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Thanks to colleagues at the World Economic Forum's Global Agenda Council on Employment for helping me understand developments outside the US, to David Coats for help with the UK literature, Pascaline Descy and colleagues at CEDEFOP(European Center for the Development of Vocational Training), Jerry Jacobs, Larry Kahn, Paul Harrington, and Paul Osterman for helpful comments.The views expressed herein are those of the author and do not necessarily reflect the views of the National Bureau of Economic Research.

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ABSTRACT

Concerns that there are problems with the supply of skills, especially education-related skills, in the US labor force have exploded in recent years with a series of reports from employer-associated organizations but also from independent and even government sources making similar claims. These complaints about skills are driving much of the debate around labor force and education policy, yet they have not been examined carefully. The discussion below examines the range of these charges as well as other evidence about skills in the labor force. There is very little evidence consistent with the complaints about skills and a wide range of evidence suggesting that they are not true. Indeed, a reasonable conclusion is that over-education remains the persistent and even growing situation of the US labor force with respect to skills. I consider three possible explanations for the employer complaints as well as the implications associated with those changes.

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Skill Gaps, Skill Shortages and Skill Mismatches:

Evidence and Arguments for the US

Peter Cappelli[1]

Prepared for *ILR Review*

Abstract:

Concerns that there are problems with the supply of skills, especially education-related skills, in the US labor force have exploded in recent years with a series of reports from employer-associated organizations but also from independent and even government sources making similar claims. These complaints about skills are driving much of the debate around labor force and education policy, yet they have not been examined carefully. The discussion below examines the range of these charges as well as other evidence about skills in the labor force. There is very little evidence consistent with the complaints about skills and a wide range of evidence suggesting that they are not true. Indeed, a reasonable conclusion is that over-education remains the persistent and even growing situation of the US labor force with respect to skills. I consider three possible explanations for the employer complaints as well as the implications associated with those changes.

Introduction:

The assertions that there are wide-spread problems with the supply of skill in the U.S. have been common in recent years. Stories in the popular press of individual employers who report that they cannot fill vacancies are frequent,[2] but there have also been a large number of detailed reports by business associations, individual companies, as well as independent organizations arguing that skill problems are widespread. The rise of these stories is especially surprising as

[1] Professor of Management at the Wharton School and Director of the Center for Human Resources and NBER. This paper was prepared for the ILR Review. Thanks to colleagues at the World Economic Forum's Global Agenda Council on Employment for helping me understand developments outside the US, to David Coats for help with the UK literature, Pascaline Descy and colleagues at CEDEFOP(European Center for the Development of Vocational Training), Jerry Jacobs, Larry Kahn, Paul Harrington, and Paul Osterman for helpful comments.

[2] A Google search for the phrase "Skill gap" shows over 330,000 references just in 2013.

they appear to have increased since the 2008 Great Recession when the flood of unemployed job seekers – most of them recently employed - far exceeded available job opportunities (BLS 2014).

The evidence driving the complaints about skills does not necessarily appear where labor market experts might expect to see it, such as in rising wages. Instead, it comes directly from employers - typically from surveys – who report difficulties hiring the kind of workers they need. The assertions explaining their reported difficulties center on the idea that the academic achievement of high school leavers is inadequate or that there are not enough college graduates in practical fields like computer science and engineering. The recommendations from these reports include increased immigration and use of foreign workers as well as efforts to shape the majors that college students choose.

These reports have had a powerful influence on public debate about the state of the labor market as well as the performance of high schools and colleges. Virtually all of them are framed in terms of concerns about the economy as a whole, but it is difficult to escape the fact that the producers of many of these reports have a material interest in the outcomes of the policies they are attempting to influence.

The arguments below examine the claims associated with complaints about the supply of skills in the US. The evidence they present as well as evidence from other sources suggests little merit to their claims. An important question raised by these reports, however, is who is responsible for the skill level of job candidates and, ultimately, of employees. Traditional employer human resource practices, such as assessing the abilities of job applicants, training employees for current jobs, and developing them internally for future roles saw employers as responsible for securing the skills they need. The thrust of these reports suggests that the education sector –

especially public-funded education – and job candidates themselves should be responsible for producing the skills that employers want. Such a change would have profound implications for society and is worth considering seriously.

Framing the Problem: The arguments that there are problems with the supply of skills available in the labor market take various forms. The most extreme complaint is the idea that there are widespread shortfalls in the basic skills of future employees. The cause is usually attributed to the failure of the education system, especially K-12 public education, to provide students with these basic skills. We refer to that position as a *"skills gap*," following its use in policy discussions.

A second complaint focuses more on job-related skills of the kind associated with particular occupations, such as the common assertion that the U.S. is short on engineers or information technology specialists. We refer to this assertion as a "*skills shortage*."

The final concern, which is much more commonly articulated outside the U.S., is the more general idea that at any given time, the supply of skills and the demand for skills could be out of synch in either direction - oversupply or undersupply. This situation could occur in specific labor markets, although with respect to educational credentials it is usually considered at the country level. We refer to it as a "*skills mismatch.*" A skill shortage is obviously a particular type of skill mismatch, and a skills gap could be a general form of mismatch. All these complaints collectively can be referred to as "*skill problems*."

The first challenge in assessing the assertions about skills problems is to have a conceptual framework for understanding the relationship between workers and their skills against employer

needs. One approach, traditionally associated with the topic of internal labor markets and the academic field of human resources and before that personnel, suggests that matching skills to job requirements is an employer problem. Over time, employers have internalized the supply of labor, selecting for general abilities at entry-level positions and then training and developing employees over a working lifetime to meet their specific skill needs (Jacoby 1983). That approach appears to have eroded substantially in recent years (e.g., Cappelli 1999), an issue we return to below.

The other approach focuses on the labor market as the mechanism for meeting employer skill requirements. The idea of job matching between employers and job seekers implies job search, which typically assumes that employers have job requirements that are generally determined exogenously, and employers then go searching for job applicants who have those skills. The search process is realistically described as "two-sided" if both employers and employees are looking for a match, and a good match is one where the skills of the applicants and the requirements of the job fit closely: neither a shortfall nor an oversupply of skill relative to those requirements.

In typical economics models of job search, the process is reasonably passive: Employers make offers to job applicants who accept the job when the offer matches or beats their reservation price. Employers raise wages to attract better applicants whose attributes are closer fits for those job requirements, and they fall if there is an excess supply of such applicants (see Mortenson 1986 for the framework of job search models). The notion of a "shortage" is foreign to this model and to most all economics-based models. Indeed, shortages in general are typically seen

as occurring only in the context of market failure, such as wartime wage freezes or restrictions on mobility, and temporary until candidates and employer adjust.[3]

In practice, of course, employers can search more extensively through recruiting activities and more careful selection, and applicants can search actively by securing better information about vacancies. We also know that job requirements are not exogenous from the supply of applicants: A shortfall of applicants that leads to higher wages in turn causes employers to substitute capital for labor in order to create new jobs with lower skill requirements (see below). Empirical evidence indicates that employers also lower the skill requirements for given jobs when labor is relatively scarce and raise them when higher quality applicants are plentiful (Walsh 1977; Brencic 2010).

What is less clear in typical models is how the supply of skills affects employer decisions on production systems and, ultimately, productivity. It certainly is true that "better" workers who are absent less, who shirk less, and who work harder will improve organizational productivity and performance even if nothing changes about their jobs (e.g., Cascio 2008 for a review). But whether more skilled applicants per se cause employers to innovate, to adopt more effective practices, or to change the way that jobs are performed is an open question that is often part of the skill gap arguments.

The recent assertions about skill problems have quite a different underlying model in mind, although it is typically unstated, and it does not include a role either for internal labor markets or for the labor market. Instead, the arguments are akin to input-output models associated with

[3] See Mortenson 1986 for a basic framework, Rogerson, Shimer, & Wright (2005) for an overview of job search models, and Borjas (2010) Chapter 6 for an survey of general labor supply questions.

operations research optimization exercises. Perhaps the closest analogy is with supply chain models where suppliers are trying to produce just the right amount of output to meet the needs of their clients at the previously agreed price (see, e.g., Cachon and Terwisch 2007). Skills are seen as coming with the applicant to the job, and job requirements are absolute such that candidates either have the necessary skills to do a job or not and if not, they cannot do the job. Finally, an important goal for public education in these arguments, including public colleges and universities, is seen as providing graduates that employers would like to hire.

Reports of Skill Gap and Skill Shortages:

The Skill Gap Idea: The broadest and perhaps most general complaint about skills has been the skill gap idea, that there is some systematic shortfall in skills, broadly defined, across entire age cohorts of the population. Typically the argument is that the decline is associated with the poor skills of school leavers, and the explanation for that shortfall is usually that schools have failed so that academic performance of students has declined.

Concerns like this in the U.S. trace their contemporary roots to the Cold War and the 1958 National Defense Education Act, which increased funding for science and engineering education in an effort to compete with the Soviet Union. The *A Nation at Risk* (1983) report highlighted declines in student achievement of all kinds in the 1970s and helped cement in the mind of the public for decades after that US schools were failing.

An equally attention-getting report by the Carnegie-funded National Center on Education and the Economy, *America's Choice: High Skills or Low Wages?* (1990), argued explicitly that productivity growth depended on increasing the skill level of the US workforce. Although the report estimated than only five percent of employers thought they face any skill problems, that

low number was attributed to the fact that employers were not introducing new, high performance work practices that would increase productivity. Among its recommendations was to establish national educational standards for students based on international standards, the establishment of skill certifications, and national training boards to organize smooth transitions between school and work.

A separate report for the US Secretary of Labor represented an extension of the America's Choice study. *The Secretary's Commission on Achieving Necessary Skills* (SCANS 1991) also envisioned a future where employee empowerment had increased, where workplaces had moved toward high performance work systems that required greater skills, and where employers trained constantly and saw human resources as investments rather than costs. The recommendations, which became known as SCANS Skills, were central to the policy debates of the 1990s. They called for a generic set of skills from high schools that included basic skills (reading, writing, math, etc.), thinking skills, such as decision making, and personal attributes such as responsibility. Developed in the Republican Bush administration, the SCANS ideas were nevertheless embraced by the Democratic Clinton administration and dominated the discussion of skills throughout the 1990s.

