employment share for New England. Occupation categories may not be strictly comparable between 1990 and later years due to classification changes. See the data appendix on the New England Public Policy Center's website for a complete listing of employment shares by occupation for each year.

industries, it appears that the demand for college-educated labor is more broadly based than simply requiring a four-year degree, yet varies by skill level across occupations. Relative to the nation, the employment of bachelor degree recipients within industries has expanded more rapidly in New England while that of associate's degree recipients has been slower.

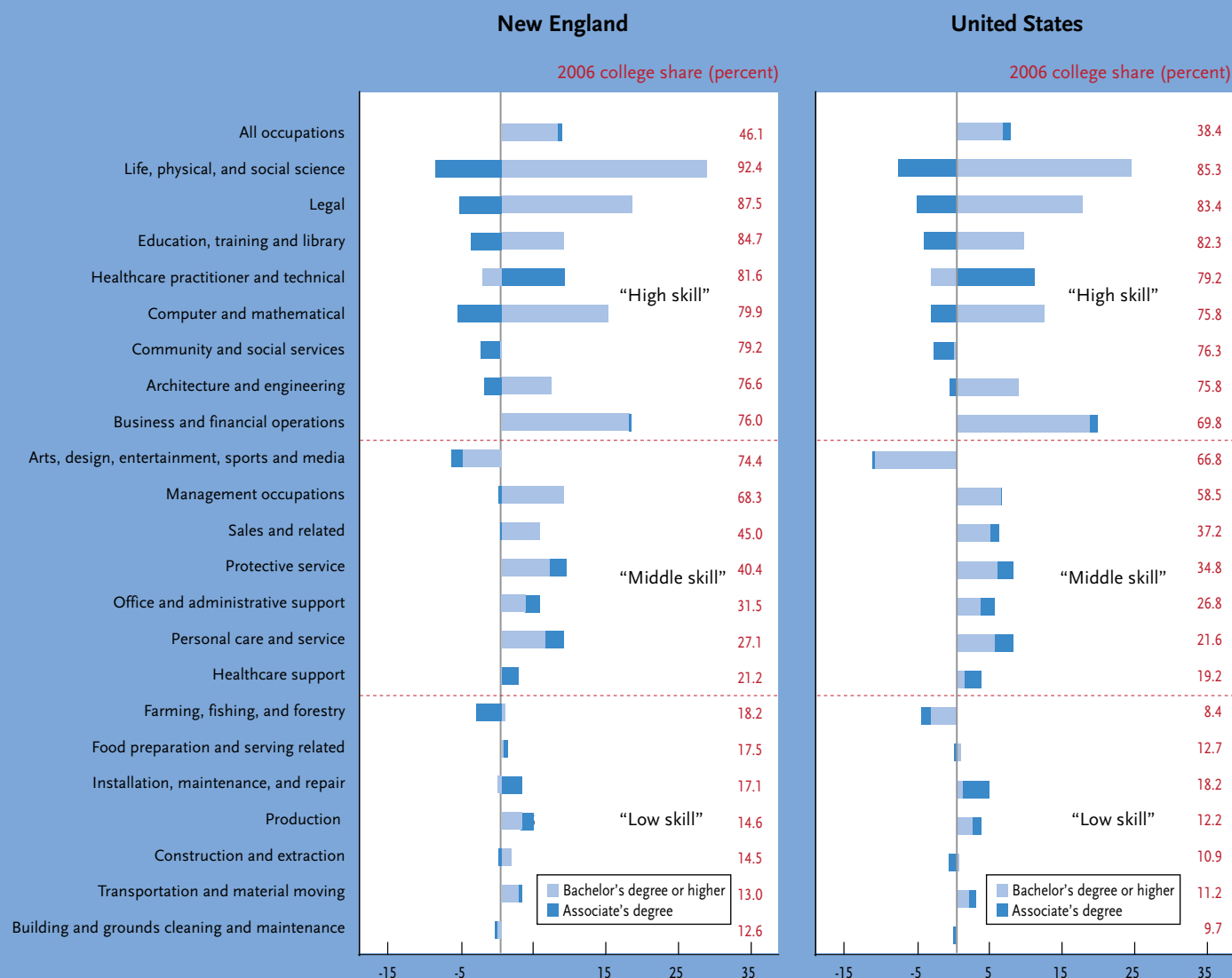
Decomposing the actual increase in the overall share of workers with a college degree

that occurred between 1990 and 2006 shows that most of the increase is due to greater employment of college-educated workers *within* occupations over time in both the region and the nation (see Table 2, page 24). If the share of college-educated workers within each occupation had not increased, the overall share of such workers would have risen by only 3.0 percentage points in New England, as occupations that employed more college-educated



**Figure 12. The share of college-educated workers has increased within most occupations in both New England and the nation since 1990.**

Percentage point change in share of workers with any college degree, 1990-2006



Source: Author's calculations based on the 1990 and 2000 decennial Census and the 2005 and 2006 American Community Surveys (combined).  
 Note: College shares are calculated as the percentage of workers aged 25-64 years who are college educated in each occupation. Occupations are listed in order of 2006 college-educated share for New England. Occupation categories may not be strictly comparable between 1990 and later years due to classification changes. See the data appendix on the New England Public Policy Center's website for a complete listing of college educated shares by occupation for each year.

workers grew more quickly than those that did not. If instead the occupation employment shares had not shifted, the overall share of workers with a college degree would have jumped by 5.1 percentage points—accounting for roughly 60 percent of the actual increase that was observed. Again, the timing and magnitude of the within-industry increase varied by skill level, occurring during the 1990s for workers with a bachelor's degree and since 2000 for

those with an associate's degree with the extent of shifting within occupations being greater for those with an associate's degree.

Data limitations prevent us from measuring the college wage premium by occupation, yet we can look to another labor market indicator—namely, the job vacancy rate—to determine which occupations have consistently exhibited an imbalance between supply and demand over time.<sup>31</sup> Relative to the nation,

**Table 2. Increased employment of college workers reflects increasing shares of college-educated workers within occupations.**

Share of workers with an Associate's degree or higher under various scenarios

	New England				United States			
	1990	2000	2006	Increase (percentage points)	1990	2000	2006	Increase (percentage points)
<b>Overall share of workers with any college degree</b>								
Actual	37.8	43.3	46.1	8.3	30.8	35.3	38.4	7.5
Holding constant share of college workers within each occupation	37.8	40.6	40.8	3.0	30.8	33.2	33.5	2.6
Holding constant employment share of occupation within the economy	37.8	40.2	42.8	5.1	30.8	32.8	35.6	4.7
Percent of increase due to:								
Changing employment share across occupations	—	—	—	38.8	—	—	—	37.2
Changing share of college workers within occupations	—	—	—	61.2	—	—	—	62.8
<b>Overall share of workers with a Bachelor's degree</b>								
Actual	29.8	35.2	37.5	7.8	23.8	28.2	30.2	6.4
Holding constant share of college workers within each occupation	29.8	32.4	32.6	2.8	23.8	26.0	26.2	2.4
Holding constant employment share of occupation within the economy	29.8	32.3	34.4	4.6	23.8	25.8	27.6	3.9
Percent of increase due to:								
Changing employment share across occupations	—	—	—	40.8	—	—	—	40.1
Changing share of college workers within occupations	—	—	—	59.2	—	—	—	59.9
<b>Overall share of workers with an Associate's degree</b>								
Actual	8.0	8.1	8.5	0.6	7.0	7.1	8.1	1.1
Holding constant share of college workers within each occupation	8.0	8.2	8.2	0.2	7.0	7.3	7.3	0.2
Holding constant employment share of occupation within the economy	8.0	7.9	8.5	0.5	7.0	6.9	7.9	0.9
Percent of increase due to:								
Changing employment share across occupations	—	—	—	11.8	—	—	—	20.2
Changing share of college workers within occupations	—	—	—	88.2	—	—	—	79.8

Source: Author's calculations based on the 1990 and 2000 decennial Census and the 2005 and 2006 American Community Surveys (combined).

Notes: Actual shares in each year are calculated as the percentage of workers age 25-64 that have a college degree in each occupation multiplied by that occupation's employment share and summed over all occupations. Shares holding constant the share of college workers in each year are calculated as the percentage of workers age 25-64 that have a college degree in 1990 in each occupation multiplied by that occupation's employment share for each year and summed over all occupations. Shares holding constant the employment share in each year are calculated as the percentage of workers age 25-64 that have a college degree in each year in each occupation multiplied by that occupation's employment share for 1990 and summed over all occupations.

New England has experienced persistently higher job vacancy rates in broad occupation categories that rely on college-educated workers (see Table 3, page 26). Among occupation groups in the region where the majority of workers have a college degree of some type, large shortfalls existed in both 2006 and 2009 in sectors such as management, computer and mathematical, business and financial operations, healthcare practitioner and technical.<sup>32</sup>

Other occupation groups where large numbers of unfilled jobs occurred, such as sales and office and administrative support, also employ a significant share of college-educated workers.

Yet what is driving the increased demand for college workers *within* these broad occupation groups? Persistent demand for college-educated workers exists even within these broad occupation groups.

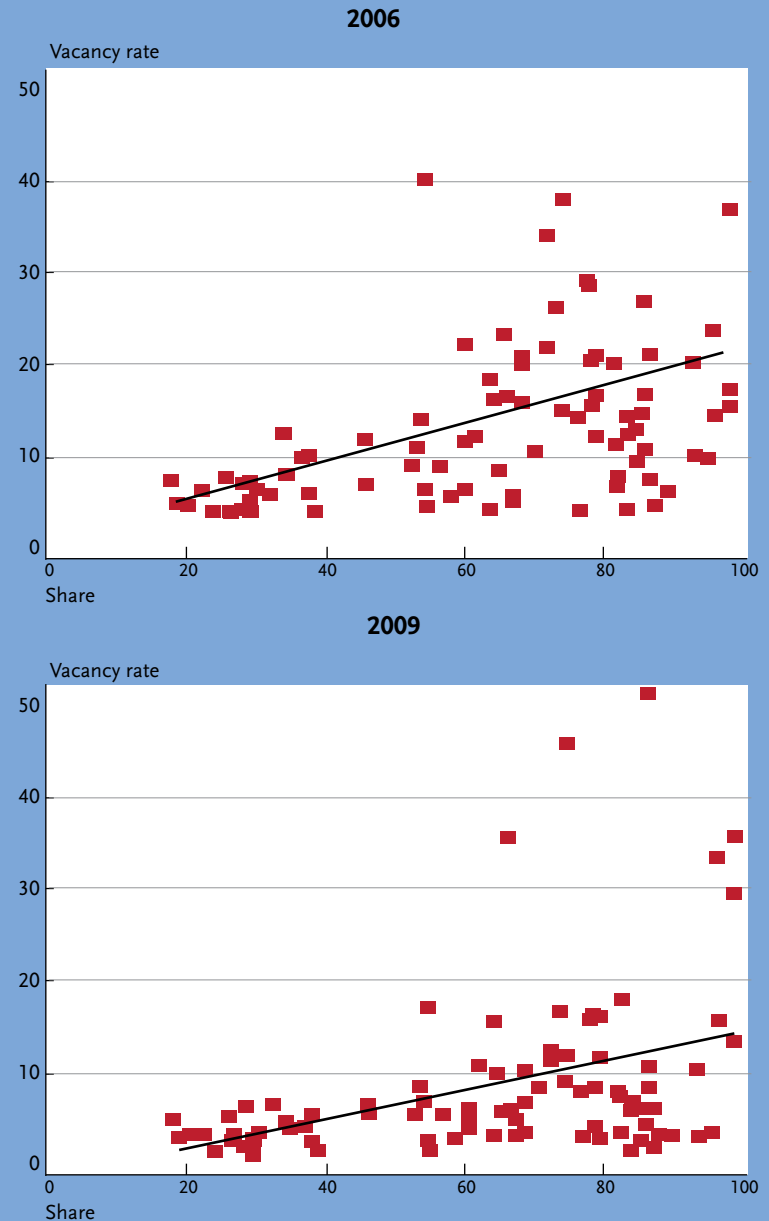
Among detailed occupations in New England that exhibited “critical” vacancies, those that employed a greater share of college-educated workers had higher job vacancy rates as of 2006 that have persisted through 2009 (see Figure 13).<sup>33</sup> A closer examination reveals that greater demand for college-educated workers reflects a combination of detailed occupations that rely on both middle- and high-skill workers. Relative to the nation, New England has experienced critical vacancies in a variety of detailed occupations that employ a large share of both middle-skill and high-skill workers (see Table 4, page 28).

That is true even within broad occupation categories such as management, business and financial operations, computer and mathematical sciences, and healthcare practitioners—categories often labeled as “high-skill”—where a significant percentage of jobs are often occupied by middle-skill workers.<sup>34</sup> For example, within the healthcare practitioner and technical occupation group, critical vacancies existed in detailed occupations such as registered nurses, radiologic technicians, respiratory therapists, and sonographers—jobs that employ a high share of workers with only some college or an associate’s degree (see Table 4). In fact, middle-skill jobs are sprinkled throughout the broad occupation categories, suggesting that such workers are not contained in just a few easily identifiable sectors. Moreover, many of the jobs held by middle-skill workers appear to be complementary to those held by high-skill workers. For example, within computer and mathematical occupations, middle-skill workers are typically employed in support jobs such as network administrators and computer support specialists that assist high-skill workers such as systems analysts and database administrators (see Table 4).

In sum, we find that little of the increased demand for college-educated workers in both New England and the nation comes from a shift in employment across industries or occupations and toward those that have higher shares of workers with college degrees. Instead, most of the increase comes from greater employment of college-educated workers

**Figure 13. Detailed occupations in New England that employ a greater share of college-educated workers had higher vacancy rates in 2006 that have largely persisted through 2009.**

Vacancy rates versus share of workers with any college degree  
Detailed occupations with “critical” vacancy rates



Source: Vacancy rates are the author's calculations of vacancies as a share of total employment for each occupation. The numbers of vacancies are from The Conference Board Help Wanted OnLine™ (HWOL) data series. Total employment by detailed occupation was obtained from the U.S. Bureau of Labor Statistics. Distribution of education attainment is based on the author's calculations from the 2006-08 combined American Community Survey. Notes: Detailed occupations with “critical vacancies” are those where the vacancy rate is greater than or equal to 4.3%, the number of vacancies is greater than or equal to 400, and total employment is greater than or equal to 1,500 in New England in 2006. The detailed occupations listed are for critical vacancies in the broad occupation groups noted above. See the data appendix on the New England Public Policy Center's website for a complete listing of vacancies and college-educated shares by occupation for New England.

