
Symposium Proceedings

Is There a Shortage of Information Technology Workers? June 12, 1998

Foreword

Dimitri B. Papadimitriou, Executive Director, The Jerome Levy Economics Institute

Session 1. How Do We Define and Count Technology Workers and Technology Occupations?

Moderator: **Frances M. Spring**, Assistant Director, The Jerome Levy Economics Institute

John Sargent, Senior Technology Policy Analyst, Technology Administration, U.S. Department of Commerce

Carlotta Cooke Joyner, Director, Education and Employment Issues, Health, Education, and Human Services Division, U.S. General Accounting Office

Session 2. Estimates of the Current Stock and Future Demand for and Supply of Technology Workers

Moderator: **Frances M. Spring**, Assistant Director, The Jerome Levy Economics Institute

Lauren Brownstein, Workforce Education Program Manager, Information Technology Association of America

Robert I. Lerman, Director, Human Resources Policy Center, Urban Institute; Professor of Economics, American University

John H. Bishop, Chair, Department of Human Resource Studies, New York State School of Industrial and Labor Relations, Cornell University

Session 3. Short- and Long-Term Directions for Policy

Moderator: **Dimitri B. Papadimitriou**, Executive Director, The Jerome Levy Economics Institute

Robert D. Atkinson, Director, Technology, Innovation, and the New Economy Project, Progressive Policy Institute

Daniel T. Griswold, Associate Director, Center for Trade Policy Studies, Cato Institute

George M. Fishman, Chief Counsel, Subcommittee on Immigration and Claims, Committee on the Judiciary, U.S. House of Representatives

Participants

Foreword

This publication provides summaries of sessions at one of the Institute's regular conferences on employment policy and labor market structure. We decided to use this symposium to explore conflicting opinions about what has recently become a controversial topic: the state of the labor market for information technology (IT) workers. Some firms and policymakers claim that there is a severe shortage of these workers, as suggested in the September 1997 Department of Commerce report, which labeled the phenomenon "America's new deficit." A number of employee groups and analysts reply that that perception is more a result of hiring and employment practices than a reflection of the true labor supply.

Clearly, the topic is important and needs to be examined from a variety of points of view because of its far-reaching policy implications in several areas, for example, education, immigration, and data collection and analysis. Should more or fewer college students be encouraged to pursue IT degrees? Can some of these positions be filled by workers with specialized (noncollege) training? Do we need to train and educate for all categories of IT work or are

only certain types of workers in high demand? Should the United States admit more foreign-born workers possessing these skills (such as by increasing the H1-B visa quota)? If so, how many? Or, should a more broad-based immigration policy be enacted that would alleviate worker shortages in any sector of the labor force? Would allowing more high-skill immigrants into the workforce harm native-born IT workers? If so, what safeguards could be put in place to mitigate such harm? How should information technology workers be identified and classified? After all, different figures arising from different methodologies used to count and define workers cannot provide a sound basis for policy decisions.

The speakers at this symposium have spent a considerable amount of time researching and examining these issues. We hope that the information provided in these proceedings will assist you in sorting reality from rhetoric.

Dimitri B. Papadimitriou
Executive Director

Session 1. How Do We Define and Count Technology Workers and Technology Occupations?

Frances M. Spring (moderator)

Assistant Director, The Jerome Levy Economics Institute

John Sargent

Senior Technology Policy Analyst, Technology Administration, U.S. Department of Commerce

Carlotta Cooke Joyner

Director, Education and Employment Issues,
Health, Education, and Human Services Division,
U.S. General Accounting Office

John Sargent

People define information technology (IT) workers in many different ways. The Information Technology Association of America (ITAA), a trade association representing technology firms, defines an IT worker as someone involved in the study, design, development, implementation, support, or management of computer-based information systems, particularly software applications and computer hardware. Using Bureau of Labor Statistics data, a 1997 Commerce Department report identifies three categories of occupations that are clearly IT jobs—computer scientists and engineers, systems analysts, and computer programmers. Computer scientists and engineers work with hardware and software developing various specialized programming languages and designing systems. Systems analysts use the hardware and software tools provided to them to solve scientific, engineering, or business application problems. Computer programmers write the codes that drive the systems and software.

