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SKILLS MISMATCH IN THE LABOR MARKET

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■ **Abstract** Researchers across a wide range of fields, policy makers, and large segments of the public believe that the work-related skills of the labor force do not match the requirements of jobs and that this explains a large part of the growth of wage inequality in the United States in the past 20 years. Opinions are divided on whether the trend is driven by workforce developments, such as an absolute decline or declining growth of human capital due to changes in educational attainment or test scores, or employer-side changes, such as accelerating growth of job skill requirements due to the spread of computers and employee involvement techniques. Some believe the problem has grown worse over time. However, the evidence is often more ambiguous and fragmentary than recognized, and the argument overlooks the roles of institutional changes and management's policies toward labor in workers' changing fortunes. Evidence suggests that the growth in educational attainment has decelerated, cognitive skill levels have remained stable, and job skill requirements have gradually increased, but a large portion of employer dissatisfaction relates to effort levels and work attitudes of young people that may represent transitory, life-cycle effects. There is little information on whether job demands are actually exceeding workers' capacities. The absence of a standardized, up-to-date method of collecting information on the actual skill content of jobs is a significant obstacle to answering this question with confidence.

INTRODUCTION

There is a widespread belief that workers' skills and education are not adequate for the demands of jobs in the current economy. Journalistic reports, employer surveys, popular and policy debates on school quality and education reform, sociological writings on the economy and the underclass, and economic accounts of the recent growth of wage inequality all suggest a mismatch between the skills workers possess and what jobs require, what economists call an imbalance between the supply of and demand for human capital. Many believe that the problem will become even more serious because the pace of change is accelerating and jobs are becoming increasingly high tech, service oriented, and reorganized to involve greater employee participation in the workplace (Bresnahan et al. 2002, see also Smith 1997).

Although many aspects of the skills mismatch issue seem self-evident to casual and even some informed observers, closer examination reveals considerable

ambiguity and uncertainty along many dimensions, some of which require better data than is currently available to resolve. The existence of a skills mismatch or skill shortage is by no means as obvious as often asserted.

After providing background and overview of the issue, this review discusses research on the level and trends in the skills workers possess and employers demand and the evidence for skill shortages or mismatches between the two. This tripartite structure is dictated by the nature of the data, which prevents a unified treatment of the question from the outset. There is limited reliable and representative data on workforce competencies and even less on job demands, and the evidence for each is largely incommensurable. The need for a more standard set of measures is one key finding that emerges from this review.

SKILLS MISMATCH AS A SOCIAL PROBLEM

The term skills mismatch can describe situations in which workers' skills exceed or lag behind those employers seek. Indeed, social scientists' views of the state of the labor market shifted from one position to the other in a relatively short time.

During the 1970s, a range of disciplines believed workforce skill levels exceeded the levels that jobs could utilize. Credentialist theories within sociology argued that employers' inflated hiring requirements led American workers to obtain more education than they really needed for their jobs (Berg 1971, Collins 1979). Signaling and queuing theories within economics also cast a skeptical eye toward the meaningfulness of educational credentials; econometric studies of the falling college–high school wage differential led to the conclusion that Americans were overeducated (Freeman 1976). A prominent government report considered the dilemma of how to make work more satisfying when job complexity at all levels seemed to fall short of workers' rising education levels and aspirations for meaningful work (US Department of Health, Education, and Welfare 1973). Deskilling theory claimed that the skill content of most jobs was actually declining, even as educational attainment continued to increase (Braverman 1974). Bowles & Gintis (1976) argued that schools socialize students into the different work norms appropriate for jobs at different levels of the class hierarchy and that this function overshadows its contribution to human capital formation in the determination of wages and related outcomes.

In the 1980s and 1990s, with the exception of cultural capital theory within the sociology of education, scholarly and policy thinking shifted in the opposite direction, dramatically in some cases. More sociologists believed that technology and sectoral shifts were increasing the relative number of high-skill jobs, as Bell's theory of a postindustrial or information economy claimed (Bell 1976, Form 1987, Attewell 1987, Wright & Martin 1987). Wilson (1987, 1996), among others, argued that these changes contributed to the problems of the urban underclass by creating an increasing mismatch between the skills of minority workers and employers' workforce requirements. Mainstream labor economists trying to explain the large growth in overall wage inequality in the 1980s observed that the college premium

rebounded from its record low point in the 1970s and reached record highs in the 1980s; they concluded that the growth in the demand for skill had outrun the supply more generally (Katz & Murphy 1992). The skills glut seemed to have turned rapidly into a severe shortage.

Separately, policy makers, employers, and the public expressed alarm at what they saw as declining academic skills among young people, reflected in falling test scores and the perceived decline of public schools. The United States seemed to rank relatively low in international test score comparisons and the Japanese, the leading economic competitor to the United States, tended to rank high. The severe economic downturn in the early 1980s added urgency to calls for action (US National Commission on Excellence in Education 1983). Government panels sought to clarify the skills that all workers needed (US Department of Labor 1991) and authorized new programs to set national occupational skill standards and strengthen the connection between school and work, including borrowing aspects of the German apprenticeship system. Given the wave of plant closures in the recession of the early 1980s, previous concerns over trends in job satisfaction and the "blue-collar blues" seemed like luxuries when the very existence of whole segments of the job structure seemed in question.

The most famous alarm came from *A Nation at Risk*, a report commissioned by the Department of Education:

> Our Nation is at risk. Our once unchallenged preeminence in commerce, industry, science, and technological innovation is being overtaken by competitors throughout the world . . . the educational foundations of our society are presently being eroded by a rising tide of mediocrity that threatens our very future as a Nation and a people . . . . If an unfriendly foreign power had attempted to impose on America the mediocre educational performance that exists today, we might well have viewed it as an act of war. As it stands, we have allowed this to happen to ourselves . . . . We have, in effect, been committing an act of unthinking, unilateral educational disarmament (US National Commission on Excellence in Education 1983).

In addition to declining high school and college entrance test scores and poor international test score rankings, the report cited increased use of remedial education, high rates of functional illiteracy, and the increased skill demands resulting from the spread of computers as reasons for concern. Citing adult literacy surveys from the mid-1970s, the U.S. secretary of education testified before Congress that approximately 50% of adults were not "proficient in meeting the educational requirements of every day adult life" (quoted in Stedman & Kaestle 1991, p.75), although even if this were true, it would apply mostly to people who completed their education prior to the ostensible decline in the school system. Low performance by young adults on a literacy survey in 1985 led the president of the Educational Testing Service to worry about the large proportion of the population that "doesn't read well enough to cope with this technological society" (Reston 1986). Since roughly the early 1980s, Britain has been engaged in an almost identical debate,

filled with similar urgency and anguish, whereas Canada has experienced a somewhat more low-key version (Payne 1999, Keep & Mayhew 1996, Krahn & Lowe 1998). The general view developed in different fields that deep-rooted skills deficiencies were a major social problem and a principal barrier to economic and social improvement.

Interestingly, although education remains pilloried in the political and public discourse, many of the economic problems that helped fuel concern in the 1980s to early 1990s diminished significantly by the mid-1990s (Levin 1998a). U.S. economic dominance is unchallenged internationally, with growth generally robust prior to the recent cyclical downturn, and the once-fearsome Japanese economy has been in the doldrums for approximately a dozen years. Low unemployment in the 1990s also boosted wages at the bottom of the distribution after significant declines in the 1980s and inequality largely stopped rising.