**Table 3. Relative to the nation, New England has experienced persistently high vacancy rates in broad occupation categories that rely on college-educated workers.**

Major Category	New England				United States			
	2006-08	2006	2009	2006-08	2006	2009	2009	
	Share of workers with any college degree	Number of vacancies	Vacancy rate	Share of workers with any college degree	Number of vacancies	Vacancy rate	Number of vacancies	
Management occupations	68.3	40,449	10.9	58.5	527,468	9.0	271,689	
Business and financial operations occupations	76.0	22,842	7.1	69.8	289,767	5.0	137,899	
Computer and mathematical science occupations	79.9	43,454	21.7	75.8	531,328	17.3	275,947	
Architecture and engineering occupations	76.6	13,662	10.0	75.8	187,229	7.7	111,726	
Life, physical, and social science occupations	92.4	8,629	11.9	85.3	77,080	6.3	58,213	
Community and social services occupations	79.2	5,244	4.2	76.3	43,071	2.5	37,292	
Legal occupations	87.5	1,652	3.4	83.4	26,388	2.7	18,732	
Education, training, and library occupations	84.7	5,636	1.2	82.3	60,886	0.7	62,004	
Arts, design, entertainment, sports, and media occupations	74.4	5,503	6.5	66.8	81,801	4.7	82,799	
Healthcare practitioners and technical occupations	81.6	35,195	8.9	79.2	441,652	6.6	372,249	
Healthcare support occupations	21.2	5,274	2.5	19.2	70,886	2.0	90,104	
Protective service occupations	40.4	1,858	1.4	34.8	27,372	0.9	22,223	
Food preparation and serving related occupations	17.5	7,292	1.3	12.7	88,402	0.8	70,539	
Building and grounds cleaning and maintenance occupations	12.6	2,337	1.0	9.7	36,917	0.8	31,280	
Personal care and service occupations	27.1	3,292	2.2	21.6	43,484	1.4	48,552	
Sales and related occupations	45.0	25,708	3.6	37.2	377,271	2.7	312,836	
Office and administrative support occupations	31.5	32,809	2.8	26.8	484,077	2.1	259,811	
Farming, fishing, and forestry occupations	18.2	294	4.5	8.4	4,712	1.0	4,780	
Construction and extraction occupations	14.5	4,124	1.6	10.9	71,836	1.1	40,532	
Installation, maintenance, and repair occupations	17.1	5,737	2.5	18.2	108,174	2.0	75,681	
Production occupations	14.6	7,910	1.8	12.2	109,785	1.1	64,426	
Transportation and material moving occupations	13.5	7,006	1.9	11.2	132,547	1.4	74,136	
Total	46.1	285,905	4.3	38.4	3,822,134	2.9	2,523,451	

Sources: The share of workers with any college degree are calculated by occupation from the 2006-08 combined American Community Survey. Vacancy rates are the author's calculations of vacancies as a share of total employment for each occupation. The number of vacancies are from The Conference Board Help Wanted OnLine™ (HWOL) data series. Total employment by detailed occupation was obtained from the U.S. Bureau of Labor Statistics.

within industries and occupations. As a result, this increase in demand for college-educated workers since 1990 is not just isolated to a few key sectors of the economy but rather is fairly widespread. Although these trends are not unique to New England, job vacancy rates by detailed occupations indicate that the region's supply of skilled labor may be constrained relative to that of the nation in key sectors of the economy such as management, business and financial operations, computer and mathematical sciences, and healthcare. Given the demographic changes on the horizon, it seems likely that New England will face even greater labor supply constraints than the nation in the future. We will explore this question in the next section.

### **What are the unique labor supply constraints that New England will face in the future?**

In this section, we make some basic calculations to indicate the size and scope of any potential future imbalance in the New England labor market, recognizing that the market will likely make adjustments to alleviate any shortfall. Specifically, we project the size and educational attainment of New England's labor force over the coming two decades as new cohorts enter the labor force and older ones retire. We compare these simulations to projections of labor demand for the region based on employment growth forecasts made by the Bureau of Labor Statistics through 2018 and the distribution of educational attainment as of 2009—calculated for each detailed occupation and then aggregated to the economy-wide level.

Based on our calculations, future demand for workers with any postsecondary education is likely to increase while future supply of workers with such skills is not likely to keep pace. Our labor supply projections suggest that New England's labor force will likely shrink over time while that of the nation is likely to grow. More importantly, shifts in the composition of the population will constrain the educational attainment of future workers in both the region and the nation. Our projections of future demand indicate that the

supply of skilled workers—particularly those in the middle of the labor market—will not grow fast enough to keep pace with demand once the economy recovers. Simulations of market adjustments such as increased educational attainment, greater in-migration of college-educated workers, and higher labor force participation among older workers do little to change this picture.

Although our future projections of supply and demand may be an indication of where future investments in human capital may be warranted, it is crucial to note that the future path of employment will be determined not only by the demands of employers and the skills of existing workers but also by future adaptations that we cannot anticipate. As such, our forecasts of future labor demand will be used only to place bounds on the problem and provide a context for our labor supply forecasts rather than to pinpoint the exact number of workers that will be demanded in the future.

### **Future demand for skilled workers is likely to increase**

How is the demand for workers of differing levels of skill likely to change over the coming decade? To examine this we make employment projections by detailed occupation and “assign” jobs to different levels of education (less than high school, high school, some college, associate's degree, bachelor's degree, advanced degree) based on the educational attainment distribution of workers currently in those occupations. We then sum employment over all occupations by each education category to get the total number of workers “demanded” by each education level.

Employment projections for New England are made by applying ten-year growth rates by detailed occupation to the region's employment in each detailed occupation as of 2008.<sup>35</sup> The ten-year growth rates are calculated from employment projections for the period 2008 through 2018 at the national level made by the Employment Projections Program of the U.S. Bureau of Labor Statistics (BLS). These projections are based on BLS In-Demand Industry Clusters, which reflect

**Table 4. Detailed occupations in New England with "critical" vacancies as of 2006 employ a large number of both middle-skill and high-skill workers.**

Critical vacancies for selected detailed occupations for New England and the United States

	New England				United States				Education Distribution		
	2006		2009		2006		2009		2006-08		
	Number of vacancies	Vacancy rate	Number of vacancies	Vacancy rate	Number of vacancies	Vacancy rate	Number of vacancies	Vacancy rate	"Low-skill"	"Middle-skill"	"High-skill"
<b>Management occupations:</b>											
Sales managers	4,236	22.2	2,588	12.8	59,785	19.4	31,933	9.7	10.2	24.4	65.4
Computer and information systems managers	3,956	20.8	1,218	5.0	46,943	18.7	12,552	4.4	5.4	25.5	69.2
Construction managers	1,022	10.7	427	5.0	18,303	8.8	6,065	3.0	38.5	32.7	28.8
Education administrators, elementary and secondary school	649	5.3	348	2.5	4,624	2.1	3,004	1.4	6.4	15.2	78.4
Education administrators, postsecondary	1,265	15.0	636	6.6	11,852	11.5	8,399	7.9	6.4	15.2	78.4
Food service managers	822	7.4	481	4.4	12,125	6.4	7,425	3.9	41.5	36.5	22.0
Medical and health services managers	3,961	26.3	2,927	16.9	49,796	21.4	35,522	13.1	10.4	28.9	60.6
Natural sciences managers	567	20.6	403	10.9	4,094	10.6	2,466	5.6	2.0	6.6	91.4
Property, real estate, and community association managers	816	12.6	568	7.3	14,985	9.6	12,266	8.1	26.4	36.0	37.6
Social and community service managers	1,447	15.6	1,015	9.6	13,490	12.0	11,424	10.0	10.5	21.8	67.7
<b>Business and financial operations occupations:</b>											
Claims adjusters, examiners, and investigators	671	5.6	414	2.5	7,821	2.8	5,448	2.0	19.2	36.6	44.1
Employment, recruitment, and placement specialists	2,571	22.5	811	6.8	36,707	19.7	10,583	5.3	15.4	33.4	51.1
Training and development specialists	848	7.4	517	4.8	11,396	5.8	8,433	4.1	15.4	33.4	51.1
Accountants and auditors	9,515	15.3	3,295	5.2	107,336	9.8	29,332	2.6	5.4	19.2	75.3
Financial analysts	1,883	10.3	791	3.5	17,739	9.0	7,313	3.1	4.8	13.0	82.3
Personal financial advisors	439	7.7	436	4.4	6,002	5.0	6,348	4.2	5.5	17.4	77.1
Loan officers	1,655	9.8	760	6.2	29,697	8.3	15,266	5.1	17.1	36.2	46.7
<b>Computer and mathematical science occupations:</b>											
Computer programmers	3,751	16.2	1,619	9.0	48,616	12.3	22,570	6.1	6.1	25.4	68.4
Computer software engineers, applications	7,930	21.5	2,638	6.8	77,064	16.3	33,357	6.7	3.0	15.7	81.3
Computer support specialists	4,535	14.7	2,471	7.6	63,549	12.4	35,129	6.5	14.7	46.8	38.5
Computer systems analysts	11,107	37.6	4,038	12.3	134,583	30.1	61,576	12.0	7.4	28.7	63.9
Database administrators	2,121	29.1	1,017	16.1	26,559	24.2	15,635	14.5	4.8	27.1	68.2
Network and computer systems administrators	2,944	16.8	1,970	10.5	43,511	15.0	34,509	10.2	9.2	42.2	48.7



	2006			2009			2006			2009			2006-08		
	Number of vacancies	Vacancy Rate	Number of vacancies	Vacancy Rate	Number of vacancies	Vacancy Rate	Number of vacancies	Vacancy Rate	Number of vacancies	Vacancy Rate	Number of vacancies	Vacancy Rate	"Low-Skill"	"Middle-Skill"	"High-Skill"
<b>Healthcare practitioners and technical occupations:</b>															
Pharmacists	1,825	15.1	2,244	16.0	25,629	10.7	29,035	10.8	0.7	4.4	94.9				
Physician assistants	410	8.8	1,088	18.1	4,735	7.5	10,972	14.3	8.4	23.9	67.7				
Registered nurses	16,926	11.0	6,351	3.9	216,039	8.9	78,095	3.0	1.4	42.8	55.8				
Physical therapists	2,967	23.9	4,420	32.8	33,717	21.6	49,949	28.6	2.4	9.0	88.5				
Respiratory therapists	617	13.7	323	6.8	6,806	6.9	5,512	5.1	3.1	69.0	27.9				
Speech-language pathologists	1,051	16.0	1,828	29.1	12,663	12.8	26,619	23.8	1.1	1.5	97.5				
Medical and clinical laboratory technologists	771	6.8	456	4.0	6,573	4.1	6,026	3.6	12.9	36.5	50.6				
Cardiovascular technologists and technicians	406	20.4	186	7.5	4,315	9.8	3,104	6.5	9.6	67.1	23.3				
Diagnostic medical sonographers	513	21.2	289	10.8	4,416	10.0	2,874	5.6	9.6	67.1	23.3				
Radiologic technologists and technicians	1,969	16.5	566	4.4	16,511	8.7	6,786	3.2	9.6	67.1	23.3				
Medical records and health information technicians	785	8.0	738	7.0	10,439	6.3	10,242	6.0	38.0	48.8	13.2				
<b>Sales and related occupations:</b>															
First-line supervisors/managers of retail sales workers	4,191	6.9	4,450	7.3	59,613	5.4	66,494	5.7	38.9	37.6	23.5				
First-line supervisors/managers of non-retail sales workers	1,204	7.9	925	6.3	16,781	5.9	14,230	5.4	29.5	32.5	38.0				
Advertising sales agents	937	12.9	775	11.3	14,861	9.3	12,917	8.5	15.6	31.1	53.3				
Insurance sales agents	1,754	11.8	1,360	9.1	25,299	8.1	21,863	6.7	19.4	36.4	44.2				
Sales representatives, services, all other	2,025	9.9	1,393	6.2	27,468	5.5	18,876	3.5	20.5	35.2	44.3				
Sales representatives, wholesale and manufacturing, except technical and scientific products	3,151	4.5	1,958	3.0	50,489	3.4	29,186	2.1	2.2	31.6	46.4				
Sales engineers	493	12.9	223	3.7	5,795	7.7	3,289	4.6	5.3	23.6	71.1				
Telemarketers	1,121	8.3	805	5.7	17,789	4.6	16,277	5.3	47.6	41.1	11.3				
<b>Office and administrative support occupations:</b>															
Payroll and timekeeping clerks	588	5.3	273	2.9	8,711	4.2	3,890	2.0	34.8	49.8	15.4				
Hotel, motel, and resort desk clerks	545	5.8	366	4.2	8,205	3.8	6,360	2.8	41.8	46.0	12.1				
Human resources assistants, except payroll and timekeeping	661	9.0	344	4.8	10,416	6.5	5,330	3.3	28.1	48.7	23.2				
Production, planning, and expediting clerks	732	5.1	354	2.5	11,006	3.8	6,228	2.3	30.1	41.9	28.0				
Executive secretaries and administrative assistants	7,080	8.2	2,755	3.7	83,854	5.6	32,968	2.4	34.8	48.7	16.5				
Legal secretaries	842	6.3	230	2.0	12,527	4.7	4,798	2.0	34.8	48.7	16.5				
Medical secretaries	1,668	5.1	1,026	3.0	16,810	4.3	13,993	3.0	34.8	48.7	16.5				
Data entry keyers	697	5.0	468	4.1	12,147	4.1	6,188	2.5	37.2	47.0	15.8				
<b>Total vacancies</b>	<b>285,905</b>	<b>4.3</b>	<b>180,004</b>	<b>2.7</b>	<b>3,822,134</b>	<b>2.9</b>	<b>2,523,451</b>	<b>1.9</b>							

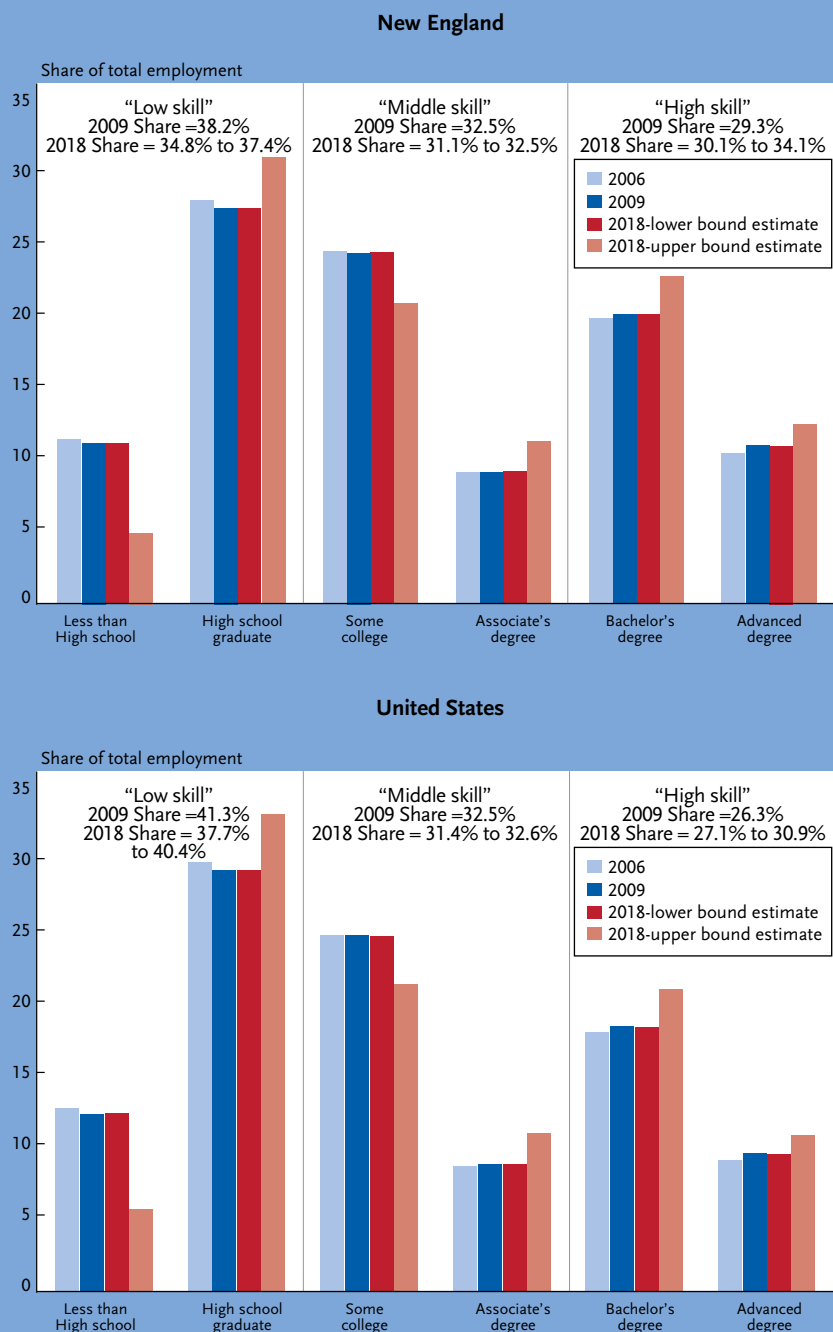
Sources: Vacancy rates are the author's calculations of vacancies as a share of total employment for each occupation. The number of vacancies are from The Conference Board Help Wanted OnLine™ (HWOOL) data series. Total employment by detailed occupation was obtained from the U.S. Bureau of Labor Statistics. Distribution of education attainment is based on the author's calculations from the 2006-o8 combined American Community Survey.