The most important action on skills in the 1990s was arguably the school-to-work movement, based in part on SCANS arguments, which asserted that the way to improve student skills and to increase employability was to bring school and employers closer together in an effort to smooth the transition from school into work. In practice that meant apprenticeships, coop programs, internships, and other arrangements that would help students see the practical value of classroom lessons first by using more business and workplace examples in the classroom and second by seeing how those examples could be applied in at work. The School-to-Work Opportunities Act

of 1994 (STWO) provided administrative and financial support to help build those connections. (See Stull and Sanders 2003 for an overview of the school-to-work movement and public policy.)

Joyce and Neumark (2001) find that 64 percent of schools had at least one school-to-work program with employers (the most popular of which was "job shadowing"), and data from the National Longitudinal Survey of Youth suggests that 38 percent of students participated in school-to-work programs. Census data from establishments finds 71 percent of for-profit establishments reporting that they were involved in some school-to-work program with their local schools (Cappelli 2001). Because establishments represent the location where business takes place rather than the firm per se, this suggests quite extensive business involvement.

The high water mark of the SCANS effort was the National Skills Standards Act of 1994, which was designed to create a voluntary system of national standards for job skills, overseen by a National Skills Standards Board. The initial efforts were organized around industries, but consensus on standards proved elusive, and interest waned. The Board's last publication, seeking comments on an approach for creating standards, was in 2002.

The Labor Shortage Argument: With the sunset of the STWO Act in 1999, a new Administration less interested in a role for government in affairs related to business, and the recession of 2001 that cooled off the tight labor market, the debate about skills changed sharply. Funding for SCANS-related efforts and school-to-work programs ended as did arguments about the need to push employers toward high performance work systems and to create skill standards.

Most of the skills-related arguments following the 2001 recession came initially from consultants who asserted that in the near future there would simply not be enough people to meet labor

demand. Those arguments were kicked off by McKinsey & Co's "The War for Talent" study (Chambers, et al. 1998), which observed the smaller "baby bust" age cohort born in the 1970s and asserted that it would soon cause a shortfall in middle-aged employee talent, although why there would be a special need for middle-age talent was not clear. Similar reports followed, such as The U.S. Chamber of Commerce (2006:13), which assumed that the impending retirement of the baby boom cohort would lead to an absolute decline in the size of the labor force and a "severe worker shortage." (See *Public Policy and Aging Report* 2004 for a collection of articles arguing that a labor shortage was coming and Challenger 2003 and Carnevale 2005 for similar arguments.) [4]

These arguments are puzzling in part because the basic claim that the population and potential labor force is or will be shrinking seems to be a simple misreading of the facts: Only the rate of increase in the labor force was expected to slow, assuming baby boomers do not delay retirement (see CBO 2013 for a review of forecasts).[5]

Several researchers pointed out other problems with these labor shortage arguments, such as the anticipated slowdown in the rate of increase in the labor force is trivial compared to changes in the demand for labor associated with the business cycle (Cappelli 2003, Freeman 2006,

[4] Concerns that the demographics of the US will cause some shortfall in the supply of labor, affecting business and the economy, continued to be voiced by The Aspen Institute (2003), Dychtwald et al. (2006), and others. The Great Recession and unemployment rates at double-digit levels have not stopped these arguments. Venneberg and Eversole (2010), Bluestone and Melnik (2010), and others assert that the retirement of the baby boomers will lead to apocalyptic shortages, with as many as 30-40 percent of jobs in sectors like healthcare being vacant.

[5] The fact that the labor force participation rate in the US has declined since the Great Recession in 2008 may say little about the longer-term availability of workers as much of the decline appears to be driven by the lack of job opportunities. In March of 2014, for example, there were 2.2 million individuals marginally attached to the labor force who were available for work but not counted as unemployed because they were not actively searching for jobs. In March of 2008, just before the economic downturn began, the figure was 1.4 million, according to the Bureau of Labor Statistics Employment Situation News Release for those months. . See MLR 2013 for information on the labor force participation rates.

Neumark, Johnson, and Mejia 2011, and Harrington and Sum forthcoming). Despite the obvious problems with these labor shortage arguments, the Society of Human Resource Management (SHRM 2003) reported that large numbers of employers in the early 2000's were preparing for a labor shortage predicted to occur by 2010. None of these projections proved to be right.

Skill Gaps and STEM Skills Reports: If the SCANS approach was aspirational ("here's what the workforce should have"), the more recent arguments have been grounded in the present, asserting that there is currently a shortfall in the skills of the workforce. The American Society of Training and Development (ASTD), whose members hold jobs as trainers, in employee development, etc., asserted that view in a series of annual reports beginning in 2003. The most interesting part of their most recent report (ASTD 2012) is that the most important explanations members saw as causes of the shortfall in skills were management actions internal to the organization.[6] Skills problem were seen as self-inflicted by management.

Other reports argue that there will be a shortage of skills associated with college education. The President's Council on Jobs and Competitiveness, a business-led council (20 of its 24 members are from business), claim that the US would have a shortfall of 1.5 million college graduates by 2020, citing McKinsey & Co. as the source (Jobs Council 2012). In perhaps the most alarmist report, Carnevale, Smith, and Strohl (2010) conclude that the demand for college graduates in the US will fall short of supply by 3 million individuals by 2018. Harrington and Sum (2010) pointed out one fundamental problem with projections like these is the assumption that every job currently held by a college graduate requires the skills associated with that degree. As Levine

[6] The most common response was that their organization had changed "strategy, goals, markets, or business models" such that the current workforce did not have the skills to meet those new approaches; in second place was the lack of "bench strength" or possible replacements for the current leadership; third place was that cuts in training investments and lack of commitment to development caused a shortfall. A shortfall in the skills of applicants came in fourth place.

(2013) points out, 60 percent of parking lot attendants in Wisconsin have at least some college education yet those jobs surely do not require college-level skills.

The focus of skill gap arguments in the 2000s shifted from broad SCANS-type skills to academic skills associated with Science, Technology, Engineering, and Math (STEM) education, particularly four-year college degrees. There have been complaints from the business community about shortfalls in the supply of such skills before (e.g., Atkinson 1990 predicted a shortfall of 400,000 scientists), but the intensity of the arguments increased sharply especially when they were joined to the debate about immigration.

A report from the US Department of Commerce (1997) argued that there was a severe shortage of IT workers in the US that required increased immigration as well as expanding education. That claim and the report itself was criticized by a Government Accounting Office report (Joyner 1998) that noted methodological problems with it such as the assumption that only graduates with IT degrees can do IT-related jobs and reliance on evidence from a tech employer group (e.g., with a survey response rate of only 14 percent). The National Research Council's (2001) report on the IT workforce avoided taking a clear position on whether there was an IT labor shortage, but its recommendations relied heavily on traditional actions that employers should take to address their perceived shortages, such as more extensive training.

The attention on skill problems shifted to STEM skills with a joint publication of the National Academies of Science, Engineering, and the Institute of Medicine called "Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future"(2007). The charge given to the Committee was how best to support science and technology in the US, both in research and in business application. A central argument of the report is that the cost and availability of skilled labor in science and technology drives multinational companies in their

decisions as to where to operate, and increasing the supply of STEM graduates and allowing more foreign STEM workers and foreign STEM students to enter and stay in the US would benefit the industry. This view represented a sharp break from the America's Choice and SCANS idea that an important goal of policy was to raise wages. Here the notion was the higher wages were actually a problem for the technology industry and therefore for the advancement of technology.

Since then, arguments about skill shortages and STEM skills in particular have been commonplace. The National Academy of Sciences produced six separate reports related to STEM skill issues just in 2012, many about expanding the supply of skill. The President's Council of Advisors on Science and Technology was one of many studies asserting a shortfall of STEM grads, arguing that the US needed an additional one million such graduates to meet demand (President's Council 2012). These arguments about a coming labor shortage are very similar to those made a decade earlier, the difference being the focus on particular skills.

The Institute of Electrical and Electronics Engineers, which represents engineers, disputed the claims of a shortfall of engineers in particular, noting a range of evidence about the difficulty that many engineers have in getting jobs and suggesting that there is actually a surplus of STEM graduates relative to demand and that a large percentage of "STEM" jobs are not performed by individuals with degrees in that field: Few computer programmers, for example, have a B.S. in Computer Science (Charette 2012). Salzman, et al. 2013 also argue against the STEM shortage idea in a report for the Economic Policy Institute (EPI). The strongest evidence in their study arguably is that roughly half of recent engineering graduates do not take jobs as engineers and of

those who do not, roughly 30 percent say there was no job available for them; another 30 percent say that the terms and conditions for those jobs were below market levels.[7]

The Computer and Technology Industry Association (2012) produced an unusually detailed report, again based on a survey of employers, where 93 percent of employers responding said that they had a skills gap. Yet 90 percent also responded that they are at least "moderately close" to "where they want to be" with respect to skills, only 15 percent said that a factor in their skill problem was insufficient focus on STEM education, and only 20 percent reported that the problem was a limited pool of skilled IT workers, the essence of the STEM skill shortage argument. A large part of their perceived skill gaps had to do with "soft skills"- work ethic and motivation (almost 20 percent said that their concern was only soft skills, and about half reported that it was equally divided between "hard" and "soft skills").

Individual employers have also produced reports claiming that there are nationwide skills problems. For example, the health science company Bayer issued a report (Bayer 2013) based on a survey of recruiters at Fortune 1000 companies reporting that their companies were creating more jobs for STEM graduates than for those with any other credentials, a surprising finding given that the Bureau of Labor Statistic's Occupational Outlook forecast projects that only two

[7] For graduates in IT, perhaps the hottest of the true STEM job markets, only about one-third fail to take IT jobs. But about 30 percent of those say that the reason was that there was no job for them, while a much larger percentage, 53 percent, say the terms and conditions for such jobs were below the prospects elsewhere. The extremes were represented by health care graduates, who are not always counted as STEM graduates, where almost three-quarters got healthcare jobs, and all other STEM grads (e.g., science and math majors) where only about 22 percent got jobs in their field. Atkinson and Stewart (2013) published a rebuttal to the Salzman et al. report for The Information Technology and Innovation Foundation (ITIF). Perhaps the most interesting point in their report is the observation that the sponsors of the various reports matter: EPI's goal, they argue, is higher wages for tech workers, they asserted, while their goal was to promotion economic growth, presumably by making tech labor easier and cheaper for IT employers to engage. (EPI is sponsored in part by labor unions; ITIF is sponsored by tech employers.)