The speed of this turnaround suggests that swings in macroeconomic forces had a far greater effect on the nation's fluctuating fortunes in the 1980s and 1990s than the modest trends in school quality or individual attainment, although no one attributes the economic improvements to schools nor has the sense of urgency surrounding school quality and reform abated (Levin 1998a). Indeed, the role reversal has been so complete that the Japanese are partly blaming their own education system for their recent economic difficulties and seeking to emulate aspects of the U.S. education system, although the reforms are controversial in Japan (Ono 2002, French 2001). Recent research also attributes the growth of other East Asian newly industrializing countries more to high levels of investment and labor force growth than to their high test scores (Levin 1998a, Robinson 1998). Any skills mismatch explanation of U.S. inequality growth and poor economic performance for the 1980s has to account for the turnaround in the 1990s that seems largely independent of trends in the stock of skills. Levin (1998a) suggests that schools are simply scapegoats for poor economic performance, whose real sources lie elsewhere.

Indeed, labor economists in the segmented labor markets tradition argued that the real problem was not disappearing low-to-medium skill jobs per se, but rather the decline of unionized manufacturing jobs, which had provided middle-class incomes for less-educated workers owing to the institutional framework in which they were embedded. The lower-end service jobs that replaced them were not really more skilled but they were lower paid. The logic of secondary labor markets also intruded increasingly into the remaining jobs in the subordinate primary sector as a result of deunionization, more competitive product markets, changing wage norms, the declining real value of the minimum wage, increasing use of contingent work, outsourcing, cheaper immigrant labor, and offshore production (Harrison & Bluestone 1988, Harrison 1994, Howell 1997, DiNardo et al. 1996). The highly restrictive macroeconomic policies designed to break inflation in the early 1980s also weakened labor's bargaining power by increasing unemployment to record postwar levels, which some argue is a far more important source of growing wage inequality than computer technology or skills mismatch (Galbraith 1998).

Identifying the problem as workers' low skills diverts attention from the role of free-market government policies and management's shortcomings in the areas of product quality, capital investment, work organization, and worker training, in this view (Levin 1998a, Mishel & Teixeira 1991). It is changes in the quality of jobs, not a shortage of human capital, that explains inequality growth. From a sociological perspective, the skills mismatch discourse can be seen as blaming those who bear the brunt of low-road management strategies, and in its more extreme forms, creating a kind of "moral panic" that generates a level of concern over skills that is disproportionate to what is warranted by a sober assessment of the evidence (Goode & Ben-Yehuda 1994).

There are critical difficulties or gaps in concept and evidence in several versions of the skills mismatch thesis. Proponents of skills mismatch have tended either to underspecify the subgroups, particular skills, precise trends, and underlying causes that they believe are the problems or offer competing, often disparate explanations that are problematic in various respects. Table 1 summarizes some of the issues threaded through this review, some of which can be clarified briefly here.

TABLE 1 Unresolved issues in the skills mismatch literature

Who lacks necessary skills?
- Recent cohorts
- Young workers
- Older workers
- Workers with a high school degree or less
- Disadvantaged minorities
- College-educated workers lacking strong math, science, or other technical training

What specific skills or qualities are in short supply?
- Basic or intermediate reading, writing, and math skills
- Advanced cognitive/intellectual skills
- Problem-solving skills
- Technology competencies
- Interpersonal ("soft") skills
- Attitudes and work ethic, effort, diligence, commitment, sense of responsibility, respect for authority

How is any trend best characterized?
- Absolute decline in the supply of skills
- Decelerating growth in the supply of skills
- Accelerating growth in the demand for skills

What is responsible for any shortage?
- Employer changes (technology, organizational changes)
- Workforce quality and characteristics
  - ◇ Failing schools
  - ◇ Underclass conditions
  - ◇ Demographic trends in cohort sizes and college enrollment rates

Much of the discussion, particularly emanating from the school failure literature, focuses on basic or intermediate cognitive skills deficits among young people and implies cohort effects. The claim is that declining educational quality or student performance has lowered the quality of more recent cohorts, a characteristic that presumably persists into the adult working lives of the affected groups.

However, another strong current identifies the main problems as deficient interpersonal and teamwork skills ("soft skills"), various attitudinal or demeanor issues, and related problems with work motivation, such as low effort and sense of responsibility, rather than any kind of skill strictly speaking (Moss & Tilly 2001).

This suggests that what is often perceived as a cohort effect may be an age effect. Recent cohorts may pass through a phase of early adulthood characterized by weak attachment to career employment. As they mature and shoulder more adult responsibilities, they grow out of casual work attitudes and adjust to or are socialized into the workplace norms of jobs that they are more interested in retaining and compensate for any modest cognitive skill deficits through on-the-job experience and situated learning (Scribner 1986).

Casual support comes from the fact that complaints regarding younger workers have persisted for more than 20 years, but similar complaints regarding older workers do not seem to have grown as the earlier cohorts aged; complaints persistently refer to age groups rather than cohorts. Cohorts cited by *A Nation at Risk* are now middle aged. Indeed, SAT scores stopped declining or started rising after 1980 (Economic Report of the President 2000, p. 148). This view implies that employers may face a chronic problem with young workers, but the issue is transient for each cohort and not progressive from the perspective of the economy overall.

Insofar as one believes the new economy places a premium on computer or similar technology-related competencies, one might expect that would also make younger workers better positioned than older ones who have greater potential difficulty assimilating new skills and face issues of skill obsolescence and retraining (US Congress Office of Technology Assessment 1990, p. 254; Kelley & Charness 1995).

If there is a skills mismatch but it is believed to be restricted to those with a high school degree or less or disadvantaged minorities, this clearly affects the magnitude of the problem and should be distinguished from the idea that schools are failing to impart skills more generally.

Likewise, debates over alleged declines in higher education, such as the public controversy over recentering SAT scores (Winerip 1994), grade inflation in higher education (Rothstein 2001), and stagnation or decline in math, science, and engineering B.A. recipients (National Research Council 2001) are also different from concerns over whether high school graduates have tenth-grade reading and math skills (Murnane & Levy 1996). A satisfying skills mismatch argument ultimately needs to specify whether the problem is a shortage of basic skills or professionals and other knowledge workers belonging to Reich's (1991) famous "symbolic analysts" category.

A final ambiguity in the skills mismatch literature is whether the principal worry is an absolute decline in skills across cohorts or other large subgroups, slowing growth in the supply of human capital, or accelerating growth in demand for human capital. The differences have clear implications for the evidence that is cited and the underlying explanation. Absolute declines or slower growth in workforce skills are supply-side problems that should be reflected in trends in worker characteristics, such as declining college enrollments or falling test scores, whereas accelerating demand suggests employer-side changes, such as the spread of computer technology or employee participation at work. Economists who argue strongly that the growth in wage inequality since the 1970s reflects a disequilibrium between the supply and demand for human capital are still undecided as to whether supply- or demand-side changes are more significant (Katz & Murphy 1992, Autor et al. 1998, Gottschalk & Smeeding 1997, Card & Lemieux 2001).

The next sections review the evidence on workers' skills, employers' needs, and possible mismatches with the preceding considerations in mind.

WORKERS' SKILLS

The most frequently used and available measure of workers' skills is the quantity of education attained, but recent concern has also focused on its quality, as measured by test score trends.

Taking education as the measure suggests that the workforce is considerably more skilled than in the past. In 1964, prior to the perceived deterioration of public education, the share of all Americans who were high school dropouts was 47% and the proportion of young people age 24–29 with less than a high school education was 31%, compared to roughly 13% for both groups in 1997 (M.J. Handel, unpublished calculations; March Current Population Survey). Clearly, one conclusion that emerges is that any view of the period prior to the late 1960s as a golden age for either workforce skills or the public education system is as much an exercise in nostalgia as a balanced assessment.