Many economists say that almost half of the long-term economic growth in the United States since World War II can be attributed to technical progress and that information technology is a leading area of this progress. It is ubiquitous throughout both the private sector and the public sector of the American economy, it is revolutionizing industry, it is responsible for the development of new products and services, and it is creating new opportunities for businesses. A shortage of IT workers would present a serious problem. ITAA has done two studies that show that many IT jobs go unfilled. As a result firms suffer decreased competitiveness and lost business; in some cases projects are shut down due to a lack of workers.

Contradicting the ITAA position, employee groups argue that there is no shortage of workers. There are many people with technical and engineering degrees who were downsized and who could fill or be easily retrained to fill the vacancies, but businesses will not hire or retrain mid-career workers because such workers require higher salaries than younger workers and they are judged to be less flexible because many have families.

Regardless of whether there is a worker shortage or a failure to connect qualified workers and jobs, there are unfilled jobs and the impact of these vacancies on the U.S. economy could be decreased productivity and an

increased cost of doing business. A shortage of IT workers could delay innovation, reduce growth of high-wage jobs, reduce U.S. exports, and increase imports as a result of the cost differentials. In its report, the Commerce Department sought to spotlight the importance of information technology to the American economy. It shows that employment growth in the information technology sector was over 10 times higher than all job growth between 1988 and 1996. IT jobs grew 133 percent, compared to 12 percent for all jobs. The unemployment rate is 1.3 percent for systems analysts and computer scientists and a little higher for programmers. Starting salaries for those with an IT degree range from \$35,000 to \$41,000. These starting salaries and the growth in overall wage rates in the sector indicate a high demand for IT workers.

The Commerce Department, joined by the Education and Labor Departments and the National Science Foundation, followed up its report with the Information Technology Workforce Convocation. The convocation, co-sponsored by ITAA, was held in January 1998 in Berkeley, California. Its goal was to bring together the various agencies and groups that have a significant interest in businesses and workers in the information technology industry.

One area the convocation addressed was improving basic math and science skills—skills that are necessary for IT workers. A second area was recruitment of underrepresented groups. The Commerce Department report found that among women, who represent 51 percent of the total undergraduate population, only 1.1 percent choose to get degrees in IT, compared to 3.3 percent of men. The report also found that blacks and Hispanics, who tend to be underrepresented in the undergraduate community, opt at a much higher rate for IT degrees than do white students.

A third area was the responsiveness of industry and higher education to each other's needs. Industry needs people with certain fundamental skills and with problem-solving skills. But higher education officials often argue that they are not in the job-training business. They see their job as teaching broader principles. There is, however, a great effort by junior colleges and technical schools to fill the gap that industry is perceiving.

A fourth important area was the image of the IT professional. Schoolchildren picture the IT worker as a person with suspenders, bow tie, pocket protector, and funky glasses—in short, a nerd. This is a barrier that must be overcome to get students to consider entering IT professions.

There are many federal initiatives designed to solve the IT labor problem. One is the School-to-Work program, jointly run by the Departments of Education and Labor. Another is the Department of Education's Groundhog Shadow Day, in which young children follow IT workers around so that they can see what they do. The federal government has allocated \$6 million for training dislocated workers. The Department of Labor has started America's Job Bank, in which employers can list job openings, and America's Talent Bank, in which workers can post their resumes. The Labor Department is now working to integrate these two systems so that openings can be matched with the potential employees.

In sum, it is not clear that there is a shortage of IT workers, but it is clear U.S. industry is struggling to deal with job vacancies. The Commerce Department is doing what it can to help.

Carlotta Cooke Joyner

The U.S. General Accounting Office examined the Commerce Department report and concluded that it had serious analytical and methodological weaknesses that undermined the credibility of its apparent conclusion that a shortage of IT workers exists. The data are insufficient to describe the supply of IT workers, and other evidence cited in the report is insufficient to support its conclusions.

Still, deficiencies in this one report do not necessarily mean there is no shortage. The GAO agrees with the Commerce Department that additional information and data are needed to characterize the IT labor market more accurately now and in the future and thinks the report can be helpful in beginning to set up some common terminology to use in talking about the problem. The GAO also feels that the report appropriately established evidence that the demand for IT workers can be expected to grow. It is on the subject of the supply of IT workers that the GAO disagrees with the report.