(registered and licensed nurses) of the top twenty occupations with the most new openings through 2020 require any post-secondary education, let alone STEM degrees (BLS 2014).[8]

A related complaint one often hears in STEM arguments is that US college students do not want to take the hard majors in college like those associated with STEM degrees and instead are coasting in easier majors and ones that have poor job prospects like liberal arts. In fact, the most popular majors in four-year colleges seem to be the most vocational: business is by far the most popular, one-in five students major in it (365,000 per year) and job skills are the focus; the second most popular major is education (104,000), another vocational field with a very close tie to jobs. The NCES defines liberal arts rather narrowly, and only 47,000 students choose that major in contrast to 76,000 in engineering (NCES Table 313). Since 2000-'01 STEM degrees have increased at a rate equal to or greater than the 32 percent increase in overall bachelor degrees: Engineering up 31 percent, Physical Sciences up 34 percent, Math/Statistics and Biology up 42 and 50 percent, respectively (NCES Table 313).[9]

More recent evidence suggests that entering college students have been responding to the employer complaints about shortfalls in STEM graduates. Jacobs and Lax (2014) find that student choices for majors in college have shifted sharply, from 21 percent in STEM fields in 2007 to 28 percent in 2011. The ratio of graduate degrees to bachelor degrees issued also rose from roughly one-in-three to one-in two from 1971 to 2012, and more than 85 percent of those degrees are in applied fields (NCES Table 318).

[8] Barnow et al's (2013) investigation of occupation-specific and regional labor shortages is an exception to those reviewed here in that it places labor market adjustments and better information front and center as the means for addressing such shortfalls.

[9] If we define liberal arts more broadly to include humanities and social sciences, the percentage of such graduates declined from 40 percent of all bachelor degrees in 1971 to about one-third in 2012. Thanks to Jerry Jacobs for this figure and for the graduate degree information as well.

Consultant Reports: Virtually every major consulting company has also weighed in on either the skills gap or skill shortage idea. As noted above, Deloitte (2011) on behalf of the Manufacturing Institute of the National Association of Manufacturing, arguing that there is a massive shortage of qualified candidates in that industry, McKinsey (2012) argued that there would be a shortage of tens of millions of educated workers across the developed economies in coming decades, and PWC (2012) noting that CEOs believe that labor shortages will impact their company success in the near future.

Two consulting companies produced reports pointing in the opposite direction, however. The Boston Consulting Group (2013) argued that there was little evidence of tight labor markets for manufacturing workers because wages were not rising. Accenture (2012) took a very different approach by surveying workers rather than employers. They found, among other things, that only one in five workers had learned any new job skills through employer-provided training in the past five years, and a plurality said that their employer relied only on their formal education and prior job experience in assigning tasks and jobs, not using any other assessments of their knowledge, skills, and abilities. As a possible sign of changing norms, 68 percent of respondents believed strongly that it was their responsibility to keep their skills up-to-date in their current job, not their employer's (only nine percent disagreed).

Perhaps the most influential and widely-quoted of the consultant reports on skill problems have been those published by Manpower, the staffing firm, in large measure because their reports provide reasonably detailed information from employers across countries on their perceived skill problems. The limitations of their data are similar to those for virtually all the business-based reports that gather data from employers: The sampling frame used for the survey is not identified but the inference is strong that it is not representative of the population of employers

from which it is drawn (e.g., the sample is likely clients of Manpower); we do not know the sample size nor the response rate to the survey, how the questionnaire was structured, who the respondents were, etc. Many of the results also suggest problems of face validity. For example, in 2010, 14 percent of US employers reported that they had difficulty filling jobs, but a year later in the 2011, when the economy and the labor market had barely changed, the figure jumped to 52 percent. Then in 2013, when the economy had begun to show some signs of improvement and one would expect hiring to become more difficult, the percentage of employers reporting difficulty actually fell to 39 percent (Manpower 2013: 7). The wording of the question asking about skill problems is not clear, which makes the validity of the responses impossible to determine.[10]

Nevertheless, the reports may be useful in providing some details as to what employers may mean when they say that they have difficulty hiring. For example, among the respondents' list of the 10 most difficult jobs for US employers to fill are laborers, a job with no discernable skill, drivers and production operators (factory workers), two positions with minimal skill, and secretaries/administrative assistance, jobs that do not necessarily require more than a high school education. It is difficult to believe that difficulties in hiring for these jobs represent a real shortfall of individuals who are able to perform the tasks required in those jobs especially given the high rate of unemployment in this period. They may well reflect problems with hiring practices.

[10] The tables in the report show the question as "How much difficulty are you having filling jobs due to lack of available talent?" which is a question about degree. But the results are reported as the percentage of employers having difficulty filling jobs, which is a binary, yes/no question. Some places in the text of the report refer to the same results as representing "hard-to-fill jobs."

When asked what the shortfall was in the applicants they see for their jobs, almost 20 percent say that the job seekers were not willing to accept positions at the rate of pay being offered, yet only five percent report that they were planning to raise pay in order to deal with difficulties in hiring. Among causes that reflected directly on attributes of the candidates, 31 percent of employers said the shortfall was lack of experience, six percent report that the problem was overqualification, and eight percent say that applicants did not want the jobs because they were contingent or part-time. Only a third of respondents report that a lack of "hard skills," the category related to skills that could be learned in school, was a problem they saw (Manpower 2013). These responses are hard to square with a skills gap view or even the skills shortage argument.

Nothing in the above employer reports indicates that difficulties in hiring refer specifically to applicants who are recent school leavers, although the conclusion is typically that they are. The vast majority of the labor force are obviously not recent school leavers: The Bureau of Labor Statistics calculates that there are about 1.3 million recent school leavers in the labor force in the age group 16 to 24 (Spreen 2013), less than one percent of the US labor force. The vast majority of job candidates, therefore, have been out of school for some time, and so the vast majority of the job applicants should be out of school for some time as well (applicants include those currently employed looking for better jobs as well as the unemployed).

Perhaps the most relevant employer-based evidence on skill problems comes from other studies that asked recruiters, rather than higher-level executives, about specific shortfalls that they saw in new hires, especially those who are recent school leavers. There have been several reports like these at least since the 1980s, and the conclusions have been similar. The complaints consistently focus on shortfalls in factors associated with conscientiousness (see Cappelli 1995). More recent surveys report the same conclusions. For example, a 2009 survey by the Business

Roundtable found that the top seven most commonly seen deficits were in those workplace attitudes. The first shortfall associated with academic skills was oral communication, in 8th place. [11] A 2011 hiring manager survey finds that of the 15 attributes listed as important for success in their organizations, only communication skills was related to an academic subject (Career Advisory Board 2011). Wolf et al (2010) reach the same conclusion for the UK, that employer complaints about school leavers have been about attitudes rather than skills.

Comparative Evidence: Some insight about the situation in the US might be gained from what employers elsewhere are reporting about skills. Although the validity and reliability of the data may be suspect (see below), a survey by the Manpower Group finds US employers fourth out of 41 countries in their complains about hiring the applicants they want, far above countries with tight labor markets like Singapore and Norway where we might expect a relative shortfall of applicants.

The economy, legal framework, and business community in the UK is arguably the most similar to the US among the world's larger economies, which might make a detailed comparison useful. The business community there has also been very active in efforts to persuade the general public and policymakers about the need to improve workforce skills. While some of the arguments mirror those in the US, others and the evidence behind them are quite different. For example, the Institute of Director's (2010) report argues that there is a significant gap between the skills employers need and those that school leavers have, but the biggest gap they see is in "soft skills": leadership, sales, communication, and customer service skills, in that order, mirroring the data but not the conclusions from US reports. The Engineering Employers Federation (2013) report

[11] See http://businessroundtable.org/studies-and-reports/american-worker-survey-telebriefing/

finds that the industries experiencing the biggest skill problems were construction and agriculture – not high-skill industries – although technical skills were the biggest shortfall in those two industries. It calls for an expansion of apprenticeship programs as the most important policy recommendation.

The Federation of Small Businesses (no date) and the British Chambers of Commerce (2011) also made a strong case that apprenticeships are the key to addressing perceived skill problems. The latter noted that while 54 percent of employers surveyed said that apprenticeships were not relevant to their businesses, 30 percent of those who took apprentices did so out of civic responsibility, something similar to what US employers reported a decade earlier in Census data (Cappelli 2001). And while almost two-thirds of employers said that they had some engagement in programs to help students make the transition from school-to-work, 14 percent had no training budgets at all and presumably did no training. (The figures for Europe as a whole are even lower, with about one-third of employers reporting that they did not provide training. The main reason employers across Europe gave for not training was that they tried to hire workers with skills so that they did not need to train. See CVTS 2013.)

The most influential of the UK business groups is the Confederation of British Industry (CBI), and their 2013 report on skills follows the model of recent US reports closely. Indeed, it begins by referencing US complaints about skills, then talking about failing schools as the cause and declining performance compared to international standards as evidence, and finally focusing on improved STEM skills, the US term, as the solution to skill problems. The evidence in their employer survey does not support that conclusion, however, as only 12 percent of employers reported having difficulty hiring college graduates with STEM skills, and the skills they are most

satisfied with are actually the "hard" STEM skills associated with IT. Despite this, respondents report that their priority for schools and college is to develop more business-relevant coursework.

Contrary to its recommendations, the CBI study also finds that work attitudes and aptitudes are the first concern from British employers who are hiring followed by the appropriateness of the candidate's academic degree for the job. Prior work experience, the number one concern for US employers, is third on the list of the UK employers. The UK employers responding report much greater involvement in education than in the US: 81 percent report they have some formal ties to schools, 70 percent have apprenticeships, 41 percent offer internships, and 61 percent say that they are willing to do more to help schools. The CBI report implies that employer-provided training is even rarer than the British Chamber of Commerce (2011) report above asserts. The CBI says that 59 percent of employers provided training for employees, implying that 41 percent did not.