Notes: Detailed occupations with "critical vacancies" are those where the vacancy rate is greater than or equal to 4.3%, the number of vacancies is greater than or equal to 400, and total employment is greater than or equal to 1,500 in New England in 2006. The detailed occupations listed are for critical vacancies in the broad occupation groups noted above. See the data appendix on the New England Public Policy Center's website for a complete listing of vacancies and college-educated shares by occupation for New England.



**Figure 14. Labor demand in New England is projected to shift towards high-skill workers and remain relatively constant for middle-skill workers.**

Distribution of labor demand by educational attainment, selected years



Source: Author's calculations.

Notes: Total number of jobs in 2009 is the sum of total employment as reported by the U.S. Bureau of Labor Statistics plus the number of vacancies as reported by The Conference Board Help Wanted OnLine™ (HWOL) data series. Total number of jobs in 2018 is calculated by applying the 2008-2018 growth rates as projected by the U.S. Bureau of Labor Statistics for the U.S. to 2008 employment for both the region and the nation separately. Employment for 2006, 2009, and the 2018 lower-bound demand measure is categorized by skill level using educational attainment by detailed occupation from the 2006-08 combined American Community Survey. Employment for the 2018 upper-bound demand measure is categorized by skill level by applying the change in the education distribution for each detailed occupation between 2000 and 2006 to the current distribution of educational attainment from the 2006-08 combined American Community Survey. See the data appendix on the New England Public Policy Center's website for details.

expected shifts in demand across industries during the decade. The shifts in demand are used to forecast changes in employment by detailed occupations, taking into account both new job growth as well as the need to replace retirees. It should be noted that historically, BLS has under-predicted the growing demand for professional and managerial occupations.<sup>36</sup>

We then assign jobs to different levels of education using the current distribution of educational attainment for each detailed occupation. The distribution reflects the share of workers at each education level within each detailed occupation based on the 2006–2008 American Community Survey. For example, among respiratory therapists, roughly 1 percent had less than a high school degree, 3 percent were high school graduates, 12 percent had some college, 57 percent had an associate's degree, 24 percent had a bachelor's degree, and 4 percent had an advanced degree. Thus, the roughly 5,000 jobs in New England projected for respiratory therapists would be parsed out by education level according to that distribution. Unlike previous studies, this procedure allows us to capture the variation across education categories within occupations rather than assigning all jobs in an occupation to a single education level.

We then sum employment over all occupations by education level to get the total number of workers demanded by each category (less than high school, high school, some college, associate's degree, bachelor's degree, advanced degree). This is what we think of as “maintaining the status quo”—the distribution of workers that employers would demand if they were to fill both old vacancies and new job openings with workers who have the same level of education as those who hold those types of jobs now. As such, we consider this to be a lower bound on the demand for workers with postsecondary education and training. That is because by using the current education distribution, our measure will only capture how demand is likely to change given changes in employment *across* occupations with different educational attainment, holding the educational distribution of workers within those occupations constant at the levels that prevailed in 2009.<sup>37</sup>

However, we have seen that as much as 60 percent of the increase in labor demand for college graduates stems from an increase in demand *within* occupations for workers with postsecondary training. To address this, we calculate the change in the education distribution for each detailed occupation between 2000 and 2006 and apply the change to the current distribution to project what demand by each education category would look like if the prevailing trends continued. We then apply this new education distribution to our employment projections to get an upper bound for labor demand by education level. That is what we think of as “upskilling”—the projected distribution of workers that employers would demand if they were to fill both old vacancies and new job openings with workers who have increased their level of education to a similar degree as workers who have held those jobs in the past. As such, we consider this to be an upper bound on the demand for workers with postsecondary education and training.

As a point of comparison, we also show the distribution of workers demanded by level of education for 2006—the most recent “peak” in the business cycle. Demand for 2006 is the sum of employment plus the number of job vacancies by detailed occupation using the Conference Board’s Help Wanted On-Line (HWOL) Index.<sup>38</sup> We parse out job vacancies using the same distribution of educational attainment that is applied to employment. This reference point can be used to gauge how demand has changed since the peak of the last business cycle in 2006.

Our projections show that labor demand in New England over the coming decade will continue to shift toward high-skill workers while remaining constant for workers in the middle of the education distribution. Our lower bound measure indicates that the share of employment for high-skill workers—those with a bachelor’s degree or higher—will increase from 29.3 percent in 2006 to 30.1 percent by 2018 (see Figure 14). The share of jobs in the middle of the education distribution—those with less than a bachelor’s degree or more than a high school degree—will hold steady at 32.5 percent. The share of jobs held

by low-skill workers—those with a high school degree or less—will decrease over time but still account for 37.4 percent of total employment as of 2018. A similar trend is projected for the nation, although low-skill jobs account for a greater share of employment compared with New England.<sup>39</sup> Taking into account potential shifts in labor demand for skilled workers *within* occupations due to changes in technology or other market forces, our upper bound measure enhances these trends.

Projections of future employment indicate rapid growth among broad occupation groups that employ a high share of college-educated workers. Across major occupation categories, new job growth is expected to be greatest in office and administrative support, healthcare practitioners and technical occupations, sales, and business and financial operations. However, these employment opportunities will vary considerably by education level for workers in New England. For example, among middle-skill workers, new job growth will be concentrated in healthcare, office and administrative support, and sales (see Table 5, next page). High-skill workers will find most new jobs in business and financial operations, computer and mathematical science occupations, education, and healthcare. Relative to the nation, the region is expected to have a greater share of job openings in key industries such as business and financial operations, education, and healthcare.

Moreover, job growth within these major occupation categories is concentrated in a few key areas—particularly for middle-skill workers. For example, middle-skill workers in the healthcare field will find the greatest opportunities exist for those trained as registered nurses, various types of medical therapists and assistants, and home health aides—almost identical to those where critical job vacancies currently exist.<sup>40</sup> Similarly, within the office and administrative support occupations, the greatest number of openings will exist in occupations such as supervisors, executive secretaries and administrative assistants, and medical and legal secretaries. Note that many of these jobs involve tasks that require personal interaction or abstract thinking and are unlikely to

**Table 5. Projections of future employment indicate rapid growth among broad occupation groups that employ a high share of college-educated workers.**

Distribution of employment by educational attainment for major occupation groups, 2009 and 2018

New England							
		"Low-skill"		"Middle-skill"		"High-skill"	
	TOTAL	Less than high school	High school graduate	Some college	Associate's degree	Bachelor's degree	Advanced degree
Total number of jobs (employment plus vacancies), 2009	6,860,444	742,548	1,826,403	1,618,827	607,756	1,334,358	730,552
Total number of jobs (replacement plus new jobs), 2018	7,601,783	822,283	2,018,933	1,795,522	676,863	1,480,504	807,677
Net new jobs	741,339	79,735	192,530	176,695	69,107	146,146	77,125
Growth rate 2009-2018		10.6		11.0		10.8	
<b>Percent of job growth in each education category by major occupational group:</b>							
Management occupations	0.6	0.2	0.3	0.5	0.5	0.9	1.1
Business and financial operations occupations	8.4	1.0	3.9	6.8	8.3	17.5	13.7
Computer and mathematical science occupations	3.8	0.2	0.7	2.4	3.3	8.9	9.4
Architecture and engineering occupations	1.1	0.1	0.3	0.6	1.3	2.7	2.5
Life, physical, and social science occupations	1.7	0.2	0.4	0.8	0.9	3.1	6.8
Community and social services occupations	2.9	0.6	1.4	2.3	2.5	5.1	6.2
Legal occupations	1.2	0.1	0.4	0.8	1.4	1.3	5.1
Education, training, and library occupations	8.8	1.5	3.0	4.8	5.1	15.0	31.2
Arts, design, entertainment, sports, and media occupations	0.9	0.2	0.3	0.7	0.9	2.2	1.2
Healthcare practitioners and technical occupations	7.0	0.6	2.2	4.9	22.7	10.0	10.6
Healthcare support occupations	6.9	7.9	9.9	9.7	6.6	2.1	1.3
Protective service occupations	2.2	1.5	2.5	3.2	2.8	1.5	0.4
Food preparation and serving related occupations	7.2	21.5	9.4	7.3	3.1	1.8	0.4
Building and grounds cleaning and maintenance occupations	3.0	9.8	4.4	2.0	1.3	0.7	0.2
Personal care and service occupations	4.2	6.2	5.6	4.8	3.5	2.7	1.2
Sales and related occupations	7.5	6.9	7.9	9.0	6.0	8.4	3.0
Office and administrative support occupations	16.1	6.9	19.5	24.6	18.4	11.8	4.0
Farming, fishing, and forestry occupations	0.1	0.3	0.2	0.1	0.0	0.0	0.0
Construction and extraction occupations	7.5	18.6	12.6	6.2	4.1	1.8	0.6
Installation, maintenance, and repair occupations	3.4	4.5	5.3	3.7	4.0	1.0	0.4
Production occupations	1.6	3.3	2.8	1.5	1.0	0.3	0.1
Transportation and material moving occupations	4.0	8.0	7.1	3.5	2.1	1.2	0.4
TOTAL	100%						

be outsourced and/or automated in the future, unlike other middle-skill jobs such as telemarketers, clerks, and computer operators.

### **Future supply of skilled labor is likely to be constrained**

How will the education/skill levels of the population change over time for New England and the nation? To examine this, we use a cohort component model that "ages" the

current population (as of 2009) over time by adding in births and in-migrants and subtracting out deaths and out-migrants.<sup>41</sup>

Our projections indicate that the working-age population in New England will stagnate and even shrink over the next two decades while that of the nation will grow. The region's population of individuals aged 25 to 64 years is projected to grow by only 2.2 percent between 2009 and 2019 and then shrink by 3.1 percent

Table 5. continued

United States							
	TOTAL	“Low-skill”		“Middle-skill”		“High-skill”	
		Less than high school	High school graduate	Some college	Associate's degree	Bachelor's degree	Advanced degree
Total number of jobs (employment plus vacancies), 2009	133,171,111	15,916,308	37,762,331	31,916,642	11,408,842	23,753,298	12,413,690
Total number of jobs (replacement plus new jobs), 2018	148,796,652	17,877,359	42,196,935	35,650,622	12,786,499	26,478,058	13,807,179
Net new jobs	15,625,541	1,961,051	4,434,604	3,733,980	1,377,657	2,724,760	1,393,489
Growth rate 2009-2018		11.9		11.8		11.4	
<b>Percent of job growth in each education category by major occupational group:</b>							
Management occupations	0.9	0.3	0.6	0.8	0.9	1.7	1.8
Business and financial operations occupations	6.5	0.7	2.6	5.1	6.8	15.5	12.5
Computer and mathematical science occupations	2.9	0.2	0.6	2.1	3.0	7.4	7.4
Architecture and engineering occupations	1.6	0.2	0.6	1.2	2.4	3.6	3.3
Life, physical, and social science occupations	1.1	0.1	0.2	0.5	0.6	2.4	5.4
Community and social services occupations	1.7	0.3	0.6	1.2	1.4	3.4	5.5
Legal occupations	0.9	0.1	0.3	0.6	1.0	1.1	4.5
Education, training, and library occupations	7.0	0.8	1.9	3.5	4.1	13.7	31.0
Arts, design, entertainment, sports, and media occupations	1.3	0.5	0.5	1.2	1.3	3.1	1.7
Healthcare practitioners and technical occupations	6.5	0.5	2.1	5.0	20.6	10.0	12.5
Healthcare support occupations	5.8	5.4	7.4	8.2	6.2	2.1	1.4
Protective service occupations	2.0	1.2	2.1	2.8	2.7	1.8	0.7
Food preparation and serving related occupations	7.4	18.0	9.2	7.4	3.5	2.1	0.5
Building and grounds cleaning and maintenance occupations	3.2	8.9	4.2	2.2	1.5	0.9	0.3
Personal care and service occupations	4.2	5.2	5.0	5.1	3.6	3.0	1.3
Sales and related occupations	7.7	7.0	7.6	9.1	6.3	9.2	3.4
Office and administrative support occupations	15.4	6.3	17.4	23.1	18.1	12.4	4.2
Farming, fishing, and forestry occupations	0.1	0.2	0.1	0.1	0.1	0.1	0.0
Construction and extraction occupations	10.3	23.5	15.5	8.1	5.6	2.7	1.0
Installation, maintenance, and repair occupations	3.8	4.4	5.6	4.1	4.5	1.1	0.4
Production occupations	3.7	6.4	6.1	3.2	2.3	0.9	0.4
Transportation and material moving occupations	6.0	10.1	9.8	5.4	3.3	1.9	0.7
TOTAL	100%						

Sources: Total number of jobs in 2009 is the sum of total employment as reported by the U.S. Bureau of Labor Statistics plus the number of vacancies as reported by The Conference Board Help Wanted OnLine™ (HWOL) data series. Total number of jobs in 2018 is calculated by applying the 2008-2018 growth rates as projected by the U.S. Bureau of Labor Statistics for the U.S. to 2008 employment for both the region and the nation separately. The distribution of jobs across education levels is our lower bound measure which is based on the actual distribution of educational attainment from the 2006-08 combined American Community Survey.