In quantifying the available labor supply, the report says that an estimated 95,000 new workers a year will be needed, but only a little over 24,000 students are graduating college with degrees in computer science areas. This

mismatch is cited as the basis for the conclusion that there is a labor shortage. The report refers to other sources of supply, such as students graduating with other degrees, but this source is not included in the estimated labor supply. The report mentions that retraining by employers does increase the supply of available workers, but, again, this labor source did not seem to be considered in the estimated supply. The report noted a rise in salaries, which it cited as evidence of a shortage. The GAO interprets the salary increase not as evidence of a shortage but as a rise more or less commensurate with the increase in earnings of other professional and specialty occupations over time.

With respect to the number of unfilled vacancies, the Commerce Department relied on an early ITAA report that had an estimate of 190,000 vacancies in the IT industry. The GAO critique of the report felt this number should not have been used at all or should have been used with substantial qualifications because it was an estimate extrapolating from a survey with a 14 percent response rate, which is not enough to be a sound basis for an estimate.

The GAO also published some reports that assessed labor demand and supply. A report issued in May found that unemployment rates are substantially lower in IT occupations than in occupations in general. Employment in the IT industry has about doubled from 1987 to 1997. Most of the growth has been in systems analysis and computer science and engineering; computer programming has been basically flat in terms of employment.

The GAO and Commerce Department research into the IT industry labor issue reveals that it is necessary to make a distinction between the IT industry as a whole and the various occupations within the industry. This distinction is often overlooked or is not clear in the data; there is often difficulty in identifying people who are working in IT occupations if they are not working for an IT business. If one asks what government or companies should do about the IT labor issue, the answers will be more apparent if the question is phrased more clearly. There is a substantial difference in salaries, employment opportunities, and labor supply by IT occupation. It is difficult to compare studies that examine these issues because the studies use different definitions of occupations and therefore come up with widely different estimates of starting salaries, job vacancies, and labor supply. The GAO and the Commerce Department agree on this—we need a better understanding of the dynamics of the labor demand and supply in the IT industry in order to develop policy.

Session 2. Estimates of the Current Stock and Future Demand for and Supply of Technology Workers

Frances M. Spring (moderator)

Assistant Director, The Jerome Levy Economics Institute

John H. Bishop

Chair, Department of Human Resource Studies, New York State School of Industrial and Labor Relations, Cornell University

Lauren Brownstein

Workforce Education Program Manager, Information Technology Association of America

Robert I. Lerman

Director, Human Resources Policy Center, Urban Institute, and Professor of Economics, American University

Lauren Brownstein

There is widespread agreement that there is a growing demand for information technology workers. Bureau of Labor Statistics growth rate projections for 1996 through 2006 predict 107 percent growth for core computer occupations versus 14 percent for all jobs. The unemployment rate for computer scientists and systems analysts is much lower than the unemployment rate for the population in general. The Information Technology Association of America (ITAA) got involved in research on this subject because of its members' concern about finding enough IT workers. (ITAA is a trade association representing 11,000 direct and affiliated member companies. It serves research and consulting functions and tracks legislative and regulatory initiatives on issues of interest to IT companies such as workforce development, taxation, encryption, intellectual property, and electronic commerce.)

ITAA has sponsored two studies of IT worker availability looking at vacancy rates and has collected data on wages. Being a business association, it also has access to a lot of anecdotal evidence from its members. The second study was a phone survey, conducted by Virginia Polytechnic Institute, of a random sample of IT companies and non-IT companies with 100 employees or more. Callers reached 60 percent of the sample and successfully completed 36 percent of the calls. The first study was a phone survey; it surveyed only companies with 500 employees or more and had a lower response rate.

The Virginia Tech survey found 346,000 vacant IT positions in core occupational clusters-computer programmers, systems analysts, and computer scientists and engineers. That represents about a 10 percent vacancy rate. ITAA members in all regions of the country believe the problem is worse in their region than elsewhere, but the survey found no significant regional differences. Even regions that are not considered hubs of the IT industry have companies that employ significant numbers of IT workers and are having trouble filling their vacancies.