Taken as a whole, the evidence from UK employers is different from their US counterparts in acknowledging that behavioral skills are the main concern, not academic skills, and in seeing apprenticeships as the preferred solution, something that is rarely mentioned in the US reports. (Recent practice in the UK has been for the government to pay most of the costs of apprenticeships, especially for younger school leavers.) More importantly, despite the many similarities and having essentially the same unemployment rate at the time the survey was done as the US (8.1 percent in the UK versus 8.2 percent in the US), UK employers ranked 4th from the bottom out of 41 countries in complaints about skill problems vs. 4th from the top in the US (Manpower 2012). Whatever is driving the US complaints, it appears to be something not found in the UK.

Academic Research on Skills:

The reports and evidence above were not written by or for an academic audience, nor did they reflect any of the prior research on questions concerning skills. Contemporary academic research on skill levels vs. employer needs arguably began with Berg's (1970) assertion that much of the investment in skills through training and education was not productive but was actually driven by hiring requirements that served other needs, such as legitimacy, and by the interests of students in going to college for reasons other than jobs, a precursor to later arguments about signaling in labor markets. It took its most important turn with Freeman's (1976) study of the sharp decline in the wage premium of college graduates from 1969 to 1974 measured relative to the wages of high school graduates. While his conclusion did not hold up in later periods (e.g., Smith and Welch 1978), others made similar arguments about education mismatches, especially Duncan and Hoffman (1981), who pursued the issue at the level of the individual worker. They examined the returns to education for individual workers relative to the requirements of their job and found that they were considerably lower for those who were over-educated as compared to where education levels equaled job requirements.

Their paper kicked off a stream of similar studies that continue today with more recent research showing the negative effects of being overqualified initially persist for years (e.g., Clark, Joubert, and Maurel 2014). Outside the US, McGuinness and Sloane (2011) found wage penalties for education mismatches in the form of more skill independent from education per se for men than jobs required, and that job satisfaction was significantly worse for those who were overeducated and overskilled for their positions. Sutherland (2012), using the recent UK Skills and Employment Survey, argues that overqualification of skills and education is widespread in the UK and that as a result increasing skills and education further is not sensible policy. Instead, policies should focus on increasing the demand for skills. Feldstead et al. (2013) use the same

data and find that overqualification of workers rose from 1986 to 2006 but then fell from 2006-2012 during the Great Recession. The decline reflected in part to increases in hiring requirements, which were the measure used for job requirements, and the fact that training and learning times were shortened for jobs: applicants were expected to come to jobs with more of the skills they will need and not to require training.[12] Mosca and Wright (2013) use micro data from UK college grads to find that there are long-term negative effects or "scarring" associated with starting out over-skilled: if one starts out underemployed, they tend to stay that way (in contrast to the earlier argument from Sicherman and Galor 1990 that those who are overqualified for their jobs may advance faster).

Researchers studying other countries find similar results. Ng (2003) finds that the overeducated earn less in Canada and in general that education-job requirement mismatches are reasonably common there. Badillo-Amador, Lopez, and Vila 2012 use the European Household Panel Survey to show that for Spain, skill mismatches have big, negative effects on wages and job satisfaction. Kostas and McGuiness (2007) report similar results for Australia - a small wage premium associated with being undereducated and a wage penalty for being overeducated. Mavromaras et al. (2013) use the new Household Income and Labour Dynamics (HILDA) data from Australia and conclude that being overeducated and overskilled are not identical but both have negative effects on wage outcomes. Mavromaras and Wei (2013) also use the HILDA data and find evidence of long-term scarring: being overskilled leads to long-term, negative effects on wages. Baert et al. (2013) find similar results for Flemish youth associated with being

[12] Gottschalk and Hansen (2003) found almost the reverse relationship in the US, where the probability of being a graduate employed in a job that did not require a graduate education declined between 1983 and 1996 as the labor market got tighter. The implication might be that in a down market US employers are more likely to hire overqualified applicants while in the UK, employers in similar circumstances are inclined to raise job requirements so that graduates are not overqualified. Gottschalk and Hansen define "graduate" jobs in a very different manner, however, based on outcomes that makes comparisons difficult: is the job title in fact filled by graduates and is there a wage premium in it for graduates?

overeducated in one's first job. The exception to the general overskilled story seems to be Italy where Cainarc and Sgobbi (2012) use face-to-face interviews of respondents about skills and conclude that there is substantial undereducation there relative to job requirements.

These results suggest that in these countries, skill mismatches are a common problem and also that overskill is a much more widespread problem than underskill. Employees benefit somewhat from being underskilled relative to the requirements of the job they are performing in that their wages are higher there than in jobs that that were a better fit for their skills (i.e., where skill requirements were lower). The costs to being over-skilled are born by employees in the form of wages that are lower than they would have earned in jobs that made full use of their skills. In a context where employees are increasingly asked to pay for their own skills, asking them to be over-skilled, where they will not be compensated for that excess skill, is a burden.

The literature specific to the US on skill mismatch is sparse. Most of it is in sociology and focuses on the more general question as to whether skill requirements in the economy are rising. The consensus view is that overall requirements may be trending upward in recent decades, albeit very slightly, although sorting out changing requirements within specific jobs is more difficult than assessing changes in the distribution of workers across jobs. The most important factor driving changes appears to be the decisions of individual employers as to how they organize work (see NRC 2005 for an overview). The study most directly on the topic of mismatches is Vaisey (2006), who compares educational qualifications to the education requirements of jobs using the US Department of Labor's O*NET job classification system to define job requirements. It shows that the average worker in the US is overqualified for their job and that the amount of that overqualification has been increasing in recent years.

Lie and Grusky (2013) use an interesting approach to assess changes in skill requirements across the workforce. They begin with the jobs of Current Population Survey (CPS) respondents from the 1970s to the present as representative of the distribution of jobs in the economy. They then use the U.S. Department of Labor's O*NET database on job requirements to capture the skills associated with each job.[13] They find increases in skill requirements over the last 40 or so years, some to do with changes in the distribution of jobs and some to do with changes in skills within jobs. The increases are modest: "academic skills" (analytic, quantitative, and verbal) up only four percent, computer skill requirements up eight percent, surprisingly small given the dramatic increase in the use of computers, and especially relevant for the STEM skills debate, no increase in science and engineering skill requirements.

Whether employers are hurt by underskilled workers and helped by overskilled is a more difficult question to answer. Acemoglu and Zilibotti (2001) examine country-level data among less developed countries and find that average skill levels below those deemed necessary for appropriate technologies used in those countries are associated with significantly lower country productivity. These skill levels are associated with the most basic skills, such as low-level literacy. Bennett and McGuiness 2009 survey prior research on skill mismatches and firm performance and report mixed results: some studies with no effect, others with negative effects. They find that for electronics firms in Northern Ireland, hiring complaints were mainly in job searches for experienced candidates. The effects of unfilled vacancies in particular on performance are negative and substantial but only appear when the analyses control for firm selection effects. Those effects are attributable largely to high performing firms. Kampelmann

[13] The measure used here is to take the government's official analyses of skills – one third of the Knowledge, Skills, and Abilities trio of requirements –for each occupation in 1979 and then compare them to more recent assessments from incumbents.

and Ryxc (2012) find positive productivity effects associated with overeducated workforces in Belgium, however.

The academic work above has many limitations, of course, especially construct validity and measurement issues. Most of these studies use education as a proxy for the level of skill an individual has or a job requires. No doubt one reason for this is the roots of the skill argument in returns to education, but a more practical reason is that education levels are much easier to assess than are skill levels. A second major problem is the difficulty in assessing the skills that jobs require. The best studies use objective assessments of the job, which requires an independent job analysis, but most ask the respondents themselves either what is required to be hired into the job or the extent to which they believe their own skills are being used.

Structural Change and Vacancy Arguments: A different set of arguments assert that the US economy or the labor market has changed in ways that have altered the balance between the supply and demand of skills. Lazear and Spletzer (2012) investigate the idea that job losses associated with the Great Recession have been in different segments of the economy than where recent job growth has been. They reject that view, noting that the pattern indicates something more like a cyclical downturn, where job losses and subsequent gains are following a pattern similar to what we have seen in previous recessions.

Rothstein (2012) examines a wide range of claims about possible changes in the structure of the economy and the labor market and rejects them all. In particular, he notes the absence of any upward pressure on wages that might be associated with a shortfall between the supply and demand of labor by industry or occupation or even a tight labor market. The best explanation for perceived difficulties in hiring by employers, he suggests, would be declines in the effort spent on recruiting. Haltiwanger, Davis, and Faberman (2012) provide evidence that employer efforts

to recruit applicants per vacancy have indeed declined during the Great Recession and have not recovered.

A measure that might well reveal hiring problems is vacancy data. Specifically, if the amount of time that positions remain vacant increases, it may suggest something about difficulty in hiring and, in turn, about the supply of qualified applicants. One of the most puzzling claims made by many of the skill problem advocates is the notion that the presence of vacancies in the labor force is evidence that jobs cannot be filled. The President's Council on Jobs and Competitiveness (Job Council 2012) makes that claim, asserting that vacancies per se reflect the inability to find qualified applicants rather than the usual view that they reflect only the fact that time is required to fill vacancies: Post the job advertisement, collect applicants, process them, hire someone, and then close down the advertisement. Deloitte (2012) on behalf of the National Association of Manufacturers, claimed that there were 600,000 good jobs in US manufacturing that cannot be filled for a lack of qualified applicants, an astonishing figure given that the Bureau of Labor Statistics reports only 220,000 total vacancies in manufacturing during the year the data for the above report was collected (BLS 2014). Osterman and Weaver (2014) investigate the labor market context in manufacturing with their own survey and find that two-thirds of employers report having no vacancies and only 25 percent have had vacancies open long enough to suggest there was difficulty in filling them. The most common of their self-reported explanations as to why filling those long-term vacancies has been difficult was that candidates lacked industry-specific skills (41 percent), and the second most common explanation was that the wages they were offering were not sufficient to attract candidates (11 percent).

Whether vacancies are taking longer to fill now than in the past is an important question. The Beveridge Curve gets at that indirectly by capturing the relationship between the unemployment

rate and the number of job openings as a proportion of the labor force. Jobs that stay open get counted again in each time series estimate, so a change in the length of time required to fill jobs would cause an apparent outward shift in the curve. Developments that cause jobs to be filled faster would do the opposite and cause an apparent inward shift in the curve.