Notes: All calculations are performed at the 6-digit SOC level for detailed sub-occupations and aggregated up.

between 2019 and 2029 (see Table 6, next page). The growth of the labor force, or the number of individuals who will choose to work, is projected to be even less favorable in New England over the next two decades. In contrast, the nation's labor force is projected to grow by 10.1 percent between 2009 and 2019 and 9.2 percent between 2019 and 2029. Note that the foreign-born population is the engine of population growth in

both the region and the nation.<sup>42</sup>

Moreover, the composition of the region's labor force will shift to include a greater share of minority and immigrant populations, although to a lesser degree than the nation. For example, the share of New England's labor force that is non-Hispanic white falls from 83.0 percent in 2009 to 64.3 percent by 2029 (see Table 6). Among the region's minority

**Table 6. Projections of future labor supply indicate that New England’s labor force will stagnate and shift to include a greater share of minority and immigrant populations.**

Individuals aged 25-64 years

New England								
	Growth			Racial/ethnic composition as a percent of population				
Population	Total	Foreign-born	Native	White	African-American	Hispanic	Asian	Other
2009	7,829,232	1,345,275	6,483,957	82.1	5.4	7.6	3.9	1.0
2019	8,001,283	1,774,001	6,227,283	73.9	7.0	11.9	5.7	1.6
2029	7,753,133	2,200,647	5,552,486	63.0	8.5	17.8	8.1	2.5
Percent change, 2009-19	2.2	31.9	-4.0					
Percent change, 2019-29	-3.1	24.0	-10.8					
Labor force								
2009	6,293,104	1,034,096	5,259,008	83.0	5.1	7.1	3.8	1.0
2019	6,347,305	1,364,177	4,983,128	74.9	6.7	11.3	5.7	1.5
2029	6,125,060	1,688,346	4,436,714	64.3	8.2	16.8	8.2	2.5
Percent change, 2009-19	0.9	31.9	-5.2					
Percent change, 2019-29	-3.5	23.8	-11.0					

United States								
	Growth			Racial/ethnic composition as a percent of population				
Population	Total	Foreign-born	Native	White	African-American	Hispanic	Asian	Other
2009	162,475,710	29,669,137	132,806,573	66.8	12.0	14.4	5.0	1.8
2019	180,816,460	43,775,450	137,041,010	58.2	13.0	20.2	6.4	2.3
2029	197,189,999	60,841,257	136,348,742	48.4	13.2	27.4	8.1	3.0
Percent change, 2009-19	11.3	47.5	3.2					
Percent change, 2019-29	9.1	39.0	-0.5					
Labor force								
2009	124,943,920	22,438,624	102,505,296	67.9	11.3	14.0	5.1	1.7
2019	137,594,448	33,091,778	104,502,672	59.1	12.4	19.7	6.5	2.2
2029	150,234,688	45,744,928	104,489,760	59.1	12.4	19.7	6.5	2.2
Percent change, 2009-19	10.1	47.5	1.9					
Percent change, 2019-29	9.2	38.2	0.0					

Source: Author’s calculations.

Notes: Supply projections are made by using a cohort-component model which ages the current population (as of 2009) over time by adding in births and in-migrants and subtracting out deaths and out-migrants. Calculations are made for individuals aged 25-64 years broken down by 5-year age cohorts, nativity, gender, and race/ethnicity. See the data appendix on the New England Public Policy Center’s website for details.

populations, the greatest increase is in the share of Hispanic workers, which more than doubles from 7.1 percent in 2009 to 16.8 percent in 2029. Similar but more dramatic shifts are projected for the national level. By 2029, the share of the nation’s workforce that is non-Hispanic white falls just below 60 percent.

The changing number and composition of the labor force illustrate two countervailing forces at work over the coming decades that will determine the supply of skilled labor in both New England and the United States. The

first is the changing composition of the labor force across both nativity and racial groups as immigrants and minorities become an increasing share of the population. That is likely to place downward pressure on the educational attainment of the population as foreign-born and minority groups are typically less educated than the native white population in New England, although they generally have higher educational attainment than their counterparts nationwide.<sup>43</sup> This will be ameliorated to some extent by the second force—rising educational

attainment across age cohorts as younger cohorts become increasingly more educated than older cohorts—even *within* racial and ethnic groups.<sup>44</sup>

Given the changing composition of the population over the next two decades, what will the distribution of educational attainment look like? To account for both of these countervailing trends, we take the projected population broken down by age, nativity, gender, and race/ethnicity and “assign” educational attainment to both entering and current cohorts based on recent trends in educational attainment.<sup>45</sup> We then sum the number of individuals over all cohorts by each education category to get the total number of workers aged 25 to 64 years that is “supplied” by each education level.

As with the demand side projections, we project both a lower and an upper bound for future labor supply. As a first step, we calculate the current distribution of educational attainment for population group by five-year age cohort, nativity, gender, and race/ethnicity for both New England and the United States using the 2006–2008 American Community Survey. Using this distribution, we assign entering cohorts the same distribution as those of similar demographic characteristics.<sup>46</sup> This is what we call our “lower bound” estimate of educational attainment because it reflects only changes in the composition of the population with no advancements in the rate of educational attainment. Note that this is the projection most commonly used by other researchers—as such our “lower bound” estimates are most directly comparable to other studies of this type.

Yet studies have shown that individuals, particularly minorities, often continue to obtain additional education and training over time as they age.<sup>47</sup> To address this, we allow current cohorts (up to age 39) to acquire additional education over the decade at the same rate as their age cohort has done in the past. We do this using the change in educational attainment by age, nativity, gender, and race/ethnicity between the 1990 and 2000 Census.<sup>48</sup> This is what we call our “upper bound” estimate of educational attainment because it reflects both changes in the composition of the

population while also allowing current cohorts to increase their educational attainment over the life cycle.

Our projections show that the changing composition of the working-age population does indeed put downward pressure on educational attainment, but that is likely to be ameliorated to some degree by individuals continuing to obtain education and training over time. For example, holding educational attainment patterns constant, our “lower bound” estimates show that the shift in the region’s population toward groups with lower levels of education would serve to increase the share of the population with less than a high school degree from 9.0 percent in 2009 to 9.9 percent in 2029 while that of high school graduates is projected to fall (see Table 7, next page). Similarly, the share of individuals with only some college would likely rise while the share completing an associate’s degree is projected to fall. And although the share with a bachelor’s degree would likely continue to rise, the share with an advanced degree is projected to fall.

Yet if we assume individuals continue to obtain additional education over the cycle—at the rate that previous cohorts have done in the past—our “upper bound” estimates suggest that these downward trends would be reversed to some degree. For example, the share of the population with less than a high school degree in 2029 would be roughly equivalent to what it was in 2009 (see Table 7). Moreover, the share of the population with a bachelor’s or advanced degree actually increases. However, while the share of individuals with some college is projected to increase slightly, the share completing an associate’s degree still falls by 1 percentage point. That is because completion rates at the associate’s degree level are low (roughly 30 percent for an associate’s versus 60 percent for a bachelor’s degree) and have shown little improvement over the past decade; even if more high school graduates choose to attend community college, degree completion rises by much less.

It is important to note that New England will continue to lead the nation in terms of educational attainment, with one

**Table 7. Projections of educational attainment reveal that the changing composition of the population will put downward pressure on the skill acquisition of the labor force but that this is likely to be ameliorated by individuals continuing to obtain education and training over their lifetimes.**

All Individuals aged 25-64 years

New England						
	Less than high school	High school graduate	Some college	Associate's degree	Bachelor's degree	Advanced degree
<b>Actual 2009</b>	9.0	27.7	17.5	8.6	22.4	14.8
<b>Lower bound: holding educational attainment patterns constant</b>						
2019	9.0	27.2	17.8	8.3	24.1	13.6
2029	9.9	26.5	18.0	7.6	24.9	13.2
<b>Upper bound: allowing educational attainment to increase over lifecycle</b>						
2019	8.7	26.6	17.9	8.4	23.9	14.6
2029	9.1	25.4	18.2	7.7	24.4	15.2

United States						
	Less than high school	High school graduate	Some college	Associate's degree	Bachelor's degree	Advanced degree
<b>Actual 2009</b>	13.2	28.5	20.9	8.3	18.7	10.4
<b>Lower bound: holding educational attainment patterns constant</b>						
2019	14.4	27.8	20.8	8.3	19.4	9.2
2029	16.3	27.1	20.6	7.9	19.6	8.5
<b>Upper bound: allowing educational attainment to increase over lifecycle</b>						
2019	13.9	27.4	21.0	8.3	19.5	9.9
2029	15.3	26.2	21.0	7.8	19.8	10.0

Source: Author's calculations.

Notes: Supply projections are made by using a cohort-component model which ages the current population (as of 2009) over time by adding in births and in-migrants and subtracting out deaths and out-migrants. The actual supply distribution for 2009 is calculated using the 2006-2008 combined American Community Survey. The lower bound estimates are made by assigning the 2006-2008 education distribution for those aged 25-29 and 30-34 as of 2009 to those individuals who will be aged 25-29 and 30-34 in 2019. The upper bound estimates are made by also assigning additional educational attainment for those aged 25-29, 30-34, and 35-39 based on the change in educational attainment for similarly aged cohorts between the 1990 and 2000 Census. See the data appendix on the New England Public Policy Center's website for details.

key exception—the middle of the distribution. Across both sets of estimates, the region has a smaller share of individuals with less than a high school degree and a greater share of individuals with a bachelor's degree or higher. Those advantages are projected actually to increase over time, primarily because the nation will experience greater shifts in population toward minority and foreign-born groups. However, in the middle of the distribution, the region is not projected to experience any relative advantage (see Table 7).

If we restrict our analysis to those who are likely to participate in the labor force, these trends are even more apparent. That is

because labor force participation rates among those with less education are typically lower than those with any postsecondary education or training. Applying current labor force participation rates to each demographic group, we see that the future distribution of educational attainment among New England's labor force participants will shift downward, with fewer high school graduates, associate's degree holders and advanced degree recipients (see Figure 15).

### Will there be a mismatch?

How will the education/skill levels of future labor force participants stack up against those



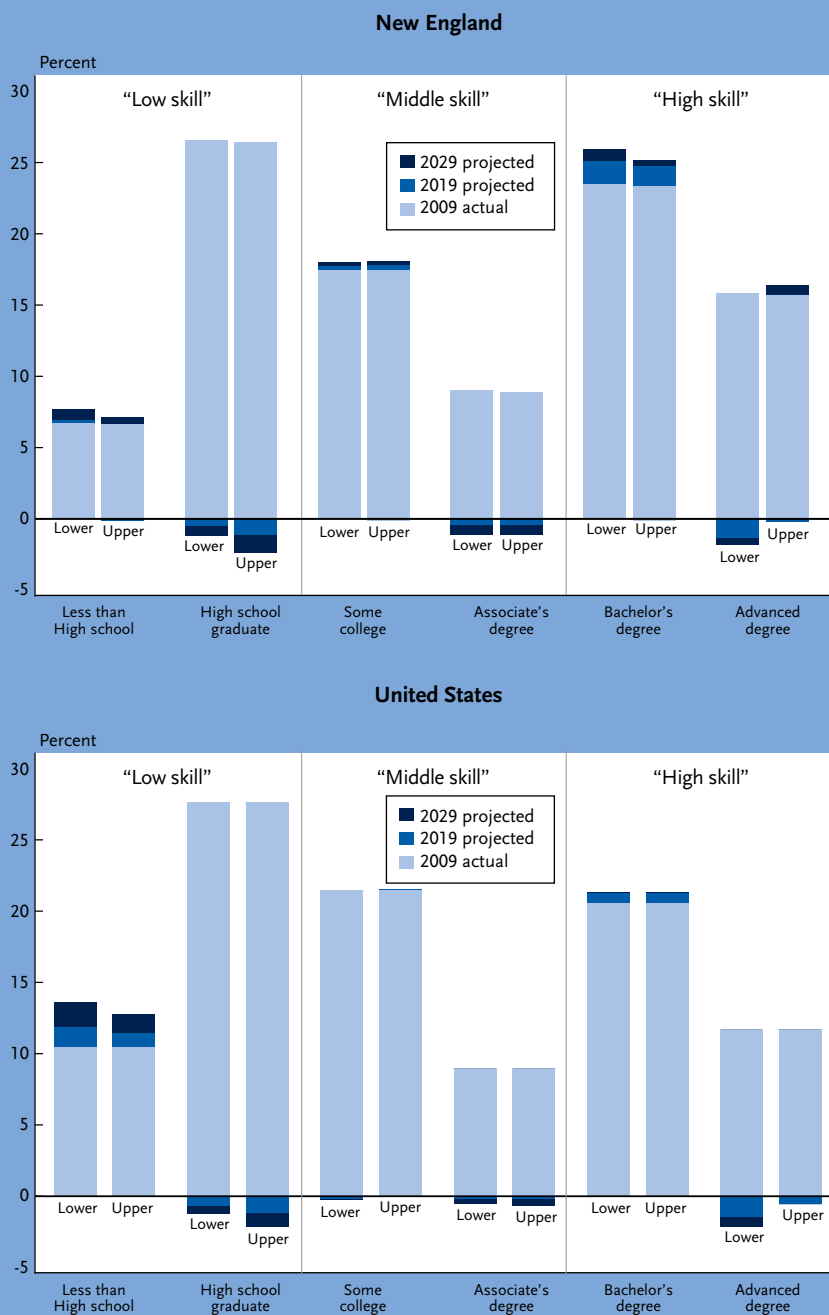
demand by firms over the next decade? To examine this, we draw on our labor demand and labor supply projections from the previous two sections. Based on those calculations, the number of jobs for middle-skill workers is expected to increase by 6 to 11 percent in New England while the number of workers is expected to increase by only one-half of a percent to a full percent. Similarly, the number of high-skill jobs is expected to increase by 11 to 25 percent while the supply of such workers is likely to rise by only 2 to 4 percent.

However, growth rates alone do not tell the whole story, as we are not necessarily beginning at a point of equilibrium in the labor market. To better assess any potential imbalances, we compare the future number and mix of jobs projected by education category to the future number and share of labor market participants by education level. We focus on both aspects because even if the share of jobs and workers is distributed similarly, we may still find an imbalance within particular segments of the labor market if the total number of workers is insufficient, as has been indicated by our earlier projections.

Our projections show that by 2018, the number of workers demanded in New England is projected to exceed supply and this imbalance will not be distributed evenly across skill categories. While labor demand for 2018 is projected to increase relative to peak demand in 2006, the region's total supply of labor is likely to fall by 2029 as the baby boom generation retires (see Figure 16, next page). Large gaps will occur for jobs that typically employ workers with a high school degree, some college, or an associate's degree. If we include younger workers aged 15 to 24 years, this serves to alleviate the gap in the high school category, yet large gaps in the middle-skill categories remain. In contrast, the United States is projected to have a smaller imbalance between the supply and demand for workers in those education categories. For example, the number of middle-skill workers is projected to fall short of demand by roughly 15 percent nationwide versus a 30 percent shortfall in New England.