The William Mercer Company conducted a salary survey for 1997. It found 16 to 18 percent wage growth among systems analysts and other core IT jobs. Those numbers are at odds with BLS statistics because BLS numbers do not include stock options, signing bonuses, and referral bonuses, which are major parts of compensation packages in the IT industry. In a recent issue of the *Sunday Washington Post*, 42 percent of the classified ads were for computer workers. This is anecdotal, but it does indicate what is happening in the industry. Price Waterhouse conducts a software business practice survey that asks, "How important an issue is recruiting quality staff?" In 1996 respondents ranked it fourteenth; in 1998 they ranked it second, in a virtual tie for first place.

Given this shortage of IT workers, or at least this extreme demand for them, ITAA has been looking at what business and public policy can do to deal with the problem. It has been trying to find ways to broaden the talent pool. Many companies have concentrated on stealing each other's workers instead of on increasing the number of workers in the pool. Companies need to look for personnel in groups that are underrepresented in the field, such as minorities, women, older workers, and people with disabilities. ITAA is interested in whether there is an industry bias against hiring mid-career professionals. Some mid-career professionals may not be hired because they do not have the requisite knowledge. IT is an industry in which companies hire on the basis of skill and credentials. A person is either a Microsoft certified systems engineer or not, and the industry hires based on what a worker knows. ITAA wants to show member companies that in many cases there is a good return on investment in training of mid-career professionals.

ITAA is also looking at some nontraditional programs for training workers. Community colleges, continuing education programs, and proprietary schools can teach the skills that IT firms need. Community colleges are starting to recognize this. It is easier for them to respond to industry needs than for four-year institutions because they are able to change their curriculum more quickly. ITAA is reaching out to guidance counselors, vocational counselors, career counselors, and parents to be sure they know what it means to work in information technology and what the industry is about.

Some businesses have come up with interesting ways to deal with the tight labor market. Cisco is a company that develops routing systems (basically, the systems that allow networks to exist). Schools that use Cisco systems were complaining that they could not find technicians to keep their systems going. Cisco attempted to train the teachers to administer the networks, but the teachers had too many other responsibilities, so Cisco began to train students to administer the networks. Students in their last two years of high school take a series of computer courses, take a certification exam, and graduate from these training academies as network administrators. They can use the training to go right into the marketplace, but Cisco finds that most of them want to go on to college to study IT. Cisco's goal is to have 2,000 of these academies running by the year 2000.

Another successful partnership between business and education is IBM's AS-400 Partners in Education Program. IBM will give a school an AS-400 (an expensive mainframe system), software, and an accompanying curriculum if, in exchange, the school agrees to teach its students the AS-400 system. The school gets the system it needs free and IBM gets people in the labor marketplace who know its product. ITAA is encouraging businesses to form partnerships like this to meet workforce needs. Such an exchange is not philanthropy; it is a sustainable partnership with returns for both parties.

There are a number of promising public policies being considered at the federal and state levels. Through regional skills alliances, local businesses can pool resources to train people, including incumbent workers. The alliances are especially useful for companies that are too small to run their own training program. The Senate is considering tax incentives for businesses and individuals to invest in training. School-to-Work is a program run jointly by the Department of Labor and Department of Education involving primary and secondary schools, community colleges, and four-year institutions. ITAA is interested in anything that gets business involved in schools, such as internships, mentorships, telementoring, mentoring via e-mail, job shadowing, and teacher-executive exchange programs (in which an executive spends time in a classroom and a teacher spends time in an office).

ITAA is involved in the discussions on Capitol Hill regarding the H-1B visa program, which allows immigrants into the United States to do specialized work. It is not just for IT workers, but it is used more by the IT industry than other industries. ITAA believes that the cap on H-1B visas needs to be raised. IT companies use the program to bring in people if they can't find Americans with skills to do a job. The cap for the entire year was reached in May this year, implying that the quota, which was determined years ago, is no longer appropriate. ITAA members contend that if they could hire Americans to do these jobs, they would because it is less expensive and easier for them. Bringing in workers costs money and a tremendous amount of time to process the paperwork. People who are brought in on H-1B visas are not cheap foreign labor. Companies are required by law to pay these immigrants the prevailing wage.