Barnichon et al. (2012) using the JOLTS data find that the Beveridge Curve did shift for the US after the Great Recession in 2009 and that the shift was caused by a decline in hires per vacancy expected at the relevant level of unemployment. Many factors could account for the relative decline in hiring, such as greater hiring of the currently employed (which keeps the unemployment rate from declining while creating vacancies elsewhere) and a decline in filling vacancies from within (which expands the vacancy rate), but this would be the strongest evidence so far that there may be problems with labor supply that make hiring more difficult. The authors conclude that a mismatch of skills in the form of unemployed job seekers coming from different industries than those where vacancies are is not part of the explanation, however, and the list of possible explanations outside labor supply altogether is extensive (e.g., greater uncertainty in the economy).

Davis et al (2013) use the same data and also find fewer hires than expected in the period since recovery from the Great Recession officially began. They also find evidence of considerable variation across employers in their ability or perhaps inclination to fill vacancies. Among their strongest findings is that growing firms and those filling many vacancies are more likely to fill a reported vacancy than are firms with a vacancy that are not growing or filling as many positions. These results suggest that something about the manner in which firms are recruiting and

selecting candidates may be explaining why vacancies last longer, as the Haltiwanger, Davis, and Faberman (2012) study cited above concluded. [14]

Skill-Biased Technological Change: Among the most cited evidence in the academic literature on skill are findings under the heading of skill-biased technological change (SBTC). In brief, the argument is traced to Tinbergen's (1974) idea that new technologies require more skilled workers and that over time, the continual introduction of new technology therefore leads to a continual demand for more skills. Societal investments in education increase the supply of skilled workers and keep wages for workers with higher skills from spiraling upward.

Katz and Murphy (1992) produced compelling evidence consistent with the Tinbergen view by looking at the college wage premium (relative to the wages of high school grads) over time and finding that it closely tracked the relative supply of college grads. Deviations from the prediction are seen as resulting from changes in technology, much as deviations in the orbits of planets is seen in astronomy as evidence of gravity from unseen heavenly bodies. The fact that the wage premium for college educations was rising in the 1980s even as the relative supply of college graduates rose is taken as evidence of a shift in technology biasing demand toward more skilled/educated workers.

"Technology" per se is not specified or measured directly in typical SBTC studies. It is assumed to be an attribute of the economy that is ever increasing and is often proxied with a simple time trend. But computer use of the kind Krueger (1993) and Autor, Katz, and Krueger (1998) examine is a favorite illustration of such technology, and it is associated with higher wages and more educated workers. Autor, Levy, and Murnane (2003) looked directly at the effect of

[14] Another important finding from their study is that 27 percent of hires take place in establishments that do not report having a vacancy, which suggests that relying on vacancies data to assess hiring may be less than perfect.

computer use on skill requirements and found that it increased non-routine, higher-skill tasks while reducing lower-skill, non-routine tasks, also consistent with a SBTC view. Goldin and Katz (2008) extend the SBTC argument and use it to explain wage patterns across US history.

Other studies suggest limitations to the SBTC argument, however. Autor, Katz, and Kearney (2008) looked at changes in the distribution of wages and conclude that increasing employment in higher skill jobs and decreasing in lower skill jobs in the 1980s explains rising wages in the former and falling in the latter. But in the 1990s, job and wage growth was only in the high end of the skill distribution, falling in the middle, while low-skill jobs also increased. Acemoglu and Autor (2011, 2012) extend that analyses to the present and find that the college wage premium has remained relatively steady in the 2000s despite a slowdown in the increase in the number of college grads, which would be consistent with a slowdown in the demand for college skills. Beudry, Green, and Sand (2013) conclude that the demand for higher-skilled jobs that require college degrees is actually declining. College grads then take jobs that require only high-school level skills. In the process, they "bump" the applicants without a college degree, who then end up with even lower skilled jobs or none at all.

More generally, the notion that technology is an incessant force creating demand for higher skills is contradicted by research in other fields. In the period after Tinbergen's work, the dominant view of technology and skills in sociology was that technology was often designed precisely to reduce skill requirements. Technology associated with scientific management such as assembly lines clearly did reduce average skill requirements, increase the supply of labor who could perform most jobs, and lower wages in the process. It also reduced the control and discretionary effort that workers could exercise in those jobs (e.g., Braverman 1974). Since then, organization-specific studies of the introduction of technology such as computer assisted design and manufacturing suggests

strongly that employer choices determine whether skill requirements rise or fall for different workers (e.g., Zicklin 1987, Keefe 1990). Acemoglu (2002) offers an intermediate view, asserting that while technological change defined broadly in recent years does appear to be biased toward creating greater demand for skill/education, it does not necessarily have to be that way. The outcome depends on the relative prices of skilled labor and therefore the incentives for employers to reduce their use of such skills.

Similarly, the notion that IT technology in particular has an inexorable effect of creating job losses through increases in productivity in industries and occupations where it is used (Brynjolfsson and McAfee 2011) does not appear to hold up in contemporary data. The relationships between IT use and productivity and with job losses change considerably at different points in time (Acemoglu et al. 2014; see also (Michel, Shierholz, and Schmitt (2013).

The related fact from these studies that there is a wage premium associated with attending college has created its own argument for expanding education. The gap between average wages for high school and for college graduates grew sharply after 1980, driven both by increases in wages for college grads (in the late 1990s) and the decline of real wages for high school graduates (in the late 1980s). As Acemoglu and Autor (2012a) note, though, college wages have been reasonably flat since about 2002, and some studies showing high wages for college graduates may come from including those with graduate degrees: real wages for those with graduate degrees continued to rise through the 2000s while those with only a bachelor's degree did not.

What we conclude from the college wage premium should be considered carefully. The wage premium at any point in time represents the difference in average wages for all college graduates vs. all high school graduates, and the average US worker graduated from high school about 20 years ago. That wage premium is not necessarily representative of the experience of new hires, however, nor necessarily predictive of the future college premium.[15] For example, the college premium declined considerably during the Great Recession, falling from 69 percent to 63 percent between 2008 and 2011 (NCES Table 438).

We also know that college graduates are different from high school graduates in ways other than their education, such as their socio-economic status, their abilities and other dispositions, and so forth, and that those differences also affect their earnings. It would be wrong to assume that a typical high school graduate is identical to the average college graduate except for their education and that the former would make the same wage as the latter if they had a college degree. Yet that assertion is commonly made, typically implicitly.

The college premium has been influenced strongly by factors that have nothing to do with the demand for college grads. The decline of unions, for example, held down wages disproportionately for high school grads and, as a result, increased the college premium, casting doubt on the uncritical use of the college premium as a proxy for the demand for college grads.

Using education as a proxy for the "skill" that employers want should be interpreted with caution as well given that the extensive literature in job analysis shows that the knowledge, skills, and abilities that are used in jobs have at best only a partial overlap with what is taught in typical college courses. As noted elsewhere, there is no evidence that skill requirements in the US have

[15] In 1995, for example, the median bachelor degree graduate age 25-34 earned 30 percent more than the median high school graduate while all bachelor degree grads over age 25 earned 50 percent more than all high school grades over age 25. In 2011, the equivalent figures were 50 percent and 65 percent, respectively.

risen at anywhere near the rate that the college wage premium has increased over the equivalent periods if at all.

Finally, the education mismatch literature cited above shows that the wage premium from a college degree comes mainly from getting access to a job that requires college-level skills. A college graduate in a job that requires only high school skills earns little more than a high school graduate in that job. That should remind us of the fallacy of composition, which in this context is equivalent to a general equilibrium problem: It may make perfect sense for an individual to secure a college degree because it will pay off. Whether it makes sense for society as a whole to send a higher percentage of high school students onto college expecting that they will all earn that same premium, in the absence of any evidence of increased demand for college-level skills, is not obvious.

Student Achievement: Comparative evidence on student achievement gets arguably the most attention in assertions that there are skill gaps caused by the US education system. Here the argument is that US students are not learning as much as those elsewhere. New datasets, especially the Trends in Math and Science Study (TIMSS), which began in 1995, and the Programme for International Student Assessment (PISA), which began in 2000, show that the US is about in the middle of the rankings of other countries on the various measures of student achievement.

Loveless (2012) notes that many observers interpret this evidence as showing that US students score worse than many other countries with higher rankings, but he notes that there is no statistically significant difference between US scores and those for countries often several positions higher in the rankings. He also notes that despite claims to the contrary, the US position has not been declining over time relative to other countries. In the first of the

international comparison tests in 1964, for example, the US scored 11th out of 12 countries. US student performance on subsequent tests has being going up in absolute terms in the both the TIMSS and the PISA tests (Loveless 2011). Scores in other countries are going up as well, though, so our position relative to other countries has remained about the same - near the middle.

The fact that Asian countries like Singapore and Korea and the Chinese cities of Hong Kong and Shanghai have now risen to the top ranks of these studies has received considerable attention, but what is not clear is how much credit for those high scores should go to their schools. As many as 70 percent of students in those countries also attend after hours tutoring classes, known as juku in Japan, cram schools in Korea, and generally as the "shadow education system" (Bray and Lykins 2012). Surely this supplemental set of practices affects student achievement.

The newest and most powerful evidence on skills across countries comes from the OECD's Programme for International Assessment of Adult Competencies (PIAAC). It is an international comparison of worker skills – literacy, numeracy, and problem-solving in an IT context – rather than student skills. It is assessed directly with tests of representative, random samples of the workforce from each country. On this assessment, the U.S. ranks 17th in literacy, 22nd in numeracy, and 14th in problem solving out of 24 countries participating, far below average. A related assessment of the US position comes from a recent study of the wage premiums associated with the PIAAC skills data. It finds the highest skill premiums are in the US, which would be consistent with a situation where these skills are in relatively short supply compared to other countries (Hanushek et al 2013).

