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Skills Gaps: A Review of Underlying Concepts and Evidence

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Skills Gaps: A Review of Underlying Concepts and Evidence

Employer reports of job vacancies left unfilled due to a lack of adequately skilled applicants have spanned U.S. industries for decades, and have often raised concerns among some Members of Congress about the broader economic implications of a potential mismatch between skills possessed by workers and those sought by employers. Some concerns center on the notion that certain skills—often higher-level or mid-level skills—that are sought by employers are not possessed by enough workers, impeding employers’ ability to find the capacities they need to operate, innovate, expand, and compete, and this ultimately slows economic growth. Other concerns relate to the plight of workers and the notion that mismatches between workers’ skills and the current or future demands of work may be a primary driver of unemployment and may render the skillsets possessed by groups of workers obsolete.

Disagreement exists about the pervasiveness of skills misalignments, and about their scale and how concentrated they are. This is called into question by suggestions that other factors—such as wage levels and working conditions—may be partially or largely responsible for unfilled positions, unemployment, or other outcomes that are sometimes attributed to skills gaps and cited as evidence of their existence.

Nonetheless, there is little doubt that work demands regularly evolve throughout many occupations and industries creating, at least on some scale, mismatches between what jobs require and the readiness of workers to perform those tasks. Large structural changes accompanying new technologies have had a substantial effect on the types of jobs available and on the work performed in industries across the economy during certain periods. Current conversations around automation, artificial intelligence, and technological change more generally indicate that such structural changes—and the potential for large-scale skills gaps—may be on the horizon in the coming years.

Central to skills gap debates are what have become perennial questions surrounding (1) the mix of education and training needed to equip workers with the skills and knowledge required for work, and (2) who should provide it, finance it, and determine its content and help workers navigate what is needed. These issues are not new—worker skills have always mattered to production, and U.S. workers and employers have long had to adapt to the changing demands of work. But identifying the mix of general and specific skills and knowledge needed in the workforce, and the appropriate roles for government, employers, and workers in developing them, can be complex.

Several separate laws authorize federal policies and programs aiming to improve the preparedness of the U.S. workforce, employing many different strategies. Some place emphasis on the development of a foundation of transferrable knowledge and skills. Others provide support for postsecondary educational pursuits and lifelong learning, allowing existing or prospective workers to select the particular types of education or training in which to invest. Other federal policies support specific types of training in areas where a shortage of skilled workers exists (e.g., cybersecurity, nursing). Still others promote skill development by encouraging employer-provided training. Relatedly, there are many federal policies that are not focused on skill development, which can also affect whether sufficient numbers of workers holding skills that meet the needs of employers are available (e.g., policies that address factors that may inhibit labor force participation among skilled workers such as availability of child care, and policies in areas such as immigration that affect the size and composition of the labor force).

This report is a response to congressional requests for the Congressional Research Service (CRS) to identify, synthesize, and explain the core components of the skills gap discourse and, to the extent possible, explore and clarify evidence on the existence of skills gaps. The report acknowledges that the *skills gap* label is often applied to several different circumstances and conditions, and it offers a discussion of the varied meanings associated with the term. The report attempts to shed light on the nature and existence of various types of skills misalignments and explores their potential policy implications.

The report presents a limited review of indicators that are commonly cited as evidence of the existence of skill misalignments. These include broad indicators examining job openings and hires, employer wage responses to unfilled jobs, educational credentials possessed in relation to those required, and the adequacy of measurable foundational skills among current (and future) workers. The report notes that these indicators, which measure trends of relevance to the skills gap

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debate, do not clearly suggest that widespread misalignments exist. At the same time, this review cannot rule out misalignments as a possibility.

The report notes as well that available existing broad indicators have limitations. For instance, not everything of interest can currently be measured. Notably lacking are accepted measures that examine the adequacy of the supply of in-demand capacities such as *soft skills*. Further, some indicators may be imprecise. As an example, some rely on educational credentials as a proxy measure for skills possessed by workers or required for work, and there is debate about whether this may be an imperfect proxy for skill levels possessed and actually required. Additionally, some indicators are generated through imperfect research. Some, for example, come from employer and industry surveys, which are seemingly well positioned to shed light on imbalances between supply and demand for skills, but these surveys often do not meet standards for quality research, and they may lack impartiality.

With regard to a more narrow examination of *skill shortages* affecting particular occupations or fields in which there is an undersupply of credentialed workers, or in which work demands may be changing rapidly, the report notes there is more agreement about the existence of some misalignments. The report highlights illustrative examples of fields in which evidence points to shortages. Also discussed is the complexity associated with isolating the causes when occupations, employers, and regions face difficulty in filling positions. That is, it is difficult to attribute hiring challenges to a skills shortage when there are often many other plausible explanations for hiring challenges.

Throughout the report, there is discussion of enduring challenges that complicate policymaking in this arena. One is that the *skills gap* label encompasses a series of somewhat separate (but interrelated) issues, and it is not clear that there is a common problem definition or consensus about what may need to be addressed. Further, it can be hard to reach agreement about respective responsibilities of workers, employers, and government in ensuring the acquisition of skills. While there are numerous federal investments promoting a skilled workforce, there is no clear agreement about whether, or the extent to which, the different skills-related challenges being addressed by federal policies need to be thought of as a continuum and addressed in an interconnected manner.

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Introduction

Concerns about *skills gaps* that adversely affect the U.S. economy are not new. They have been mentioned in congressional deliberations for many years, and with considerable frequency in the past decade. Employer reports of job vacancies left unfilled due to a lack of adequately skilled applicants have spanned U.S. industries, and have often raised concerns among some Members of Congress about the broader economic implications of a potential mismatch between skills possessed by workers and those sought by employers.¹

Concerns about skills gaps also garner considerable media attention, with some coverage focused on the types of skills being sought by employers and on the economic consequences that may stem from a lack of adequately skilled workers. Other coverage raises questions about whether the supply of skilled workers is actually inadequate.²

Academic research on skills gap-related topics is robust as well, and focuses on several issues. Some research examines the nature and existence of skill misalignments. Other research points to a variety of factors leading to lingering vacancies reported by employers, suggesting that reducing skills mismatches may require policy approaches that include but also extend beyond support for skills investment. Relevant factors identified in research include rapid changes in employer needs or consumer demand, rapid technological change affecting the nature of work, geographical mismatches in the supply of workers with in-demand skills and the locations of available jobs, fluctuations in the size of the labor force, and the cost to employers of investing in workers' skills especially in tight labor markets where returns on those investments are uncertain.³

¹ For instance, in recent years the following congressional hearings before an array of congressional committees have focused on themes related to skills mismatches and gaps: House Committee on Small Business, Subcommittee on Innovation and Workforce Development, *Mind the 'Skills' Gap: Apprenticeships and Training Programs*, June 4, 2019; House Committee on Small Business Subcommittee on Economic Growth, Tax, and Capital Access, *Shrinking the Skills Gap: Solutions to the Small Business Workforce Shortage*, June 14, 2018; House Committee on Education and the Workforce, Subcommittee on Higher Education and Workforce Development, *Closing the Skills Gap: Private Sector Solutions for America's Workforce*, May 19, 2018; House Ways and Means Committee, *Jobs and Opportunity: Local Perspectives on the Jobs Gap*, April 12, 2018; Joint Economic Committee, *A Record Six Million U.S. Job Vacancies: Reasons and Remedies*, July 12, 2017; Senate Committee on Commerce, Science and Transportation, *Closing the Skills Gap and Boosting U.S. Competitiveness*, June 29, 2017; Senate Committee on Small Business and Entrepreneurship, *Bridging the Skills Gap: How the STEM Education Pipeline Can Develop a High-Skilled American Workforce for Small Business*, May 22, 2013; Senate Committee on Commerce, Science and Transportation, Subcommittee on Innovation and Export Promotion, *Promoting American Competitiveness: Filling Jobs Today and Training Workers for Tomorrow*, April 17, 2012; and Joint Economic Committee, *The Road to Economic Recovery: Prospects for Jobs and Growth*, February 6, 2010. Congressional discussions about the inability of employers to find qualified workers date back to at least the 1960s. For example, concerns about the lack of skilled workers were raised during hearings of the Senate Committee on Labor and Public Welfare on the Manpower Development and Training Act of 1962 and on the Higher Education Act of 1965.

² Media coverage devoted to skills gaps includes Minaya Ezequiel, "Companies Seek to Fill Skills Gap by Retraining Their Own Workers; a tight labor market amplifies need to develop skills internally," *The Wall Street Journal* online, March 8, 2019; Matt O'Brien, "The skills gap is fixed, because there was no skills gap," *The Washington Post*, January 14, 2019; Peter Murphy, "Tax Incentives Needed To Close Workplace Skills Gap," *Investor's Business Daily*, September 7, 2018; Douglas Belkin, "More Companies Teach Workers What Colleges Don't: Amid skills gap companies focus less on four-year degrees and more on skills that workers have or can learn," *The Wall Street Journal* online, March 22, 2018; and Noam Scheiber, "President's Plan to Expand Apprenticeships Rekindles 'Skills Gap' Debate," *The New York Times*, June 16, 2017.

³ For materials that frame various aspects of the skills gap debate, see Peter Cappelli, *Why Good People Can't Get Jobs: The Skills Gap and What Companies Can Do About It*, Wharton Digital Press, 2012; Andrew Weaver, *The Myth of the Skills Gap*, MIT Technology Review, August 25, 2017; Dan Restuccia et al., *Different Skills, Different Gaps, Measuring and Closing the Skills Gap*, Burning Glass Technologies Report for the U.S. Chamber of Commerce

The federal government has had a long-standing role in supporting the development of work-related skills using varied policy approaches. Federal policies aiming to improve the preparedness of the U.S. workforce are authorized through several federal laws, and address what can be viewed as a series of inter-related issues. Some place emphasis on the development of a strong foundation of transferrable knowledge and skills. Others provide support for postsecondary educational pursuits and lifelong learning, allowing existing or prospective workers to select the particular types of education or training in which to invest. Other federal policies support specific types of training in areas where a shortage of skilled workers exists (e.g., cybersecurity, nursing). Still others promote skill development by encouraging employer-provided training.⁴ Relatedly, there are many federal policies that are not focused on skill development that can also affect whether sufficient numbers of workers holding skills that meet the needs of employers are available (e.g., policies that address factors that may inhibit labor force participation among skilled workers such as availability of child care, and policies in areas such as immigration that affect the size and composition of the labor force).

About This Report

This report is a response to congressional requests for the Congressional Research Service (CRS) to identify, synthesize, and explain the core components of the skills gap discourse and, to the extent possible, explore and clarify evidence on the existence of skills gaps. The report acknowledges that the skills gap label is often applied to several different circumstances and conditions and explores the varied meanings associated with the term.

The report also attempts to shed light on the nature and existence of varied types of skills misalignments and explores their potential policy implications. It opens with operational definitions for three terms—*skills mismatch*, *skills gaps*, and *skill shortages*—to help clarify some of the key underlying issues and concepts that are prevalent in the skills gap discourse, and provides a framework for discussing them more precisely. It then offers an overview of the various issues and explanations that commonly surface in the skills gap debate. The next section of the report examines commonly cited evidence of skills mismatches, gaps, and shortages, noting the strengths and limitations of key sources. Although the section notes the likelihood of mismatches, gaps, and shortages in some instances and comments on some expectations for future trends, it does not attempt to draw firm conclusions from the reviewed sources about their presence in the current economy. The report then examines potential employer responses to skills misalignments, and closes with a discussion of federal policies designed to deal with existing or

Foundation, March 2018; James Bessen, *Employers Aren't Just Whining—The Skills Gap Is Real*, Harvard Business Review, August 2014; Andrew Weaver and Paul Osterman, *Skill Demands and Mismatch in U.S. Manufacturing*, ILR Review 70(02), March 2017, pp. 275-307; Seamus McGuinness, Konstantinos Pouliakas, and Paul Redmond, *Skills Mismatch: Concepts, Measurement and Policy Approaches*, Journal of Economic Surveys, Vol. 32, 2018, pp. 985-1015; Anthony Carnevale, Nicole Smith, and Jeff Stroehl, *Help Wanted: Projections of Job and Education Requirements Through 2018*, Georgetown Center on Education and the Workforce, June 2010; and Lawrence Kahn, *Skill Shortages, Mismatches, and Structural Unemployment a Symposium*, ILR Review 68(2), March 2015, pp. 247-250.

⁴ For overviews of several of these approaches, see CRS Report R44252, *The Workforce Innovation and Opportunity Act and the One-Stop Delivery System*, by David H. Bradley; CRS Report R43301, *Programs Available to Unemployed Workers Through the American Job Center Network*, by Benjamin Collins, David H. Bradley, and Katelin P. Isaacs; CRS Report R45171, *Registered Apprenticeship: Federal Role and Recent Federal Efforts*, by Benjamin Collins; CRS Report R43351, *The Higher Education Act (HEA): A Primer*, by Joselynn H. Fountain; CRS Report R41967, *Higher Education Tax Benefits: Brief Overview and Budgetary Effects*, by Margot L. Crandall-Hollick; CRS Report R45223, *Science, Technology, Engineering, and Mathematics (STEM) Education: An Overview*, by Boris Granovskiy; and CRS Report R45977, *The Elementary and Secondary Education Act (ESEA), as Amended by the Every Student Succeeds Act (ESSA): A Primer*, by Rebecca R. Skinner.

potential misalignments between the skills sought by employers and those possessed by workers. This discussion devotes attention to policy approaches focused on investing in skills as well as other approaches toward addressing misalignments.

Although much of the discourse on skills mismatches, gaps, and shortages tends to focus on employers' perspectives and potential economic impacts, such skills misalignments can have significant consequences for workers as well. Just as workers with in-demand skills are well placed to find work and bargain over compensation and working conditions, those who do not hold sought-after skills risk unemployment or poor job matches. Further, changing work demands can be costly for workers who to varying degrees pay for education, trainings, and certifications that may lose value over time. Similarly, incomplete information about workforce demands can lead some workers to invest in the wrong types of skills. In response to the task CRS was asked to take on, and in line with many prominent policy discussions and available analyses, this report focuses on employers' recruitment challenges and approaches to improve the alignment of skills held in the workforce to those sought by employers. While an in-depth analysis of workers' challenges and the impacts of skills misalignment on them are outside the scope of this report, they affect individual livelihoods and also have broader social and economic implications.

Defining Terms

As noted above, varied meanings associated with vocabulary used in skills gap debates is the source of confusion. Consequently, a good starting point for an exploration of the skills gap discourse is discussing the different meanings that can be ascribed to *skills* and *gap*. These terms are not always used in a precise manner, and they are often not used in a consistent manner. This likely adds to disagreement about skills gaps.

An effort is made here to clarify meanings for these terms. It is not aiming to construct a definitive set of definitions; rather, it is intended to identify some important conceptual distinctions in the conditions being described by various terms and to highlight how terms will be used henceforth in this report. In the review of the skills gap literature and discourse that comprises the majority of this report, several key terms will be used in the manner delineated below.

Clarifying the Meaning of Gaps

While there is little disagreement about the existence of mismatches between evolving demands of work and the skills and knowledge possessed by workers, there is substantial disagreement about the scale of these mismatches, relating to their depth, breadth, and how concentrated they are. Some core distinctions related to the scale and nature of misalignments are captured in the commonly used terms *skills mismatch*, *skills gaps*, and *skill shortages*.⁵ They can be conceptualized as follows:

- *Skills Mismatch*: An imbalance—an over-supply or under-supply—between the types or level of skills available and labor market needs. The term does not necessarily imply a certain scale of imbalance.
- *Skills Gap*: A shortfall in the aggregate supply of a certain skill or set of skills broadly sought by employers (e.g., communication or computational skills).

⁵ This taxonomy of terms, and the use of the terms in this report, is largely based on work presented in Peter H. Cappelli, ILR Review, 68(2), March 2015, *Skill Gaps, Skill Shortages, and Skill Mismatches: Evidence and Arguments for the United States*, pp. 251-290.

- *Skill Shortages*: A shortfall in the supply of specific skills associated with particular occupations (e.g., a dearth of workers prepared to work as nurses or special education teachers).

In this report, the term *skills mismatch* is the most broad, inclusive, and flexibly used term, encompassing relatively smaller-scale misalignments between what workers are prepared to do in relation to existing work demands as well as larger-scale misalignments. For example, a need for employees to become proficient in a new software package that a business adopts for handling financial transactions and tracking inventory or to master new features in an updated version of Excel might constitute smaller-scale misalignments. Larger-scale misalignments might involve large groups of workers lacking fundamental types of skills (e.g., computational or communication skills) or knowledge.

A *mismatch* can characterize misalignments going in either direction, not just misalignments wherein employers cannot find what they are seeking. For instance, it could characterize workers possessing in-depth skills in areas no longer sought by many employers, or too many individuals investing in education or training in areas in which limited job opportunities exist.

The term *skills gap* characterizes a situation in which, on a widespread basis, employers have difficulty finding employees possessing adequate levels of skills required for work. This might include critical thinking skills, mathematical or programming skills, or soft skills such as communication or the ability to work effectively in groups. The connotation is that there is a shortfall of skills that are of fundamental importance to many types of work.

The term *skill shortage* is used to depict situations in which employers in particular fields (e.g., science, technology, engineering, and mathematics [STEM] fields) are unable to find sufficient numbers of workers with the type or level of skill sought to fill available positions. This can encompass situations in which not enough workers pursue degrees or training in in-demand disciplines, work requirements change in a manner calling for more workers with highly specialized skills (e.g., advanced manufacturing), or when new fields emerge, like cybersecurity, requiring skills and knowledge for which no formal preparatory path previously existed.