Robert I. Lerman

A recent article in *The New York Times* read, "Unable to hire enough teachers, the Dallas School Board voted last month to lure them with \$1,500 signing bonuses. Corporate recruiters paid out much larger bonuses, averaging \$17,500 to Cornell's Business School graduates. Even Burger King has gotten into the bonus game, offering some \$5,000 in some cities to hire away restaurant managers from rival fast food chains. And then, one 30-year-old woman recently hired as a consultant at Price Waterhouse accepted the preferred \$85,000 salary without challenge, but balked at the \$5,000 signing bonus. 'I barely had to say that \$5,000 was not enough, and they said, fine, would \$10,000 make you happy?'" This article demonstrates that the job market for information technology workers may be tight, but so is the job market in general. As a further example, some counties in South Carolina have an unemployment rate under 2 percent not for high-tech workers but for all workers.

For employers this seems to be the worst of all times, but for workers it seems to be among the best of times. The impression in Europe is that the United States is a great job-creating machine, but it creates lousy jobs. However, two-thirds of the jobs created from 1988 to 1996, a period of reasonable job growth, were professional, managerial, or technical. The rise in the wage premium paid to college-educated workers is evidence that the United States has experienced a rising demand for high-skilled workers in general. For example, the average earning gap between young college and high school graduates jumped from 25 percent to 50 percent in a fairly short time, and the unemployment rate gap widened. This is part of a long-term trend that is not restricted to the IT industry, although the IT careers and jobs in those fields contribute to it.

Only about 27 percent of all 25- to 34-year-olds have a bachelor's degree and another 8 percent have an associate's degree. In other words, 35 percent of relatively young Americans have a degree beyond high school, and 65 percent do not. Another 20 percent have had "some college" and some have gotten into technical fields. A smaller number do not have a high school degree or equivalent. These numbers are not expected to increase much in the coming years. There is rapid job growth in high-skilled fields, but educational completion is not increasing much. Test scores indicate that 17-year-olds are not accomplishing much more than they did 20 or 25 years ago, in spite of the rising demand for skills.

There has been enormous job growth in the IT industry, but BLS statistics show that median earnings of computer scientists and analysts have been flat relative to all professionals. These statistics do not take into account stock options and bonuses for IT workers, but they do not take them into account for other professionals either. Stock options are a fairly risky compensation scheme. If companies do not perform, stock options are not worth much. If employers insist on this way to compensate people, they will attract only those people who are willing to take risks. However, if that is what they chose to do, they should not complain to policymakers if this nontraditional compensation practice does not yield what they want.

In comparisons of the pay of the top rank of computer scientists to the pay of secondary school teachers (an occupation some people feel is very underpaid) in several metropolitan areas, it has been found that in some cities computer scientists make considerably more. For example, in Charlotte, North Carolina, they make almost \$28 an hour and secondary school teachers make about \$20. But, in other areas, such as Columbus, Ohio, computer scientists make \$26 an hour and secondary school teachers make \$28 to \$38. If computer companies' response to difficulty in hiring at the existing wage is just to put out ads and not to raise salaries, then it is not surprising that they perceive some sort of shortage.

Although the labor market for IT workers is tight, that condition is part of an overall tightness in professional fields in general. The forecasted increase in demand for IT workers over the next 10 to 12 years is probably understated, but IT companies have been able to absorb college graduates from a range of fields. In 1993 to 1994, of all B.A.'s that went into computer-related occupations, only one-third were computer science and information science majors.

Retaining existing IT workers is another strategy industry can pursue to expand the IT workforce. Although the well-publicized notion that older programmers experience high unemployment is incorrect (the unemployment rate for programmers over 40 is about 2 percent), workers of all ages currently exit the IT field at high rates. Perhaps those who leave do not have the latest language, but it is possible to teach people the basics. Workers may be leaving to seek better compensation, but if it is a matter of compensation, there is no reason for the government to intervene. Similarly, government training programs should not be limited to the IT field; IT is not a matter of national significance on the level of preparing for the Second World War nor is it necessarily more important than steel or other basic industries.

The H-1B program is not a satisfactory approach to the expansion of supply because it brings people in on a temporary basis and ties them to their employer to get a continuing or possibly a permanent visa. Instead, the United States could expand the immigration of highly skilled people, allowing firms to bring in anyone they want at a salary of \$70,000 or more. Many of the H-1B visas have actually been used to hire people with only middle-level skills.