Academic preparation in school – which happened decades before for the average respondent – is not closely related to the poor showing of US workers relative to other countries, however, despite assertions in the popular press. The PIAAC authors note that the US has a more educated

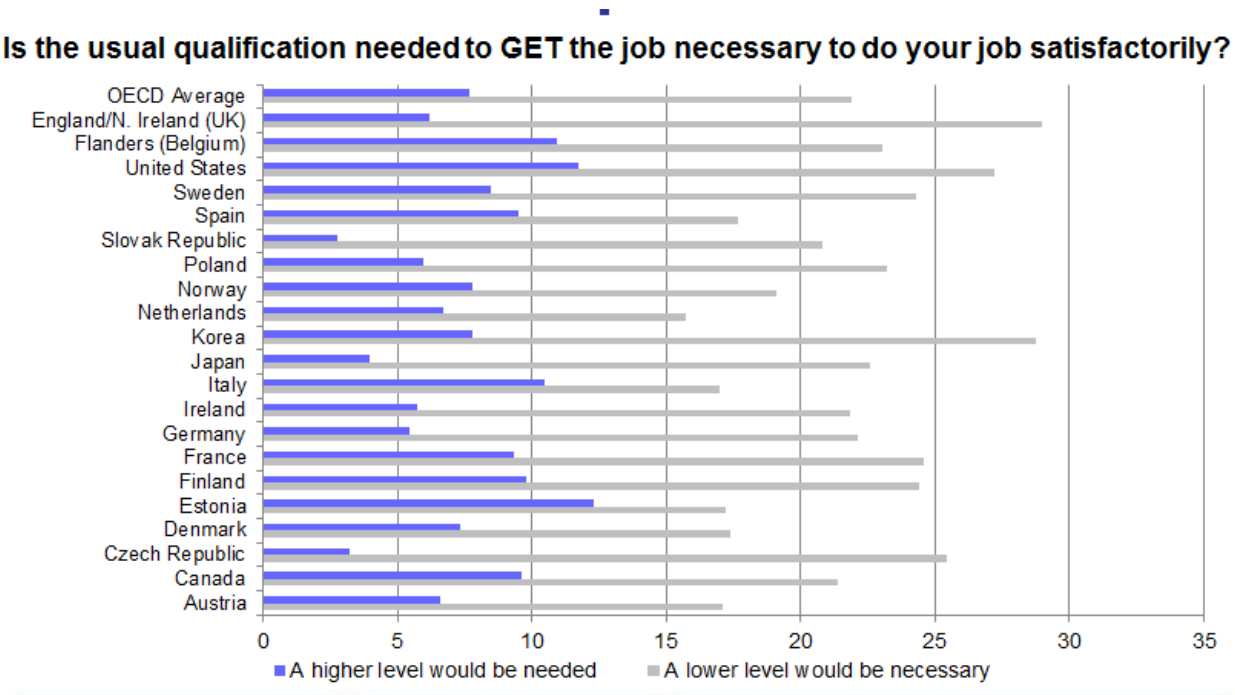
workforce than average, and more important, the relative position of the US in student achievement is much higher than its position in worker skills. As noted above, US students come out about average in most international comparisons of academic achievement and also did so in earlier decades when most of the PIAAC respondents were in school. (Many of the worst-performing countries in this study are not in the PIAAC study, though, which keeps the two from being strictly comparable.) Together these results suggest that something is happening to the reading and numeracy skills of US workers after they leave school that is different from what is happening in other countries.

More puzzling in these data are the differences in scores by age group. Overall, younger workers perform much better on the PIAAC skills tests than do their older counterparts, suggesting widespread upgrading of skills over the generations. Except in the US. Younger workers here score about the same as older workers: a little worse than those age 25-44, a little better than those older than 44 years. Here again, the relative academic achievement of US school leavers compared to other countries has remained about the same over time, so that it cannot be the case that declining academic achievement of US school leavers over time could be the explanation. The best explanation for these results points to events after leaving school, such as more upskilling on-the-job (workplace training or education jobs that keep such skills sharp) now for younger workers in other countries as compared to the US, although some part of the gap may have to do with immigration practices: immigrants to the US have had lower cognitive skills than immigrants to other countries (Kahn 2005).

The PIAAC also asked respondents about the hiring criteria associated with qualifications (academic degrees and similar credentials) in their current job and compared them to the qualifications of the respondent. Hiring criteria are not identical to job requirements, of course,

and we would expect the former to rise when applicants are plentiful, as they have been in recent years. Nevertheless, the results in Figure 1 show more than 50 percent of workers in OECD countries believe that their current job could be performed with fewer qualifications (education and credentials) than are currently required by their employer as compared to those who report that more qualifications are actually required. The US scores are similar to the OECD average.

Figure 1: Hiring Requirements vs. Performance Requirements



Source: Konstantinos Pouliakas, CEDEFOP analysis of PIAAC data.

A different but related complaint is the idea that the US is declining in the amount of graduates with college degrees it produces relative to other countries. As with the assertions cited earlier that the US is facing some labor force shortage, these complaints appear to misread the most basic evidence. The absolute number of graduates is certainly not declining: As noted above, Bachelor degrees increased from just under 1.3 million in 2000-'01 to just over 1.7 million in 2010-'11 or a 31 percent rise, and Associate degrees increased by even more, from 580,000 in

2000-'01 to 940,000 in 2010-'11 or a 62 percent increase versus population growth of only 11 percent (NCES Tables 312 and 313). It is true that the US does not lead the world in having the highest percentage of college graduates in the population, but it has not for some time. Russia, Canada, Japan, and Israel have a higher percentage of graduates. (Strictly speaking, the measure used for comparison is for post-secondary degrees, not all of which are comparable to bachelor degrees. OECD 2013; Chart A1.1.)

What is more distinctive is that the US is one of the few countries where the younger cohort age 25-34 does not have more education than does the older cohort. Israel, Finland, Germany, and Brazil are also in that situation. The shortfall in the US cohort is attributable to men as women in this age group do have more degrees than does the older cohort. One complication with the conclusion that the younger cohort in the US is behind those in other countries is that US citizens are far more likely to earn college degrees later in life than are those in other countries, so the US position in the rankings should change.[16] Whether and how the US position in rankings like these matters is not obvious, though. We return to this question below.

Where the US does not look good in a comparative sense is our graduation rate from college, where we are second from the bottom with roughly 60 percent of those who enroll graduating (OECD Chart A4.1). Again, this low position may reflect the fact that so many US students are part-time (58 percent) and may eventually graduate after the data were collected. We do lead the world in spending per degree, however (OECD Chart B1.2). Individuals in the US bear a much greater share of the costs of post-secondary education than average, but the UK, Korea, and Chile pay an even higher share (OECD Chart B1.2).

[16] For example, 13 percent of full-time, US undergraduate students in four-year colleges are over age 25. http://nces.ed.gov/programs/coe/indicator_csb.asp. Figure 1.

Summarizing and Assessing Evidence of Skill Problems:

The contemporary reports arguing that there are skill problems in the workforce offer little in the way of compelling evidence to support that claim, and the evidence that they present is often contradictory. Objective evidence from government data and from other sources does not support any of the claims about skill problems. In fact, the evidence appears to be compelling that the US is experiencing exactly the opposite problem, a substantial skill mismatches in the form of individuals with more education than their current jobs requires and a surplus of educated and skilled workers who cannot find jobs at all, let alone jobs appropriate for their education and skill level.

Employer-led complaints about skill problems in the US broadly defined are not new. Alchian, Arrow, and Capron (1958) respond to assertions about perceived shortages of engineers and scientists in the 1950s, noting among other things that those complaining had a poor understanding of how labor markets actually work.[17] More recently, Mangum (1990) reports on manufacturing employers complaining that they faced a skill shortage since WWII and chronicles a history of assertions since suggesting that there would be skill problems, all of which turned out to be false. Rosenthal (1982) assessed complaints from manufacturers of a skill shortage coming out of the 1981 recession and finds no evidence of it. His recommendations, that employers seeing difficulty in hiring should raise their wages, train more to develop talent internally, or substitute technology for labor to reduce their demand, are standard, textbook solutions that are largely absent from the current discussions.

[17] The framework they use, still useful today, considers many possible definitions of "shortage," including nontechnical usage. They describe the idea of a "dynamic shortage," where employers cannot hire more candidates at the wage they are currently paying, as among the most common situations causing complaint. In such cases, time lags and morale complications can ensue while the employer adjusts to higher wages, but they do not see public policy interventions as helpful.

Reports of employer complaints have accelerated dramatically in recent years, though, especially since the Great Recession with its unprecedented and paradoxical (for the complainers) surfeit of available talent. Indeed, much of the attention that complaints about skill problems have received during the recession in the popular press may well have been because of the "man-bites-dog" aspect of the claims: With all these people looking for jobs, why can't this employer fill theirs?

What the complaints from employers about skill problems might actually mean remains elusive because the employer-driven studies are so poorly designed and conducted that it is difficult to know what real information they contain. It does seem safe to conclude, though, that to the extent they are real, employer complains probably reflect concerns about hiring experienced candidates as there are so many more of them than school leavers; that concerns about school leavers per se focus on maturity, not academic skills; and that many – perhaps most - employer problems with hiring appear to be self-inflicted, such as inadequate pay and training.

Questions that ask "Are you having difficulty finding the candidates you need to fill your vacancies?" are maddeningly ambiguous. It could be that simply following the many steps and issues to consider in textbook descriptions of recruiting and selection processes could constitute difficult. We also know that self-serving biases should inflate complaints: It is much easier to assert that there is something wrong with the candidates than to acknowledge that our own practices are at fault.

One explanation for the large number of employer-based complaints may be that it is just part of the broader rise in recent years in business lobbying to influence public opinion and policy in ways that benefit employers (Waterhouse 2014). The employer complaints in the IT sphere, for

example, go hand-in-hand with lobbying efforts to increase access to foreign workers on H1B status. The basic conflicts between labor and management are not far from the surface in many of these exchanges, with employer groups arguing for more supply and, in turn, lower wages and greater employer power in the employment relationship, while labor and employee groups (albeit considerably fewer of these) argue for the opposite. The reports on skill problems from consulting firms are also consistent with a self-serving explanation: Their business models are based on helping business clients address perceived problems. Highlighting or even asserting problems and then offering solutions to them are common practices. The firm HRMarketer.com (no date), which provides advice on how to sell consulting services to human resource departments, offers a related explanation. It recommends that vendors produce white papers and other reports addressing big questions to build credibility with clients, and one of those questions they note is the shortfall of talent.