The rate of growth in attainment has varied over time and depends on the measure (e.g., mean years of education versus categories of attainment). In general, March Current Population Survey (CPS) data for the 1960s to 1990s indicate that attainment for the entire population grew most rapidly through the mid-1970s, slowed somewhat between 1975–1982 and 1982–1991, and slowed somewhat more so in the 1990s. Attainment among those age 24–29 rose most rapidly between 1965 and 1975, owing to both rapidly declining high school dropout rates and rising college attendance rates, boosted in part temporarily by Vietnam draft deferments. For young workers, the trend in attainment was largely flat between 1975 and 1990 and turned up somewhat between 1990 and 1997, a period when economic conditions improved but concern over education remained intense. Inequality in attainment as measured by the coefficient of variation declined approximately 25%–30% for all workers and young workers between 1962–1982 and then remained flat (M.J. Handel, unpublished calculations).

If education is the measure of skill, then the workforce is more skilled than ever, although the trend was flat for young workers when concern over both education and the economy were great (1975–1990). Of course, if employers' requirements have risen faster than trends in attainment, then stability or even growth in attainment may be insufficient to prevent shortages and the bidding up of wages for the more educated, but this is not evidence of absolute decline in either human capital stocks or school performance.

Because of concern over variations in the quality of schooling and the coarseness of educational categories, test scores have been used as another, arguably more precise, measure of cognitive skills, although such data are not plentiful, especially if one wants long time series with large, representative samples.

IQ tests show large gains for Americans throughout this century, including every postwar decade for samples as recent as 1995, the most current, and there is no obvious recent change in the slope of growth (Flynn 1998). The gains are so large that intense controversy persists over whether they can be taken at face value because they imply either very high rates of almost subnormal intelligence in the early twentieth century or very high rates of giftedness today, depending on which sample is taken as the standard. Even if cohort gains in mean IQ scores do not signify commensurate gains in actual intelligence, they do not suggest declines. The struggle in explaining IQ trends is discovering the reason for their unexpected and robust growth.

Since 1974, the General Social Survey has administered a 10-word vocabulary test selected from a larger intelligence test. This is the most complete time series for a representative sample of Americans, but its brevity and relatively small sample size introduce more measurement error and sampling variance than is ideal. The mean for all workers does seem to have declined erratically by as much as 6% between the late 1970s and late 1980s but then climbed to its highest level in the 1990s (Handel 2000). Although there has been strong disagreement over whether scores declined for younger cohorts (Alwin 1991; Wilson & Gove 1999a,b; Glenn 1999; Alwin & McCammon 1999), there are much better data on this subject.

One of the most frequently cited are college entrance exams, such as the SAT, whose decline beginning in the mid-1960s initiated the recent concern over the state of public education in the United States. However, less widely reported is that math SAT scores started rising around 1980 and exceeded 1971 levels by the mid-1990s, despite the growing share of high school students taking the exam, though verbal scores did not recover. By contrast, the rival American College Test shows English scores exceeding earlier levels while the rebound in math did not fully offset the earlier decline (Economic Report of the President 2000, p. 148; Boesel & Fredland 1999, p. 72). Contrary to popular impression, the SAT and American College Test test score declines are highly cohort-specific and ceased or reversed long ago.

However, the problem with SAT trends is that the population of test takers is not random. The composition and percentage of high school students who self-select into the test pool has changed so much over time that some believe no

credible conclusions can be drawn from this data (Hauser 1998, p. 224). Others argue that a genuine decline can be inferred in the early 1970s, at least, when scores continued to drop despite the presumed increased selectivity of test takers resulting from declining college enrollments after the end of Vietnam draft deferments for college students (Koretz 1992). This conclusion is clouded by the fact that the shorter, Preliminary Scholastic Aptitude Test has been normed on representative samples of high school juniors and apparently shows no trend in either the mean or inter-quartile range since the early 1960s, and the variance seems to have declined during this period (Williams & Ceci 1997). However, some argue that there was an upward drift in the scaling of Preliminary Scholastic Aptitude Test scores over time that masks declining performance (Jones 1981).

The best time series of inter-cohort data is the U.S. Department of Education's National Assessment of Educational Progress (NAEP), sometimes called the Nation's Report Card, which has a continuous series of reading and math scores for representative samples of 17-year olds since the early 1970s; the test instrument has remained roughly the same over this time. Reading scores did not change significantly between 1971 and 1999, in contrast to SAT scores. Math scores dipped approximately 2% between 1973 and 1982 and then rose until reaching a level in 1999 approximately 1% higher than 1973 (Campbell et al. 2000). Overall test score inequality for both math and reading also declined since the 1970s, due mostly to gains at the lower percentiles, contradicting the impression that the lower part of the distribution is losing ground (Campbell et al. 2000). Black math and reading scores rose and closed roughly one half of the black-white gap during the 1980s, also contradicting popular impressions, before losing some ground in the 1990s, a development that is still poorly understood (Campbell et al. 2000).

The dominant impression from NAEP scores is their stability, although if employer skill demands are rising, then this relative stability may be cause for concern, but it is still a far cry from the common rhetoric of declining student achievement and failing schools.

There is much less complete or representative information on adult cognitive skills over time. A review of several tests administered to large, representative samples in the 1970s and early 1980s concluded that approximately 20% of the adult population at that time had serious difficulties with common reading tasks and another 10% had better but still marginal functional literacy skills (Stedman & Kaestle 1991, p. 109). The different tests are not comparable, preventing trend analyses, but most included only a small proportion that completed their education in the late 1960s–1970s, when educational quality is believed to have declined. Therefore, this figure might be taken as an informal estimate of the low-skilled share of the labor force during the most prosperous years of the old economy and an informal baseline against which more recent estimates may be evaluated.

The richest source of data is the cross-sectional National Adult Literacy Survey (NALS) (1992), sponsored by the U.S. Department of Education, which asked a large, representative sample of adults to answer questions based on real-world situations thought to reflect everyday life and work. The test measured skills in dealing

with prose (e.g., newspaper articles, product instructions), documents (e.g., payroll forms, bus schedules, graphs), and quantitative materials (e.g., calculating a tip, balancing a checkbook, determining interest from a loan advertisement). Because the scores on the three scales tend to be so similar, Table 2 reports the simple average across the scales for all Americans and various subgroups (column 1) and the difference between subgroup means and the overall mean in standard deviation units (column 2). The NALS also reported results in terms of performance levels (column 3), defined by various cut-points to facilitate interpretability for policy makers and the public, as did the NAEP.

The most widely reported result was the large number of Americans (22%) in the lowest literacy level, Level 1 (column 3). Less noticed was that the implications for the quality of the labor force are not clear cut. One third of those scoring in Level 1 were over 65, many of whom are retirees, less educated than younger cohorts, and have depressed cognitive functioning due to aging. Likewise, approximately 25% in Level 1 were foreign born, many with limited English skills and low levels of schooling completed in their native countries. Approximately two thirds in Level 1 did not finish high school and one third did not complete more than eighth grade. One quarter also reported a disability that prevented them from participating fully in work and nearly one fifth reported impaired vision (Kirsch et al. 1993).

The percentage of full-time workers in Level 1 (13%) is considerably lower than in the population as a whole, but clearly many Americans in the overall population performing at Level 1 are either not in the labor market for reasons unrelated to low skills or have been drawn into the U.S. labor market from abroad, often to work for employers who are happy to trade off these workers' lower English literacy skills for the low pay they will accept. Clearly, the reported numbers in Level 1 cannot be used in a straightforward manner to draw conclusions about the number of native-born potential job seekers who are hard to employ because of low skills. Nor can one draw conclusions about the adequacy of American schools in equipping the future workforce with skills. Indeed, educational professionals and researchers using the NALS complain that the demographic heterogeneity within Level 1 limits the usefulness of the category (Sherman et al. 1998).

Nevertheless, column 2 indicates that the unemployed and working poor do have below-average scores. Approximately 15%–20% of those in Levels 1 and 2 were unemployed in 1992, compared to approximately 8% in Level 3, 5% in Levels 4 and 5, and a national average of 7.4% (Sum 1999, pp. 39, 45).