Clarifying the Meaning of *Skills*

In the skills gap discourse, the term *skills* largely functions as a composite term. It can interchangeably refer to knowledge, skills, competencies, and even attributes possessed by workers.

The skills gap discourse is often centered on the adequacy of current or future workers' *knowledge* and *skills*. There are not universally accepted definitions of these terms.⁶ There is, however, some consistency in components of descriptions of *knowledge* and *skills* forwarded

⁶ One recent effort attempting to help clarify some of these definitional issues was an interdisciplinary examination undertaken by the National Academy of Sciences aiming to define the set of key skills embodied in labels such as *21st century skills*, *new basic skills*, *deeper learning*, and *higher order thinking*. That work, which focused on aligning lists of 21st century skills from various sources with research-based taxonomies of cognitive, interpersonal, and intrapersonal skills, noted that these labels are typically used to include an array of both cognitive and non-cognitive skills. In other words, labels such as *21st century skills* can encompass many different types of skills including “critical thinking, problem solving, collaboration, effective communication, motivation, persistence, and learning to learn.” For more information on this effort, see National Research Council of the National Academies, Committee on Deeper Learning and 21st Century Skills, *Education for Life and Work: Developing Transferable Knowledge and Skills in the 21st Century*, James W. Pellegrino and Margaret L. Hilton, eds., National Academies Press, 2012. (Hereinafter referred to as *Education for Life and Work: Developing Transferable Knowledge and Skills in the 21st Century*).

across many sources, and it is useful to attempt to identify some of the core elements of each to help facilitate a more precise exploration of what workers may be missing. With that aim in mind, the following depictions of *knowledge* and *skills* are forwarded:

- *Knowledge* can be thought of as having a command of facts, concepts, theories, and principles, or a theoretical or practical understanding of disciplines, subjects, processes, or technical material; and
- *Skills* can be thought of as having the ability to do something, such as perform mathematical computations, read, write, research, or think critically.⁷

Sometimes groups of skills are labeled or further categorized as being *academic skills*, *cognitive skills*, *non-cognitive skills*, or *technical skills*.⁸ Another type of skills that receives substantial attention in the skills gap discourse is frequently labeled *soft skills*, which, depending on the definition, can include interpersonal or people skills, ability to work well as part of a team, communicating well with others, and work ethic.⁹

Making matters more complex, knowledge and skills are often categorized as being *basic* versus being *applied*.¹⁰ These distinctions can be meaningful, as they may suggest where the acquisition of such skills and knowledge can best occur or should occur. This set of issues often features prominently in policy debates, as does consideration of the nature of the capacities employers are seeking that workers may be lacking. For these reasons, it is important to consider that while the term *skills* is often used as a catch-all term, determining what it is depicting can be central to navigating the skills gap discourse.

In this report, the term *skills* will sometimes be used as a composite term to broadly describe observed or theorized imbalances between preparedness and capacity of workers and the demands of work (e.g., employers report being unable to find the *skills* they need). The use of *skills* in this manner is consistent with much of the literature. The report takes care to use the terms *knowledge* and *skills* as delineated above when attempting to explore or clarify material pertaining to the nature of imbalances.

⁷ While it is helpful to delineate separate characteristics of skills and knowledge, it is also the case that they are frequently described as being inter-connected. For instance, one such description is in *Education for Life and Work: Developing Transferable Knowledge and Skills in the 21st Century*, p. 23, which presents the view that knowledge that can be transferred or applied in new situations can be characterized as 21st century skills. In this construct, the authors explain “knowledge includes both content knowledge in a domain and also procedural knowledge of how, why, and when to apply content knowledge.” They refer to this blend of content knowledge and related skills as *21st century capacities*.

⁸ For other frequently cited efforts that present taxonomies of skills that include some of these terms see *What Work Requires of Schools: A SCANS Report for America 2000*, The Secretary’s Commission on Achieving Necessary Skills, U.S. Department of Labor, June 1991, pp.13-15; and *An Occupational Information System for the 21st Century: The Development of O*NET*, Peterson et al., Washington DC, American Psychological Association, 1999.

⁹ As is discussed throughout this report, employers often identify soft skills prominently among the skills they have difficulty finding at a level consistent with expectations. For a discussion of soft skills and many of the definitional and practical issues schools attempting to help impart them face, see Grover J. Whitehurst, *Hard Thinking on Soft Skills*, Evidence Speaks Reports, Vol. 1, #14, Brookings Institution, March 24, 2016. For a more in-depth sense of which skills constitute soft skills, see skills characterized as interpersonal and intrapersonal in *Education for Life and Work: Developing Transferable Knowledge and Skills in the 21st Century*.

¹⁰ There is no universally accepted definition of these terms, but basic skills and knowledge might be thought of as foundational knowledge and skills such as reading comprehension, writing with clarity and use of appropriate grammar, or foundational knowledge of techniques and approaches used in mathematics or science. Whereas applied skills might include writing in formats or genres emphasized in occupations, or applying knowledge of mathematical concepts to particular work-setting problems or projects.

What Spurs Debates About Skills Gaps?

Indications of some imbalance between the supply and demand sides of the labor market are generally the impetus for many skills gap debates. Notably, when employers experience difficulty in filling jobs (i.e., open positions go unfilled for long periods), particularly during periods of relatively high unemployment, concerns emerge about the adequacy of available workers. Similarly, when employer surveys that are designed to gauge employers' needs and the suitability of available workers reveal dissatisfaction with the availability of adequately prepared workers, concerns surface about the skill level of the workforce. Projections also play a role in this debate, as large-scale efforts that attempt to forecast the future educational needs of the workforce (with educational credentials serving as a proxy measure for skill level) sometimes predict impending mismatches on a sizable scale.

Rival explanations for imbalances between supply and demand in the labor market also abound, suggesting the prominence of skills gaps may be overstated. For instance, it is often suggested that unfilled vacancies and unemployment may be a function of the wage levels and working conditions being offered or workers' lack of access to affordable childcare or eldercare as opposed to being indicators that adequately skilled workers are unavailable. Broader analyses and projections of mismatches between educational credentials required for positions and those possessed in the workforce are rebutted by suggestions that credentials are an imperfect proxy for skill demands associated with many types of work and that many positions require educational credentials that are not well matched with actual demands of the job. Employer concerns about the readiness of available workers are rebutted by suggestions that employers may lack willingness to invest in the training and development of workers, preferring instead to onboard employees requiring limited scale-up costs.¹¹ This implies employer dissatisfaction with available candidates may be a function of employers becoming pickier.

Nonetheless, there is little doubt that work demands regularly evolve throughout many occupations and industries creating, at least on some scale, mismatches between what jobs require and the readiness of workers to perform those tasks. It is also well documented that large structural changes accompanying new technologies have had a large effect on the types of jobs available and on the work performed in industries across the economy during certain periods. Current conversations around automation, artificial intelligence, and technological change more generally suggest that such structural changes may be on the horizon in the coming years.¹²

Is This a New Issue?

The debate about skill misalignments and the underlying challenges reflected in the debate have existed for some time. For frame of reference, in early U.S. history, skill requirements and systems to develop them were more transparent and clearly defined. Prior to the industrial

¹¹ Employers' willingness to invest in training is influenced by many factors, including an employer's expectations about how long the worker will stay with the firm. See the discussion in the "Employer-Provided Training" section of this report.

¹² For a variety of perspectives on evolving skill demands in light of technology, artificial intelligence, and automation, see Mark Muro, Robert Maxim, and Jacob Whiton, *Automation and Artificial Intelligence: How machines are affecting people and places*, The Metropolitan Policy Program at Brookings, January 2019; Daron Acemoglu and Pascual Restrepo, *Automation and New Tasks: How Technology Displaces and Reinstates Labor*, National Bureau of Economic Research Working Paper 25684, March 2019; Carl Frey and Michael Osborne, *The future of employment: How susceptible are jobs to computerisation*, *Technological Forecasting and Social Change*, Vol. 114: January 2017, pp. 254-280; and David Autor, *Why Are There Still So Many Jobs? The History and Future of Workplace Automation*, *Journal of Economic Perspectives*, Vol. 29: No. 3, Summer 2015, pp. 3-30.

revolution, for example, the majority of the population participated in an agrarian and handicraft economy. Much of what workers needed to learn to perform work was well understood and transmitted in a family, in an agrarian setting, or in small-scale craft operations. The likelihood that changes to work processes (e.g., through rapid technical innovation) would dramatically affect workers' capacity to perform their jobs was comparatively low. The *employer's* incentive to train workers thoroughly was relatively high, as was the likelihood of receiving a satisfactory return on that investment.

In subsequent periods, determining how best to prepare workers for work and who is responsible for job preparation has been more complicated. Compounding the challenge is the reality that work requirements are often a moving target. Multiple factors have dramatically affected the types of jobs that are available to workers, the requisite skills and knowledge associated with those positions, and whether workers can rely on mastering a relatively finite set of skills or need to evolve continually to keep pace with changing work demands.

Schools have played a central role (i.e., at a minimum, a role in equipping youth with foundational skills and knowledge) at the elementary and secondary levels, and increasingly this has been the case at the postsecondary level as well. Employer-provided training (formal and informal) has also played a key role. Workforce development programs and services have been employed, on a targeted basis, to address these issues as well.

These issues are not new—worker skills have always mattered to production, and U.S. workers and employers have long had to adapt to the changing demands of work.¹³ But identifying the mix of general and specific skills and knowledge needed in the workforce, and the appropriate roles for government, employers, and workers in developing them, can be complex.

Review of the Evidence of a Skills Mismatch

This section of the report examines data and research findings that feature prominently in discussions about the existence of a skills mismatch in the United States, with a particular focus on broad indicators.¹⁴ Official data on job openings and hires provide broad indicators of unmet employer demand for workers, and can help identify industries that face greater staffing challenges. Employers' viewpoints as collected through industry reports provide further insights, and comparisons of workers' educational attainment to employers' reported educational requirements can address the specific question of whether there exists an over- or under-supply of educated workers in today's labor market.

In general, when broad indicators are examined, the available data do not reveal a clear skills mismatch in the economy, but they also do not rule one out. For example, in aggregate, the number of workers with a college degree appears to be greater than the number of jobs that explicitly require them.¹⁵ However, because official data on employers' educational requirements generally do not identify qualitative characteristics (e.g., the degree holder's field of study), a

¹³ For an overview of the types of occupational shifts that have occurred historically, which played a role in changing work demands, see Ian Wyatt and Daniel Hecker, *Occupational Changes During the 20th Century*, Monthly Labor Review, March 2006.

¹⁴ As noted earlier, *skills mismatch* is a broad and inclusive term that encompasses relatively narrow occupational misalignments between workers' skill sets and existing work demands (i.e., skill shortages, such as a local shortage of experienced plumbers), broad-based deficiencies (i.e., skills gaps, such as a widespread shortage of foundational skills) and other types of misalignments. As a matter of feasibility, broad indicators of mismatches are the focus of this section of the report. Skills gaps and shortages are examined separately in this report.

¹⁵ While the overall number of college graduates and career certificate holders appears to meet or exceed employers' needs, there may yet remain a mismatch when specific postsecondary credentials are considered.

skills mismatch may yet exist in certain industries or occupations. Employer reports and job openings data indicate that hiring in some industries is more challenging than in others. Again, these sources do not contain enough detail to distinguish job vacancies that remain open because skills are scarce from those that remain open due to insufficient compensation offers or other reasons.

Job Openings and Labor Turnover Data

Debate around a prospective skills mismatch is frequently discussed in the context of job openings. Notably, official data show that the number of job openings have exceeded job hires in recent years, and reveal cross-industry differences in employers' success filling open vacancies. These patterns bolster claims that employers cannot find the workers they need, but do not necessarily identify a skills mismatch. That is, while some job vacancies remain open when in-demand skills are scarce, persistent job openings can also point to a strong economy, with employers adding new positions as they expand production but struggle to fill jobs in the face of low unemployment. In short, while job-openings data are important to assessing employers' unmet labor needs, additional information is often needed to identify the forces driving hiring challenges (e.g., skills deficits, competitive labor markets, or other explanations).

The Bureau of Labor Statistics (BLS) Job Openings and Labor Turnover Survey (JOLTS) is the primary data source for job openings and related measures.¹⁶ JOLTS data provide important information on job openings, hires, and labor turnover more generally, but they do not provide information on the *content of job openings* (e.g., skills required, task-content of jobs, compensation offered), which limits their usefulness in explaining recent patterns. **Figure 1** plots JOLTS data on the number of hires over the course of a month and the number of jobs open at the end of a month, and shows that both indicators (hires and openings) tend to rise and fall with economic cycles (i.e., they are *procyclical*). This pattern is intuitive, as businesses tend to increase staffing in response to rising consumer demand.¹⁷ Job openings levels rose above hires temporarily in June and August of 2014 and have been continually above hires from January 2015 to November 2021 (with the exception of May and June 2020).¹⁸ This may indicate greater recruitment challenges (e.g., due to a competitive labor market or to a skills mismatch). It could also reflect lower job posting costs, an increased willingness among employers to hold positions open for longer periods, or that workers are more selective about jobs.

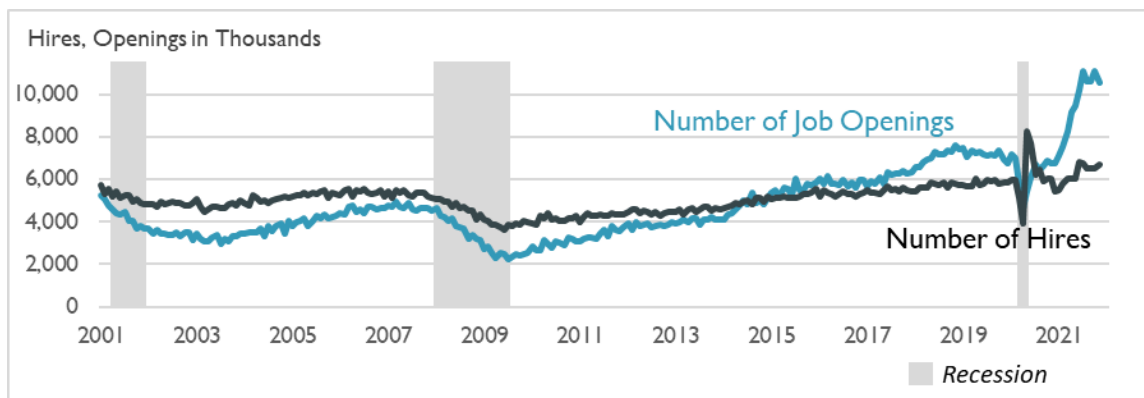
¹⁶ The BLS JOLTS collects information on job openings and hires, as well as job separations, and provides insights into job turnover in the U.S. labor market on a monthly basis. Data and program information is at <https://www.bls.gov/jlt/>.

¹⁷ A business may also have a greater need to fill openings created by employees who have left the firm. Voluntary separations (*quits*) rise during expansions when alternative job opportunities are more abundant.

¹⁸ Both job openings and hires fell in March and April 2020, with some rebound starting in May. The particularly large numbers of hires in May and June 2020 likely reflect the rehiring of workers who were on temporary layoffs.

Figure 1. Job Openings and Hires

December 2000 through November 2021, in thousands



Source: Figure created by CRS using data from the Bureau of Labor Statistics (BLS) Job Openings and Labor Turnover Survey (JOLTS) and the National Bureau of Economic Research (NBER; recessionary periods).

Notes: Job openings indicate the number of job positions that were open (available) at the end of the reference month. Hires indicate the number of persons hired over the entire reference month. JOLTS data for November 2021 are preliminary.

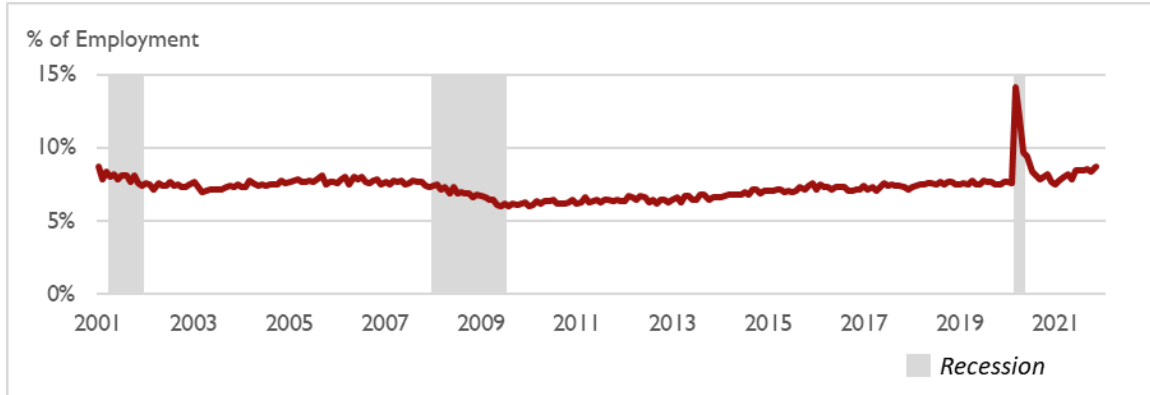
Also relevant to employer’s staffing challenges, JOLTS data reveal a notable and fairly steady rate of worker movement between jobs. **Figure 2** shows that the *churn rate*—defined here as the total number of job hires and separations in a given month as a share of employment—is procyclical and has fluctuated between about 6% and 9% of employment for the last 20 years.¹⁹ This means that while employers operate in a labor market characterized by a lot of worker movement (which affects staffing even when workers hold in-demand skills), in aggregate there has not been a marked long-term change in the rate of worker movements in recent decades.²⁰

¹⁹ Additional discussion of the churn rate used in this section is in BLS, “Which industries need workers? Exploring differences in labor market activity,” *Monthly Labor Review*, January 2016, at <https://www.bls.gov/opub/mlr/2016/article/which-industries-need-workers-exploring-differences-in-labor-market-activity.htm>.