Yet there are likely to be some labor market adjustments over the next decade in

**Figure 15. Relative to the nation, the skill mix of New England's labor force is likely to continue to be skewed towards those with a Bachelor's degree or higher.**



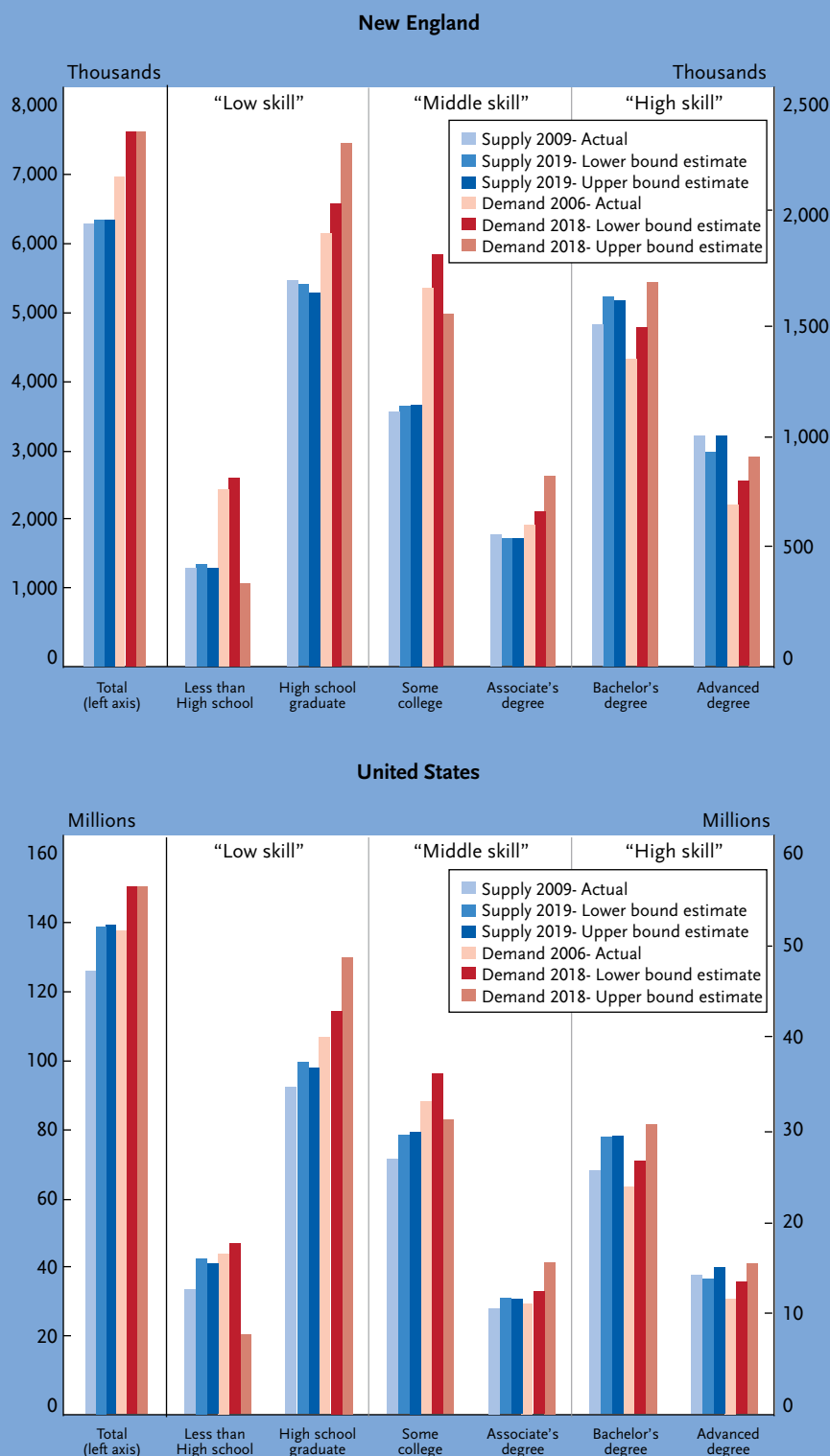
Source: Author's calculations.

Notes: See notes on Figure 15 for supply-side estimates. See notes on Figure 14 for demand-side estimates. See the data appendix on the New England Public Policy Center's website for details.

response to these gaps on the part of both employers and workers. As we have shown, the demand for skilled workers has outpaced supply since the 1980s. In the future, we can expect to see some of the same adjustments

**Figure 16. The number of workers in New England is projected to fall short of demand, but this imbalance will not be distributed evenly.**

Labor force participants aged 25-64 years



Source: Author's calculations.

Notes: See notes on Figure 15 for supply-side estimates. See notes on Figure 14 for demand-side estimates. See the data appendix on the New England Public Policy Center's website for details.

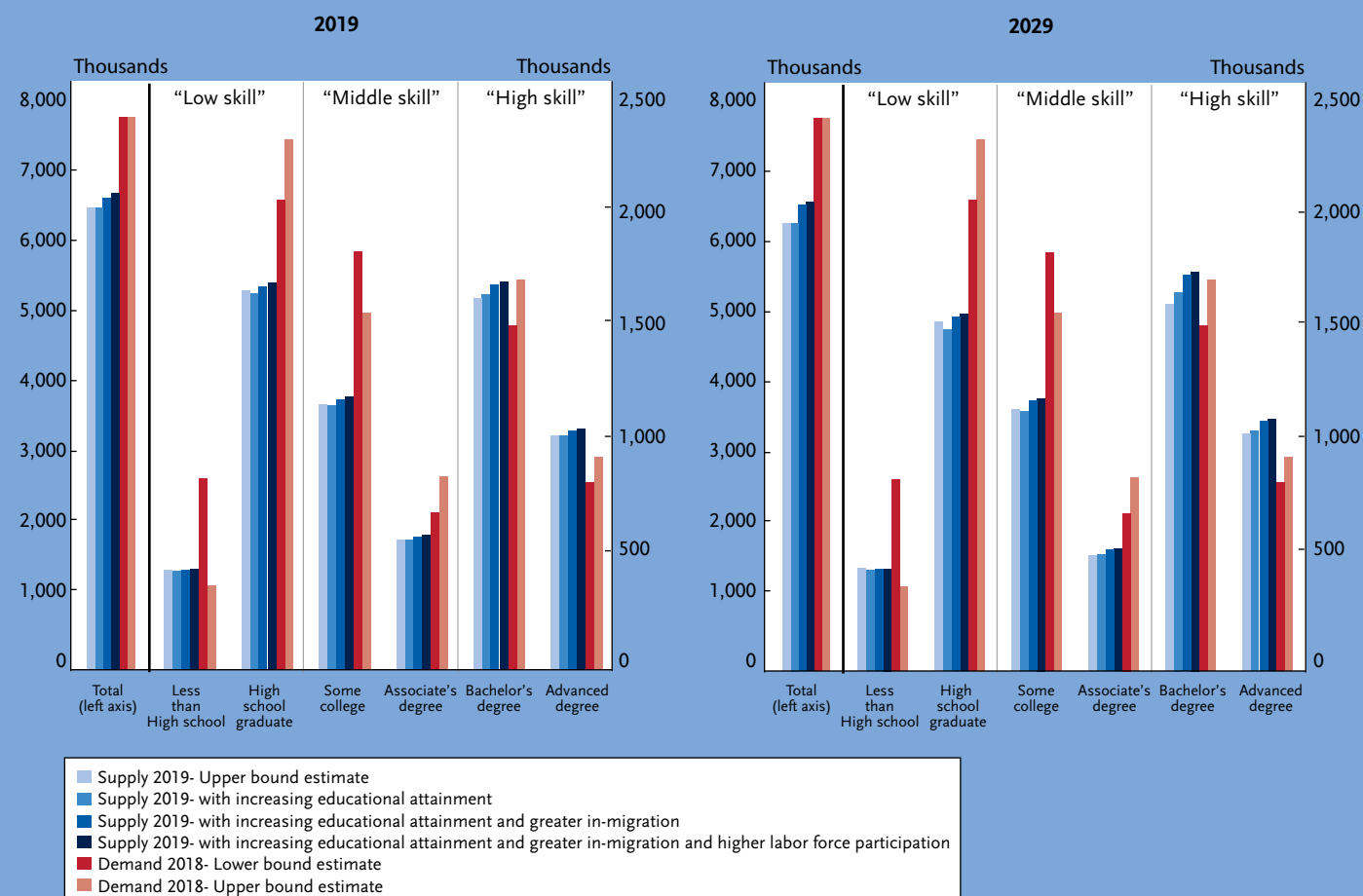
that occurred in recent decades, although they are likely to be magnified as the growth in the supply of college-educated workers will be constrained. As the demand for college-educated workers rises, so will their wages, increasing the wage premium for those with any postsecondary education and training. Younger workers are likely to respond by migrating into the area from other parts of the country. Moreover, older workers may choose to stay in the labor force longer, delaying retirement due to portfolio losses suffered during the Great Recession. In the long run, entering cohorts of workers are likely to obtain more education and training in response to higher wages.

To capture the increasing educational attainment of new labor force participants, we extrapolate from the experiences of recent cohorts. Over the past decade, high school graduation rates and college continuation rates have increased for most groups.<sup>49</sup> Similarly, college completion rates have also increased over time, although not as uniformly across groups.<sup>50</sup> Extrapolating from these historical trends, we assume relatively modest increases in educational attainment for native entering cohorts—particularly since educational attainment has typically increased more rapidly in New England compared with the nation in the past.<sup>51</sup>

To account for greater in-migration among younger workers, we use the typical response rates for workers with varying levels of education from earlier labor market studies. Previous research has found that workers with greater levels of educational attainment are more likely to migrate in response to job opportunities possibly due to having greater information about labor market opportunities in other areas or greater financial resources for moving.<sup>52</sup> Moreover, the migration response is larger among younger versus older workers within each education category. Based on estimates from the literature, we assume a positive in-migration response of 5 percent for those with a bachelor's degree or higher, 2.5 percent for those with some college or an associate's degree, and zero for those with a high school degree or less. We apply these migration rates to labor force participants aged 25 to 39 years.

**Figure 17. Increasing educational attainment, greater in-migration, and higher labor force participation are not likely to meet projected labor demand for the region.**

Labor force participants aged 25-64 years



Source: Author's calculations.

Notes: See notes on Figure 15 for supply-side 2019 upper bound estimate. Estimates for increasing education attainment, greater in-migration, and higher labor force participation are based on historical trends and estimates responses from the literature. See notes on Figure 14 for demand-side estimates. See the data appendix on the New England Public Policy Center's website for details.

To account for greater labor force participation among older workers in response to the Great Recession, we use the typical increase associated with a change in retirement assets. A recent study by the Urban Institute found that older workers are delaying retirement as a result of the portfolio losses associated with the financial crisis and as firms have moved away from contributions to defined benefit plans.<sup>53</sup> The authors estimate that the labor force participation rate of older workers has increased by roughly 5 percent in response to these pressures. We assume that workers age 55 to 64 years will increase their labor force participation rates by the same amount across education levels.

Despite these adjustments to account for market forces, labor supply in New England continually falls short of labor demand. Our simulations show that additional educational attainment in response to rising wage premiums based on recent trends is not likely to be large enough to fill the projected skills gap over the next two decades—particularly among middle-skill workers (see Figure 17).<sup>54</sup> For example, whereas the number of high-skill workers is projected to increase by 3 percent, the number of middle-skill workers is projected to increase by less than half a percent. This is primarily due to the lower college continuation and college completion rates for those attending two-year institutions.<sup>55</sup> To get a similar increase in the

number of middle-skill workers, college continuation rates for entering cohorts would have to increase by 20 percent across all racial and ethnic groups immediately. For example, this would mean that approximately 70 percent of Hispanic high school graduates would be expected to go on to college whereas roughly 59 percent do now.

Adding in the potential migration response of younger workers shows that migration is also unlikely to be able to fill the gap between the projected demand and supply of skilled workers (see Figure 17). To meet the projected demand for middle-skill workers, net migration among individuals with either some college or an associate's degree into New England would need to increase by 67,000 to 78,000 annually and remain at that level over the coming decade. Yet the region typically experiences net out-migration each year—especially among those with greater levels of education.<sup>56</sup> Although the region has experienced less out-migration during the Great Recession, this may only be a temporary phenomenon. Previous research shows that New England has been losing fewer residents to other parts of the country in recent years in large part because economic conditions in the region have been slightly better than the nation and households have not been as mobile due to the drop in the housing market.<sup>57</sup> As economic conditions in the rest of the nation improve relative to the region during the recovery, New England is likely to experience increasing out-migration once again. Regardless, even as of 2009, among the six New England states only Massachusetts had a small net positive influx of individuals, while the region as a whole still lost roughly 17,000 individuals on net to the rest of the nation.<sup>58</sup>

Finally, if we also take into account the potential for higher labor force participation among older workers, our simulations illustrate that even under the best case scenario, labor supply is not likely to be large enough to meet projected labor demand by 2018 (see Figure 17). By our calculations, even if workers currently aged 55 years and older were to delay their retirement by five years, this would only fill roughly 40 percent of the gap between the projected demand and supply of middle-skill

workers. A five year delay in retirement for middle-skill workers would imply a significant increase in labor force participation, increasing current rates by 10 percent among those aged 55 to 59 years, 20 percent for those aged 60 to 64 years, and 50 percent for those aged 65 years and older. Such a sharp jump in the share of older workers choosing to work is unlikely to occur. Moreover, any boost from the delayed retirement of the baby boom generation would be temporary as this cohort will inevitably leave the labor force at some point in the future.