Not surprisingly, there are large test score gaps between high school dropouts and high school graduates and between high school graduates and those with some college. However, there is no difference between GED holders and high school graduates. Differences in scores by level of postsecondary schooling are also significant but more gradual. Occupational differences are also in the expected direction and parallel the results by education level.

Contrary to popular impression, age is negatively associated with test scores even for those under 65, lending no support to the idea that younger Americans have poorer literacy skills than older ones. Those age 55–64, who would have

TABLE 2 National Adult Literacy Test Scores (NALS), 1992

	Mean	SD units	Percentage (employed full-time)
All	270		
Level 1 (0–225)			22.0 (13.0)
Level 2 (226–275)			26.7 (24.3)
Level 3 (276–325)			31.3 (35.3)
Level 4 (326–375)			16.3 (22.3)
Level 5 (376–500)			3.3 (5.0)
In labor force	283	0.20	
Employed full-time	287	0.27	
Unemployed	258	−0.19	
Not in labor force	241	−0.45	
Employed full-time			
≤1.25 poverty level	251	−0.30	
Not poor	298	0.44	
Out of labor force			
≤1.25 poverty level	213	−0.89	
Not poor	265	−0.08	
Some high school	228	−0.66	
GED	267	−0.05	
High school diploma	268	−0.03	
Two-year college degree	305	0.55	
Bachelors degree	319	0.77	
Postgraduate degree	332	0.97	
Manager/professional/technical	320	0.78	
Clerical/sales	291	0.33	
Craft	267	−0.05	
Operator/laborer	251	−0.30	
Services	262	−0.13	
Age (high school dates)			
19–24 (1986–1991)	279	0.14	
25–39 (1971–1985)	283	0.20	
40–54 (1956–1970)	283	0.20	
55–64 (1946–1955)	257	−0.20	
65+ (≤1945)	225	−0.70	
White	284	0.22	
Black	230	−0.63	

Note: All values are simple means of prose, document, and literacy scores. Values in column 2 subtract the overall mean from values in column 1 and divide by the full sample estimate of standard deviation of 64 (Devroye & Freeman 2001). Some occupational means are weighted averages of means for narrower occupational groups. Unless otherwise noted, figures refer to all Americans, not simply workers. Source: Kirsch et al. (1993, pp. 17, 26, 31, 33) and Sum (1999, pp. 24, 62).

graduated high school in the reputed golden years of American education (1946–1955), clearly have lower scores than more recent cohorts, who supposedly bear the effects of less-rigorous schooling. Many fewer in the older group actually finished high school, but a significant gap remains even after controlling for educational attainment (Smith 1995, p. 214; Freeman & Schettkat 2001; but see OECD & Stat. Can. 2000). The NALS data provide no evidence that more recent cohorts have lower cognitive skills than older cohorts.

As with other tests, the race gap is large and roughly three quarters of the gap remains when comparisons are within education groups, although there are no formal analyses controlling for age, family background, or quality of schooling (Kirsch et al. 1993, p. 35). However, consistent with the narrowing of black and white scores on the NAEP, the race gap is positively associated with age; the gap for 19–24 year olds in 1992 was approximately one-third less than for 40–54 year olds, which is consistent with the view that racial disparities are declining over time (Kirsch et al. 1993, p. 39).

The meaning of test scores like the NAEP and NALS is much debated and important for understanding their value and limitations for the skills mismatch debate. The best-known disputes are between skeptics who believe the tests underestimate the real-world skills of minorities and low-scoring individuals and are biased either in their content or in their method of use in employee selection (Hartigan & Wigdor 1989, Jencks 1998, Sticht 1992) and those in education, industrial/organizational psychology, and traditional intelligence psychology who argue that test scores are among the strongest predictors of outcomes, including job performance (Schmidt & Hunter 1998, Gottfredson 1997). Many of these debates involve the meaning of test score rankings.

However, less noticed are the problems in drawing conclusions about the absolute level of real-world proficiencies from test scores, particularly when reported in terms of discrete performance categories and accompanying illustrative sample items and competency descriptions. Evaluators of the NAEP report significant reliability and validity problems with the performance levels, some of which can give misleading impressions of the tasks individuals can perform, and evaluators recommend that the reporting of results by performance levels be discontinued (Pellegrino et al. 1999; Linn et al. 1996, p. 27; Campbell et al. 2000). Although the NALS has not received the same scrutiny, respondents' self-reports of their literacy practices and competencies are higher than what would be expected on the basis of their scores (Kirsch et al. 1993), and sample items and their assigned performance levels also suggest that individuals' real-world capabilities would be underestimated if their performance on NALS tasks were interpreted literally as reflecting the tasks they could and could not perform in their daily lives (e.g., calculating a tip, reading a bus schedule, understanding a news article) (Sum 1999).

In fact, these test scores are only probabilistic indicators of actual performance, and there is significant variation and dispute over which probability thresholds to use in mapping scores into categories of cognitive performance (Campbell et al. 2000, p. 93; Sherman et al. 1998, p. 28; Stedman & Kaestle 1991; Mathews 2001).

Using different standards can significantly alter the proportions assigned to grade-level equivalents or various literacy categories, such as marginal, basic, and proficient. Even given a probability standard, all agree that those in one level have nontrivial probabilities of succeeding on higher-level tasks. For example, individuals with NALS scores of 250, in the middle of Level 2 and a bit below the average for high school graduates, have approximately a 50% probability of performing tasks at Level 3, where two-year college grads cluster, and approximately a 30% probability of performing tasks at Level 4, which is above the average for those with at least a B.A. (Sum 1999).

The fact that individuals who are assigned to one level can perform tasks at a higher level greatly complicates efforts to draw very specific or strong conclusions from test scores about absolute skill levels in the labor force. Most popular reports of test results ignore this fact. One analysis of media reports on the NAEP criticized them for using simplistic descriptions of the performance levels and tending to "misrepresent student achievement as discontinuous—students either can or cannot do what is in the descriptions of the levels. Both of these tendencies are illustrated, for example, by a statement that students at Level 200 'know how to add' " (Linn et al. 1996, p. 26). *Education Week*, reporting on the large number in the NALS Levels 1 and 2, declared, "Nearly half of all adult Americans cannot read, write, and calculate well enough to function fully in today's society" (quoted in Stiles 2000, p. 23). A well-known education writer concluded from reports generated from an earlier, young-adult version of the NALS that "80 percent can't calculate a tip in a restaurant or figure out which bus will get them home by using a schedule that is no more difficult than the ones most of us decipher every day" (Kozol 1986). These do not seem to be plausible conclusions.

Numerous studies of situated cognition or practical intelligence suggest that performance of solitary individuals on abstract tasks in formal settings yield unrealistically low estimates of people's actual functional abilities in daily life. In these real-life situations, tasks are performed in context and people have greater internally generated motivation to develop proficiency, which they achieve by acquiring a stock of domain-specific knowledge and developing their own heuristics for solving problems. The knowledge and techniques are gained through daily experience, learning from others, and participation in a community of practice and may be tacit rather than easily expressed as formal propositions (Stasz 2001; Scribner 1986; Ceci & Liker 1986; Schooler 1998, p. 70; Sticht 1992; Stedman & Kaestle 1991; see also Hunt 1995, p. 67, 93).

Even analyses using the NALS find that after controlling for test scores and other covariates, workers are paid substantially more if they hold jobs requiring more reading, writing, and math tasks (Carbonaro 2002). This suggests that work-related competencies are partly independent of the skills measured by both education and cognitive test scores. The skills workers can develop and for which they are rewarded are partly a function of the jobs employers offer, rather than the intrinsic capacities of individuals acting as a kind of hard constraint.