²⁰ The sharp increase in the churn rate during the 2020 recession reflects the swift and sizeable degree of job loss early on in the COVID-19 pandemic, and subsequent recall of workers from temporary layoffs. For additional discussion, see CRS Report R47047, *Job Openings and Labor Turnover Before and During the COVID-19 Pandemic*, by Paul D. Romero, Isaac A. Nicchitta, and Sarah A. Donovan.

Figure 2. Worker Churn Rate

December 2000 through November 2021, in thousands



Source: Figure created by CRS using data from the Bureau of Labor Statistics (BLS) Job Openings and Labor Turnover Survey (JOLTS) and the National Bureau of Economic Research (NBER; recessionary periods).

Notes: The worker churn rate is the total number of job hires and separations in a given month as a share of employment. Data for November 2021 are preliminary.

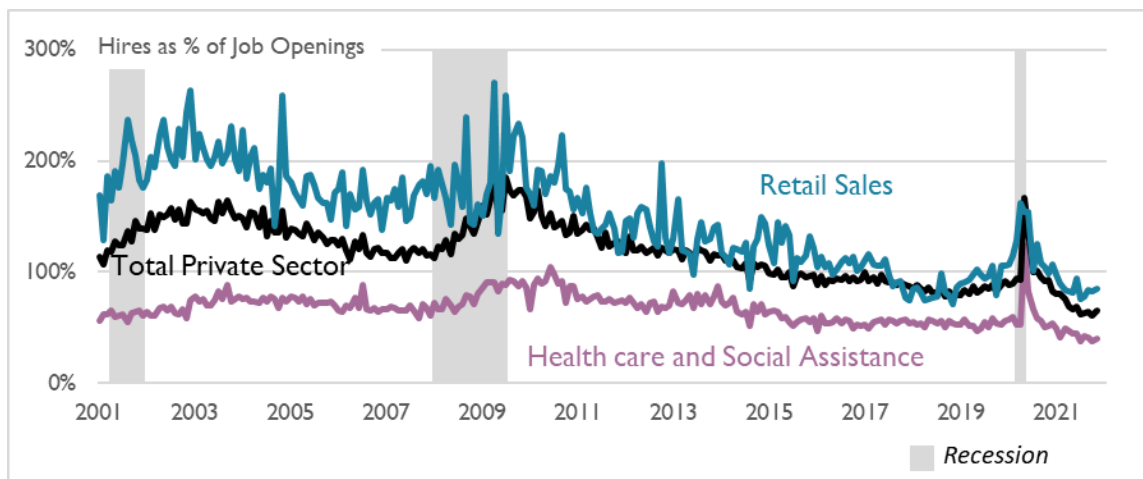
Analysis at the industry level suggests that some employers face greater staffing challenges than others. This is shown in **Figure 3**, which plots the *fill rate*—the number of hires in a given month as a percentage of the number of job openings at the end of the month—for the private sector as a whole and two industries selected to show the range of rates (the retail sales sector and the health care and social assistance sector). Fill rates below 100% indicate that job openings at the end of the month exceeded hires made during that month (e.g., 200 hired and 400 openings would show a fill rate of 50%), and potentially flag hiring challenges. Likewise, fill rates above 100% indicate that hiring in a given month exceeded the number of job openings remaining at the end of the month (e.g., 175 hires and 100 openings would show a fill rate of 175%).

Overall, private sector employers had fill rates above 100% until 2015—consistent with **Figure 1**—when job openings started to exceed monthly hires. In general, fill rates for retail sales were above the industry average and exceeded the fill rate for the health care and social assistance industry. That retail sales jobs are easier to fill is not unexpected, as most positions appear to have relatively few specialized or scarce skill requirements. For perspective, nearly 23% of retail sales positions in May 2020 were retail salespersons (i.e., whose primary function is to sell merchandise to customers), another 19% were cashiers, and 13% were laborers and material movers. By contrast, 33% of positions in the lower-fill-rate health care and social assistance industry were for healthcare practitioners and in technical occupations and 29% were in healthcare support occupations.

The fill rate declined in both industries (and in private sector industries overall) from 2010 to 2020. While a skills mismatch explanation is possible, it is not the obvious primary cause. For one, the unemployment rate also declined considerably over this period (from 9.8% in January 2010 to 3.5% in January 2020), indicating that the labor market was becoming increasingly competitive. In addition, given the occupational composition of the retail sales industry (i.e., predominantly sales and cashiers positions) a skills deficiency argument appears less compelling.

Figure 3. Fill Rate for Selected Private Sector Industries

December 2000 through November 2021



Source: Figure created by CRS using data from the Bureau of Labor Statistics (BLS) Job Openings and Labor Turnover Survey (JOLTS) and the National Bureau of Economic Research (NBER; recessionary periods).

Notes: The fill rate is the number of hires in a given month as a percentage of job openings at the end of the month. Data for November 2021 are preliminary.

Employer Surveys and Industry Reporting

As consumers of workers' skills, employers and industry groups can provide nuanced insights on the availability of in-demand skills in their particular labor markets. These perspectives are sometimes captured in employer surveys, which collect information for various purposes and can take many forms. Federal agencies, for example, may sponsor employer surveys to improve the allocation of government resources.²¹ Private sector organizations, such as human resources consultants (sometimes called *workforce solutions companies* or *recruitment experts*), have sponsored or conducted employer surveys as well.

Some surveys provide a broad gauge of employer experiences, polling employers across multiple industries and sometimes across countries.²² Such data can help to identify broad gaps in skills (i.e., that exist across multiple industries), but may lack details needed to develop a policy response. For example, a recent Manpower Talent Shortage report indicates that “skilled trades (electricians, welders, mechanics)” were the hardest-to-fill positions in the United States.²³ Additional data and analysis are needed to determine if such positions are hard to fill because employers receive little response to job postings, because applicants do not have the needed

²¹ For example, a recent DOL-funded study collected and examined information from employers to learn how to support and leverage strong relationships between employers and workforce development providers. See Molly Scott, Lauren Eyster, and Yipeng Su et al., *The Employer Perspectives Study: Insights on How to Build and Maintain Strong Employer-College Partnerships*, Trade Adjustment Assistance Community College and Career Training Round 4 Evaluation, Prepared for the U.S. Department of Labor, Washington, DC, October 2018, <https://www.dol.gov/sites/dolgov/files/OASP/legacy/files/Employer-Perspectives-Study-Report-Round-Final.pdf>.

²² The Manpower Group reports, for example, its *Talent Shortage* report is based on information collected from more than 24,400 employers across six sectors and 44 countries and territories; see “About This Survey” at <https://go.manpowergroup.com/talent-shortage>.

²³ Manpower Group, *Talent Shortage 2020, Closing the Skills Gap: What Workers Want*, <https://go.manpowergroup.com/talent-shortage>.

skills, because of high turnover in such occupations, because qualified workers are reluctant to relocate for work, or for other reasons.²⁴

Some employer organizations survey their members (employers) on a regular basis, providing some insights on how staffing challenges have evolved over time. The National Federation of Independent Business (NFIB), for example, publishes a monthly jobs report based on its Small Business Economic Trends data, which have been collected from NFIB members since 1974. NFIB reported that in April 2021, 54% of surveyed business owners struggled to find qualified applicants (an increase over the March 2021 report).²⁵ Detailed analyses are sometimes provided through industry reports, which may be sponsored by industry organizations, and often describe industry employers' current and projected workforce needs, hiring challenges, and strategies for addressing skill shortages.²⁶ Given their narrower focus, industry reports can be helpful to understanding the specific staffing challenges and their drivers.

Employer surveys and industry reports can be illuminating sources, shedding light on specific occupation and skill needs generally or in a particular industry, but they are limited in a few key ways. For one, they may base their findings in part on proprietary business data, which—though valuable—complicates the verification of some claims. Relatedly, they may draw their sample from members who opt to participate in the survey. This can result in small and select samples, both of which can limit the representativeness of findings.²⁷ Finally, to the extent that employer or industry groups use the results of such surveys to advocate for greater government investment in workforce development programs, these groups may have incentives to emphasize a skills shortage or a skills mismatch interpretation of employer experiences when other interpretations are possible.

Workers' Educational Attainment and Employers' Educational Requirements

Some studies have explored the potential for a mismatch between workers' educational attainment and employers' educational requirements (i.e., an over- or under-supply), using a variety of methods.²⁸ While formal education is not the only mechanism by which workers acquire skills, it provides some indication of the skill sets available to employers and is relatively straightforward to observe in labor force data.²⁹ And a research focus on educational mismatch is

²⁴ Recruitment challenges may stem from employer decisions as well, such as below-market wages offers or setting unrealistic qualifications requirements.

²⁵ The NFIB Jobs Report for April 2021 is at <https://assets.nfib.com/nfibcom/2021-April-Jobs-Report-FINAL.pdf>.

²⁶ For example, the Manufacturing Institute, part of the National Association of Manufacturers, has collaborated with Deloitte to publish multiple reports on employers' staffing needs in the U.S. manufacturing sector; see <http://www.themanufacturinginstitute.org/Research/Skills-Gap-in-Manufacturing/Skills-Gap-in-Manufacturing.aspx>.

²⁷ For example, the Society for Human Resource Management (SHRM) 2019 Skills Gap Survey had was based on responses from 1,028 SHRM members who responded to an invitation to participate; SHRM reports that 20,000 invitations were sent, translating into about a 5% response rate. The methodological note to its report cautions readers that "although SHRM is confident in its research, it is prudent to understand that the results presented in this survey report are only truly representative of the sample of HR professionals responding to the survey." Society of Human Resource Management, *The Global Skills Shortage, Bridging the Talent Gap with Education, Training, and Sourcing*, 2019, <https://www.shrm.org/hr-today/trends-and-forecasting/research-and-surveys/pages/skills-gap-2019.aspx>.

²⁸ A review of studies is in Seamus McGuinness, Konstantinos Pouliakas, and Paul Redmond, *Skills Mismatch: Concepts, Measurement and Policy Approaches*, Journal of Economic Surveys, Vol. 32, 2018, pp. 985-1015.

²⁹ Many workers gain the skills and knowledge they need through formal or on-the-job training and work experience. Non-school preparation can be significant for some jobs. For example, the BLS reports that entry-level physicians typically complete a three to seven-year internship and residency program in addition to obtaining bachelor's and

supported by business reports and posted job requirements, which show that workers' education levels are meaningful to employers. In 2020, for example, nearly 70% of civilian workers were in jobs for which employers identify a minimum educational level for average job performance.³⁰ Analysis of online job-postings requirements also show rising employer demand for bachelor's degrees.³¹

The literature on educational mismatch for the United States in particular is relatively small and has produced mixed findings, with some finding little evidence of a mismatch and others raising concerns about a shortfall of college-educated workers.³² Current national survey data suggest the number of college-educated workers may be sufficient to meet employers' needs. BLS data show, for example, that—based on employer reports—about 23% of jobs held in 2020 required at least a bachelor's degree for average job performance. In terms of supply, however, 44.0% of employed workers (29.5% of unemployed workers) had acquired at least that credential.³³ At the other end of the spectrum, BLS data also show that whereas employers indicated that 71% of jobs held in 2020 required a high school degree or less education, more than 90% of employed workers had at least graduated from high school.

Another approach to assessing a mismatch on educational attainment is to ask workers whether they hold the necessary credentials to do their job, or if a higher level is needed or a lower level would be sufficient. The 2017 Organization for Economic Cooperation and Development (OECD) Survey of Adult Skills put that question to U.S. workers, who largely reported that they held the necessary degree (59.2%) or that a lower level of education would be sufficient (31.4%).³⁴

medical school degrees. This is not the case for all jobs, however. BLS data also indicate that many jobs can be performed with little specific training: employers reported that in 2020, nearly 31% of workers were in jobs that required more than a short demonstration but not more than one month of preparation time. Bureau of Labor Statistics (BLS), Occupational Requirements in the United States, 2020; data series ORUV1000000000000065. Estimates are preliminary.

³⁰ Employer's reports on minimum educational requirements for average job performance are from BLS, Occupational Requirements Survey (ORS), 2020, <https://www.bls.gov/ors/>.

³¹ Educational requirements in job postings are from Burning Glass Technologies, *Moving the Goalposts: How Demand for a Bachelor's Degree Is Reshaping the Workforce*, September 2014, <https://www.burning-glass.com/research-project/credentials-gap/>. The share of employed U.S. workers with a bachelor's or higher degree has also been rising: from 28% in 1994 (the first year for which BLS published such statistics) to 44% in 2020.

³² For example, the American Action Forum projects that by 2029 the labor market may face an undersupply of workers with a bachelor's or higher degree that exceeds 8 million workers. Douglas Holtz-Eakin and Tom Lee, *Projecting Future Skill Shortages Through 2029*, American Action Forum, July 18, 2019, <https://www.americanactionforum.org/research/projecting-future-skill-shortages-through-2029/>.

³³ That workers' educational attainment exceeded minimum educational requirements for jobs in 2020 does not necessarily indicate an overeducated workforce. Education can increase the range of jobs available to a worker and help workers advance their careers, and has value (e.g., in terms of quality of life, intellectual enrichment, life management, health) that may not be measured by labor markets. Data on minimum educational requirements are from BLS, ORS, 2020, <https://www.bls.gov/ors/>; and data on the educational attainment of employed and unemployed workers are from BLS, Current Population Survey (CPS), <https://www.bls.gov/cps>.

³⁴ CRS calculations based on the OECD Program for the International Assessment of Adult Competencies public use file published by the U.S. National Center for Education Statistics at <https://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2020222>. Similarly, Michael J. Handel summarizes job requirements from data he collected through his Survey of Skills, Technology, and Management Practices (STAMP), and finds "half of the jobs are described by workers as requiring no more than a high school degree, and over 30% of workers report their jobs require less education than they have attained personally." See Michael J. Handel, "What Do People Do at Work? A Profile of U.S. Jobs from the Survey of Workplace Skills, Technology, and Management Practices (STAMP)," *Journal of Labour Market Research*, vol. 49 (2016), pp. 177-197.

Employment Projections and Typical Levels of Education Needed for Entry

The BLS Employment Projections (EP) program develops 10-year projections of labor market growth and contraction at the occupational level; the most recent projections describe the 2020 to 2030 period.³⁵ In addition to employment levels, the EP program also publishes the level of education that is typical for entry into each occupation. *Typical entry-level education* is determined by a number of factors, including the educational attainment of workers who currently work in the occupation and evolving training needs for new entrants in the occupation.³⁶ The estimates of occupational employment growth can be combined with data on the level of education that is typically needed to enter each occupation to offer some insight into the educational demands of the current and near-future labor markets.³⁷

Table 1 presents the employment levels in 2020 and projected employment levels in 2030 in occupations by typical educational level needed for entry.³⁸ In short, the numbers in **Table 1** do not suggest a drastic rise in the share of jobs requiring a higher education degree at entry. BLS projects that employment in occupations with typical entry-level education at the postsecondary level will grow faster than the national average. Conversely, employment in occupations where the typical entry-level education is a high school diploma or less are projected to grow at a rate slower than the national average. But these differences in growth result in only incremental changes to each occupational group's overall share of the labor market. For example, despite the relatively slower employment growth projected for occupations that typically do not require postsecondary education for entry, the share of employment in these occupations is expected to decline by less than a percentage point. Similarly, the employment share of occupations that typically require a bachelor's degree or more is projected to increase by less than a percentage point. This projected employment share of occupations that typically require a bachelor's degree would still be less than the approximately 44% of employed workers (employed in any occupation) with at least a bachelor's degree in 2021.³⁹

³⁵ For example, the EP program projects the number of registered nurse or retail salesperson jobs that are expected to exist in the national labor market at the beginning and end of a 10-year period. The most recent projections cover 2020 through 2030 and include approximately 800 occupations. The BLS employment projections methods are described at <https://www.bls.gov/opub/hom/emp/calculation.htm>. The BLS approach is not embraced by all researchers. For example, Carnevale et al. provide a critique of BLS projection methods and apply an alternative estimation strategy. See Anthony Carnevale, Nicole Smith, and Jeff Stroehl, *Recovery: Job Growth and Education Requirements Through 2020*, Georgetown Center on Education and the Workforce, June 2013, <https://cew.georgetown.edu/cew-reports/recovery-job-growth-and-education-requirements-through-2020/#resources>; and Anthony Carnevale, Nicole Smith, and Jeff Stroehl, *Help Wanted: Projections of Job and Education Requirements Through 2018*, Georgetown Center on Education and the Workforce, June 2010.

³⁶ In some cases, typical education may be higher than the minimum education for average job performance described in the prior section and measured by the BLS Occupational Requirements Survey. For more information, see BLS, Employment Projections, "Measures of education and training," <https://www.bls.gov/emp/documentation/education/tech.htm>.