A second explanation is that the rise in employer complaints about difficulties in hiring reflects something real even if it is not caused by any change in the supply of skill in the labor market. Hiring may well be more difficult now simply because employers have to do much more hiring these days because of widespread and substantial declines in employee tenure (see Hollister 2011 for a survey), which translates into more frequent vacancies and more hiring to fill them. The decline of life-time employment practices and the associated rise of lateral hiring have been underway for some time especially in larger organizations (Cappelli 1999). The fact that the decline in tenure is disproportionately associated with larger firms where promotion from within had been more common (Bidwell 2013) may have an even bigger effect on hiring to the extent that it undermines promotion-from-within systems or is a marker for their decline: when

employees who have been promoted from within leave unexpectedly, it may be difficult to fill their job from within because no internal candidates may be ready for advancement.

A decline in promotion-from-within systems also increases hiring challenges substantially by expanding the range of jobs through which hiring takes place: from standard "entry-level" jobs, which require minimal skills, to virtually every position in the organization. The much wider range of hiring would, in turn, require finding experienced candidates who either are or have worked elsewhere. Finding such candidates with the precise skills to fill these jobs is much more challenging than finding inexperienced school leavers for entry-level jobs. Systematic data on external hires is difficult to obtain, but a proprietary survey from the same pool of employers over time (CareerXroads 2013) finds that 72 percent of their positions were filled from outside in 2007. Outside hiring dropped sharply during the recession to less than half of all placements but then rose back up to 58 percent in 2012.

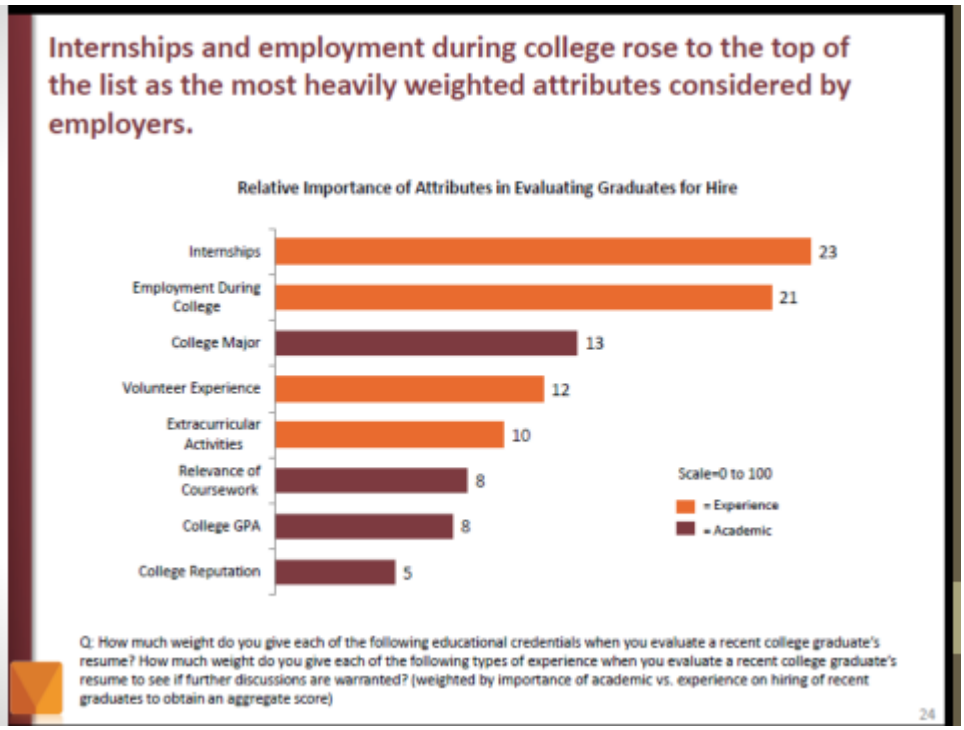
Hiring directly from college – a proxy for entry-level jobs – accounted for only 5.5 percent of all new employees hired by these firms. Presumably most of the other 94.5 percent were experienced hires. Another proprietary survey of large employers (12,000 average employees) reports that only 15 percent of the positions they filled in April 2014 could have been performed by an applicant just out of high school or college.[18] The common assumption that employer complaints about skill problems necessarily refers to jobs filled by new graduates is hard to square with these data.

[18] There is no evidence of how many recent grads, if any, we hired into those positions. The average position filled had 74 applicants, and the average hire had nine years of experience. 227 employers responded to the survey conducted by Recruiting Trends magazine. Thanks to the editors for making the results available.

When employers do hire from college, the evidence suggests that academic skills are not their primary concern. A survey of employers conducted by the Chronicle of Education (2013) in Figure 2 shows that work experience is the crucial attribute that employers want even for students who have yet to work full-time and that the relevance of coursework to the job in question is just not that important:

Figure 2

Employer Preferences for Applicant Attributes



Source: Chronicle of Higher Education, 2012.

Few employer reports of skill problems ask what it is employers are looking for in candidates that they cannot find, but the evidence in Figure 4 suggests that it is work experience, even for school leavers. As the European employers above explained about why they do not train, these employers are seeking to get the skills they need through hiring, and a significant part of those skills appears to come from work experience. Hiring candidates who already have skills in turn

becomes more important once one no longer has training and apprenticeship programs as an alternative.

Credible evidence on employer-provided training in the US is remarkably hard to come by, especially recently. The data we do have suggests that in 1979, young workers received on average about 2.5 weeks of training per year. By 1991, Census data found only 17 percent of all employees reporting that they received any formal training that year. Several surveys of employers around 1995 indicate that somewhere between 42 and 90 percent of employers offered some training (the lower number indicating more programmatic training) with the amount of training an individual received per year averaging just under 11 hours. The most common training topic was workplace safety.[19] Those figures also include what vendors provide when they bring in new equipment: "Here's how to work this copier."

The above data are now almost 20 years old, and there is little new from government sources. In 2011, Accenture surveyed US employees and found that only 21 percent had received *any* employer-provided formal training in the past five years. To be clear, that means almost 80 percent had no training in five years, and no doubt many of those had no training in the years before that, either.

The most important source for craft-based skills has been apprenticeship programs. Data on the extent of US apprentices and programs is not extensive, but the Department of Labor data on apprentice programs registered with them and that meet certain quality standards shows a sharp decline from 2002 to 2012 – roughly 33,000 programs to roughly 21,000 – and an even steeper

[19] For a review of data on the extent of training, see Lynch and Black, Sandra E.. 1998 and Frazis, Gittleman, and Joyce. **2000.**

decline in the number of apprentices – roughly 500,000 in 2003 to approximately 280,000 in 2012.[20] The approximately 50,000 annual graduates of these programs is a drop in the bucket of a labor force of 160 million.

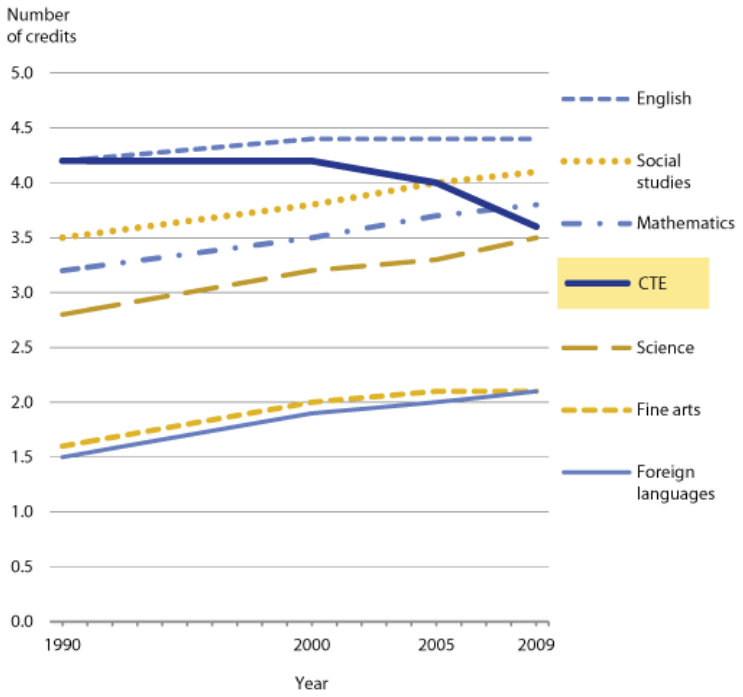
Whether these measures are representative of trends in all apprenticeship programs is not clear as there certainly are non-registered apprenticeship programs, and the data for those other programs is not available in any systematic fashion. The Department of Labor has pushed since 2004 to identify and register more programs (OECD 2012:4), so if the rate of registration has been increasing, then the decline in actual apprentice programs would be greater than the data here suggest. Further, the quality of apprenticeship programs is not necessarily constant. Bilginsoy (2003) notes that in the construction industry, union-management joint apprenticeship programs have been in decline as the unions running them declined. They are being replaced by employer-based programs where the latter do not perform as well as those in the former, perhaps because the employers are in more of a hurry to get the trainees into the jobs they need now, and many more apprentices leave the employer-led programs before they complete them.

One area where employer complaints about shortfalls in the supply of skill have unique credibility is with skilled trades. Especially for smaller employers, an important source of workers who had at least basic trade skills was vocational education programs in high schools. Figure 3 (NCES) illustrates course-taking among students who graduate from public school. Beginning in 1990, vocational courses declined precipitously especially in comparison to the rise in other subject areas.

[20] Curiously, the number of "program completers" remains unchanged over this period at just over 50,000 even though the number of programs and the number of apprentices declined sharply. That translates to about two completers per apprentice program each year. See ETA 2012.

FIGURE 3
High School Credits by Subject Area

Figure 1. Average number of credits earned in each subject area by public high school graduates, 1990 to 2009



CTE: Career and Technical Education
Source: NCES Career/Technical Education Statistics.

Within vocational education curricula, "industrial arts," which includes skilled trades and other mechanical skills, declined even faster. The average number of credits taken per student in that subject area fell by half from 2000 to 2005 (BLS Table 2.17) [21] The US already had the least proportion of vocational education in secondary school education of any of the industrialized countries (OECD 2010). Employers who relied on vocational education to provide their new

[21] Here NCES data suggests slightly different trends using different occupational classifications (CTE Figure 2). The percentage of students earning credits in the "construction" area fell only slightly, from 1990 to 2009, by 0.7 percent. The percentage in "manufacturing," which would include machinist skills, fell by 9.5 percent. Interestingly "business" coursework declined by almost 20 percent while at the undergraduate level it expanded considerably in the same period. These data only say whether students are taking any courses, in contrast to the BLS data which indicates how many courses they are taking.

hires would indeed find a shrinking pool of candidates. This appears to be the best evidence of something that has changed in the supply of labor to manufacturing employers.