Those associated with the NALS recognize some of these complexities. They caution, "These results do not answer the question, 'Are the literacy skills of our nation's workers adequate?'" (Sum 1999, p. xvi) and that the performance levels "do not enable us to say what specific level of prose, document, or quantitative skill is required to obtain, hold, or advance in a particular occupation" (Kirsch et al. 1993, p. 9). Yet at other points they also contributed to the sense that the test results provide such information:

> For an economy that has supposedly moved into the "information age" and is becoming dependent on high-performance workplaces to spur economic growth, competitiveness, and productivity, many members of the existing labor force appear ill-equipped with respect to key literacy proficiencies (Sum 1999, p. 33, also see Kirsch et al. 1993, p. xxi).

An NCES working paper advised those working on a follow-up to the NALS administered in 2002, called the National Assessment of Adult Literacy (NAAL), to learn from the problems associated with the reporting of NALS results:

> All audiences for the NAAL will be longing for simplicity. But the complexities of adult literacy proficiency must be conveyed. Although the public and policymakers will almost certainly be looking to the results of the NAAL to answer the question of how many Americans are "literate enough," the designers, reporters, and interpreters of the NAAL should resist the temptation to directly address this question (US Department of Education 2000, p. 26).

Although tests may be better at ranking than at providing measures of absolute competencies, rankings of national test scores avoid the latter pitfall while speaking to some of the labor force quality issues often associated with the skills mismatch debate. Those worried about U.S. skills argue that the nation's exceptionally low rankings in international comparisons threaten its economic competitiveness. The best data for this purpose is from the International Adult Literacy Survey, modeled on the NALS, which was administered to representative samples of adults in a number of countries between 1994–1998, unfortunately not including Japan.

The United States is among a lower scoring group of advanced industrialized nations that includes most other English-speaking countries plus Belgium and Switzerland, whereas Germany, the Netherlands, and the Scandinavian countries perform better and the differences are usually significant ($p < .05$) (OECD & Stat. Can. 2000). The average American is at the fifty-third percentile of the pooled sample, which is not exceptional but not dire either, despite some portrayals (Sum et al. 2002, p. 30). The U.S. GDP per worker remains the highest (Penn World Tables, http://pwt.econ.upenn.edu). Scandinavia and the Netherlands are not usually considered serious economic threats to the United States. Although Germany's current woes may be attributable to longstanding difficulties in absorbing the former East Germany that mask its skills advantage, this also suggests the significance of macroeconomic factors, as well as skills, in overall economic performance.

U.S. scores in the fifth percentile are quite a bit lower and the score in the ninety-fifth percentile rather higher than for most countries, and cognitive skill inequality is highest in the United States (OECD & Stat. Can. 2000, Sum et al. 2002, p. 27). Implications are considered further in another section. Here it is sufficient to note that the low scores of immigrants to the United States explain a large part of the differences in skill inequality between the United States and other countries, but none of the difference in wage inequality (Devroye & Freeman 2001, p. 7). "While it might be tempting to conclude that poor quality education is responsible for low U.S. test scores at the bottom, consideration of the native sample suggests that this argument applies only partially to men and perhaps not at all to women" (Blau & Kahn 2001, p. 24; see also Sum et al. 2002).

Summary

Although the skills of the workforce have been questioned by many in the skills mismatch camp, reports of declining test scores, educational attainment, and school quality are typically exaggerated; scores for young people are as high or higher today compared to 30 years ago, and test score inequality has declined, although not uniformly, over this period. NAEP data suggest that stories of absolute cognitive skill declines among young people have little empirical basis.

Literacy surveys of adults in the 1970s, who mostly completed schooling before the late 1960s, found larger numbers than expected performing poorly even then. NALS results for adults in 1992 suggest that more recent cohorts, including those educated when test scores were declining, have higher literacy than nonelderly older cohorts, even controlling for education.

Of course, if job skill requirements are increasing, then stability or even modest increases in cognitive skills might still imply a growing skills gap, especially if job requirements have increased rapidly.

Attempts to infer real-world capacities from test performance overlook serious obstacles and typically underestimate the complexity of tasks individuals can perform in their daily lives. Perhaps the most telling fact arguing against a literal interpretation of NALS performance levels is that the United States has achieved its current and past levels of economic performance with the people who scored as they did.

International test score comparisons also do not show the United States performing particularly poorly relative to other advanced industrialized countries, nor does the United States test score rank reflect its relative economic performance.

JOB SKILL REQUIREMENTS

If it is difficult to determine precisely the skills workers have, it is even more difficult to know the skills employers require them to use at work. There are few detailed sources of information on what people actually do at work. Research strategies have included analysis of trends in the distribution of workers across

occupations, mean education by occupation, and the well-known direct measures of job complexity from the *Dictionary of Occupational Titles* (DOT), but all have well-known limitations (Cain & Treiman 1981, Spenner 1990, Attewell 1990; but see Handel 2000).

For a topic that has provoked so much interest there has been surprisingly little effort to develop a standard methodology or scheme for rating job skill demands and to apply it across time for large, representative samples. The Department of Labor is developing a replacement for the DOT called the Occupational Information Network, or O*NET, but whether it will be useful for researchers is uncertain (National Research Council 1999).

Also complicating efforts to understand job skill requirements are variations in skill requirements within occupations across employers and even within employers across time depending on cyclical variations in the quality of the available labor supply (Bills 1992). This means that, in many cases, skill requirements are more a range than a single point. One matched employer-employee sample found that as many as 26% of recently hired high school dropouts had jobs that their employers reported "required" a high school diploma, although such educationally "underqualified" employees accounted for a relatively small share of the total sample (Moss & Tilly 2001, pp. 54, 82).

Despite these difficulties, there is no lack of observers and researchers willing to assert that skill demands are increasing substantially, whether due to the spread of computers, employee involvement programs, or the growing share of service sector jobs in the case of interpersonal skills. Research focusing specifically on the skill and wage impacts of computers and employee involvement is reviewed elsewhere (Handel 2003, Handel & Gittleman 2004), so the following concentrates mostly on the broader literature on skill demands.

In general, trend studies indicate a shift toward jobs requiring more skills, but there is little evidence for acceleration in the past two decades. Cross-sectional studies often suggest employers are less concerned about cognitive skills deficits than what they consider poor work habits, motivation, demeanor, and attitudes.

Trend Analyses

Spenner's (1979) well-known work using the DOT found little net change in mean skill requirements or modest upgrading over time. Despite questions over methodology (Cain & Treiman 1981), Spenner reviewed a number of other studies that reinforced his original conclusion of likely moderate and gradual skill upgrading over time (Spenner 1988).

By contrast, the Hudson Institute's Workforce 2000 report (Johnston & Packer 1987) made bold claims for an emerging skills mismatch, garnering both attention and criticism, although the criticism received much less attention than the original assertions.

The report claimed that by 2000 "even the least skilled jobs will require a command of reading, computing, and thinking that was once necessary only for the professions" and every high school graduate will need the ability to "solve

complex problems requiring algebra and statistics" (Johnston & Packer 1987, p. 116), although the Bureau of Labor Statistics (BLS) occupational projections and DOT ratings the report used did not support such sweeping assertions. "Unless the nation is able to bring even its least able workers up to higher standards of education and skills, it is likely that average rates of unemployment will rise," especially for disadvantaged minorities, who were forecast to increase rapidly as a proportion of the labor force (Johnston & Packer 1987).

It is hard to see how the authors could have been optimistic about reaching this goal in such a short time when they also cite results from the early, young-adult version of the NALS to make the familiar claim that large numbers of adults age 21–25

> lack even the basic skills essential for employment . . . only a quarter of whites, 7 percent of Hispanics, and 3 percent of blacks could decipher a bus schedule; only 44 percent of whites, 20 percent of Hispanics, and 8 percent of blacks could correctly determine the change they were due from the purchase of a two-item restaurant meal (Johnston & Packer 1987).