School-to-work programs are another promising way to increase the IT workforce. The success of a career academy in Oakland, California, is an example. It began as a vocational school in a tough area of Oakland, but now has become a combination health, bio-science, and computer academy with 180 students. If we can apply this kind of approach broadly, we will see how quickly this shortage will disappear.

John H. Bishop

The government must be careful in adopting policies to address a perceived shortage of IT workers. Any policy that is adopted cannot be easily reversed should forecasts turn out to be inaccurate. Once the quota for H-1B visas goes up, it will be hard to move it back down. The decision always lags behind the problem. Even if there is a shortage today, there might not be one in the future.

It is impossible to project accurately and reliably the number of people in a particular occupation 10 years in the future, but we need to estimate the future in order to make judgments based upon a concept of shortage. In 1984 the BLS projected 520,000 computer science and systems analysis jobs in 1995; instead there were 860,000. In 1990 the BLS predicted 987,000 computer science and systems analysis jobs by 2005; the actual number is already way ahead of that. But, the BLS projected more electrical engineering jobs than were actually needed; it predicted a 53 percent increase and there was a 9 percent decline. Fortunately, most electrical engineers can do work in computer science. One reason computer science and systems analysis jobs were able to grow was people moved from electrical engineering into them.

These kinds of projections of supply and demand are unable to capture the economy's ability to move people between related occupations. The BLS projected 1.1 million jobs for the sum of computer science and electrical engineering and what happened was 1.2 million. Is there an alternative method to evaluate the urgency of the need to expand the number of people with these types of skills? One way is to look at relative weekly wage rates. The wage rate has been slightly higher for electrical engineers than for computer scientists. There is not much of a trend up for computer scientists relative to clerical workers or secondary school teachers. The relative weekly wage for computer programmers has gone up.

Starting salaries and stock options are alternatives to salary increases. Starting salaries (not including stock options) for both electrical engineers and computer scientists have gone up in the last year or so, suggesting a strong market. The cost of stock options has essentially taken all the profits of some companies. For example, Dell, one of the most profitable companies in the IT industry, is losing huge amounts of money because of stock options. Microsoft would have essentially zero profits if statistics took account of the amount of money that it pays workers in the form of stock options. Compensation in the form of stock options equals 2 percent of GDP, and a big chunk of that is in the IT industry, suggesting that there has been a lot more of an increase in the wage rates in this industry than the statistics we normally use tell us.

These are temporary situations. Just five years ago there was no shortage of people in computer science and engineering. In fact, there were complaints about downsizing and an excess supply of electrical engineers in the military who would not have anything to do. Based on such conditions, some engineering schools cut back on the number of admissions. Shortages are impossible to predict because the predictions involve two moving numbers and the forecast is the gap between them.

Supply is the number of people going to college or the number of people in a particular occupation, which is very hard to anticipate, and forecasters do not calculate the response of students to a good labor market in their choice of a field. In some schools the number of students in computer science majors doubled last year. So the Bureau of Labor Statistics, as good as it is, has been making consistent errors in its projections. It predicted 22 percent growth in managerial jobs over an 11-year period, and instead there was a 51 percent increase. That error is roughly equal to the total supply of people graduating with M.B.A's and B.A's in business over a 10-year period. Sophocles had it right when he said that what men have seen they know, but what shall come hereafter no one before the event can see.

Another reason to use caution in predicting a surplus is that the U.S. labor market is flexible. Supply-demand gaps are temporary, but policies tend to last for a long time. Consequently, policy discussion should shift toward longer-term considerations and focus on three questions: (1) Are there real externalities created by IT workers? (2) What is the effect of a policy that makes it easier to import IT workers from abroad on our ability to raise potential GDP and to drive unemployment rates low? (3) How efficient are educational programs and how successful are the students who complete these programs?

Do we want more high-skilled people in the country? A large share of the top group of IT workers are engaged in research and development. Businesses underinvest in R&D because of their imperfect ability to capture the benefits, many of which go to customers. Consequently, more people with these high skills doing R&D is a benefit for all of us. More people in the high-skilled workforce increases the payoff to physical capital investment. Much computer learning comes not from the classroom, but from experimenting with a program or getting help from people who already know about it. People with skills help other people learn those skills. High-skilled people save more than the average worker (which increases capital per worker nationwide, causing higher wages) and, of course, they pay more taxes. All of these are reasons why making it easier to import people with these skills is a good idea.