³⁷ CRS used information on the "typical education needed for entry" for each occupation in 2020 from EP Table 1.7 (<https://www.bls.gov/emp/tables/occupational-projections-and-characteristics.htm>) to group occupations by educational level. Employment levels were then tabulated for 2020 (estimated employment) and 2030 (projected employment) by education level. Results were verified against the "2020 Employment" and "Employment Change" for each educational level in Table 5.2 (<https://www.bls.gov/emp/tables/education-summary.htm>).

³⁸ While each occupation is assigned a single level of education typical to entry, many occupations have workers at differing education levels. For example, the EP specifies that the typical educational level for a construction manager is a bachelor's degree and the typical educational level for a paralegal is an associate's degree, even though each occupation has workers with higher and lower levels of education. For a distribution of education level by occupation, see EP Table 5.3 at <https://www.bls.gov/emp/tables/educational-attainment.htm>.

³⁹ Arguably, a share of workers with at least a bachelor's degree in 2021 will have left the labor market by 2030, for

Table I. Employment by Typical Level of Education Needed for Entry
2020-2030 employment projections, in thousands

Typical Education Level Needed for Entry	Employment 2020	Projected Employment 2030	Change, 2020-2030	Employment Share, 2020	Employment Share, 2030
No postsecondary education	93,452	99,522	6.5%	60.8%	60.2%
No formal educational credential	34,302	37,355	8.9%	22.3%	22.6%
High school diploma or equivalent	59,150	62,167	5.1%	38.5%	37.6%
More than high school, less than a bachelor's degree	16,687	18,073	8.3%	10.8%	10.9%
Some college, no degree	3,869	3,985	3.0%	2.5%	2.4%
Postsecondary nondegree award	9,543	10,469	9.7%	6.2%	6.3%
Associate's degree	3,275	3,619	10.5%	2.1%	2.2%
Bachelor's degree or higher	43,395	47,830	10.2%	28.2%	28.9%
Bachelor's degree	36,408	40,012	9.9%	23.7%	24.2%
Master's degree	2,783	3,239	16.4%	1.8%	2.0%
Doctoral or professional degree	4,204	4,578	8.9%	2.7%	2.8%
Grand Total	153,534	165,424	7.7%	100.0%	100.00%

Source: Data tabulated using Bureau of Labor Statistics (BLS) Employment Projections (EP) Tables 1.7 and 5.2, at <https://www.bls.gov/emp/tables.htm>.

Note: Data in the table reflect the sum of occupational employment in which the specified level of education needed for entry is considered typical.

Because the employment projections are based on changes at the occupational level, a key assumption in developing the data is that the typical level of education in an occupation will not change between 2020 and 2030. If the typical level of education in some occupations increases, then the distribution of employment in occupations at higher levels of education may increase at a rate faster than that suggested by the table.

Educational Attainment: Qualitative Considerations

The discussion above suggests that the U.S. workforce has the educational credentials desired by employers when measured at a broad level. But college graduates experience a range of outcomes in the labor market, indicating that some degree-holders are more in demand (or productive) in the workplace than others. This variability may be, in part, a response to a greater range of skills

retirement or other reasons. Some positions in 2030 that require a bachelor's degree or higher education will hire from the pool of new labor market entrants. See BLS, CPS, *Labor Force Statistics Database* (at <https://www.bls.gov/cps/data.htm>) for information on the number of workers in the civilian noninstitutional population 25 years and over with at least a bachelor's degree.

and abilities brought to the labor market by bachelor's degree holders (i.e., worker characteristics), and to differences in degree-granting institutional characteristics (e.g., preparation quality, coursework) or specialized training (e.g., field of study).

Research shows that field of study matters to labor market outcomes, perhaps reflecting a relative scarcity of certain skill sets in the labor market as well as differences in employers' valuation of specialized skills. In terms of skills mismatch, this may suggest a *horizontal mismatch*—that is, workers may hold the required *level* of education but not in the field sought by employers.⁴⁰ For example, analysis by the Federal Reserve Bank of New York shows that whereas the overall median earnings of college graduates early in their careers was \$42,000 in the 2018-2019 period, early-career earnings varied by college major (from \$32,300 for family and consumer science majors to \$68,000 for chemical and electrical engineers).⁴¹ Another study found similar patterns among career certificate programs.⁴² In addition to documenting a considerable range of annual earnings across certificate programs (e.g., \$15,300 for a medical assisting certificate graduate and \$33,900 for a graduate with a certificate in licensed vocational nursing), the study found that several certificate programs with the highest enrollments had low earnings (e.g., 10 of 15 programs with the most graduates had “typical earnings of \$18,000 or less”), raising questions about a potential oversupply of certain credentials.⁴³ So while BLS data and some studies suggest that the overall number of college graduates and career certificate holders meets or exceeds employers' needs, there may yet remain a mismatch when *specific* post-secondary credentials are considered.

Skills Not Measured by Educational Credentials

Employers have general and specific skill needs that are not captured fully by educational credentials. For example, some job postings solicit cognitive skills (e.g., problem solving) or social skills (e.g., communication, teamwork) in addition to educational requirements, or condition employment on applicants' ability to pass a background check or other measure of trustworthiness.⁴⁴ Assessing a mismatch between the supply and demand for these skills is

⁴⁰ In addition, workers may be employed outside of their field of study. For example, an individual trained as a chemist may be employed as an industry consultant.

⁴¹ Federal Reserve Bank of New York, “The Labor Market for Recent College Graduates,” May 21, 2021, https://www.newyorkfed.org/research/college-labor-market/college-labor-market_compare-majors.html. Another study that examined pay differentials across college majors also identified chemical and electrical engineering among top-earning majors, while a major in “music and speech/drama” was a low-earning major. Joseph G. Altonji, Lisa B. Kahn, and Jamin D. Speer, “Cashier or Consultant? Entry Labor Market Conditions, Field of Study, and Career Success,” *Journal of Labor Economics*, vol. 34, no. S1 (2016), pp. S361-S401. In related work, the same authors found that the pay differential between higher- and lower-paying college degrees increased over the 1993-2011 period; see Joseph G. Altonji, Lisa B. Kahn, and Jamin D. Speer, “Trends in Earnings Differentials across College Majors and the Changing Task Composition of Jobs,” *American Economic Review*, vol. 104, no. 5 (2014), pp. 387-93.

⁴² The Aspen Institute, *From College to Jobs: Making Sense of the Labor Market Returns to Higher Education*, 2015, <https://www.aspeninstitute.org/publications/labormarketreturns/>.

⁴³ This could suggest an oversupply of workers with such training, but other explanations are possible. For example, earnings may be low because the programs prepare workers for entry-level jobs that require considerable employer-provided training or supervision.

⁴⁴ David Deming and Lisa Kahn found, for example, that employers seeking candidates for professional occupations frequently include cognitive (37% of professional job postings), social skill requirements (36% of professional job postings), or both (25% of professional job postings) in postings *in addition to educational attainment requirements* (59% of postings; among such postings with educational requirements, the average requirement is 15.7 years of school). David Deming and Lisa B. Kahn, “Skill Requirements across Firms and Labor Markets: Evidence from Job Postings for Professionals,” *Journal of Labor Economics*, vol. 36, no. S1 (2018), pp. S337-370 (hereinafter, “Deming and Kahn, 2018”).

challenging, because few surveys attempt to measure them in workers at a national level, but there is some indication that an undersupply may exist. A 2017 survey of small businesses, for example, indicates that among firms that reported recent difficulties in hiring, 36% gave “lack of soft skills” as a reason and 23% gave “difficulty passing background check, credit check, or drug test” as a reason that hiring was challenging.⁴⁵

In addition, workers can gain skills and expertise through nondegree postsecondary programs (e.g., certifications), apprenticeships, and on-the-job training (formally and informally acquired). Recent BLS data and projections point to strong and continuing demand for workers in the middle-skill range (i.e., education and/or training beyond high school but less than a college degree) in some occupations. For example, industrial machinery mechanics, electricians, and fitness instructors are examples of occupations that do not require a post-secondary degree for entry-level positions, had median annual earnings in 2019 that were greater than the overall median (\$39,810), and were projected by BLS to grow by at least 50,000 jobs and with average or better employment growth between 2019 and 2029.⁴⁶

Review of the Evidence for the Existence of Skills Gaps

A skills gap describes a shortfall of a certain skill or set of skills broadly sought by employers. A gap in the supply of foundational skills (e.g., reading comprehension, numeracy), for example, would have far reaching consequences for U.S. employers, as these skills are needed in most occupations. Digital literacy and soft skills are also required, to varying degrees, in many workplaces. Given their large-scale nature, identifying and measuring skills gaps generally requires national-level assessment. Federal statistical agencies, like the National Center for Education Statistics (NCES) and BLS, that are able to collect nationally representative data, play key roles in measuring countrywide supply and demand for certain skills. Some research organizations and business consultants provide additional insights into the extent of gaps by collecting or analyzing large-scale data or examining the skill content of jobs (See the “Employer Surveys and Industry Reporting” section of this report for a discussion, including of the limitations of these resources). Available prominent sources do not seem to clearly identify a sizable gap in foundational skills or basic digital skills in the U.S. workforce. However, several available sources generate findings that lend themselves to multiple interpretations, and it is often difficult using existing indicators to map assessed skill levels (of workers or those preparing to enter the workforce) against the precise level of skills needed across the workforce. Moreover, several types of skills are not addressed in existing sources. Additional research—including the development of standardized measures—could assess the sufficiency of soft skills in the U.S. workforce.

⁴⁵ The study was based on data from the 2017 Small Business Credit Survey (SBCS), which included a module on hiring challenges and firm responses to such challenges. Hiring difficulties are prevalent; about two-thirds of firms with recent job openings reported challenges. Such firms were asked to select from a survey-provided list of reasons that hiring was difficult, and were permitted to select more than one reason. Ellyn Terry and Mels De Zeeuw, *How Do Firms Respond to Hiring Difficulties? Evidence from the Federal Reserve Banks’ Small Business Credit Survey*, Federal Reserve Bank of Atlanta, Community and Economic Development Discussion Paper No. 2018-1, August 21, 2018, <https://doi.org/10.29338/dp2018-01> (hereinafter, “Terry and De Zeeuw, 2018”).

⁴⁶ BLS, Occupational Projections Database, <https://www.bls.gov/emp/data.htm>.

Foundational Skills

Foundational skills, such as reading comprehension and math skills, establish a base upon which future career skills are built. As expected, these types of skills are broadly sought by employers. For example, BLS reported that nearly all jobs in 2020 had a minimum formal education or literacy requirement.⁴⁷ Extending beyond narrow characterizations of basic skills, a recent Pew Research Center analysis indicated that “fundamental skills” such as critical thinking, writing, speaking, reading comprehension, active listening and learning, and judgment and decisionmaking were important to work performance in about 70% of occupations.⁴⁸

A limited number of national level resources assess the foundational skills of current or future workers. Results from the National Assessment of Educational Progress (NAEP), a nationally representative assessment of U.S. students, that examines some core foundational skills, suggest that most 12th grade students in 2019 had at least basic math and reading skills (70% of students in reading and 60% of students in math). At the same time, these results suggest sizable populations of students possess a skill level below the basic 12th grade skill level in these areas (30% in reading and 40% in math) as assessed by NAEP.⁴⁹

Mapping these NAEP results against the skill content of jobs in the economy is not a straightforward exercise. In part, this is because NAEP does not purport to assess students against the skill requirement of jobs; it is focused on assessing learning expected at certain grade levels in school.⁵⁰ It is also hard to decipher the proportion of jobs that demand 12th grade skill levels in these domains. Consider, for instance, that 22% of employment in the United States is in occupations typically requiring no formal educational credential. Another 39% of employment is in occupations typically requiring a high school equivalent education. It is difficult to glean the

⁴⁷ According to employer responses to the BLS 2020 Occupational Requirements Survey (ORS), 69.5% of jobs required at least a high school degree, and 27.2% of jobs that did not have a minimum formal educational requirement required literacy. See <https://www.bls.gov/ors/>.

⁴⁸ The Occupation Information Network (O*NET) database was a key source of information for the Pew Research Center study. The O*NET database contains standardized and occupation-specific descriptors on hundreds of U.S. occupations. It was developed and is maintained by the North Carolina Department of Commerce with financing from the Department of Labor Employment and Training Administration. Additional information is at <https://www.onetcenter.org/>. Rakesh Kochar, *Women Make Gains in the Workplace Amid a Rising Demand for Skilled Workers*, Pew Research Center, January 2020, <https://www.pewsocialtrends.org/2020/01/30/women-make-gains-in-the-workplace-amid-a-rising-demand-for-skilled-workers/>.

⁴⁹ Specifically, 2019 NAEP assessments indicated that 60% of 12th grade students were, at a minimum, able to solve mathematical problems that require the direct application of concepts and procedures in familiar mathematical and real-world settings, and when reading text appropriate to 12th grade, 70% of 12th grade students were, at a minimum, able to demonstrate an overall understanding and make some interpretations of the text. These students demonstrated either a basic, proficient, or advanced level of achievement on assessments. Students’ performance on the NAEP assessments varies across subgroups of the population. The level of performance required in each domain likely varies across occupations. In any case, efforts to improve students’ performance at the individual and group levels may yield considerable benefits for students, regardless of whether or not employers currently find these foundational skills in sufficient supply. A discussion of the NAEP and other assessments is in CRS Report R45401, *National and International Educational Assessments: Overview, Results, and Issues*, by Rebecca R. Skinner. Assessment results are at <https://www.nationsreportcard.gov/>.

⁵⁰ NAEP assesses students in relation to standards that define what students should know and be able to do in particular subjects. The NAEP Governing Board works with subject matter experts, practitioners, members of the business community, and members of the public when establishing standards. Standards are collaboratively developed based on the knowledge and experience of various stakeholders, and are focused on knowledge, skills, and competencies that are relevant to many endeavors, not just those applicable to work. For more information on NAEP and its focus, see CRS Report R45401, *National and International Educational Assessments: Overview, Results, and Issues*, by Rebecca R. Skinner.

precise share of this set of occupations requiring the 12th grade level of skill in these foundational areas as that skill level is assessed by NAEP. Hence, NAEP results (based on those not yet fully in the workforce) may lend themselves to multiple interpretations if applied to debates about the potential existence of a broad undersupply of foundational skills.

Another relevant resource is a large series of work readiness assessments conducted over the 2006 to 2011 period by the ACT, which in addition to college entrance exams and educational assessment work, develops and administers job readiness assessments for a large array of corporate clients. These assessments indicate that workers generally have foundational reading and applied mathematical skills needed by employers.⁵¹ However, ACT analysis also revealed that information location skills—skills that are important in many types of work—were lacking for numerous worker groups.

One more source generating findings of relevance at a national (and international) level is the OECD Survey of Adult Skills, which presents survey respondents with a series of questions about the extent to which and ways in which they use skills in their everyday life and at work. The survey also administers some assessments to gauge respondent’s levels of proficiency in these skill domains. Finally, in one set of analyses, it maps assessed skill level against self-reported level and nature of use of skills at work. Findings are reported on whether assessed skill levels are well matched with, or whether respondents are under-skilled or over-skilled in relation to, the skill demands they report facing at work (in qualifications, literacy and numeracy skills, and field of study). These findings suggest that in 2017, U.S. respondents were typically well-matched or over-skilled in terms of qualifications and literacy and numeracy skills; about half of U.S. respondents reported they were well-matched in their field of study.⁵²

Basic Digital Skills

Use of digital technology in U.S. workplaces suggest broad demand for basic digital skills across occupations and industries.⁵³ National data on the workplace role of digital technology are scarce, but some studies have been able to document the widespread nature of digital skills through occupational analysis and online job posting requirements. Researchers from the Brookings Institution, for example, analyzed the digital skill content of hundreds of occupations using the Occupation Information Network (O*NET) database, a DOL-funded catalog of standardized job characteristics for hundreds of occupations, and found that a majority of jobs in 2016 had a medium or high digital content level.⁵⁴ High digital content jobs—such as software developers,

⁵¹ The ACT work readiness standards are based on a nationally representative sample of *jobs* in a given occupation. ACT’s work readiness findings (i.e., the degree to which workers possess certain foundational skills) are based on a large sample (4 million assessments) but the methodology section of the report does not indicate whether this sample is nationally representative. ACT, *The Condition of Work Readiness in the United States*, 2013, <http://www.act.org>.

⁵² See Organization for Economic Cooperation and Development (OECD), *Skills Matter: Additional Results from the Survey of Adult Skills*, OECD Skills Studies, 2019, Table A5.6, <https://doi.org/10.1787/1f029d8f-en>.

⁵³ For example, office-based work regularly relies on word-processing and other productivity software (e.g., spreadsheets), networked offices, and communication technology. Retail jobs use digital point-of-sale and inventory technology. Navigation and communication software are used in transportation jobs. Construction work and production jobs use digital technology to schedule and document work, improve workplace safety, and run diagnostic tests on machinery.

⁵⁴ Mark Muro, Sifan Liu, Jacob Whiton, and Siddharth Kulkarni, *Digitization and the American Workforce*, Brookings Institution, November 2017, <https://www.brookings.edu/research/digitalization-and-the-american-workforce/>. The Occupation Information Network (O*NET) database was a key source of information for the Brookings study. The research team constructed a measure of digital content using the two O*NET measures: “the overall knowledge of computers and electronics required by a job” and “the centrality of computers to the overall work activity of the

computer systems analysts, and financial managers—made up about 23% of employed workers, and medium digital content—such as lawyers, mechanics, registered nurses, and office clerks—made up an additional 47.5%. Similarly, a study of middle-skill job postings in 2016 by Burning Glass Technologies (BGT) indicated that 82% of middle-skill jobs required some proficiency in digital skills.⁵⁵ The ability to use productivity software (e.g., word processing, spreadsheets) effectively appears to be a baseline digital skills requirement; the majority (78%) of middle-skill postings in 2016 required applicants to be able to use this software.