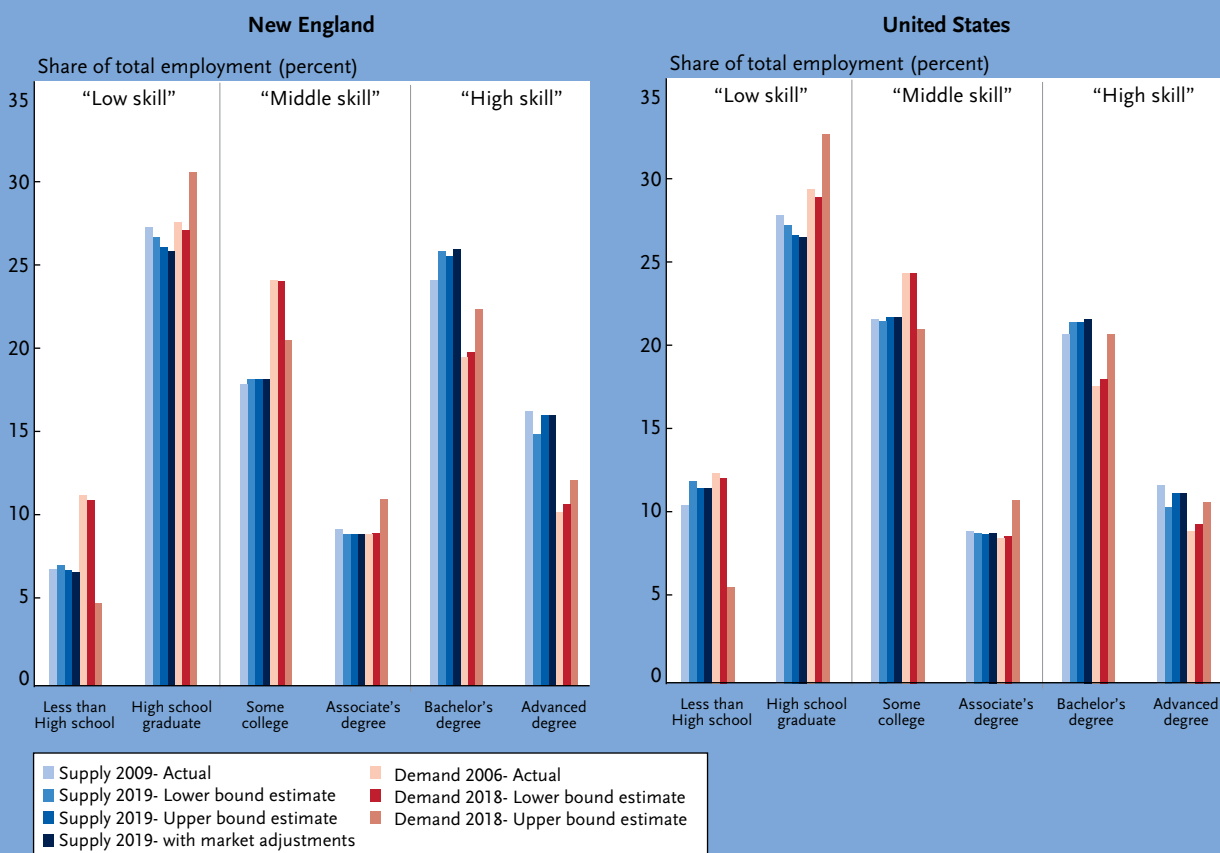
Much of what is driving our analysis thus far is the overall shortfall in the *number* of workers that New England will face in the coming decades. Even if all individuals aged 25 to 64 years were in the labor force, the number of middle-skill workers would still fall short of the projected demand. Yet how well does the overall *mix of skills* likely to be demanded by employers match up with the shares of the population by education level? Looking at the relative distribution of jobs versus workers indicates that any potential mismatch is likely to be largest among those in the “middle-skill” category (see Figure 18). In this category, labor supply is likely to fall short of demand by 4 to 6 percent in New England versus 1 to 2 percent for the nation—even including our market adjustments. To meet the projected gap in New England, college continuation among entering cohorts would have to increase by 50 percent across all racial and ethnic groups immediately. Such a large and immediate gain is clearly not attainable; this rough calculation is simply meant to demonstrate the magnitude of change that would be required. However, if the college continuation rate of both entering and existing cohorts (up to age 39) were raised by 20 percent, the gap would be reduced by one-third to one-half over the course of the decade.

## Summary of findings

The evidence presented here indicates that although New England currently has many more workers seeking employment than job opportunities, in the long run the supply of skilled workers is not likely to keep pace with demand over the next two decades. Moreover, although these underlying trends are not unique to the

**Figure 18. The mismatch between labor demand and supply in the middle of the labor market is projected to be greater in New England versus the nation.**

Distribution of labor supply and labor demand by educational attainment, 2019



Source: Author's calculations.

Notes: See notes on Figure 15 for supply-side estimates. See notes on Figure 14 for demand-side estimates. See the data appendix on the New England Public Policy Center's website for details

region, New England will likely face even greater challenges in maintaining an adequate supply of skilled workers compared with the nation—particularly those required to fill “middle-skill” jobs that require some postsecondary education but less than a bachelor’s degree.

### Our main findings suggest that:

- Since 1990, the region’s population of working-age adults with any postsecondary education and training has been growing more slowly than that in the rest of the United States due to a combination of slower population growth and greater net domestic out-migration.
- Yet high and rising rates of educational attainment have helped New England

increase the percentage of its population with postsecondary training. However, while the region has led the nation in terms of increasing the “high-skill” share of its population (individuals with a bachelor’s degree or higher), it has consistently performed below average in terms of increasing the share of “middle-skill” workers (individuals with some college or an associate’s degree).

- New England employers are willing to pay a premium for workers with any postsecondary education despite there being more of them. Moreover, this premium has been growing over time, indicating that the demand for such workers has continued to outpace their supply. While this situation

is not unique to the region, New England differs from the nation in one important regard: The imbalance between the supply and demand for labor is greatest among “middle-skill” workers—those with some college or an associate’s degree.

- Most of the increased demand for college-educated workers in both New England and the nation comes from greater employment of college-educated workers within industries and occupations, indicating that this trend is not just isolated to a few key sectors of the economy but rather is fairly widespread. Although these trends are not unique to New England, job vacancy rates indicate that the region’s supply of skilled labor may be constrained relative to that of the nation in key sectors of the economy such as management, business and financial operations, computer and mathematical sciences, and healthcare.
- Looking forward, our labor supply projections suggest that New England’s labor force will likely shrink over time while that of the nation is likely to grow. More importantly, shifts in the composition of the population will constrain the educational attainment of future workers in both the region and the nation.
- Our projections of future demand indicate that the supply of skilled workers—particularly those in the middle of the labor market—will not grow fast enough to keep pace with demand once the economy recovers. Simulations of market adjustments in response to higher wages for skilled workers such as increased educational attainment, greater in-migration of college-educated workers, and higher labor force participation among older workers do little to change this picture.

The methodology used in this report takes a more detailed approach than previous studies, yet a few caveats are in order. For example, our measures of “skill” rely on the educational distribution of individuals currently employed within each detailed occupation. As we have already noted, using educational attainment at the detailed occupation level (e.g. radiation therapists) accounts for the variation in skill

found within broad occupation groups (e.g. healthcare practitioners), reducing the potential for over-estimating the share of jobs by each skill level.

In addition, our projections capture the distribution of workers that employers would demand if they were to fill both old vacancies and new job openings with workers who have the same level of education as those who hold those types of jobs now. As such, we do not make any subjective judgments as to whether a particular occupation is “low-skill” or “high-skill” unlike those that rely on a particular classification system.<sup>60</sup> This allows us to capture occupations that may be in transition as employers respond to new technological advancements by employing workers with greater skill.

However, it should be noted that the demand projections for New England rely on the share of individuals in each detailed occupation with some postsecondary degree as observed at the national level. Yet our earlier comparisons indicated that New England employs a greater share of college-educated workers than the nation within each of the broad education categories. On the one hand, this reduces the potential for our demand projections to be driven by the greater supply of college-educated workers found in New England relative to the nation.<sup>61</sup> On the other hand, if one believes that the demand for college workers is not driven by their increasing supply, then our skill gaps for New England are likely to be underestimated.

In addition, data limitations will cause our analysis to mask potential shortfalls within certain occupations. This is particularly true of many middle-skill jobs that require specific technical training that cannot be met by more general post-secondary education. For example, having an abundance of individuals with some college or an associate’s degree will do little to alleviate the persistent shortage in registered nurses unless those individuals obtain a nursing degree.

All in all, the trends described in this report are not likely to be a temporary phenomenon. The demand projections reflect an ongoing trend that was well underway before



the Great Recession where technological change and other forces have been increasing the demand for more educated workers for decades. Similarly, the supply projections stem from demographic trends that have been on the horizon for quite some time and are likely to continue into the next decade and beyond. That said it is crucial to note that the future path of employment will be determined not only by the demands of employers and the skills of existing workers but also by future adaptations that we cannot anticipate. Yet despite the possibility of future market adjustments, we would argue that there is still a role for public policy. We discuss this debate in greater detail in the next section.

### **What role can *public policy* play in addressing the potential gaps in New England's labor force?**

Given the combination of slow population growth and the retirement of the baby boom generation, policymakers and business leaders in New England are worried that there will be too few workers to sustain economic growth and prosperity in the region. In addition, unfilled job vacancies in high-skill occupations, coupled with unemployment among low-skill workers, have led to increasing anxiety that there is a growing mismatch between the skills of the region's labor force and those demanded by New England employers. Finally, there has been a long-standing concern around the impact of persistent labor shortages in key industries and occupations and the long-term consequences for the region's ability to attract and retain both workers and firms.

### **We cannot rely on market responses alone**

In the short run, the economy will likely adjust to any skills mismatch through changes in wages, employment, and unemployment. In the past, rising wage premiums for those with a bachelor's degree have increased the supply of such workers through rising educational attainment, greater in-migration, and higher labor force participation. Yet workers in the middle of the skills distribution are less mobile

than those at the top, suggesting that raising wages may not attract enough migrants as demonstrated by our earlier simulations. Similarly, our estimates showed that relying on individuals to obtain additional education and training in response to wage differentials is not likely to meet future demand—a scenario that we have seen over time as wage premiums for those with any postsecondary education and training have been rising for decades.

Alternatively, employers may choose to hire less qualified individuals and provide more training. However, private sector training investments by firms are often limited due to a variety of market failures. For example, an employer may be reluctant to invest in training workers if it is fairly easy for other firms to hire workers away once they are trained. Typically, employers will hedge their bets by financing worker training through lower wages. However, this strategy may be less viable for middle-skill workers due to institutional constraints such as minimum-wage laws. Thus relying on the private sector to provide training for middle-skill workers is likely to result in suboptimal investments.

Labor force constraints may also provide an incentive for firms to invest more in capital, hence improving labor productivity and ameliorating the need for middle-skilled workers to some extent. Indeed, over the past several decades, firms have increasingly automated or outsourced routine tasks and jobs—many of which were held by middle-skill workers, resulting in job declines in particular industries and occupations. Yet the shift towards more flexible and non-routine tasks is evident both within and between education and occupation groupings, affecting workers throughout the economy.<sup>62</sup> For example, a recent study of off-shoring jobs finds that there is little or no correlation between an occupation's "offshorability" and the skill level of its workers.<sup>63</sup> Thus, the demand for middle-skill jobs that require manual or non-routine cognitive tasks is not likely to be met through additional automation or outsourcing on the part of firms.

Indeed, despite greater automation and off-shoring, middle-skill jobs still account for roughly one-third of New England's

employment—suggesting there will be a continued need for workers with some postsecondary education and training that is less than a bachelor's degree. What's more, at least half of all middle-skill jobs are in occupations such as healthcare (nurses, EMTs, therapists), sales (retail sales and supervisors), protective services (firefighters, police officers, correctional workers), education (teacher assistants), and office and administrative support (executive/medical/legal secretaries and administrative assistants). These are all growing occupations that typically rely on some interpersonal interaction that cannot be outsourced or automated, suggesting that perhaps firms have reached the limits of feasibility in terms of applying such strategies given their production processes.

Finally, some have questioned whether policymakers in New England should be concerned about a lack of middle-skill workers when the region excels at producing high-skill workers with a bachelor's degree or higher. Indeed, this question hinges on the substitutability versus complementarity of workers with varying degrees of skill—a very difficult thing to measure. Yet even if high-skill workers are able to perform jobs that require less education, it is unlikely that they would choose to do so unless there were no other options. Migration of workers by differing levels of education show that those with a bachelor's degree or higher typically leave New England at a higher rate than those with less education.<sup>64</sup> This is particularly true of “young professionals”—four-year college graduates aged 25 to 39 year—who are less constrained in terms of mobility and have greater opportunity to reap the benefits of their skills in any number of locations across the nation. Thus it seems that relying on high-skill workers to fill middle-skill jobs would be a risky strategy for any region when workers are able and willing to relocate.

Moreover, it is not unreasonable to think of the work that middle-skill and high-skill workers do as complementary to one another. For example, hospitals need both high-skill workers such as physicians as well as middle-skill workers in supporting roles such as licensed practical nurses, radiologic

technicians, sonographers and the like. Engineering firms rely on both high-skill engineers with bachelors or advanced degrees as well as drafters and technicians with associate's degrees. Life sciences companies employ both Ph.D. scientists as well as certified technicians to work in their labs. And all types of businesses require both executive management as well as administrative support staff.

Given that there is likely to be some degree of complementarity between workers of different skill levels, any potential mismatch yields important implications for policymakers to consider. Employers that rely on middle-skill workers may choose to locate or expand elsewhere, thereby slowing job creation. Firms that find it necessary to substitute capital or other sources of labor may raise prices or reduce quantity/quality of services, raising the overall cost structure of the region and making it less attractive to both businesses and workers looking to relocate. Increasing inequality among groups of workers will mean fewer resources for low-income families and greater demands on state and local programs.

In sum, although market forces are likely to lessen the severity of any future imbalance between the supply and demand for skilled labor to some extent, market imperfections and other constraints suggest that New England cannot rely on market responses alone. These constraints suggest that there is a role for public policy to provide workers with the education and training they need to qualify for occupations that are likely to be in high demand in the future. We turn to these policy options in the next section.

### **Potential policy solutions are limited**

What policies might be useful in creating a better match between workers and the sectors of the economy where we expect the greatest job growth? All else being equal, there are larger gaps in the middle of the skill distribution than at the upper end. Fortunately, these changes will occur gradually, but now is the time to make additional investments in human capital, particularly for those who are currently having difficulty in finding a job in the wake of the Great Recession.

This is not the first time that New England, or even the nation, has faced a potential shortage of workers. During the 1950s and 1960s, similar fears regarding a labor crisis were raised. In the ensuing decades, both the number of workers and the skill sets of the labor force changed to meet the demands of employers, resulting in greater productivity. A combination of greater labor force participation, increasing immigration of workers from abroad, and rising educational attainment contributed to increasing the quantity and quality of workers in the United States during that period.

However, it's unlikely that New England will be able to draw on those same sources for additional labor to address the current skill shortage.<sup>65</sup> Labor force participation has stabilized over the past decade and further increases are likely to be small. Even among older workers whose portfolios were affected by the financial crisis, any boost in labor force participation is likely to be temporary at best. Furthermore, delays in retirement are more likely among those with a bachelor's degree or higher rather than middle-skill workers who tend to work in more physically demanding jobs. Indeed, our simulations indicate that even a temporary boost in labor force participation among the baby boom generation will not be sufficient to meet the rising demand for skilled workers.

Although immigration has been a boon to New England as a source of labor supply in recent years, relying on immigrants to increase the stock of skilled workers presents a host of challenges. Many recently arrived immigrants do not have a bachelor's degree or proficient English language skills.<sup>66</sup> In addition, U.S. policy that continues to emphasize family reunification over skill requirements coupled with increasing economic opportunities in other countries is unlikely to attract enough skilled workers from abroad. Finally, immigration policy that is specifically targeted toward skilled workers, such as the H1-B visa program, generally favors those with a bachelor's degree or higher rather than middle-skill workers.<sup>67</sup>

That leaves us with increasing the postsecondary educational attainment of the population—in essence, growing our own talent. Our results suggest that, in addition

to ongoing efforts to expand more traditional four-year baccalaureate attainment, policymakers should consider specific education and training policies that target growing categories of middle-skill jobs. Our analysis of the premium paid to college-educated workers shows that postsecondary education is still a good investment. In response to this growing college wage premium, college enrollment has risen considerably but college completion rates have not risen commensurately.<sup>68</sup> Although it is not surprising that college completion rates would stagnate as the fraction of students enrolling in college rises, this suggests that there may be room to improve the outcomes of these initial college investments.