Different countries have made different choices as to who is responsible for aspects of skills (see Biavaschi 2012 for an overview). The US is already the outlier in having fewer vocational education options and generally requiring individuals to get and pay for a larger amount of job skills themselves after leaving high school. Much has been made of the importance of community colleges as providers of skills in the US, and the Obama Administration has followed previous administrations in calling for an increase in their role (White House no date). They are funded largely at the local level, however, and whether they will have the resources to take on the training that employers do not want to do is an open question. [22]

A final explanation for employer complaints relates to the above, and that is the highly specific and idiosyncratic nature of contemporary hiring requirements. It is common to assume, for example, that a job opening for a position such as a machinist is reasonably standard, but that turns out not to be the case.[23] This situation is consistent with Lazear's (2003) skill weights view, where the appearance of firm-specific skills can be generated by a unique mix of general skills in job requirements and different priorities attached to those skills across employers.

[22] It is difficult to trace course taking per se at community colleges, and we know that a great many students who go there to pick up job skills do not intend to pursue a degree. While most Associate degrees from community colleges are indeed in very applied fields, one-third are in liberal arts (NCES 2013 Table 312), a far greater proportion than in bachelor degree programs. The explanation appears to be that community colleges also play a role as a feeder into four-year degree programs, and liberal arts majors represent that pathway.

[23] To get a simple sense of job requirements for machinist positions, I investigated the vacancies posted on the Monster.com website for May 13th 2014. Machinist openings are subdivided into 13 categories based on differences in job requirements. Within the "CNC" subcategory, every job required prior experience (one also required further training through a community college certificate program). Most required experience with particular brands of CNC machine tools. Every job had at least one requirement that did not appear in any of the other job openings.

If job requirements across employers are highly specific and somewhat unique, then the supply of available workers is constrained, perhaps sharply so. It creates the possibility of monopsony for employers, upward sloping supply curves for labor. Monopsonists who pay equivalent workers the same wage – non-discriminating monopsonists – find wage levels rising quickly when they try to hire more workers, and they end up hiring fewer and producing less than if labor supply was more elastic (see Manning 2003). Job applicants might find it very difficult to determine which skills they should acquire where requirements are specific and varied. In the absence of very good information about jobs and mobility, they may find themselves skilled but also unemployed or at least under-employed.

An obvious solution to the monopsony problem and indeed to virtually all the skill problems reported by employers is to increase training and produce the skilled workers they want themselves. Anecdotally, employers often express the view that they cannot afford to train employees for fear that they will be hired away at a higher wage by competitors, the text-book problem of providing general skills. Whether that is simply a rationalization or an opinion based on evidence is important to know. The counter to that view is the extensive literature starting in the recent period with Acemoglu and Pischke (1998) on how the provision of general skills can be structured to address that problem.

Conclusions:

Overall, the available evidence does not support the idea that there are serious skill gaps or skill shortages in the US labor force. The prevailing situation in the US labor market, as in most developed economies, continues to be skill mismatches where the average worker and job candidate has more education than their current job requires. Persistent, high levels of unemployment reflect the fact that job seekers still outnumber available job openings. While it is certainly true that a bigger supply of cheaper labor would be useful to employers, it is not clear

that such a situation would be useful for the country as a whole, and any claims to that effect should be examined carefully.

It is not clear what the apparent rise in employer complaints about skill problems represents in part because of the poor quality of information presented as part of the complaints. No doubt some component of the complaints is simply an effort to secure policy changes that lower labor costs. It may well be that some component of the complaints represents real problems associated with changes in employer behavior, such as greater outside hiring and associated increases in employee turnover and reduced training and internal development. Some of these changes might be driven by the behavior of other employers. For example, increases in turnover may be driven by the hiring practices of other employers, and smaller employers who in the past had been able to meet their skill needs by hiring skilled apprentices away from larger employers may find that there is no one to hire when those apprenticeship programs are gone. Efforts to hire skills rather than build them from within would create much more specific and variable job requirements across employers that would vastly increase not only the difficulty in hiring but also the experience of having to raise wages above current levels in order to find appropriate candidates.

The implications that follow from the above conclusions are important to consider. The proposals in the various employer-led reports to increase student academic achievement, reduce drop-out rates, and generally improve the quality of secondary school education are difficult to object to, but these goals are already accepted. The challenge has been how to achieve them. The interest is in having applicants with more accountability, motivation, and maturity is also hard to argue with, but these attributes are also typically associated with growing up. How schools can accelerate that process and make 18 year olds act like 28 year olds is not clear.

A more important implication of many of the above reports is the underlying shift they represent in responsibility for the provision of a workforce. The notion that employers are responsible for recruiting and retaining employees and then training and developing them to meet changing skill needs, textbook human resource concepts is hard to see in any of these reports even where the results show that employer practices are driving much of their perceived skill problems.

The view that emerges from these arguments is one where responsibility for developing the skills that employers want is transferred from the employer onto job seekers and schools. Such a transfer of responsibility would be profound in its implications. Schools, at least as traditionally envisioned, are not suited to organize work experience, the key attribute that employers want. Nor are they necessarily good at teaching work-based skills. Those skills are easiest and cheapest to learn in the workplace through apprentice-like arrangements that one finds not only in skilled trades but also in fields like accounting and medicine. Unlike in the classroom, problems to practice on do not have to be created in the workplace. They exist already, and solving them creates value for others. Observation and practice is also easiest to do where the productive work is being done, and employment creates incentives and motivation that typical classrooms cannot duplicate.

At the post-secondary level, where job skills have traditionally been offered in the US schools, the shift in the responsibility for skills from employers to students has important implications for the students and their families. The obvious implication is that because the costs must be paid up-front, those individuals without the capital to pay the fees lose access to those skills, again in contrast to earlier periods where employers provided more opportunities for on-the-job learning and training. That shift in responsibility also pushes risk onto students and their families. The employers who are calling for more STEM graduates, for example, are not offering to hire the

students who are now starting such programs when they graduate. The student and their families who pursue specific education in hopes of the job at the end are taking a substantial financial risk should those jobs not be there at the end.

Proposals like those in the state of Florida would push students toward vocational majors by shifting state funds to college majors where employers say they want to hire (typically STEM fields) and away from majors where they do not (Anderson 2011). Governments do not have a particularly good record of forecasting where jobs will be years in advance, however, and students and their families would bear the costs when those forecasts are wrong.

More generally, if the labor market is not enticing students to pursue particular fields, should public policy push them to do so? Manufacturers, for example, have long complained about the shortage of students interested in machinist training programs and assert that the cause has been that schools and guidance counsellors were not advocating for those programs. But the pay for such jobs has declined by 20 percent in real terms over the past two decades while the skill requirements for those jobs have shifted toward computer use, a field with better pay. The number of machinist jobs has already declined by 20 percent in that period (the total number of jobs in the economy has increased by 40 percent) and is expected to decline further (Cappelli 2012). The reasons why there has been a decline in the number of students taking vocational education courses that could prepare them for manufacturing jobs merits further attention, but we should not assume that it is independent from the attractiveness of the jobs offered at the end of those programs.

Assuming that the government cannot become the staffing agency for employers, are we faced with a future where employers are frustrated because they cannot find the specific skills they

want to hire at the same time that jobs seekers and especially school leavers cannot get the skills that employers really want because no one will give them initial work experience?

Some employers may see a market opportunity for getting skills more cheaply by training even if competitors want to hire away the workers they train. We know that employers can provide even general skills training if the arrangements are structured appropriately (Acemoglu and Pischke 1998) as we see in temporary help (Autor 2001), with tuition reimbursement plans (Cappelli 2004), and in most all professional service firms – consulting, accounting, etc. – where liberal arts graduates are turned them into consultants and bankers, respectively, through on-the-job training. Traditional apprenticeship programs operate the same way.

Assuming not enough employers figure out how to manage that option, are there alternative arrangements? The arrangements favored by the school-to-work movement in the 1990s may still have merit. In them, the boundary between school and work blurred. Employers helped schools to provide work-based learning content that supplemented academic material and offered learning opportunities in the workplace that were not necessarily paying jobs. The employer's incentive to participate was the ability to identify promising students to hire before the students ever went on the job market, and the costs of the programs were minimal.

The topic of skill problems in the US represents something reasonable new for labor market and public policy discussions. It is difficult to think of a labor market issue where academic research or even research using standard academic techniques has played such a small role, where parties with a material interest in the outcomes have so dominated the discussion, where the quality of evidence and discussion has been so poor, and where the stakes are potentially so large. The perspective and interests of employees and students have been almost completely absent from these discussions. There has been little testing of the assumptions behind arguments, and the

costs and benefits of various proposals have not been considered. The situation described above seems to be unique to the US.[24]

One factor in the relative lack of academic research on these topics no doubt has been the lack of information and data about skills per se. The standard classification of job requirements into "knowledge, skills, and abilities" reminds us that education, which has served as a proxy for skills in most discussions, only maps onto part of the "knowledge" category, leaving the other attributes of job requirements out of the picture. There are many important reasons for being concerned about education, but seeing it as the equivalent of skill is certainly a mistake. One of the unfortunate consequences of using education as the proxy for skill has been to see schools, the providers of education, as the mechanism for dealing with skill problems and leaving training and on-the-job experiences out of the story.

A final lesson for the US academic research community from the current discussion of skill problems is that in the absence of clear, objective research findings, it is easy for advocates to make claims that are simply assertions and claims that even casual acquaintance with real evidence would indicate are false. Perhaps the many organizations and foundations that have supported the advocacy-oriented approaches above might be persuaded to help change the debate by supporting real research on the role of skills in the US economy.

[24] For example, the Global Agenda Council of the World Economic Forum on Employment, whose members are predominately outside the US, saw the notion that there might be skill gaps and skill shortages as irrelevant. Indeed, an employer representative from outside US asserted that "no one makes such arguments." See GAC 2014 for a global view.

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