As the previous section indicated, these kinds of extrapolations from test scores to workplace competencies cannot be taken at face value.

No subsequent research using BLS occupational data and DOT ratings supports these conclusions. These studies find no acceleration in the growth of cognitive skill requirements of jobs in the 1980s–1990s relative to the 1960s–1970s and that BLS projections do not imply such acceleration (Howell & Wolff 1991, Mishel & Teixeira 1991, Handel 2000; for Britain, see Robinson 1998).

Sum (1999) and Barton (2000, pp. 15, 19) replace DOT measures of occupational skills with mean NALS scores and find job literacy requirements almost completely unchanged over the periods 1990–2005 and 1986–2006, respectively, based on BLS occupational data and projections for the terminal years. "Unless substantive upgrading of literacy-related skills occurs within occupations, these data provide little evidence of a major skills mismatch due to higher literacy requirements in future jobs" (Sum 1999, p. 95). Of course, if one believes a significantly more skilled job structure than projected is socially desirable, even stability may be cause for concern.

The Hudson Institute (Johnston & Packer 1997) recently issued an updated report, Workforce 2020, that reaffirms the conclusions of the previous report, but it was not examined for this review.

Consistent with findings of limited change, studies using the GSS vocabulary test do not find any consistent tendency for test scores to be increasingly associated with occupation across cohorts or with occupational status and earnings between the early 1970s and mid-1990s for all cohorts (Weakliem et al. 1995, Hauser & Huang 1997).

The cross-sectional National Employers Survey (NES) (1994) asked employers for retrospective information on trends in job skill demands. It found 57% reported that skill requirements and training for production or other front-line jobs had increased in the previous 3 years, with almost all others reporting stability rather

than declines for both items. However, there is no way to assess whether the magnitude of the upgrading was great or slight, whether the retrospective assessments are reliable, or how these establishment-level figures translate into incidence rates for the workforce (National Center on the Educational Quality of the Workforce 1994).

The Rural Manufacturing Survey (1996) conducted by the Economic Research Service of the Department of Agriculture, which includes a large urban subsample, found that only approximately 15% of employers reported basic reading and math skill requirements rose "a lot" in the previous three years, and 50%–60% reported no change. Approximately 32%–40% reported computer and interpersonal/teamwork skills requirements rose "a lot." Still, only 5%–15% of employers reported "major" problems in finding qualified applicants for production jobs with any of these skills. The largest problem was finding workers with a "reliable and acceptable work attitude," cited by approximately 30% of employers (Teixeira 1998).

The Multi-City Study of Urban Inequality also asked retrospective questions about skill changes in jobs requiring no more than a high school degree for a sample of employers in Atlanta, Boston, Detroit, and Los Angeles between 1992 and 1994. Approximately 40% reported a rise in skill requirements in the previous 5 to 10 years, and only approximately 1% reported declining skill requirements (Moss & Tilly 2001). Responses were approximately evenly split on whether the new skill demands were cognitive (basic reading, writing, and math) or social and communication skills. However, there is no way to determine the magnitude of the change from this data.

In one of the most thorough and rigorous studies of skill change, Fernandez (2001) administered two waves of surveys and conducted extensive observation and interviews in a single factory before and after its relocation from an antiquated facility to a new, state of the art, automated plant. Management also adopted a new employee-involvement philosophy giving workers greater discretion, decision making, problem-solving, and record-keeping functions. Using an impressive variety of measures, Fernandez showed convincingly that skill demands rose after the changeover.

However, there are reasons to question whether the increase is qualitatively large. Workers self-reports of reading, writing, and math use in the new plant were only modestly higher than before, the average number of documents workers used on the job rose but their level of complexity was fairly stable, and the reading and math demands remained fairly simple. Worker reports indicated they believed the formal education required for their jobs increased from 10 years to 11.5 years, but even the higher figure is roughly equal to the average level of education of workers in the original plant. The average training time remained constant, suggesting the existing workforce could absorb the skill upgrading relatively easily.

Indeed, one of the most telling pieces of evidence against a mismatch interpretation is the plant management's no-layoff pledge to its workers, which meant that the vast majority of those working at the two sites were identical. Measures of turnover and the racial composition ($\sim$55% minority) were also unaffected by

the move, despite widespread fears of a mismatch between minorities' skills and high tech work.

Despite "massive upgrading" of the production technology, only one job was totally automated away and the plant had no difficulty maintaining total employment at previous levels ($\sim$ 200 hourly workers), although the addition of a few additional craft workers increased overall wage inequality among the blue collar workforce. This kind of occupational shift is also easily tracked for the economy overall, and craft workers do not appear to have grown as a percentage of all workers (Handel 2000).

Given that the complete substitution of a technologically backward plant with a state of the art facility is a more dramatic change than is typical for the economy overall, even these changes are likely to be an upper-bound measure of the skill impacts one might expect from automation and employee involvement in manufacturing as a whole.

Training supplements to the Current Population Survey (CPS) for January 1983 and January 1991 indicate no increase in workers' need for specific skills or training to obtain their current job. The number receiving training after obtaining their current job rose from 35% to 41% between 1983 and 1991, mostly due to increased formal company-provided training, but data from the 1970s suggest even faster growth then (Handel 2000, p. 254). Analyses indicate that the growth in training accounts for little of the growth in the returns to education in the 1980s (Constantine & Neumark 1996).

Cross-Sectional Studies

Cross-sectional information on employer skill demands comes from both survey and case study research, which often have richer measures than time series based on the DOT.

Employer data from the Multi-City Study of Urban Inequality project found that over half of jobs requiring less than college require daily reading of paragraphs, arithmetic, computer use, and dealing with customers, and 30% require daily writing of paragraphs. Between two thirds and three quarters required a high school degree, general work experience, and job-specific work experience, but approximately 80% were also open to hiring those with GED degrees and welfare recipients (Holzer 1996).

Similar items from the January 1991 CPS for those with no more than a high school degree yielded estimates closer to 30% for reading, writing, and computer use and a similar estimate for arithmetic or math (55%), whereas figures for those with more education were approximately 20 percentage points higher (Handel 2000). Unfortunately, neither source has information on the level of complexity of the reading, writing, math, and other tasks performed at work.

Rosenbaum & Binder's (1997) qualitative interviews with Chicago-area employers in various industries offering entry-level jobs suitable for high school graduates found that approximately 70% required basic academic skills. Other

similar studies find far fewer skill demands, at least at the entry level (Hughes et al. 1999).

A number of sources suggest that the importance employers place on interpersonal skills and work habits rivals cognitive skill demands. Holzer (1996, p. 60) found employers seemed to place great weight on factors that are "signals of general employability and readiness for work, rather than . . . measures of specific skills." The NES found that employers' top two criteria in hiring nonsupervisory and production workers were applicants' attitudes and communication skills, followed by previous work experience, whereas years of schooling, grades, and even scores on pre-employment tests and industry-based credentials were considerably farther down the list (National Center on the Educational Quality of the Workforce 1994). In focus groups, many of the employers said they refused to hire applicants under age 26 (Applebome 1995). Results of numerous other surveys of employers conducted by polling groups or human resource consultants are consistent with these results (Cappelli 1995, O'Neil et al. 1992).

Bowles & Gintis (2002) cite the NES finding on employers' hiring criteria and other similar results as evidence for their long-held view that workers are rewarded for their willingness to follow managers' directions and observe other workplace norms as much as for the cognitive skills emphasized by human capital theory. As additional evidence, they combed through numerous studies and found that the inclusion of cognitive test scores in standard wage equations reduces the education coefficient by only approximately 18% on average, leaving 82% of the effect of education on wages unexplained by cognitive skills and presumably reflecting the effect of schooling in socializing people in ways employers value. Both cognitive skills and years of education are strongly associated with earnings, but they appear to be largely independent of one another and the inclusion of test scores in a standard human capital model increases R^2 by only 0.01 on average. The main value of education in this view is that it signals to employers that workers are more or less reliable, responsible, hard working, self-disciplined, take more initiative, and have a greater sense of self-efficacy.