This is particularly true of two-year institutions that are the primary source of postsecondary education for middle-skill workers. Over the past century the role of community colleges has expanded from providing relatively easy access to college coursework to providing a range of job skills training including associate's degrees, vocational certificates, remedial education, English as a Second Language (ESL) learning, and other programs that serve the educational needs of the local community.

While often portrayed as the stepchildren of the higher education family of institutions, community colleges are often the main contact with higher education for a large proportion of young people. As of 2007, two-year institutions accounted for roughly 24 percent of total college enrollment in New England versus 44 percent nationwide.<sup>69</sup> Moreover, upwards of 90 percent of community college students are native to their institution's state.<sup>70</sup> Previous research shows that retention rates upon graduation are higher for native versus non-native students.<sup>71</sup>

Yet the region's higher education system seems skewed toward private institutions that produce bachelor degree holders, perhaps at the expense of community colleges and other education and training programs. Indeed, the New England states typically invest less in their public institutions compared with the national average. While the nation paid an average of \$242 per person in annual state taxes to support public higher education and student aid in the states, five of the six New England states pay

less than \$200 per capita as of fiscal year 2007 (see Table 8). Even adjusting for the region's lower enrollment in public institutions, four of the six New England states had appropriations per full-time enrollment that were lower than the national average.

But simply pouring more resources into community colleges is not the answer. With greater resources comes the responsibility to make sure that those resources are spent efficiently and effectively. Among first-time students who start at a four-year college, approximately three-quarters persist to the second year, compared with roughly half of first-time students who start at a two-year college.<sup>72</sup> Within six years, students who begin at a four-year college are twice as likely as those who begin at a two-year college to earn a degree.

Moreover, of the six New England states, only New Hampshire and Maine have two-year public college completion rates that are above the U.S. average (see Table 9). In comparison, five of the six New England states have a four-year completion rate that is higher than the national average for four-year public and four-year private institutions.

What can be done to encourage greater degree completion among two-year college students in New England? The policy solutions designed to address this issue often focus on two broad areas. The first is the availability of financial aid to two-year college students, which may take the form of grants or loans. The second is the two-year college institutional environment, which includes remedial education, student support services, learning communities, and transfer agreements.

We have shown that future gaps stem from changes in the composition of the labor force toward greater shares of immigrant and minority populations. Further gains in educational attainment among these traditionally disadvantaged groups would require significant investment in financial aid. Previous studies have shown that the gap in college attendance rates by parental income, race, and ethnicity remain large and may have even widened over the past several decades.<sup>73</sup> Considerable evidence exists that reductions in college costs greatly increase college attendance for youths from moderate-income families.<sup>74</sup>

In addition to financial assistance, community college students often face greater challenges to completion than those attending four-year institutions. Two-year college students are more than twice as likely to be enrolled part-time, and more than half of two-year college students are employed, compared to only 38 percent of four-year college students. Two-year college students are far less likely to be of traditional college-going age (18 to 24) than four-year college students, and they are also more likely to be of minority descent and from families of lower socioeconomic status. Finally, students who first attend two-year colleges are less academically prepared than students who first attend four-year colleges, whether this is measured by standardized test score, highest

**Table 8. The New England states typically invest less in their public institutions compared to the nation.**

Appropriations, FY 2007

	Per capita		Per full-time enrollment	
	Amount	Rank	Amount	Rank
Connecticut	\$252	23	\$10,079	4
Maine	\$196	38	\$6,406	28
Massachusetts	\$155	46	\$8,666	6
New Hampshire	\$94	50	\$3,370	49
Rhode Island	\$173	45	\$6,548	26
Vermont	\$137	49	\$3,031	50
U.S.	\$242		\$6,773	

Source: *Trends & Indicators*, The New England Board of Higher Education, various years.

**Table 9. Relative to the nation, New England's community colleges graduate a lower share of students; the region's four-year private institutions are more competitive.**

Degree completion rates

	Two-year public		Four-year public		Four-year private	
	Rate	Rank	Rate	Rank	Rate	Rank
Connecticut	11	46	55.0	18	70.0	5
Maine	29	14	47.5	33	70.5	3
Massachusetts	17	32	53.7	24	73.7	2
New Hampshire	26	17	64.1	4	60.4	19
Rhode Island	10	48	53.8	22	68.5	8
Vermont	15	38	59.2	11	67.7	9
US	22		53.4		60.7	

Source: Author's calculations based on data from the National Center for Education Statistics.  
Note: Completion rates are three-year averages for 2006-2008.

math course taken in high school, or participation in remedial education.<sup>75</sup> Recognizing that many community college students are “nontraditional” and creating programs and resources that meet their needs is key if we are to be successful in raising educational attainment among this group. Programs in other states have shown that offering stipends, child care, and transportation during periods of study can boost completion rates.<sup>76</sup>

In addition, postsecondary training at community colleges should be career oriented and focus on preparing students for middle-skill jobs that are expected to be in high demand. Indeed, previous research suggests that computerization and outsourcing have replaced “routine” jobs in the middle of the labor market relative to jobs at the high end where abstract reasoning is required or even jobs at the low end, where social interaction is needed.<sup>77</sup> However, middle-skill jobs still account for a sizable share of the labor market, accounting for roughly one-third of employment in New England as of 2009. These jobs often require specific skill sets rather than general knowledge. Although ample employment opportunities will exist in a variety of good-paying jobs in the middle of the labor market over the next decade, it is important to recognize that these opportunities will be limited to growing sectors of the economy such as education and healthcare.

Greater communication between firms that hire “middle-skill” workers and the institutions that educate them could better align training curriculum with employer needs. For example, Bunker Hill Community College in Massachusetts has a corporate training center dedicated to meeting the training needs of area employers. More recently, the Massachusetts Community Colleges have established MASS\*NET, to provide low-cost, high-quality on-site/on-campus training programs for local businesses. Just last month, President Obama announced the *Skills for America's Future* campaign, an industry-led initiative to improve industry partnerships with community colleges and build a nationwide network to maximize workforce development strategies, job training programs, and job placement.<sup>78</sup> Such partnerships between community

colleges and employers to develop training programs, while successful in the past, are likely to require flexibility and strategic planning on the part of institutions that may be difficult to achieve under the current institutional structure.

Better collaboration among community colleges could provide the strategic direction needed to achieve these goals while also providing some cost savings to make better use of limited resources. Under a single, unified system, community colleges could be part of an overall workforce development strategy for the state that encompasses a variety of postsecondary education and training, including employer and vocational training programs, certificate programs, apprenticeship programs, career centers, and ESL programs under one “roof.” For example, the fifteen Massachusetts Community Colleges were finally designated as part of an established system as of 2008. As an initial first-step towards greater coordination across the system’s campuses, the Massachusetts Community Colleges Executive Office conducted an audit of best practices and policies with financial support from Jobs for the Future.<sup>79</sup> The goal of the audit was to help promote achievement among academically under prepared students. More recently, the heads of all 29 public university campuses in Massachusetts—both two-year and four-year institutions—have signed on to the Vision Project, an initiative designed to bring greater recognition, and eventually the hope for greater funding, to the public system. One of the goals of the initiative is to communicate with businesses about workforce needs and develop academic programs that fit employer needs.<sup>80</sup>

Strengthening community colleges can be a win-win-win for students, employers, and the region. For students, it can be an inexpensive stepping stone to a four-year degree or specialized training for a middle-skill career. For employers, it can be a local partner to develop job-specific training programs for current employees or a nearby source for future recruiting. For the region, it can be a workforce development tool that is used to strengthen growing sectors of the economy while serving to reduce economic inequality and poverty.

## Endnotes

- <sup>1</sup> “Recent Survey Finds Shortage of Skilled Workers.” *The Business Times*, February 1, 2005; Kevin Kelley. “Tight Labor Market Barely Relaxes as Recession Looms.” *Vermont Business Magazine*. November 1, 2001; and Navjeet Singh and Michael Goodman. “The Skills Gap: Labor Supply and Demand.” Commonwealth Corporation, Research and Evaluation Brief. October 2005.
- <sup>2</sup> Barry Bluestone and Mark Melnik. “After the Recovery: Help Needed. The Coming Labor Shortage and How People in Encore Careers Can Help Solve it.” Northeastern University, Kitty and Michael Dukakis Center for Urban and Regional Policy, April 2010; “Growing Talent: Meeting the Evolving Needs of the Massachusetts Life Sciences Industry.” University of Massachusetts, Donahue Institute, November 2008; Robert Gavin. “State Expects to See Fewer Young Skilled Workers.” *The Boston Globe*. November 1, 2008; and Mal Leary. “National Study Shows Shortage of Skilled Workers in Maine by 2018.” *Bangor Daily News*. June 20, 2010.
- <sup>3</sup> U.S. Census Bureau. “State Interim Population Projections by Age and Sex: 2004–2030.” <http://www.census.gov/population/www/projections/projectionsagesex.html>.
- <sup>4</sup> David Autor, Frank Levy, and Richard Murnane. “The Skill Content of Recent Technological Change: An Empirical Exploration.” *Quarterly Journal of Economics*, Vol. 118, No. 4. November 2003; and David Autor and Daron Acemoglu. “Skills, Tasks and Technologies: Implications for Employment and Earnings.” *Handbook of Labor Economics* Vol. 4. Orley Ashenfelter and David Card, eds. Elsevier. 2010.
- <sup>5</sup> This relationship is known as the Beveridge curve, where the unemployment rate and the job vacancy rate move in opposite directions. As the economy expands, the unemployment rate generally falls, reflecting a decreased pool of excess workers. Simultaneously, the job vacancy rate is expected to increase as businesses seek workers to fill new and existing jobs.
- <sup>6</sup> As of the fourth quarter, the Massachusetts job vacancy rate jumped from 2.4 percent in 2004 to 3.2 percent in 2006. At the same time, the December unemployment rate for New England was roughly constant at 4.6 percent in 2004 and 4.5 percent in 2006.
- <sup>7</sup> Alicia Sasser. “The Future of the Skilled Labor Force in New England: The Supply of Recent College Graduates.” NEPPC Research Report No. 08-1. September 2008.
- <sup>8</sup> Navjeet Singh and Michael Goodman. “Skills Gap: Where Are the Jobs?” Commonwealth Corporation, Research Evaluation and Brief. Vol. 4, No. 1. August 2006.
- <sup>9</sup> See page 23 of David M. Blank and George J. Stigler. *The Demand and Supply of Scientific Personnel*. New York: National Bureau of Economic Research. 1957.
- <sup>10</sup> Kenneth J. Arrow, and William M. Capron, “Dynamic Shortages and Price Rises: The Engineer-Scientist Case.” *Quarterly Journal of Economics*, May 1959.
- <sup>11</sup> David Autor, Richard Murnane, and Frank Levy. “The Skill Content of Recent Technological Change: An Empirical Exploration.” *Quarterly Journal of Economics*. Vol. 118, No. 4. November 2003.
- <sup>12</sup> Robert C. Feenstra, ed. *The Impact of International Trade on Wages*. University of Chicago Press, 2000).
- <sup>13</sup> Peter Buerhaus, Douglas Staiger, and David Auerbach. *The Future of the Nursing Workforce in the United States: Data, Trends, and Implications*. Jones and Bartlett Publishers. 2008.
- <sup>14</sup> Claudia Goldin and Lawrence Katz. “The Race Between Education and Technology: The Evolution of U.S. Educational Wage Differentials, 1890 to 2005.” National Bureau of Economic Research Working Paper No. 12984. March 2007.
- <sup>15</sup> Stephen P. Coelen. “Regional Educational Attainment: Will Supply Measure up to Demand?” Massachusetts Institute for Social and Economic Research (MISER), University of Massachusetts Amherst, February 1996.
- <sup>16</sup> These trends largely reflect those of an earlier NEPPC report that showed that the region has been adding fewer recent college graduates over time. The number of individuals aged 22–27 years who have completed a bachelor’s degree or higher actually fell by 11.3 percent in New England between 1990 and 2000. Since 2000, the region’s stock of recent college graduates has grown by only 8.7 percent. In contrast, the rest of the United States has seen double-digit growth among recent college graduates. For more details see Alicia Sasser. “The Future of the Skilled Labor Force in New England: The Supply of Recent College Graduates.” NEPPC Research Report No. 08-1. September 2008.
- <sup>17</sup> See Table 16 in Alicia Sasser. “The Future of the Skilled Labor Force in New England: The Supply of Recent College Graduates.” NEPPC Research Report No. 08-1. September 2008.
- <sup>18</sup> Note that educational attainment in 1980 is not strictly comparable with that in 1990 and later years. Starting in 1990, the decennial Census asked respondents about completed degrees (e.g., associate’s degrees, bachelor’s degrees). Prior to that, respondents were asked only the number of completed years of education. I treat individuals with 16 years of completed education in 1980 as having a bachelor’s degree.
- <sup>19</sup> To be able to make comparisons over time, I estimate real hourly wages in each year across education levels based on predictions from ordinary least squares regressions to account for changing characteristics of workers over time that are associated with earnings. Real average hourly wages are estimated separately for men and women in each year using ordinary least squares regressions. The dependent variable is the natural log of the hourly wage, calculated as annual earnings divided by the product of weeks worked per year and hours worked per week. Independent variables include education as a piecewise linear combination of dummies (a dummy for less than a high school diploma and linear years of schooling for less than high school, a dummy for some college and linear years of schooling for some college, a dummy for an associate’s degree, a bachelor’s degree, and an advanced degree as well as linear years of schooling beyond a bachelor’s degree). Other independent variables include a quartic in potential experience as well as dummy variables for race, ethnicity, and foreign-born status. Predictions are calculated for an individual with fifteen years’ experience at the 2006-based average of all other characteristics.
- <sup>20</sup> Similar trends are observed when comparing the growth of actual (rather than estimated) real hourly wages by education level. See Figure A1 in the appendix.
- <sup>21</sup> Other studies show similar trends in earnings by education level. See Deborah Reed. “California’s Future Workforce: Will There Be Enough College Graduates?” Public Policy Institute of California, 2006.
- <sup>22</sup> The college wage premium for female workers followed a similar trend, increasing from 37.6 percent in 1980 to 59.9 percent in 2006.
- <sup>23</sup> The wage premium for individuals with an advanced degree, while larger in magnitude, followed a similar trend.
- <sup>24</sup> See Sheldon Danziger and Peter Gottschalk. *America Unequal*. New York and Cambridge, Massachusetts: Russell Sage Foundation and Harvard University Press, 1995; David Card and John E. DiNardo. “Skill-Based Technological Change and Rising Wage Inequality: Some Problems and Puzzles,” *Journal of Labor Economics*, Vol. 20, October 2002, pp. 733–783; Richard B. Freeman. “How Much Has De-Unionization Contributed to the Rise in Male Earnings Inequality?” in Sheldon Danziger and Peter Gottschalk, eds., *Uneven Tides: Rising Inequality in America*, Russell Sage Foundation, New York, 1993, pp. 133–163; Robert C. Feenstra, ed., *The Impact of International Trade on Wages*. Chicago,