While some observers have pointed to a lack of digital skills in some industries,⁵⁶ there does not appear to be a widespread absence of these skills in the U.S. workforce. The results of the 2017 OECD Survey of Adult Skills, for example, revealed that most U.S. adults (ages 16 to 65) had at least basic technology skills.⁵⁷ The survey results indicated that more than 30% of adults could complete straightforward tasks using common technology applications and simple reasoning, and an additional 31% could perform more advanced tasks using both common and more specific technology and more sophisticated problem-solving skills.⁵⁸

Soft Skills

The term *soft skills* generally captures workers' ability to interact effectively with others (e.g., customers, teams of coworkers, the public) and includes skills such as social intelligence, communication skills, the ability to set goals and plan and carry out tasks, and a positive attitude toward work and learning. Employers demand for such skills can be measured through employer surveys and job posting requirements, and seen in labor market outcomes for positions that rely on strong soft skills. For example, a survey conducted by the National Association of Colleges and Employers revealed that the top three attributes sought by employers in 2019 were problem-solving skills, ability to work on team, and a strong work ethic.⁵⁹ Interpersonal skills are a clear

occupation.”

⁵⁵ The study defined *middle-skill jobs* as those for which most job postings do not require a bachelor's degree and at least 50% offer a \$15 hourly wage. Burning Glass Technologies, *The Digital Edge: Middle-Skill Worker and Careers*, September 2017, <https://www.burning-glass.com/research-project/digital-skills-gap/>

⁵⁶ For example, participants in a panel hosted by the National Skills Coalition in 2020 highlighted a prevalence of low digital skills among workers in certain industries (e.g., manufacturing); see HRDive, *Millions of US workers have 'limited or no digital skills*, February 2020, <https://www.hrdiver.com/news/millions-of-us-workers-have-limited-or-no-digital-skills/572048/>.

⁵⁷ The OECD Survey of Adult Skills is designed to measure the proficiency—as defined by the OECD—of working-age adults (16-65 year-olds) in three key information-processing skills (literacy, numeracy, and problem solving in technology-rich environments) and to allow for international comparisons. The survey has been conducted in over 40 countries since 2011, including the United States in 2011-2012 and 2017. The survey defines *problem solving in technology-rich environments* as “using digital technology, communication tools and networks to acquire and evaluate information, communicate with others and perform practical tasks” and assesses respondents' abilities “to solve problems for personal, work and civic purposes by setting up appropriate goals and plans, and accessing and making use of information through computers and computer networks.” Additional information on survey design is at <https://www.oecd.org/skills/piaac/about/#d.en.481111>. Recent results are in OECD, *Skills Matter: Additional Results from the Survey of Adult Skills*, OECD Skills Studies, 2019, <https://doi.org/10.1787/1f029d8f-en>.

⁵⁸ Another nearly 20% could successfully complete simple information and communications technology (ICT) tasks but could not complete those with greater complexity. Specifically, such individuals could complete tasks based on well-defined problems involving few steps and that do not require any categorical or inferential reasoning. The survey also provided insights into digital *illiteracy* among U.S. adults; the share of adults with no or little ICT in the United States was 7.4%, which was below the OECD-country average of 16.3%.

⁵⁹ National Association of Colleges and Employers (NACE), *Key Attributes Employers Want to See on Students' Resumes*, January 13, 2020, <https://www.nacweb.org/talent-acquisition/candidate-selection/key-attributes-employers-want-to-see-on-students-resumes/>.

asset to workers in the service sector, particularly those who interact with the public.⁶⁰ Analysis of job postings requirements by BGT indicated that communication skills were the top-ranked baseline skills sought by employers across all occupations during the September 2014 to August 2015 period.⁶¹ BGT uses the term *baseline skills* to denote skills (including soft skills) “sought by employers across multiple occupations and that are not typically taught in training programs.” Customer service was the second-ranked baseline skill in front-facing jobs like customer and client support; hospitality, food, and tourism; and sales. A study by the Georgetown University Center for Education and the Workforce linked data on recent labor market outcomes to data describing occupational *competencies* (in this context, occupational knowledge, skills, and abilities) and identified communication, teamwork, sales and customer service, leadership, and problem solving and complex thinking as the top five competencies in high demand. Of these, communication had the highest demand across occupations.⁶² Further, economist David Deming observed that high-skill occupations with the fastest employment growth (between 2000 and 2012) were those that “require significant interpersonal interaction” (e.g., managers, teachers, physicians, nurses).⁶³

Assessing the sufficiency of soft skills in the U.S. workforce is particularly challenging. The term does not refer to a single, agreed-upon set of worker skills, and so employers may refer to different and sometimes industry-specific soft skills when citing concerns about a soft skills gap.⁶⁴ In addition, soft skills must be assessed in context (e.g., communication skills in a customer service role may differ from those needed in a technical work environment) and some soft skills are more abstract than others (e.g., the ability to set goals may be easier to observe and assess objectively than creative-thinking skills).⁶⁵ For these reasons, a standardized measure of soft skills in the student population or in the workforce has yet to be developed, and it is therefore not possible to assess with confidence whether or not a widespread deficiency in soft skills exists in the U.S. workforce.

⁶⁰ This is a potentially large group. BLS estimates that in 2019, about 75% of workers had some interaction with the public, <https://www.bls.gov/opub/ted/2020/three-fourths-of-workers-had-to-interact-with-the-public-in-2019-4-3-percent-worked-around-crowds.htm>.

⁶¹ Burning Glass Technologies, *The Human Factor: The Hard Time Employers Have Finding Soft Skills*, 2015, http://www.burning-glass.com/wp-content/uploads/Human_Factor_Baseline_Skills_FINAL.pdf.

⁶² Anthony Carnevale, Megan L. Fasules, and Kathryn Peltier Campbell, *Workplace Basics: The Competencies that Employers Want*, 2020, Georgetown University Center on Education and the Workforce, 2020, cew.georgetown.edu/competencies.

⁶³ Deming proposes that this pattern may be driven in part by technological change. That is, whereas technological progress can substitute some aspects of cognitive-intensive work, technology is a poor substitute (currently) for social interaction but may complement it. See David J. Deming, “The Growing Importance of Social Skills in the Labor Market,” *The Quarterly Journal of Economics*, vol. 132, no. 4 (2017), pp. 1593-1640. The complementarity of cognitive and social skills is not new theory. Catherine Weinberger found evidence of such a relationship using data on labor market outcomes over 1979 to 1999. Catherine J. Weinberger, “The Increasing Complementarity between Cognitive and Social Skills,” *The Review of Economics and Statistics*, vol. 96, no. 5 (December 2014), pp. 849-861.

⁶⁴ For example, finance sector employers may use a soft skills gap to refer to challenges hiring workers with strong teamwork skills. Kate Davidson, “Employers Find ‘Soft Skills’ Like Critical Thinking in Short Supply,” *Wall Street Journal*, August 30, 2016, online edition.

⁶⁵ A discussion of the challenges of measuring students’ soft skills in a school environment is in Grover J. Whitehurst, *Grading soft skills: The Brookings Soft Skills Report Card*, the Brookings Institution, Evidence Speaks Report, Vol. 2, No. 4, December 15, 2016, https://www.brookings.edu/wp-content/uploads/2016/12/es_20161215_whitehurst_evidence_speaks.pdf.

Review of the Evidence for the Existence of Skill Shortages

While evidence reviewed in this report does not conclusively suggest pervasive skills gaps, that does not rule out the possibility of *skill shortages*—excess demand for specific skills, often associated with particular occupations—at the national or local level. Employers’ skill demands vary across occupations and location, and some needs can be quite specific (e.g., proficiency in a particular software or specialized experience).⁶⁶ Where certain skill sets are relatively rare overall or scarce in certain locations, employers may struggle to fill positions due to a lack of available qualified workers.⁶⁷ This section provides a snapshot of selected skill shortage examples and more generally identifies several factors that can contribute to skill shortages, and other conditions that create hiring challenges that are unrelated to the workforce skills.

Selected Examples

Comprehensively surveying evidence of skill shortages across fields and locales is beyond the scope of this report. For illustrative purposes, this section notes two selected examples of generally accepted skill shortages and their apparent drivers. No attempt is made here to assess the scale or concentration of skill shortages.

Cybersecurity Jobs

Digital security concerns have increased with the proliferation of digital technology in commerce and individuals’ daily lives, and generated heightened demand for qualified and highly skilled cybersecurity personnel. Over the 2013–2018 period, the number of cybersecurity positions posted online increased by 94%; by comparison, growth in information technology postings was 30% over the same period.⁶⁸ Concerns about an insufficient supply of cybersecurity skills in the labor market are widespread, and some indicators point to a shortage. For example, employers report that hiring skilled cybersecurity workers takes longer than hiring IT professionals more generally, and wage offers are higher on average.⁶⁹

Meeting demand for cybersecurity skills is challenging on many levels. At the forefront is that the cybersecurity field is dynamic. New technologies and threats emerge each year, creating the continual need to maintain and enhance the skill levels of incumbent workers within the cybersecurity field. In addition, and perhaps in response to the changing nature of skill requirements, employers hiring cybersecurity workers tend to be quite selective. BGT reports, for

⁶⁶ Deming and Kahn show that the mix of skill requirements varies considerably across professional occupations. For example, relatively few postings (7%) for registered nurses listed “writing” as a required skill (compared to 20% across all professional occupation postings) and computer skills (required in 11% of RN postings, vs. 29% for all professional postings), but a relatively large share of RN postings required customer service skills (38% vs. 20% in all professional postings). See Deming and Kahn, 2018.

⁶⁷ Terry and De Zeeuw find that whereas 19% of small firms reporting hiring challenges report trouble finding workers with basic skills (math, reading, or writing), 63% report that hiring was complicated by a lack of job-specific skills, education, or experience. See Terry and De Zeeuw, 2018.

⁶⁸ Burning Glass Technologies (BGT), *Recruiting Watchers for Digital Walls: The State of Cybersecurity Hiring*, June 2019, https://www.burning-glass.com/wp-content/uploads/recruiting_watchers_cybersecurity_hiring.pdf.

⁶⁹ The BGT analysis reveals that in the September 2017 to August 2018 period, cybersecurity positions took 50 days, on average, to fill, whereas IT jobs more generally had an average fill-time of 41 days. In terms of pay, the average advertised salary for cybersecurity positions was \$12,700 higher (16%) than the average advertised salary for IT jobs.

example, that employers are seeking workers who not only meet educational requirements, but also have several years of relevant work experience, and certifications—some of which can only be obtained by experienced workers who are relatively rare among otherwise skilled workers.

Teachers—Specialty Fields

Reports of understaffing at elementary and secondary schools raise concerns about a national teacher shortage at times, and fuel calls for federal policy to improve the recruitment and retention of the teaching profession in general. Of particular concern is a lack of teachers trained in specialty fields, such as math, special education, foreign languages, and the physical sciences (e.g., chemistry, physics).⁷⁰ For example, among public schools that had teaching vacancies in the 2015-2016 school year, 9.1% reported challenges filling general elementary positions and a much higher share reported challenges filling special education positions (31.4%) and mathematics positions (30.4%). The geographic distribution of teachers can also create *local shortages* of teachers (i.e., an insufficient number of teachers in a particular location), overall and for specialty subjects in particular, with high-poverty communities and rural schools more likely to report unfilled vacancies than others. To illustrate, whereas 31.4% of schools overall with a special education vacancy reported challenges filling the position, the share was 34% in rural communities and 33.1% in schools with at least 75% of students approved for free or reduced-price lunches.

A shortage of specialty field teachers reveals insufficient numbers of teachers (or prospective teachers) with the necessary credentials for the positions and who are willing to accept a teaching job in the specialty field. California administrative data for the 2017-2018 school year reveal, for example, that due to schools' inability to hire qualified teachers, about 65% of California's first-year special education teachers did not hold the required credentials for their position and had instead obtained a waiver, intern credential or provisional intern permit, or short-term or limited assignment permit.⁷¹ Further, there is no guarantee that teachers trained in specialty fields and who are fully credentialed will stay in such positions. Special education teachers, for example, may also qualify for general education positions and transition there if pay and working conditions are not appealing. Teachers with math and science degrees may be drawn to career opportunities outside of teaching.⁷²

In the sections that follow, several broader explanations for why shortages may exist are considered, followed by a discussion of hiring challenges that may appear to be skills-related, but are due to other factors.

Rapid Changes in Employers' Needs or Consumer Demand

Economic theory predicts that shortages will be temporary if employers increase compensation or otherwise make jobs more attractive, and workers respond to these incentives by obtaining the in-

⁷⁰ Department of Education, National Teacher and Principal Survey 2015-2016, https://nces.ed.gov/surveys/ntps/tables/ntps1516_20180119007_s1n.asp.

⁷¹ Naomi Ondrasek, Desiree Carver-Thomas, Caitlin Scott, and Linda Darling-Hammond, *California's Special Education Teacher Shortage*, Learning Policy Institute, February 2020, <https://learningpolicyinstitute.org/product/pace-california-special-education-teacher-shortage-brief>.

⁷² Analysis of 2016 and 2017 data by the Learning Policy Institute indicates that 7.3% of teachers, on average, report they intend to leave teaching when a better opportunity becomes available (see <https://learningpolicyinstitute.org/product/understanding-teacher-shortages-interactive>).

demand skill or relocating to areas where their existing skill set is in short supply. But even in well-functioning labor markets, this process can break down.

For example, skill shortages may endure over time in industries or occupations with rapidly changing skill requirements.⁷³ One study shows, for example, that applied STEM job requirements changed to a greater degree over the 2007 to 2017 period than job requirements in other occupations, likely contributing to staffing challenges in those workplaces.⁷⁴ When new required job skills are gained through intensive education and training (i.e., are *not* generally learned on the job by incumbent workers), firms may face a continuous recruitment cycle, replacing workers with obsolete skills with recent graduates on an ongoing basis. Shortages can persist in such a scenario when skill acquisition requires a long preparation period; rising wages may draw workers to a field, but the new supply of skilled workers will occur with a potentially lengthy delay.⁷⁵ Skill shortages are further possible when skill standards change rapidly and training is costly to workers, such that they are reluctant to make an investment that might turn out to have a relatively short payoff period.

Similarly, rapid changes in consumer demand for goods and services, particularly those that require specialized skills, can create conditions that foster shortages, at least temporarily. A housing boom or a natural disaster, for example, can markedly increase the demand for skilled construction workers. Albeit more gradually, an aging population will raise demand for health care and personal services on a potentially large scale.

Limits on worker mobility can also lead to shortages, even when the number of skilled workers overall is sufficient to meet employers' demand. This can happen when workers are not able or not willing to move to locations experiencing a particular skill shortage. Restrictions on foreign labor can also have an effect.⁷⁶

Local Shortages

Local shortages (i.e., skill shortages affecting particular geographic locations) can occur despite a sufficiently large pool of skills in the national workforce. For example, data on student enrollment and teacher statistics suggest that a national teacher shortage is unlikely.⁷⁷ However, the

⁷³ Rapidly changing work requirements can be associated with challenging staffing situations *separate from a short supply of skill*. Employers may need to recruit more frequently than they had in the past or more frequently than other employers; this kind of skill turnover can result in firms hiring from a pool of recent graduates, who, while well-trained, are less experienced and potentially more likely to change jobs than the workforce overall.

⁷⁴ Applied STEM occupation with high task replacement rates over the 2007-2017 period include mechanical drafters, computer programmers, architectural and civil drafters, software developers. David J. Deming and Kadeem L. Noray, *STEM Careers and Technological Change*, National Bureau of Economic Research, Working Paper No. 25065, September 2018, <http://www.nber.org/papers/w25065>.

⁷⁵ BLS ORS data for 2018 indicate that, overall, 17.9% of workers were in jobs that required at least four years of specific vocational preparation before hire (degree, certification, training, experience). Workers in other occupation groups faced such a requirement with greater frequency. For example, 40.2% of workers in community and social services occupations were in positions that required at least four years of preparation; other examples are life, physical, and social science jobs (55.5% of workers); architecture and engineering occupations (55.8% of workers); business and financial operations (54.2% of workers); computer and math jobs (64.1% of workers); legal occupations (64.6% of workers); and management (76.7% of workers), among others.

⁷⁶ Foreign labor considerations are discussed in the "Reliance on Foreign Labor" section of this report.