Case studies provide more detail on skills used on the job but further illustrate the difficulty of determining the relative importance of cognitive skill demands. Murnane & Levy (1996) argue that high levels of employee involvement in two auto plants generated demand for high levels of skill. However, Levin & Kelley (1994, p. 99) and Graham (1993) found that most of the screening and training time is to select for and inculcate teamwork skills and high work commitment and instill the corporate culture. General Motors's joint venture NUMMI plant with Toyota achieved its success with mostly former GM workers.

Smith's (1999) detailed study of the math used by production workers in 16 auto plants found generally modest math requirements, ubiquitous use of calculators, and only modestly higher demands at the Japanese transplants. He concluded that "The equivalent of an eighth-grade mathematics education is adequate preparation for modern, nonprofessional work," although he acknowledged that some of this reflects job tasks specifically designed around the perceived limitations of workers,

and some workers may have initially had difficulties with them (Smith 1999, p. 871).

Mercedes and BMW have recently located auto plants in rural South Carolina and Alabama, states with among the lowest test scores and levels of educational investment (Levin 1998b), but aggressively probusiness government policies, such as low taxes and subsidies, right-to-work laws, and low wages. Levin suggests that threshold literacy skills are necessary for such jobs, but that productivity depends more on management practices and investment levels.

Bailey & Bernhardt (1997) generally found little or no meaningful change in job duties or skill requirements in retail firms that claimed to be implementing employee involvement practices.

Summary

Trend data indicate that job skill requirements are rising, but not more rapidly than in the past. Even with this growth, there are few reports that cognitive skill requirements are high in an absolute sense for jobs filled by high school educated workers, although the data are not strong in this area and low demand for skills in these jobs may partly reflect employer adjustments to the limits of their workforce. Many studies suggest that employers place as much or greater weight on noncognitive factors, such as work effort and cooperative attitudes. The upgrading effects of technology and employee involvement on skill requirements appear modest (see also Handel 2003, Handel & Gittleman 2004).

The question of whether even these gradual changes have strained the abilities of the available workforce remains.

EVIDENCE FOR SKILLS MISMATCH

Considering trends in workers' skills and employers' requirements separately from one another and from the question of mismatch reflects the fact that the yardsticks used across studies are incommensurate. This means the evidence on the question of mismatch is even more indirect and fragmentary than for either side of this equation taken individually. This points to the critical need for a better framework for subsequent data collection that can compare the skills of people and jobs using a common yardstick.

One can define skills mismatch or skills shortage as a situation in which some workers want employment or more work hours and employers have unmet labor needs but will not draw from the underemployed group at existing wages because those workers' skills are too low. In neoclassical economics, upward or downward wage flexibility equilibrates supply and demand efficiently, so any such imbalance should be transitory. In this case, one could define mismatch as any significant departure from traditional wage differentials across skill groups.

The main problem with an exclusive reliance on wage movements and a supply and demand framework for inferring skills shortages is that wage differentials

reflect institutional as well as market forces, such as variations in rent sharing, rather than skill differences alone, as even some who hold a neoclassical interpretation of recent inequality growth recognize (Katz & Summers 1989).

If increased inequality since the 1980s does reflect a skills shortage, one might expect employers would show some awareness of it. Journalistic accounts and employer poll and survey data do suggest firms have substantial difficulty finding qualified young workers for relatively routine entry-level positions, at least in urban areas. Most of these accounts reflect the popular theme of public school failure and the low basic cognitive skills of recent high school graduates and their general lack of readiness for the world of work (Hull 1991; Hollenbeck 1994; Barton 1990; Economic Report of the President 2000, p. 134).

However, difficulties in finding workers with desired social skills, attitudes, and motivation frequently ranked as high or higher than dissatisfactions with cognitive skill levels, although complaints about unexpectedly low cognitive skills are also not uncommon (Hollenbeck 1994; Teixeira 1998; National Association of Manufacturers 2001; Public Agenda 1999; for Britain, see Robinson 1998). Employers' dissatisfaction with young workers' computer skills tended to rank near the bottom of their concerns (Public Agenda 1999).

In one of the few academic studies, Rosenbaum & Binder (1997) also found employers complained about the number of young high school grads who could not read or perform math at eighth grade levels. Employers believed the cognitive skills of recent high school graduates had declined over time and reported they had to simplify tasks to match employees' skills or supervise them more closely than they desired (Rosenbaum & Binder 1997, p. 73). Rosenbaum & Binder concluded that the prevalence of low-skilled jobs reflects a workforce that is unprepared for more skilled and autonomous work rather than management shortcomings or preferred labor strategies.

However, these employers' judgments of young people's skills are not consistent with national NAEP data, and there are reasons to be cautious about inferring workers' long-term job abilities from young adults, as noted earlier, although Rosenbaum & Binder argue that narrow, situated learning on the job yields context-bound skills that are not strong enough for further advancement.

In the mid-1990s, the NES and the Rural Manufacturing Survey found the average employer judged 20%–25% of their current production or front-line workers not fully proficient at their jobs (National Center on the Educational Quality of the Workforce 1994, Teixeira 1998). This might seem high because they refer to people already matched to jobs as presumably more qualified than the general applicant pool, but these figures also do not control for tenure or age and there are no historical figures against which to benchmark them.

Most economists infer an increased scarcity of human capital from the fact that the relative wages of college graduates continued to increase even as their relative supply increased, although there is no consensus on whether the source is an acceleration of demand for skills as a result of the spread of computers or deceleration in the growth of the supply of skills as a result of the post-Vietnam

drop in college attendance (Katz & Murphy 1992, Autor et al. 1998, Danziger & Gottschalk 1995, Gottschalk & Smeeding 1997, Levy & Murnane 1996, Card & Lemieux 2001).

Few economic studies identify the specific skills believed to be in short supply, but the general view seems to be that higher-level cognitive skills associated with college graduates are relatively scarce. By contrast, in none of the other literature did employers complain about a shortage of college-educated workers or their high wages and expressed limited concern with computer skills. Employers complain almost exclusively about work attitudes and basic skills of noncollege workers.

Some researchers even claim that an oversupply of college graduates persisted into the 1980s, a time when others believe an acute shortage of college grads raised the college–high school wage differential. Hecker (1992, p. 4) found that the percentage of college grads who were unemployed or in occupations not requiring a college degree rose from approximately 12% (in 1967) to 18.6% (in 1980) during the "over-education" years and continued to rise modestly to 19.9% during the years of ostensible shortage (1990).[1] Furthermore, the supply of college graduates grew 62% between 1979 and 1990, whereas employment in managerial, professional, technical, and high-skilled detailed occupations in other broad occupational categories grew only 57% (Hecker 1992, p. 7).

Hecker noted that inequality during the 1980s resulted more from the declining real wages for males with high school degrees or less than from increases in real wages for college graduates and concluded that sectoral shifts from manufacturing to services is a more likely cause of inequality growth than a shortage of college educated workers. BLS research also did not uncover evidence that employers wanted to hire more college graduates at current wages than they actually hired. Hecker concluded that even greater increases in the supply of college graduates would have only increased the number of underutilized college-educated workers, although he recognizes that even college graduates in occupations that do not require degrees receive higher wages than high school graduates in those occupations (Hecker 1992, p. 11).