- Illinois: University of Chicago Press, 2000; David S. Lee. "Wage Inequality in the United States During the 1980s: Rising Dispersion or Falling Minimum Wage?" *Quarterly Journal of Economics*, Vol. 114, No. 3, 1999, pp. 977–1023.
- <sup>25</sup> For example, an IT specialist who works for a manufacturing firm would be counted as working in the manufacturing industry whereas an IT specialist working for a university would be counted as working in the education services industry. Yet both individuals would be counted as working in the "computer and mathematical" occupation. Conversely, even though a group of workers is categorized as working in the mining industry, not all such employees are miners. These firms also employ IT specialists, accountants, and a variety of workers in other occupations.
- <sup>26</sup> See Table A1 in the appendix for a listing of employment shares by industry over time.
- <sup>27</sup> See Table A1 in the appendix for a listing of college-educated shares by industry over time.
- <sup>28</sup> David Autor, Frank Levy, and Richard Murnane. "The Skill Content of Recent Technological Change: An Empirical Exploration." *Quarterly Journal of Economics*. Vol. 118, No. 4, November 2003.
- <sup>29</sup> For a detailed list of the share of industry employment by occupation in New England, see Table A3 in the appendix.
- <sup>30</sup> See Table A2 in the appendix for a listing of employment shares by occupation over time.
- <sup>31</sup> The sample size for New England is not sufficiently large enough to estimate the college wage premium by occupation.
- <sup>32</sup> Occupations in New England with "persistent" vacancies were defined as those having vacancy rates that were higher than the overall average in both 2006 and 2009 and had greater than 10,000 openings to fill.
- <sup>33</sup> Detailed occupations are those at the six-digit level of the Standard Occupational Classification system. Occupations with "critical" vacancies in New England are those where the vacancy rate is greater than or equal to the overall rate for the region (4.3 percent), the number of vacancies is greater than or equal to 400, and total employment is greater than or equal to 1,500 as of 2006. For a complete listing of detailed occupations with critical vacancies, see Table A4 in the appendix.
- <sup>34</sup> For additional detailed examples of the distribution of educational attainment by sub-occupations for each of the broad occupation groups, see Figures A5a through A5v in the appendix.
- <sup>35</sup> One drawback to this method is that we are assuming that occupations within New England will grow at the same rate as the nation over the decade. However, one advantage to this method is that we are capturing shifts in labor demand at the national level that are exogenous to, or not affected by, labor supply responses at the regional level due to increased in-migration or rising educational attainment.
- <sup>36</sup> See John H. Bishop and Shani Carter. "How Accurate are Recent BLS Occupational Projections?" *Monthly Labor Review*, October 1991, pp. 37 – 43; Richard B. Freeman "Is A Great Labor Shortage Coming? Replacement Demand in the Global Economy." NBER Working Paper No. 12541, September 2006; Ian D. Wyatt. "Evaluating the 1996–2006 Employment Projections." *Monthly Labor Review*, September 2010.
- <sup>37</sup> Note that there are other ways to characterize the skill level of a given occupation. For example, the Bureau of Labor Statistics has used multiple classification schemes over time, such as the "eleven category" system and the "education cluster" system—both of which have been abandoned in favor of using the full distribution of educational attainment for each detailed occupation. More recently, the U.S. Department of Labor developed the Occupational Information Network (O\*NET) system to classify jobs according to five "job zones" depending on the level of preparation exhibited by the educational distribution of current workers which is fairly similar to the methodology used in this study. Yet, there are several drawbacks to using the BLS estimates of employer requirements to measure future needs. First, the BLS reports only one level of required qualifications of entry into an occupation. Employer needs are likely to differ across specific positions, firms, and industries and for entry-level versus more advanced positions. In addition, the training requirements approach does not incorporate the potential need for upgrading of skills in the future.
- <sup>38</sup> It should be noted that, relative to the employment figures, the number of vacancies indicated by the Help Wanted On-Line Index is likely to be skewed toward jobs that require more skilled workers who typically search for job openings online. However, given that job vacancies account for less than 5 percent of total employment, this bias is likely to be relatively small.
- <sup>39</sup> These trends are consistent with those documented by other researchers, with one distinct difference. Previous studies also project that job growth will be greater for high-skill occupations yet typically find that middle-skill jobs account for the largest share of employment. For example, Holzer and Lerman (2007) find that middle-skill jobs account for roughly 45 percent of total employment. This difference arises due to how jobs are categorized by educational category. Whereas we divide employment for each detailed sub-occupation across education levels according to the current distribution, other studies assign all jobs associated with a broad occupation category to a skill category (low, medium, or high). See Harry J. Holzer and Robert I. Lerman. "America's Forgotten Middle-Skill Jobs." Washington D.C.: Workforce Alliance, 2007; Anthony P. Carnevale, Nicole Smith, and Jeff Strohl. "Help Wanted: Projections of Jobs and Education Requirements Through 2018." Washington D.C.: Georgetown University Center on Education and the Workforce, June 2010.
- <sup>40</sup> For a complete listing of detailed occupations that are expected to grow rapidly in New England, see Table A5 in the appendix.
- <sup>41</sup> To project the future population over the next two decades, we begin with a baseline population of individuals aged 25 to 64 years for 2009 broken down by five-year age cohorts, nativity, gender, and race/ethnicity for both New England and the nation. We then calculate a ten-year "survival rate" for each group equal to the percentage of that group that appears in both the 1990 and 2000 Census. For example, 95 percent of white males aged 25–29 in New England in 1990 were still living in New England as of 2000. Note that this "survival rate" represents a combination of mortality and migration rates as individuals may disappear over the decade by either dying or leaving the region. These survival rates are applied to the 2009 baseline population to get the projected population for 2019, and again to get the projected population for 2029. As a final step, we calculate labor force participation rates for each group and apply them to our projected populations to get the projected labor force for 2019 and 2029.
- <sup>42</sup> Antoniya Owens. "A Portrait of New England's Immigrants." NEPPC Research Report No. 08-2. November 2008.
- <sup>43</sup> For example, the immigrant population tends to exhibit a bifurcated education distribution, having a high share of individuals with less than a high school degree and a high share with an advanced degree. Among the region's native population, African-American and Hispanic populations typically lag behind Asian and white populations in terms of educational attainment. For a comparison of the distribution of educational attainment by nativity, race, and ethnicity, see Figures A2 and A3 in the appendix.
- <sup>44</sup> Among native whites, the share of individuals with a bachelor's degree has been increasing across cohorts such that roughly 30 percent of those aged 25–34 years now have a bachelor's degree. The share completing a B.A. has also been rising among African Americans, yet the majority still have only a high school degree. Among Hispanics, the share



without a high school degree is twice that of African-Americans and has remained steady across cohorts, indicating little progress in educational attainment for this group over time.

- <sup>45</sup> For example, individuals currently aged 15–19 years and 20–24 years in 2009 will be assumed to “enter” the labor force by 2019 when they are aged 25–29 and 30–34 years. Current cohorts are those who are already in the labor force—those aged 25 to 64 years old in 2009. Although many of the current cohorts will remain in the labor force over the next two decades, individuals aged 55 to 64 years will be assumed to “exit” the labor force every ten years.
- <sup>46</sup> For example, 28.4 percent of native white males aged 25–29 years in New England currently have a bachelor’s degree. We assume that 28.4 percent of native white males currently aged 15–19 years in 2009 will also have a bachelor’s degree by the time they are aged 25–29 in 2019. For an example of this methodology, see Table A6 in the appendix.
- <sup>47</sup> “Racial/Ethnic Differences in the Path to a Postsecondary Credential.” National Center for Education Statistics. Issue Brief. June 2003.
- <sup>48</sup> For example, among native white males aged 30–34 years in New England in 1990, an additional 3 percent had an advanced degree by the time they were 40–44 years in 2000. We assume that an additional 3 percent of native white males in New England in 2009 will have an advanced degree by the time they are aged 40–44 in the year 2019. For an example of this methodology, see Table A6 in the appendix.
- <sup>49</sup> Succeeding cohorts of individuals often exhibit greater educational attainment perhaps due to advancements in K–12 education, increased college readiness, or expansions in financial aid. For recent trends in high school graduation and college continuation rates by race and ethnicity, see Figure A4 in the appendix.
- <sup>50</sup> For a listing of college completion rates by race and ethnicity, see Table A8 in the appendix.
- <sup>51</sup> Note that these assumptions do not vary by gender although significant gender differences in college attendance and completion have been documented. For a detailed breakdown of the methodology see the appendix.
- <sup>52</sup> See John Bound and Harry J. Holzer. “Demand Shifts, Population Adjustments, and Labor Market Outcomes during the 1980s.” *Journal of Labor Economics* 18(1), January 2000, pp. 20–54.
- <sup>53</sup> Richard W. Johnson and Corina Mommaerts. “How Did Older Workers Fare in 2009?” Washington D.C.: The Urban Institute, March 2010.
- <sup>54</sup> For example, the share of the population with less than a high school degree falls by 2 percentage points between 2009 and 2029 while the share with a bachelor’s degree increases by 3 percentage points. The one area where we continue to see little improvement is in the middle of the distribution. While the share of the population with some college increases slightly by half a percentage point, the share completing an associate’s degree still falls by nearly a full percentage point.
- <sup>55</sup> For example, whereas roughly 55 percent of 4-year public students and 66 percent of 4-year private students in New England complete their degrees, only about 20 percent of community college students do. For a listing of college continuation and completion rates by race and ethnicity see Figure A4 and Table A8 in the appendix.
- <sup>56</sup> See Table A9 for net migration rates of various groups by age and education level.
- <sup>57</sup> Sasser, Alicia. 2009. “Voting with Their Feet? Local Economic Conditions and Migration Patterns in New England.” New England Public Policy Center Working Paper No. 09-1, July.
- <sup>58</sup> See Table 5. Estimates of the Components of Resident Population Change for the United States, Regions, States, and Puerto Rico: July 1, 2008 to July 1, 2009 (NST-EST2009-05). U.S. Census Bureau, Population Division, December 2009.

<sup>59</sup> Author’s calculations based on the 2005–2007 combined American Community survey.

<sup>60</sup> For example, some researchers have suggested that instead of using the educational distribution of individuals currently employed in a given occupation, one should rely on education and training requirements developed by the Bureau of Labor Statistics. These education and training requirement categories have proved unreliable in the past, prompting the BLS to create a more detailed system called O\*NET. While O\*NET can be used to learn more about the tasks and work activities for a given occupation, it still relies on a survey of respondents to determine the education level required—similar to the methodology we use here. The difference is that the BLS then categorizes the occupation into one of five job zones, thereby eliminating the variation in educational attainment within each occupation. Yet employer needs are likely to differ across specific positions, firms, and industries and for entry-level versus more advanced positions. In addition, the training requirements approach does not incorporate the potential need for upgrading of skills in the future.

<sup>61</sup> For example, at times it has been argued that Americans are in fact overeducated and that firms employ a greater share of college-educated workers simply because they are so plentiful (Freeman, 1976). While this may have been the case during the 1970s when the college wage premium was falling, it would be difficult to make the case over the past several decades when the college wage premiums has been rising. Even within detailed occupations, college-educated workers earn a premium over their less educated counterparts, suggesting that employers are willing to pay more because these workers are more productive (Reed, 2006).

<sup>62</sup> David H. Autor, Lawrence F. Katz, and Melissa S. Kearney. “The Polarization of the U.S. Labor Market.” *American Economic Review Papers and Proceedings*. Vol. 96, No. (2. May 2006.

<sup>63</sup> Blinder, Alan S. 2007. “How Many U.S. Jobs Might Be Offshorable?” CEPS Working Paper No. 142, March.

<sup>64</sup> See Table A9 for net migration rates of various groups by age and education level.

<sup>65</sup> Jane Little and Robert Treist. “The Impact of Demographic Changes on U.S. Labor Markets.” *New England Economic Review*. 1st quarter 2002.

<sup>66</sup> Antoniya Owens. “A Portrait of New England’s Immigrants.” NEPPC Research Report No. 08-2. November 2008.

<sup>67</sup> The H-1B program was established in 1990 by the Immigration Act of 1990 (IMMACT 90) for foreigners interested in working in the United States. The H-1B is a visa used by an alien who will be employed temporarily in a specialty occupation. A specialty occupation requires theoretical and practical application of a body of specialized knowledge along with at least a bachelor’s degree or its equivalent.

<sup>68</sup> See Figure A4 in the appendix for college continuation trends over time. See Table A7 in the appendix for college completion trends over time.

<sup>69</sup> Author’s calculations based on data from the National Center for Education Statistics.

<sup>70</sup> Author’s calculations using the Integrated Postsecondary Education System from the National Center for Education Statistics. Percentages computed by dividing the number of first time degree seeking students who were residents of that state at the time of their admission by the number of total first time degree seeking undergraduates. To get state percentages, university level percentages were averaged with a weight on the total first time degree seeking undergrads for each institution. To get the US average the state percentages were averaged with weight placed on the proportion of total degree seeking undergrads from that state. This data is for 2008.

<sup>71</sup> See Alicia Sasser. “The Future of the Skilled Labor Force in New England: The Supply of Recent College Graduates.” NEPPC Research Report No. 08-1. September 2008.

- <sup>72</sup> Molly F. McIntosh and Cecilia Elena Rouse. "The Other College: Retention and completion rates among two-year college students." Washington D.C.: The Center for American Progress, February 2009.
- <sup>73</sup> David T. Ellwood and Thomas Kane. "Who is Getting a College Education? Family Background and the Growing Gaps in Enrollment." In S. Danziger and J. Waldfogel, eds., *Securing the Future*. New York: Russell Sage Foundation, 2000, pp. 47-83; James J. Heckman and Pedro Carneiro. "The Evidence on Credit Constraints in Post-Secondary Schooling." *Economic Journal*, 112(482), October 2002, pp. 705-734.
- <sup>74</sup> Susan Dynarski. "The Behavioral and Distributional Implications of Aid for College." *American Economic Review*. 92 (2), 2002, pp. 279-85; Thomas J. Kane. *The Price of Admission*. Washington, D.C.: Brookings Institution Press and Russell Sage, 1999.
- <sup>75</sup> Molly F. McIntosh and Cecilia Elena Rouse. "The Other College: Retention and completion rates among two-year college students." Washington D.C.: The Center for American Progress, February 2009.
- <sup>76</sup> Harry J. Holzer and Demetra S. Nightingale. "Strong Students, Strong Workers." Washington D.C.: Center for American Progress, December 2009.
- <sup>77</sup> David H. Autor, Lawrence F. Katz, and Melissa S. Kearney. "The Polarization of the U.S. Labor Market." *American Economic Review Papers and Proceedings*, 96 (2), May 2006, pp. 189-194.
- <sup>78</sup> "President Obama to Announce Launch of Skills for America's Future." White House press release. October 4, 2010.
- <sup>79</sup> Massachusetts Community Colleges Executive Office. 2009 Annual Report.
- <sup>80</sup> Mary Moore. "Public College Stature is Key, Group Says." *Boston Business Journal*, June 4-10, 2010.

Methodology, data appendix, and state tables available at the New England Public Policy Center's web site: <http://www.bos.frb.org/economic/neppc>



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