⁷⁷ CRS estimates, for example, that in 2017 there were enough employed elementary and secondary teachers to produce an average student-teacher ratio of approximately 14. ACS data indicate that in 2017, there were 62.66 million individuals who were ages 5 to 19 (an upper-bound estimate of the number students in that year; for comparison, Digest of Education Statistics data for 2017 indicate a projected K-12 enrollment of 56.5 million students) and there were 4.48

geographic distribution of teachers may yet be problematic; some schools may face *local shortages* (i.e., an insufficient number of teachers in a particular location) while schools in other areas face a surplus. American Institutes for Research projections produced in 2015 showed, for example, a growing expected surplus of general education teachers in Massachusetts over 2016 to 2024, but an expected shortage of teachers in Oklahoma over the 2015 to 2019 period (with variation by region within Oklahoma).⁷⁸ Other research showed that within states and school districts, high-poverty and high-minority areas are more likely to face shortages of qualified teachers than low-poverty and low-minority areas.⁷⁹

Industry Clustering

Geographic clustering of certain industries—for example, in technology and innovation⁸⁰—can increase the likelihood of local skill shortages in cities and towns located outside of clusters. For example, some manufacturing firms that have adopted more modern production technologies may face challenges attracting skilled software engineers if there is not a great deal of overlap between manufacturing locations and innovation hub cities.⁸¹ Spatial concentration of high-productivity industries can also have ripple effects, as the wealth created by these sectors attracts nurses, teachers, plumbers, and other workers who provide local services, sometimes drawing them away from other geographic areas.⁸²

Declining Geographic Mobility

Between 1981 and 2020, the share of U.S. residents who moved to a different county fell from about 6% to under 4%.⁸³ This steady decline in geographic mobility may compound recruitment challenges for some employers seeking scarce skill sets. For example, although studies of mobility by occupation form a relatively small body of literature, one study establishes relatively low rates of mobility among registered nurses and observes that this pattern likely contributes to

million employed school teachers (3.75 million elementary school teachers, 0.74 million secondary school teachers) providing an average student-teacher ratio of approximately 14 in that year.

⁷⁸ Jesse Levin, Alex Berg-Jacobson, and Drew Atchison et al., *Massachusetts Study of Teacher Supply and Demand, Trends and Projections*, American Institutes for Research, Washington, DC, December 2015, https://www.air.org/sites/default/files/downloads/report/Massachusetts-Study-of-Teacher-Supply-and-Demand-December-2015_rev.pdf; and Alex Berg-Jacobson and Jesse Levin, *Oklahoma Study of Teacher Supply and Demand, Trends and Projections*, American Institutes for Research, Washington, DC, September 2015, <https://www.air.org/sites/default/files/downloads/report/Oklahoma-Study-of-Teacher-Supply-and-Demand-September-2015.pdf>.

⁷⁹ Leib Satcher, Linda Darling-Hammond, and Desiree Carver-Thomas, *A Coming Crisis in Teaching? Teacher Supply, Demand, and Shortages in the U.S.*, Learning Policy Institute, September 2016, pp.13-15, <https://learningpolicyinstitute.org/product/coming-crisis-teaching>.

⁸⁰ Enrico Moretti, *The New Geography of Jobs*, New York, Houghton Mifflin Harcourt, 2014 (hereinafter, “Moretti 2012”).

⁸¹ Some manufacturers echo the idea that location decisions should be made based on where desired workforces are located rather than a hope that such workers can be enticed to move to the manufacturer. “[CEO Tim] Sullivan, who chaired Gov. Walker’s Council on Workforce Investment in 2013, said that after struggling to find people to fill jobs for the business he led in South Milwaukee, he realized that ‘you have to take the jobs to the community.’” Dan Shafer, “Is the skills gap more of a ‘geography gap’ in the Milwaukee area?”, *Milwaukee Business Journal*, November 2016, <https://www.bizjournals.com/milwaukee/news/2016/11/23/is-the-skills-gap-more-of-a-geography-gap-in-the.html>.

⁸² See Moretti 2012, Chapter 2, for a discussion of how job creation in the innovation sector can raise demand for workers providing local services.

⁸³ The share who moved to a different state similarly declined from about 3% to around 1.5% over the same period. Census Bureau, Annual Geographic Mobility Rates by Type of Movement, 2020, <http://www.census.gov/data/tables/time-series/demo/geographic-mobility/historic.html>.

the limited ability of health care employers to attract skilled nursing to rural or other underserved areas.⁸⁴ Although there is no consensus on the direct cause of the decline in geographic mobility, studies of recent migration patterns suggest several possible drivers, including insufficiently flexible housing markets, lower financial benefits (within a given occupation) from moving to another labor market, state occupational licensing and credential requirements, and broader labor market changes that have reduced labor dynamism, among others.⁸⁵

Hiring Challenges Created by Other Factors

In some cases, skills mismatches may be used to explain hiring challenges that are driven by other factors. Examples include the following:

- **Competitive Labor Markets.** Low unemployment rates may mean that employers must compete to fill vacancies and retain incumbent workers in periods of economic expansion. This can lead to longer vacancies and arduous recruitment efforts but does not necessarily indicate a skill shortage. What employers view as a skill shortage may to some degree reflect a labor market in which demand for labor exceeds the number of available workers at all skill levels. As noted in the prior section, the periods with the largest number of job openings (sometimes cited as evidence of a skills gap) tend to coincide with the periods of lowest unemployment.
- **High Turnover Occupations.** Occupations characterized by high turnover can create ongoing and costly recruitment cycles for firms, despite ample supply of sufficiently skilled workers in local markets. For example, JOLTS data show that the “accommodations and food services” industry has one of the highest job opening rates but also one of the highest rates of turnover.⁸⁶ Thus, employers may attribute vacancies to a skills gap when they are at least partially attributable to turnover that is common to the industry.
- **Employers’ Evolving Skill Demands.** Employer claims of skills mismatches are predicated on the assumption that employers are able to precisely identify their labor needs and recruit accordingly. However, employers’ skill requirements can change over time as firms adopt new production processes, meet new regulatory requirements, or respond to changing consumer demand. Firms facing new skill demands may need to enter unfamiliar labor markets, and subsequent vacancies may be at least partially due to employers’ inexperience in a new field rather than a dearth of qualified workers.

⁸⁴ Christine T. Kovner, Sean P. Corcoran, and Carol S. Brewer, “The Relative Geographic Immobility of New Registered Nurses Calls for New Strategies to Augment that Workforce,” *Health Affairs*, vol. 30, no. 12 (2011), pp. 2293-2300.

⁸⁵ Benjamin Austin, Edward Glaeser, and Lawrence H. Summers, *Saving the Heartland: Place-based Policies in 21st Century America*, Brookings Papers on Economic Activity, Conference Drafts, March 2018, <https://www.brookings.edu/bpea-articles/saving-the-heartland-place-based-policies-in-21st-century-america/>; Greg Kaplan and Sam Schulhofer-Wohl, “Understanding the Long-Run Decline in Interstate Migration,” *International Economic Review*, vol. 58, no. 1 (2017), pp. 57-94; Janna E. Johnson and Morris M. Kleiner, *Is Occupational Licensing a Barrier to Interstate Migration*, NBER Working Paper 24107, December 2017, <https://www.nber.org/papers/w24107>; and Raven Molloy, Christopher L. Smith, and Abigail Wozniak, “Job Changing and the Decline in Long-Distance Migration in the US,” *Demography*, vol. 54, no. 2, pp. 631-653.

⁸⁶ Bureau of Labor Statistics (BLS), *Job Openings and Labor Turnover – May 2020*, USDL-20-1348, July 7, 2020.

- **Increased Demand for Credentials and *Credential Inflation*.** Some analyses have found that the educational requirements in job postings for some occupations exceed the educational levels of persons typically in those occupations. Assuming no fundamental change in the nature of these jobs, the increase in requirements may create an education mismatch in which types of workers who have historically been qualified for a particular occupation become unqualified.⁸⁷
- **Occupational Regulation.** Some states regulate employment in selected occupations, often citing public health, safety, and trust interests.⁸⁸ States may require workers in certain occupations to register with a state agency, be certified to use a particular occupational title, or obtain a state occupational license. The costs and requirements associated with occupational regulation vary by state and type of regulation. For some workers, state occupational requirements can limit geographic mobility due to the costs and administrative burden of obtaining new credentials. Further, some workers in *local markets* may hold skills in demand by local employers, but are deterred from seeking the state credential because upfront costs are too high. In both cases, vacancies may go unfilled even when sufficiently skilled workers are available.⁸⁹
- **Unappealing Jobs.** Some employers may struggle to find workers not because skills are in short supply but because the work is unappealing to many workers. This can occur, for example, if workers perceive job tasks to be dangerous or working conditions unpleasant, and pay and workplace benefits do not sufficiently compensate workers for these risks and circumstances.⁹⁰

Potential Employer Responses to Skills Misalignments

This section focuses on some possible employer responses to a skills misalignment—a skills mismatch, gap, or shortage—as a way of attracting or retaining workers. These responses include wage increases, substitution of technology for labor, employer engagement with training providers, employer-provided training, and increased reliance on foreign labor. While this list is not intended to be exhaustive, it represents a range of potential responses.

⁸⁷ See Harvard Business School, “Dismissed by Degrees,” October 2017, <https://www.hbs.edu/managing-the-future-of-work/Documents/dismissed-by-degrees.pdf>

⁸⁸ National Conference of State Legislatures, Center for Excellence in State Occupational Licensing, <https://www.ncsl.org/research/labor-and-employment/occupational-licensing.aspx>.

⁸⁹ Discussion of the potential wage and employment impacts of occupational licensing is in Ryan Nunn, *Occupational Licensing and American Workers*, The Hamilton Project, June 2016, https://www.hamiltonproject.org/papers/occupational_licensing_and_the_american_worker.

⁹⁰ For example, challenges faced by the trucking industry in attracting truck drivers is unlikely to be due to a skill shortage, and more likely related to long hours of driving—often at night and on weekends and holidays—and a high risk of occupational injury (due to elevated risk of a motor-vehicle incident). Bureau of Labor Statistics (BLS), Occupational Outlook Handbook, Heavy and Tractor-trailer Truck Drivers, last updated on June 12, 2019, <https://www.bls.gov/ooh/transportation-and-material-moving/heavy-and-tractor-trailer-truck-drivers.htm>; and Stephen V. Burks and Kristen Monaco, “Is the U.S. labor market for truck drivers broken?,” *Monthly Labor Review*, March 2019, <https://www.bls.gov/opub/mlr/2019/article/is-the-us-labor-market-for-truck-drivers-broken.htm>.

Increasing Wages and Compensation

As noted earlier, skill shortages are expected to be temporary in a competitive labor market if employers raise wages to attract qualified workers. Over the longer term, rising wages in a given occupation may incentivize workers to increase their human capital in order to fill in-demand jobs. While wages are not the only factor in attracting workers, they are a strategy that employers have some control over, as opposed to other issues that may be important to recruiting qualified workers such as quality of life, geography, and commuting patterns.⁹¹

In the context of reported skill shortages, there is often discussion about why employers are, or are not, increasing wages as a worker attraction and retention strategy.⁹² While there is disagreement about the relative importance of wage increases as a strategy to address skills mismatches, there is agreement that higher wages play some role in attracting and retaining skilled employees and that wage growth may indicate a potential mismatch between supply and demand. For example, a recent employer survey indicates that a sizeable majority—75%—of manufacturing employers indicate a willingness to offer pay increases to attract and retain skilled employees.⁹³

Recent real average hourly earnings trends suggest that some employers may have raised wages to attract or retain employees. Between the end of the Great Recession in June 2009 and the beginning of the 2020 recession in February 2020, cumulative growth in inflation-adjusted average hourly earnings was nearly 7.0% (by CRS calculations), which translates to a 0.6% average annualized growth rate.⁹⁴ Growth was not even across that period: between June 2009 and January 2015, real average wages grew at an average annualized rate of 0.4%; this rate was close to 0.9% from January 2015 to January 2020.⁹⁵ (JOLTS data show that 2015 was the year in which job openings started to exceed job hires).

Relatively high earnings growth in the second half of the last economic expansion (January 2015 to January 2020) raises questions about the extent to which rising wages indicate employers' response to general labor market tightening (i.e., demand is high for all workers) as opposed to unmet demand for specific skill sets. For example, whereas average hourly earnings grew in the relatively high-skilled professional and business services industry over that period at an average annualized rate of 0.9%, they grew at *higher rates* in the leisure and hospitality (1.5% overall,

⁹¹ A recent study finds that some employers use the offer of employer-provided training (in this case, in emerging information technology systems) as a strategy to recruit workers. Tambe et al. (2019) show that firms that invest in such emerging systems were able to hire workers at lower wages than those that did not make such investments. These hiring gains were in some instances short lived, as the study also shows that such workers are more likely to leave the firm. Prasanna Tambe, Xuan Ye, and Peter Cappelli, *Paying to Program? Engineering Brand and High-Tech Wages*, NBER Working Paper 25552, February 2019, <https://www.nber.org/papers/w25552>.

⁹² For example, Heidi Shierholz and Elise Gould, *Why is real wage growth anemic? It's not because of a skills shortage*, Economic Policy Institute, Working Economics Blog, July 2018, <https://www.epi.org/blog/why-is-real-wage-growth-anemic-its-not-because-of-a-skills-shortage/>.

⁹³ Deloitte Development LLC, *2018 Deloitte and The Manufacturing Institute skills gap and future of work study*, 2018, p. 11, <https://documents.deloitte.com/insights/2018DeloitteSkillsGapFoWManufacturing> (hereinafter, "Deloitte 2018").

⁹⁴ Average hourly earnings data from the BLS Current Employment Survey were adjusted for inflation by CRS using the BLS CPI-U.

⁹⁵ BLS data show high wage growth between March and April 2020 (at the start of the pandemic and recession), which reflects greater employment loss among low-wage workers. Tomaz Cajner et al., *The U.S. Labor Market during the Beginning of the Pandemic Recession*, Brookings Institution, Brookings Papers on Economic Activity, June 25, 2020.

3.3% in the alcohol-serving drinking places subsector) and retail (1.0% overall, 2.1% in the clothing and clothing accessories subsector) industries.⁹⁶

Another way to understand wage changes in particular industries is to compare job openings data to changes in wages. Rising wages in a sector with a relatively high rate of job openings may be an indicator of a skills gap or shortage in that sector. As noted previously, the job openings rate is calculated by BLS as the ratio of total job openings to total job positions (i.e., the sum of people employed and the number of job openings) multiplied by 100.

Table 2. Job Openings Rate and Real Earnings Growth in Selected Industries

Industry	Job Openings Rate January 2015	Job Openings Rate January 2020	Average Annual Wage Growth January 2015 – January 2020
Total Private	3.9	4.6	0.8%
Mining & Logging	1.8	2.7	0.5%
Construction	2.3	3.4	0.9%
Manufacturing	2.6	3.1	0.4%
Wholesale Trade	2.6	2.8	0.4%
Retail Trade	3.8	4.6	1.0%
Information	3.9	5.0	2.4%
Financial Activities	3.8	4.6	1.3%
Professional & Business	5.0	5.6	0.9%
Education & Health	4.1	5.0	0.2%
Leisure & Hospitality	5.1	5.2	1.5%
Other Services	3.2	4.3	0.9%

Sources: Figure created by CRS using earnings data in constant 1982-1984 dollars from Bureau of Labor Statistics (BLS) Current Employment Survey (CES), and BLS Job Openings and Labor Turnover Survey (JOLTS) data.

Data in **Table 2** show the job openings rate for major industries in January 2015 and in January 2020, along with the average annual percentage change in inflation-adjusted hourly earnings in those industries.⁹⁷ If skill shortages were driving job openings, one might expect to see rapidly increasing earnings in the relatively higher-skilled industries. This pattern is seen for some high-skilled industries, like information and financial activities sectors, but not all. For example, the professional and business services sector had annual wage growth rates 0.1 percentage point above average, and the education and health sector had below-average wage growth. By contrast, the relatively lower-skill leisure and hospitality sector had strong wage growth paired with a modest increase in the job openings rate. While wage growth and job openings rates were positive across this five-year period for all industries, there is not a generalizable trend in wage increases by industry that points to skill shortages as the sole challenge facing employers in hiring.

⁹⁶ Wage growth in some of these occupations may be driven in part by recent state-level minimum wage increases. See CRS Report R43792, *State Minimum Wages: An Overview*, by David H. Bradley and Abigail R. Overbay.

⁹⁷ As observed earlier, January 2015 was an approximate turning point in overall average hourly earnings growth. Between June 2009 and January 2015, real average wages grew at an average annualized rate of 0.4%; the rate was close to 0.9% from January 2015 to January 2020. This may be related to stronger labor market conditions; by 2015, the U.S. labor market had recovered to a considerable extent from large losses during the 2007-2009 recession.

Substituting Technology for Labor

Employers facing prolonged or costly recruitment cycles may look to technology as a means to mitigate hiring challenges. Conversations around labor shortages in agriculture, trucking, and construction industries, for example, have explored the potential impacts of labor-saving technologies. Nascent agricultural technologies such as an apple-picking robotic arm, introduced in fall 2019, suggest that technological options may be in reach for some farmers struggling to find workers during harvest times.⁹⁸ In addition, some observers believe that autonomous vehicle technology may eventually help to alleviate reported truck driver shortages (and otherwise improve the trucking industry in terms of safety and efficiency) by changing the tasks required of drivers and possibly replacing them.⁹⁹ The results of a business survey conducted by Associated General Contractors of America in late 2019 indicate that 32% of surveyed firms reported that they adopted new labor-saving technologies (such as lean construction and building information modeling [BIM]) as a strategy for coping with staffing challenges.¹⁰⁰

In some cases, technology can and has replaced a portion of workers' tasks. Reducing the number of tasks associated with a job can increase worker productivity, possibly also reducing demand for workers or work hours for a given level of production. It may also change the mix of skills needed in each hire. For example, automatic teller machines (ATM) perform a subset of bank-teller tasks like dispensing cash withdrawals and accepting deposits, freeing up time for bank tellers to focus on more complex tasks; similarly, legal firms' adoption of document-search software has changed the way paralegals do legal research.