Tyler et al. (1995) argue in favor of the mainstream skills shortage view by showing that the problem of college-educated workers in noncollege jobs in the 1980s was increasingly a problem for older males compared to other groups. They attribute this development to the restructuring and downsizings in the 1980s that harmed the employment prospects of even more educated older workers. However, it is notable that the rates of employment in traditionally noncollege jobs remained high for workers with a college degree throughout the 1980s, despite the ostensible shortage of college educated workers, although the increased high school/college wage differential found even within noncollege jobs has also been

[1]Hecker (1992, p. 4) classifies the following jobs as not requiring a college degree based on BLS surveys: retail sales, clerical and other administrative support, craft, operator, laborer, service occupations, and farm work, excluding insurance adjusters and investigators, craft supervisors, police officers, and farm managers.

used to argue that computers have raised their skill demands from noncollege to college level (Boesel & Fredland 1999).

Using test scores rather than education as the measure of skills, Murnane et al. (1995) found that the wage differential associated with a standard deviation in math test scores for 24-year-old workers rose from approximately 2.5% to 6.9% for males and from approximately 5.6% to 10.6% for females between 1978 and 1986, controlling for education and other variables (calculated from Murnane et al. 1995). The authors are somewhat inconsistent in interpreting the results as indicating whether it is math skills per se that are increasingly rewarded or cognitive skills more generally, for which the math scores are good proxies.

However, even the highest-scoring males in 1986 earned less than the lowest-scoring males in 1978 and the situation was nearly the same for females, suggesting that more is at work than just changing returns to skills. The whole structure of wages seems to have shifted downward.

Earnings models using NALS data also complicate this picture. Interaction models indicate the returns to cognitive skills depend on the frequency with which they are exercised at work (Sum 1999, Carbonaro 2002), supporting the institutionalist position that rewards depend partly on managerial strategies and the quality of jobs offered as well as an individual's own human capital.

Cross-sectional comparative studies using the International Adult Literacy Survey cast more serious doubt on test scores and inequality in cognitive skills as the explanation for the high levels of U.S. wage inequality. They find that greater inequality of cognitive skills in the United States does not explain much of the higher U.S. earnings inequality relative to European countries (Devroye & Freeman 2001, Blau & Kahn 2001).

Devroye & Freeman (2001) found that two thirds of the difference in earnings inequality between the United States and the other countries they study is within test score groups. In fact, the standard deviation of earnings among U.S. workers with the same test scores is greater than the standard deviation of earnings for all workers in the European countries. This suggests some of the limits of explanations of inequality based on variation in cognitive skills.

One of the more unexpected findings that casts doubt on the more extreme skills mismatch arguments is the remarkable employment rate of the large number of former welfare recipients who have left the program since the mid-1990s and the generally favorable evaluations of their skills and performance by employers. Approximately 75% of former recipients work at some point in the year after leaving, usually full-time, and 30% of current recipients are employed, despite their low levels of education (Moffitt 2002).

Holzer & Stoll (2001) found that the proportion of jobs filled by former welfare recipients that require daily reading, writing, math, and computer use is only somewhat below that for a sample of jobs filled by noncollege workers generally. Only 10%–20% of employers rated these employees worse relative to others in similar positions and only approximately 10% reported problems with either basic or job-related skills. The most frequent problems were absenteeism related to childcare, transportation, and physical health problems. Although workers hired are not a

random sample of all former welfare recipients, the large number exiting the rolls and finding employment suggest that creaming cannot explain all of these results.

Although employment for many is unstable and problems with job retention are related to low education and skills, they are also related to low wages and lack of health insurance (Campbell et al. 2002). Quits outnumbered dismissals by two to one in Holzer's survey and often reflect personal issues, as well as low attachment to low-paying jobs, rather than cognitive skill deficits. Their median wages are approximately $7 per hour in 1998, approximately $2 above the minimum wage, but clearly the quality of these jobs is a concern (Holzer & Stoll 2001). The low pay and probable dependence of such jobs on a strong business cycle confirm that these workers are toward the bottom of the job hierarchy and vulnerable. Former welfare recipients usually fill jobs in the secondary labor market. However, it is not accurate to say that their low skills shut them out of the labor market and the absence of better-paid employment partly reflects structural shifts in the kinds of jobs the economy generates rather than the intrinsic limits of potential workers. The experience of the 1990s also suggests the importance of a strong macroeconomy, which can be overshadowed by a singular focus on individuals' skills (Galbraith 1998).

Summary

Employers do complain about the difficulty of meeting their labor needs with the workforce available to them, but it is not clear if the concerns are more with workers' attitudes than cognitive skills and whether the complaints apply to many groups beyond young workers, for whom many of the problems may be transitory. There is no historical data against which to benchmark the current levels of expressed dissatisfaction.

The increased rewards to education and test scores suggest human capital shortages at least in the 1980s, but they may also proxy for other institutional shifts. Test scores do not explain much of the unusually high levels of inequality in the United States compared to continental Europe. The stability of U.S. inequality and education premia in the 1990s in the absence of great change in the supply of human capital and in the presumed presence of continued increases in the demand for skill and spread of information technology is also hard to reconcile with a simple supply and demand story.

Despite the apparent increasing importance of human capital, there is room in the labor market for large numbers of even very-low-skilled workers, at least under favorable macroeconomic conditions, although the low wages in these service sector jobs remains a problem.

CONCLUSION

Firm conclusions about skills mismatch are hampered by three problems: difficulties ascertaining the job-relevant skills employees possess, even less information on the skills their jobs require, and problems relating the two kinds of evidence to one another.

There is little evidence of absolute declines in cognitive or hard skills in the United States or generally poor performance relative to other advanced industrialized countries, despite frequent extreme statements to the contrary in popular and policy circles. However, there is also evidence of decelerating growth of human capital and stability in cognitive test scores that may be a problem in the context of skill demands that appear to be gradually rising. Nevertheless, such a judgment requires better information than is currently available on the absolute level or complexity of these skill needs and whether they are really increasingly exceeding the capacities of some subgroups. It is even unclear how much of any problem is a shortage of cognitive skills rather than employer dissatisfaction with effort levels or work-related attitudes and whether it extends beyond a transitory stage of young adulthood and some fraction of disadvantaged minorities.

The results do not suggest computer skills are in particularly short supply, despite the technology focus of much of this debate, nor is there evidence of a general shortage of other technical or high-level skills.

In many cases, the lack of historical data makes it impossible to know whether recent levels of expressed dissatisfaction are higher than in the past.

A key question is whether policies to increase human capital are the solution to the problem of high inequality and low wages for some groups. Although the goals of increasing achievement in elementary and secondary schools and raising postsecondary enrollment are worthy, there is room for debate over methods (e.g., vouchers, high-stakes testing), exaggerated conceptions of the problem in the case of public school reform, and the expected outcomes of these efforts. Raising everyone's absolute cognitive skills and work readiness will not increase wages and decrease inequality if wages are determined by the structure of jobs and one's relative position in the worker queue (Thurow 1975).

There is an implicit view that increasing the supply of skill will satisfy pent-up demand or perhaps create its own demand. However, education levels grew exceptionally rapidly in the late 1960s–1970s and merely depressed the college premium. At the same time, the overall wage level, which grew at an unprecedented rate between 1948 and 1972, entered a 25-year period of stagnation at exactly the time when unprecedented numbers of the highly educated entered the work force. Increasing human capital stocks at the bottom is desirable for its own sake, but recent changes in the wage structure may not reflect human capital scarcities as opposed to management strategies. Wages may be more responsive to institutional reforms that more directly affect compensation or economic activity, such as maintaining the value of the minimum wage, union protections, and strong macroeconomic growth, as opposed to changes in education or skill levels.

The research also shows that although some efforts have been made to track trends in workers' skills, the measures have been so disparate and applied so irregularly that real progress on the question of skills mismatch requires development of a new, validated, standardized method of measuring job skill demands

administered consistently to representative samples of workers over time to understand exactly in what ways work is changing.

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