At the far end of the spectrum, technology has replaced certain workers almost entirely; for example, telephone switchboards, once operated manually by workers, are largely automated. This trend of technological substitution is expected to continue; in the not-too-distant future, for example, driverless vehicles or drone technology may replace some delivery drivers. Technological advancements can also allow some employers to replace U.S.-based workers with those working in other countries; specifically, technology can increase the feasibility of offshoring of tasks that do not need to be performed in proximity to the consumer (e.g., bookkeeping, call-center activities, diagnostic radiology).

Employers' ability to adopt labor-saving or labor-replacing technology depends on its availability and costs. Some technology, like personal computers and data management software, have long been available to firms at prices that are low relative to human labor, and can be easily integrated into current workspaces.¹⁰¹ Use of programmable industrial robots has increased in every U.S. industry in the last 10 years, but growth rates and the concentration of robots has varied widely

⁹⁸ Examples of recent labor-saving agricultural investments are discussed in Emma Cosgrove, "More than Robotics is Needed to Solve Farm Labor Shortage," *AgFunderNews*, July 13, 2017, <https://agfundernews.com/more-than-robotics-is-needed-to-solve-farm-labor-shortage.html>. A more general discussion of recent investments in agricultural technology is in Mario Parker, "In Trump's America, Heartland Hooks up with Silicon Valley," *Bloomberg*, May 11, 2017, <https://www.bloombergquint.com/markets/in-trump-s-america-heartland-is-hooking-up-with-silicon-valley>.

⁹⁹ Peter Slowik and Ben Sharpe, *Automation in the Long Haul: Challenges and Opportunities of Autonomous Heavy-Duty Trucking in the United States*, International Council on Clean Transportation, Working Paper 2018-06, 2018, <https://theicct.org/publications/automation-long-haul-challenges-and-opportunities-autonomous-heavy-duty-trucking-united>.

¹⁰⁰ Associated General Contractors of America and Sage, *The 2020 Construction Hiring and Business Outlook*, October 2020, <https://www.agc.org/sites/default/files/Files/Communications/2020%20Construction%20Hiring%20and%20Business%20Outlook%20Report.pdf>.

¹⁰¹ For example, a calculator performs sums and other mathematical tasks at a much lower cost than a worker doing such tasks with pencil and paper, requires little room in the workplace, and is easy to operate.

across industries, suggesting that such technology is more cost-effective in some industries than others.¹⁰² For example, in 2014 there was an estimated 0.02 industrial robots per 1,000 workers in the construction industry; by contrast, there were 117.72 industrial robots per 1,000 workers in automotive production that year. Automation and artificial intelligence technologies continue to advance, and will likely allow for replacement of many more human tasks and will likely be employed in a wider range of workplaces in the future. Currently, however, commonly affordable technological alternatives are out of reach for some jobs. For example, while it is easy to see how technology can make some carpentry tasks safer and allow for more precise and rapid execution, technology to replace other carpentry tasks—such as those that employ creative thinking, decisionmaking, or flexibility in changing environmental conditions—are not currently on the market.

Even where labor-saving technology is available, its adoption can create additional skills needs for employers, potentially trading one hiring challenge for another. As noted, the manufacturing industry has been at the forefront of task automation and is the largest user of industrial robots. As a result, manufacturing firms are more productive but also have new needs for skilled workers to program, operate, and maintain their robotic fleets.¹⁰³

Employer Engagement with Education and Training Providers

Increasingly, traditional education providers, especially those focused on career and technical education such as community colleges, have been involving the local business communities in program development to better match educational course offerings with the skills most sought after by local employers. Employer involvement in such programs can range from an advisory role to provision of instructional materials to a direct role in crafting course curricula and offering opportunities for work-based learning.

Such initiatives have the potential for reaching a broad range of students in the employers' immediate geographic areas and for being responsive to rapidly changing employer demands.¹⁰⁴ This same specificity to a particular geographic area and set of potential employers can also make such programs difficult to scale across industries and regions. On the other hand, some experts have noted that “many successful partnerships [among government, industry, and educational institutions] avoid the ‘one size fits all approaches’ and respond to the workforce needs in a specific region or industry.”¹⁰⁵

¹⁰² For industry-level estimates of industry robots per worker, see Appendix Table A1 in Daron Acemoglu and Pascual Restrepo, *Robots and Jobs: Evidence from US Labor Markets*, National Bureau of Economic Research Working Paper 23285, March 2017, <https://www.nber.org/papers/w23285>.

¹⁰³ A 2018 joint study from Deloitte and the Manufacturing Institute (part of the National Association of Manufacturers) describes recent and projected hiring challenges reported by the U.S. manufacturing industry, and identifies new skill needs in manufacturing (e.g., “digital talent, skilled production, operational managers”). Deloitte 2018.

¹⁰⁴ David Autor, David Mindell, and Elisabeth Reynolds, *The Work of the Future: Shaping Technology and Institutions*, Massachusetts Institute of Technology (MIT), Task Force on the Work of the Future, Fall 2019, pp. 33, https://workofthefuture.mit.edu/sites/default/files/2019-09/WorkoftheFuture_Report_Shaping_Technology_and_Institutions.pdf

¹⁰⁵ National Science Board, *The Skilled Technical Workforce: Crafting America's Science & Engineering Enterprise*, Report no. NSB-2019-23, September 2019, p. 25, <https://www.nsf.gov/nsb/publications/2019/nsb201923.pdf>.

While community colleges have become increasingly central to the national conversation about skill development and labor market preparation, their relationship with employers remains largely ad hoc and has not resulted in an extensive literature on labor market impacts.¹⁰⁶

Employer-Provided Training

Employer-provided training encompasses a range of training and educational activities often, but not exclusively, occurring at an employer's worksite at multiple points and in multiple forms, ranging from career exploration for youth to highly specialized technical training for incumbent workers. Activities considered employer-provided training include, but are not limited to, organizational orientation, formal and informal on-the-job training, registered and unregistered apprenticeships, classroom training, tuition subsidies, and a range of general skills training. The length, costs, and quality of employer-provided training vary widely given the broad range of activities it encompasses. Employers' decisions to invest in firm-provided training depends on several factors, including the degree of firm-specific skills needed to perform work effectively, the availability of skills among job seekers, the cost of providing skills, the expected payoff period to investment (e.g., expected employee tenure), and the extent to which employers can share a portion of skill investment costs with workers (e.g., directly or in the form of lower wages).

While data on the composition and intensity of employer-provided training are limited, there is evidence that in aggregate spending on employer-provided training is substantial and likely exceeds federal government investment on training programs, particularly funding for the primary federal workforce development program (the Workforce Innovation and Opportunity Act [WIOA], P.L. 113-128), which has been funded at about \$5 billion per year recently.¹⁰⁷ A 2019 announcement by Amazon to spend about \$700 million on employee training for 100,000 workers by 2025 highlights the role of employer-provided training.¹⁰⁸ An estimate from the American Society for Training and Development (ASTD), for example, found that aggregate spending on training by U.S. employers in 2012 was about \$164 billion, or an average expenditure of \$1,195 per employee in the firms participating in the survey.¹⁰⁹ More recent data from the ASTD (now called the Association for Talent Development, or ATD) survey suggested that the average expenditure per employee had increased to \$1,296 in 2017.¹¹⁰ Data from other sources suggested that aggregate employer expenditure on employee training is even higher. According to an analysis from the Georgetown University Center on Education and the Workforce, employers spend about \$590 billion annually on training—\$177 billion on formal training and an additional \$413 billion on informal, on-the-job training.¹¹¹

¹⁰⁶ Paul Osterman and Andrew Weaver, "Community Colleges and Employers: How Can We Understand their Connection?", *Industrial Relations*, September 6, 2016, at <https://onlinelibrary.wiley.com/doi/full/10.1111/irel.12150>.

¹⁰⁷ CRS Report R44252, *The Workforce Innovation and Opportunity Act and the One-Stop Delivery System*, by David H. Bradley. Robert I. Lerman, Are Employers Providing Enough Training? Theory, Evidence and Policy Implications, National Academy of Sciences Symposium on the Supply Chain for Middle Skill Jobs: Education, Training, and Certification Pathways, Washington, DC, June 24, 2015, p. 21, http://sites.nationalacademies.org/cs/groups/pgasite/documents/webpage/pga_168146.pdf (hereinafter, "Lerman, 2015").

¹⁰⁸ Eric Newcomer, "Amazon's \$700 Million Training Pledge Is Actually a Bargain," *Bloomberg*, July 12, 2019, <https://www.bloomberg.com/news/articles/2019-07-12/amazon-training-program-is-a-700-million-bargain-jxzz5qik>.

¹⁰⁹ Lerman, 2015, p. 12.

¹¹⁰ Association for Talent Development (ATD), "New ATD Research: Investment in Talent Development on the Rise," press release, <https://www.td.org/press-release/new-atd-research-investment-in-talent-development-on-the-rise>.

¹¹¹ Anthony P. Carnevale, Jeff Strohl, and Artem Gulish, *College Is Just the Beginning: Employers' Role in the \$1.1*

Total private sector spending is clearly sizable, but aggregate dollar amounts do not impart information on where and how those funds are used. For example, if a large share of training funds is used for company orientations, it is unlikely that private spending is making progress toward bridging a U.S. skill deficit. Aggregate dollars also do not provide a gauge of the distribution of training across worker groups, or the quality of training. Despite the prevalence of some form of employer-provided training, there has not been a federal government-sponsored, nationally representative survey of employers' training activities since 1995.¹¹² Of the data sources on employer-provided training that do exist, they often differ in methodology, timeframe, and purpose. For example, some surveys look only at large firms, and others are part of larger household surveys not designed around employer-provided training questions. Available government-sponsored survey data on employer-provided training are discussed in the **Appendix**.

Because work-based learning can take a broad range of forms, it is not possible to make a general characterization about the quality assurance and employment relevance of work-based learning. In addition, due to a lack of consistent data, it is difficult to precisely characterize the relative roles of government, employers, and employees in financing relevant training and education. The limited empirical evidence on the scope of employer-provided training suggests that while employers emphasize specific types of training for employees, employers also provide a "considerable amount" of general training that could be used in settings other than the employee's current job.¹¹³ Some empirical evidence suggests a positive correlation between wage gains, firm innovation, productivity, and profitability from increased levels of employer-led training.¹¹⁴

Reliance on Foreign Labor

The option to hire foreign workers may allow some employers to address skill shortages, at least in the short-term, by expanding the boundaries of the U.S. labor market. Current immigration policy allows employers to pursue employment of foreign workers, particularly where the supply of U.S. workers is insufficient to meet employers' needs. Moving production or service-delivery to foreign countries (i.e., *offshoring* or *foreign outsourcing*) with greater availability of workers with in-demand skills can be another option for some employers.

Under current law, foreign nationals may enter and be employed in the United States as *temporary* workers (i.e., nonimmigrants), or as lawful *permanent* residents (LPRs, i.e., green card holders).¹¹⁵ In many cases, an employer must petition the Department of Homeland Security on

Trillion Postsecondary Education and Training System, Georgetown University Center on Education and the Workforce, Washington, DC, 2015, p. 3, <https://cew-7632.kxcdn.com/wp-content/uploads/2015/02/Trillion-Dollar-Training-System-.pdf>. As noted by the authors, these estimates involved extrapolation.

¹¹² *Ibid.*, p. 12. However, the Senate Appropriations Committee report that accompanied the Consolidated Appropriations Act, 2018 (P.L. 115-141) directed BLS to study options for a new survey on employer-provided training.

¹¹³ Robert I. Lerman, Signe-Mary McKernan, and Stephanie Riegg, "The Scope of Employer-Provided Training in the United States: Who, What, Where, and How Much?," in *Job Training Policy in the United States*, Christopher J. O'Leary, Robert A. Straits, and Stephen A. Wandner, eds. (Kalamazoo, MI: W.E. Upjohn Institute for Employment Research, 2004), pp. 211-243.

¹¹⁴ Lerman, 2015, pp. 8-9, and Carolyn J. Heinrich, "Workforce Development in the United States: Changing Public and Private Roles and Program Effectiveness," in *Labor Activation in a Time of High Unemployment: Encouraging Work while Preserving the Social Safety Net*, Douglas Besharov and Douglas Call, eds. (Oxford University Press, 2016).

¹¹⁵ Discussions of temporary worker visas and related issues are in CRS Report R43735, *Temporary Professional, Managerial, and Skilled Foreign Workers: Policy and Trends*, by Jill H. Wilson; CRS Report R44849, *H-2A and H-2B Temporary Worker Visas: Policy and Related Issues*, by Andorra Bruno; and CRS Report R44306, *The H-2B Visa and*

behalf of a visa applicant, obtain a certification from the Secretary of Labor that U.S. workers are not available or qualified for the job offered to the foreign worker (i.e., a *labor certification*), and demonstrate or attest that the job offer is made under conditions that will not adversely affect the employment, compensation, and working conditions of similarly employed workers in the United States. Individuals seeking to enter and work in the country in skilled occupations must also demonstrate that they meet visa-specific statutory educational and work experience requirements.

Within this framework, employment-based immigration policy appears to have the potential to address some U.S. skill shortages, but there are limits. For example, annual caps on some work-based visa categories limits the capacity of foreign labor to alleviate large-scale shortages and excess demand for many visa categories may create years-long wait times. The application process can also be costly to employers in terms of administrative effort (e.g., documentation of recruitment efforts) and fees. And, although employer sponsorship may be required to apply for most employment-based visas, a foreign national who obtains LPR (permanent) status may subsequently work for any employer; so while such workers contribute to a skilled U.S. workforce generally, they may be less effective at solving geographic mismatches or the needs of a specific employer. That said, foreign labor may provide relief to employers struggling to fill vacancies on a relatively-small scale, and may be a desirable option when in-demand skill sets are rare or expensive. Temporary visas may also help employers working in sectors with rapidly changing skill needs (e.g., STEM occupations). In some instances, Congress has used immigration policy to address specific skill shortages more directly.¹¹⁶

Despite safeguards put in place by U.S. immigration law, the option to hire foreign workers may provide some U.S. employers incentives to give preference to foreign workers to the potential detriment of U.S. workers, and possibly contribute to persistent skill shortages or mismatches. This can happen, for example, if employers seek out pre-trained foreign workers who are willing to relocate to employers' worksites rather than investing in the skills of local job applicants (see "Employer-Sponsored Training" section of this report) or raising compensation to levels and benefit combinations sufficient to attract qualified U.S. workers in other fields or locations. Further, annual caps on many work-based visas mean that employers' use of foreign labor to fill *non-shortage vacancies* translates into fewer visas available to alleviate *bona fide* shortages. Use of foreign labor may be a limited long-term strategy—and, some observers might argue, an unfair strategy for U.S. workers—if competition with foreign workers weakens incentives for U.S. workers to pursue in-demand skills.¹¹⁷

the Statutory Cap, by Andorra Bruno. An overview of the employment-based immigration system is in CRS Report R45447, *Permanent Employment-Based Immigration and the Per-country Ceiling*, by William A. Kandel. A discussion of permanent legal immigration more generally is in CRS Report R42866, *Permanent Legal Immigration to the United States: Policy Overview*, by William A. Kandel. Some foreign nationals who are admitted to the United States on visas other than work-related visas (e.g., foreign students) may be permitted to work if they meet certain criteria.

¹¹⁶ In 1999, for example, Congress created a new nonimmigrant visa category, H-1C, to allow for the admission of up to 500 nurses annually to work in health professional shortage areas. This visa category expired in December 2009. See P.L. 106-95. Another example is the Conrad 30 program, designed to encourage immigration of foreign physicians to medically underserved communities. The Conrad 30 program is discussed in CRS Report R43735, *Temporary Professional, Managerial, and Skilled Foreign Workers: Policy and Trends*, by Jill H. Wilson.

¹¹⁷ Research that examines the potential for immigration to adversely affect employment prospects and wages for certain groups of workers includes George J. Borjas and Joan Monras, "The Labor Market Consequences of Refugee Supply Shocks," *Economic Policy*, vol. 32, no. 91 (July 2017), pp. 361-413; and John Bound, Gaurav Khanna, and Nicolas Morales, *Understanding the Economic Impact of the H-1B Program on the U.S.*, National Bureau of Economic Research, Working Paper No. 23153, February 2017, <https://www.nber.org/papers/w23153>.

Federal Efforts to Address Skill Misalignments and Relevant Policy Considerations

Misalignments between the skills and knowledge sought by employers and those possessed by workers are problematic if they adversely affect the well-being of individuals or economic prosperity on a broader scale. While it is difficult to pin down the scale and nature of misalignments on a national level, it is clear that mismatches on some scale are inherent in the organization and evolution of work, and that skill shortages have been and likely will continue to be perennial challenges affecting various industries, employers, and regions.

Investing in Skills

One way to address misalignments is by supporting efforts to develop workers' skills. For more than a century, the federal government has had some presence in supporting policy approaches that have focused on trying to develop skilled workers to enhance the alignment between the skills possessed by available workers and those sought by employers. In contemplating a federal role in investing in the development of workers' skills, some of the factors that have consistently received consideration pertain to defining the scale and nature of the skills-related challenges being addressed. Other factors given consideration pertain to the locus of interventions and, for instance, whether policies should (1) support employers' investments in employees, (2) support the educational and training pursuits that workers (or prospective workers) select to pursue, (3) encourage individuals to pursue training in specific fields or occupations where shortages of skilled workers are known to exist, or (4) help to ensure that elementary and secondary schools or even postsecondary programs are equipping students with the types of foundational and transferable knowledge and skills that maximize students' prospects for success as workers.

Other factors that garner consideration when federal policy approaches are contemplated relate to the appropriate federal versus state and local role in providing types of services. Concepts related to *responsibility* also factor prominently in this policy arena. It is not always easy to reach agreement about where the obligation should rest to ensure that workers are equipped with the skills and knowledge required for work. It may be the responsibility of schools, employers, government, or individual workers—and this may change as it relates to different types of basic or applied knowledge and skills.

There are many objectives that federal policies aim to address while trying to better align the preparedness of workers with the demands of work. Efforts to support the development of skilled workers can address many different challenges. Some of the primary federal policy objectives and accompanying strategies that have been employed to address them include the following:

- *Helping workers to meet evolving demands of work.* Some policy approaches anticipate a need for advanced skills, and that over time changing work requirements are a given and that mismatches between evolving work requirements and what workers are prepared to do naturally ensue. Thus, there is a role for federal policies in supporting advanced skill acquisition and efforts aiming to help workers *upskill*. Among the strategies employed to address this are broadly available, portable, traditional student financial aid (e.g., grants and loans) that supports the educational or training pursuits individuals choose to

pursue.¹¹⁸ Similarly, financial assistance provided through the tax code (e.g., tax credits and tax-advantaged savings accounts) supports lifelong learning and individuals' educational or training pursuits in short-term and long-term postsecondary programs.¹¹⁹ While these programs and benefits do not direct students to follow any specific career pathways or obtain any particular skills, they do collectively make available much of the federal support for workforce development investments.

Other approaches with similar aims, although much smaller in scale, include (1) assistance provided through the tax code that encourages employers to invest in the skill development of employees and (2) workforce development assistance that provides training and related assistance to dislocated workers and to workers in need of additional training to remain employed.¹²⁰

- *Addressing concerns that widespread skill deficiencies (or skills gaps) applicable to many types of work may exist now, or could in the future.* Some policy approaches are premised on the notion that there are essential competencies that need to be acquired for many purposes, including for roles as workers. Strategies focused on addressing this include efforts that broadly support the acquisition of foundational knowledge and skills that are of fundamental importance in many types of work.

Federal financial support typically supplements state and local funding in elementary and secondary education; the most prominent federal programs in this area provide supplemental funds that help with extra costs associated with educating some sizable populations of students, such as economically disadvantaged students, language minority students, and students with disabilities.¹²¹ The traditional role of these federal investments has been to ensure that disadvantaged students are able to have the same educational opportunities and receive the same general or foundational skills as their more advantaged peers, allowing them to be prepared to pursue postsecondary education or enter the job market.

Another way federal policy aims to address these concerns is through the implementation of college- and career-ready standards and assessments aligned to these standards. To receive some federal elementary and secondary education grants, states are required to adopt challenging academic standards intended to encourage greater focus on college and career readiness.¹²²

¹¹⁸ For more information, see CRS Report R43351, *The Higher Education Act (HEA): A Primer*, by Joselynn H. Fountain; and CRS Report R46306, *Direct Federal Support of Individuals Pursuing Training and Education in Non-degree Programs*, by Cassandra Dortch, David H. Bradley, and Alexandra Hegji.

¹¹⁹ For more information, see CRS Report R41967, *Higher Education Tax Benefits: Brief Overview and Budgetary Effects*, by Margot L. Crandall-Hollick.

¹²⁰ For more information, see CRS Report R41967, *Higher Education Tax Benefits: Brief Overview and Budgetary Effects*, by Margot L. Crandall-Hollick; and CRS Report R44252, *The Workforce Innovation and Opportunity Act and the One-Stop Delivery System*, by David H. Bradley.

¹²¹ See CRS Report R45977, *The Elementary and Secondary Education Act (ESEA), as Amended by the Every Student Succeeds Act (ESSA): A Primer*, by Rebecca R. Skinner; and CRS Report R41833, *The Individuals with Disabilities Education Act (IDEA), Part B: Key Statutory and Regulatory Provisions*, by Kyrie E. Dragoo.

¹²² See CRS Report R46245, *ESEA: Title I-A Standards, Assessments, Accountability, Report Cards, and Frequently Asked Questions*, by Rebecca R. Skinner.

Foundational and transferrable skills essential for some workers are supported by broadly investing in student financial aid and providing financial assistance through the tax code to make postsecondary-level skill acquisition more widely accessible.

- *Addressing shortages of skilled workers for certain occupations, industries, or employers.* Some policy approaches aim to address an undersupply of appropriately trained or credentialed workers in particular fields. Some of these fields may be viewed as important to economic growth. Concerns about shortages may also be focused on occupations of particular importance to certain industries, regions, or communities. Shortages may be a result of particular areas (e.g., some STEM fields) perennially attracting fewer students (and then workers) than are needed to fill available jobs, of work requirements changing in fields and newly requiring specialized skills (e.g., advanced manufacturing), or of new fields emerging for which preparatory paths are emerging as well and not necessarily well established (e.g., cybersecurity, machine learning engineer).

Federal strategies are sometimes focused on encouraging and subsidizing academic pursuits in areas aligned with fields or occupations with a dearth of workers (e.g., STEM fields) using mechanisms such as grants or loan forgiveness, and/or on supporting the certification, development, or operation of school or work-based training programs (which might include apprenticeships).¹²³

Federal support is also provided for career and technical education (CTE) programs at the secondary and postsecondary levels that help CTE students attain technical skills; earn industry-recognized credentials, certificates, or postsecondary degrees; and prepare for high-skill, high-wage, or in-demand occupations in current or emerging professions. These programs incentivize collaboration between education providers and employers, encouraging work-based learning opportunities, and working to ensure that programs of study offered by CTE providers are aligned with the education and skill needs of local employers.¹²⁴

- *Addressing education or training needs associated with populations of concern.* Some policy approaches aim to enhance the employability of targeted populations (e.g., individuals from low-income populations or populations with high unemployment rates, veterans transitioning into the civilian workforce, individuals with disabilities). Strategies used to address this can involve directly supporting education and training for targeted populations, and providing safety net services for such populations on an ongoing basis. These approaches do not typically aim to address the needs of the general population or broad structural

¹²³ For more information on these types of efforts, see, for example, CRS Report R45223, *Science, Technology, Engineering, and Mathematics (STEM) Education: An Overview*, by Boris Granovskiy; CRS In Focus IF10654, *Challenges in Cybersecurity Education and Workforce Development*, by Boris Granovskiy; CRS Report R43571, *Federal Student Loan Forgiveness and Loan Repayment Programs*, coordinated by Alexandra Hegji; and CRS Report R45171, *Registered Apprenticeship: Federal Role and Recent Federal Efforts*, by Benjamin Collins.

¹²⁴ For more information, see CRS Report R44542, *Carl D. Perkins Career and Technical Education Act of 2006: An Overview*, by Boris Granovskiy.

issues associated with skills gap-related problems. They may operate without regard to any evidence of employers experiencing difficulty in locating well-trained workers. These policy approaches are more typically focused on enhancing the employability of targeted populations, with skill investment as a part of the policy strategy.¹²⁵

- *Ensuring reliable labor market information is available, including information on the scale and nature of misalignments between the skills and knowledge sought by employers and those possessed by workers.* Some policy approaches aim to ensure the availability of information that can be used to help guide decisions of employers, workers, educational professionals, and policymakers. Surveys and research efforts are or have been supported that focus on the condition of the labor market, readiness and educational credentials of workers, training investments of employers, skill requirements of jobs, and projected occupational growth (and related skill and credential requirements).¹²⁶
- *Sustaining systems that assess and coordinate support for local areas' workforce needs.* Federal workforce development policy has established a One-Stop delivery system featuring state and locally run workforce development boards that coordinate federal funds providing various employment and training related supports to meet their areas' workforce needs. One-stop locations are run by local workforce development boards, which are partnerships of representatives from business, the workforce, education and training providers, and government.¹²⁷ Local boards are required to support employment and training activities in "in-demand" occupations and to prioritize serving individuals with "barriers to employment" (e.g., low-income, ex-offenders). They also administer several federal funding streams that can be used to support education and training activities and that focus on assisting unemployed and underemployed individuals.

Cohesion and Coherence of Investments in Skill Development

As is evident from the discussion above, the array of federal efforts that provide support for the development of skills vary along many dimensions. They vary with regard to the specific policy problems or issues they attempt to address (e.g., ranging from ensuring all young students are equipped with foundational skills required for future success to helping dislocated workers reskill after job loss). They also vary considerably with regard to the strategies they employ to address their respective aims (ranging from directly providing grants or tax benefits to individuals to offset the costs of education/training to certifying the quality of apprenticeship programs). This

¹²⁵ For more information on these types of efforts, see, for example, CRS Report R43855, *Rehabilitation Act: Vocational Rehabilitation State Grants*, by Benjamin Collins; CRS Report R42755, *The Post-9/11 GI Bill: A Primer*, by Cassandra Dortch; and CRS Report R43301, *Programs Available to Unemployed Workers Through the American Job Center Network*, by Benjamin Collins, David H. Bradley, and Katelin P. Isaacs.

¹²⁶ For information about these resources, see <https://www.bls.gov/audience/jobseekers.htm>

¹²⁷ With hundreds of local boards across the country, each targeting services to local needs and leveraging local resources, it is challenging to characterize the main approaches of local boards or assess their effectiveness. Some studies have examined particular aspects of some local boards' structure or strategies (e.g., collaborating with community organizations). For example, a GAO report examined 14 local collaboration initiatives that had been identified as particularly innovative to learn more about effective strategies and challenges associated with them; U.S. Government Accountability Office (GAO), *Innovative Collaborations between Workforce Boards and Employers Helped to Meet Local Needs*, GAO 12-97, January 2012, <https://www.gao.gov/products/GAO-12-97>. A database of research and reports on workforce issues, including local workforce boards, is maintained at <https://strategies.workforcegps.org/home/>. For more information on the one-stop delivery system, see CRS Report R44252, *The Workforce Innovation and Opportunity Act and the One-Stop Delivery System*.

breadth and variation among federal efforts sometimes leads to questions about whether collectively they constitute a piecemeal or coherent approach.

Among the factors that may detract from connectedness are that (1) many of the federal programs originate from different legislation, and are administered by different federal agencies; (2) they operate in different service provision arenas in which primacy of the federal role differs; and (3) there is no clear agreement about the extent to which the different skills-related challenges being addressed by federal policies need to be thought of as a continuum and addressed in an interconnected manner.

Addressing Misalignments Without Investing in Skill Development

Efforts aiming to enhance the alignment between the skills possessed by available workers and those sought by employers need not necessarily focus on the development of workers' skills. Alternatively, emphasis can be placed on many types of strategies that have the potential of getting skilled workers to where they are in demand, as opposed to developing skilled workers.

For example, policies focusing on expanding the size of the skilled labor force can be employed to address skill shortages. Immigration policies, for instance, have been used to attract skilled workers in areas of particular need. In tight labor markets, these policies can be applied more broadly to address the needs of employers across many industries.¹²⁸ Focus can also be placed on attempting to encourage skilled workers who have exited the labor force to re-enter. Strategies might involve addressing factors that may keep them out of the labor force (e.g., a need to provide eldercare or childcare).¹²⁹

Emphasis can also be placed on addressing issues associated with geographic mobility that may be separating skilled workers from employers seeking them. That is, strategies can focus on providing support for relocation, transportation, or even residential expenses. Trade Adjustment Assistance for Workers, for instance, is an example of a program that provides relocation allowances to help match involuntarily unemployed trade-affected workers with work opportunities.¹³⁰

It is also plausible, as has been discussed throughout this report, that factors such as working conditions or wages might be the cause of employers' inability to attract and retain workers at desired skill levels. Similarly, employers may actually be seeking *work experience* or highly specific applied skills and knowledge. Under these circumstances, questions might arise about whether government intervention is necessary, and whether markets instead should be relied upon to provide remedies.

¹²⁸ For an overview of these policies and related issues, see CRS Report R44849, *H-2A and H-2B Temporary Worker Visas: Policy and Related Issues*, by Andorra Bruno. Also see the discussion in the "Reliance on Foreign Labor" section of this report.

¹²⁹ For information on current federal childcare policies, see CRS Report R44528, *Trends in Child Care Spending from the CCDF and TANF*, by Karen E. Lynch. Such policies have more typically been used to support low-income working families, promoting self-sufficiency through work. Also see CRS Report R44993, *Child and Dependent Care Tax Benefits: How They Work and Who Receives Them*, by Margot L. Crandall-Hollick and Conor F. Boyle, which describes more broadly targeted tax benefits that help subsidize some child and dependent care expenses of working parents. Child and dependent care subsidies can be targeted in various ways in attempts to expand labor force participation or to help address particular shortages.

¹³⁰ For more information, see CRS Report R44153, *Trade Adjustment Assistance for Workers and the TAA Reauthorization Act of 2015*, by Benjamin Collins.

Appendix. Government-Sponsored Surveys of Employer-Provided Training

Data on employer-provided training from four different government surveys, ranging from the mid-1980s through the mid-2000s, indicate that while a majority of *establishments* offered some training (formal or informal), a minority of *workers* received training. Specifically, about 70% of employers reported that they provide some form of formal training, while the share of workers receiving formal training was consistently less than 50%.¹³¹ The surveys include the National Employer Survey (NES), the Survey of Employer-Provided Training (SEPT), the National Household Education Survey (NHES), and the Survey of Income and Program Participation (SIPP).

Table A-1. Major Government Surveys of Employer-Provided Training

Survey	Years	Coverage	Training Concepts
National Employer Survey (NES)	1993, 1995	Private establishments with 20 or more employees	Formal: any structured training either on-the-job or offsite Informal: unstructured observation or one-on-one instruction
Survey of Employer-Provided Training (SEPT)	1993, 1995	Private establishments of all sizes (1993); private establishments with 50 or more employees (1995)	Formal: any structured training either on-the-job or offsite Informal: unstructured, unplanned, and easily adapted
National Household Education Survey (NHES)	1991, 1995, 1999, 2001, 2003, and 2005	Household survey	Participation in “work-related” courses
Survey of Income and Program Participation (SIPP)	1984, 1987, 1990, 1993, 1996, 2001, 2004, and 2008	Household survey	Employer-provided or sponsored training for at least 1 hour

Sources: NES: <https://www.census.gov/econ/overview/mu2400.html>; SEPT: <https://www.bls.gov/ept/overview.htm>; NHES: <https://nces.ed.gov/nhes/publications.asp>; SIPP: <https://www.census.gov/programs-surveys/sipp/tech-documentation/topical-modules.html>

Notes: Results from the SEPT 1993 and SEPT 1995 surveys are reviewed in Harley J. Frazis, Diane E. Herz, and Michael W. Horrigan, *Employer-provided training: results from a new survey*, Bureau of Labor Statistics, Monthly Labor Review, Washington, DC, May 1995, <https://www.bls.gov/opub/mlr/1995/05/art1full.pdf>; and Harley Frazis et al., *Results from the 1995 Survey of Employer-Provided Training*, Bureau of Labor Statistics, Monthly Labor Review, Washington, DC, June 1998, <https://www.bls.gov/opub/mlr/1998/06/art1full.pdf>.

The SEPT and the NES programs surveyed employers, were conducted in the mid-1990s, and had similar concepts of formal and informal training; as opposed to the SIPP and NHES programs, which were household surveys and based on employee responses.

¹³¹ Robert I. Lerman, Signe-Mary McKernan, and Stephanie Riegg, “The Scope of Employer-Provided Training in the United States: Who, What, Where, and How Much?,” in *Job Training Policy in the United States*, Christopher J. O’Leary, Robert A. Straits, and Stephen A. Wandner, eds. (Kalamazoo, MI: W.E. Upjohn Institute for Employment Research, 2004), p. 222.

The SEPT and NES data showed the following:

- A majority of employers offered some sort of *formal* training. For employers with 50 or more employees, 78% (NES) to 93% (SEPT) reported providing some formal training in the previous year. When the sample is expanded to include smaller employers (i.e., employers with 20 or more workers), the rate was slightly lower (about 70%).
- Nearly all employers offered some type of *informal* training. The NES data indicated that 97% of employers provided informal training in the course of a year. Given the broad scope of activities included in informal training (e.g., unstructured observation), it is not surprising that the incidence of informal training was nearly ubiquitous.¹³²
- The share of employees who received employer-provided training differed across surveys, but in each case was lower than the shares of employers that report that they offered training. While the SEPT data indicated that 70% of employees received employer-provided training, data from other sources showed that in the 1990s the percentage of workers receiving training ranged from about 10% to 40%. The relatively high figure from the SEPT data is an outlier among the existing sources and likely reflects that it includes only workers in firms with 50 or more employees and uses a broader (more inclusive) definition of training.
- The SIPP survey is valuable for understanding trends as it contains the same methodology and concept of training over time. The SIPP data showed an increase in the share of workers who reported receiving employer-provided training from 1984 (6%) to 1996 (20%), and then a decline to around 15% in 2008, the most recent year available.¹³³

In general, the SIPP data indicate that receipt of employer-provided training was more likely to occur for workers who were full-time, had higher levels of educational attainment, were employed at larger firms, had management and professional occupations, and were prime-age (25 to 60).¹³⁴

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¹³² Ibid., p. 219.

¹³³ One analysis of the 2001 to 2009 decline in the SIPP data indicates that about 13% of the decline can be attributed to the rising share of part-time workers who generally receive less training than full-time workers. See C. Jeffrey Waddoups, "Did Employers in the United States Back Away from Skills Training During the Early 2000s?", *ILR Review*, vol. 69, no. 2 (March 2016), pp. 405-434.

¹³⁴ Ibid., pp. 415-416.

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