What is the state of the labor market today? The current 4.3 percent unemployment rate is the lowest since the 1960s. One reason for this is that there has been less wage inflation than expected. In the past people believed that when unemployment falls below some point, inflation would start to accelerate, and so the Federal Reserve Board has to raise interest rates to slow the economy down. Most people had thought that the NAIRU was 6.5 percent; then they lowered it to 6.0 and then to 5.5. Now unemployment is below 4.5 percent and inflation has not broken out and there is only a small amount of wage inflation.

How has the labor market been able to get so tight without inflation? NAFTA, GATT, and downsizing generally have reduced inflationary pressures. Downsizing is the product of systems analysis. It is re-engineering, that is, rethinking the whole way the company does things, and, generally, it is the implementation of a computer solution by IT workers. The high rate of productivity growth in many companies has made people think they are at risk of losing their job and has made them less demanding in terms of wage increases.

The role of welfare reform has not gotten as much attention as it should. In the last couple of years there has been a dramatic increase in the labor force participation rate of never-married mothers and of separated and divorced mothers, and coincident with that there has been a large drop in the share of single parents who are on AFDC or TANF. Welfare reform is shoving a large number of less-skilled people into the labor market; consequently, we need some skilled people at the other end.

Colleges are producing 1.1 million or 1.2 million graduates a year on average and recently there has been an increase in the share of all workers who are college graduates, but there is a need for further expansion of that supply. The largest source of the increase in employment in the last few years is population growth. The next two largest sources are reductions in unemployment and increases in labor force participation. However, there has been no change in the labor force participation rate of college graduates, and no change for people with some college and high school graduates. The entire increase in employment, holding population constant, is from high school dropouts entering the labor force.

How has the economy been handling the influx of high school dropouts? It has been putting them in slightly better jobs, and all along the hierarchy, people are moving up. There has been a decline of 27 percent (about a million people) in the number of welfare cases since passage of the welfare reform, and there will be another 25, 30, or 40 percent decline in the next few years. As a result, there are another million people headed into the labor market without skills. However, there will be some losers if we increase the supply of college graduates, and they will be IT professionals who will face more competition from other professionals.

One consequence of government stimulus of the supply of people with high skills will be lower wages for this group. But we need not be too concerned that a Cornell graduate who currently makes \$52,000 might make only \$45,000. We should be more concerned about raising the wages of people who are being asked to work 2,000 hours at \$6 or \$7 an hour—people who make \$12,000 or \$14,000 a year. One way to reduce the growth of inequality is to let more people in at the top of the skill distribution.

We should not be concerned that there is an oversupply of people at the top. Since the late 1980s there has been a sharp increase in the portion of people graduating from college relative to the size of the age cohort. But, because the size of the age cohort fell during this period, the absolute number of people in this age bracket going to college dropped dramatically. This is why we have such a strong demand not just for IT workers, but for college graduates in all occupations. Despite the fact that people have responded to the good times and have increased their tendency to go to college, it has not produced a huge flood of people on the labor market, forcing down wages.

Because there seems to be little danger of oversupply at the top, we can afford to increase immigration of high-skilled workers. If the United States raises the H-1B quota by 60,000 a year, that would be an increase of only about 6 percent in the number of high-skilled people entering the market. That number will not make a big change in the total demand and supply conditions for college graduates.

One cannot expect that companies in this high turnover industry are going to do a huge amount of general training. Therefore, it is going to require school-based training. At present much of the training is done by for-profit organizations, with high tuition charges, and so the public sector needs to get into this business. The common belief is that the field changes too fast for the public sector to do a good job of training, but it must try because the payoff for doing it well is so high. If the private sector can do it, there is no reason why community colleges cannot do it also. Public colleges and universities should expand training, both for the general public and for IT professionals, and then monitor how well those programs are doing.

The solution to the H-1B visa problem is to allow as many people in as businesses can hire as long as they are paid above a certain wage. Perhaps business should have to pay a fee to ensure that they are not using the program as a way to drive down American wages. If a firm is willing to pay at least \$5,000 extra, it indicates that the immigrant is really preferred over an American worker. Currently, firms must pay at least that much in paperwork costs. Streamlining the process and replacing the procedural costs with a \$5,000 fee would also allow the government to spend that money on something else.

A strong case can be made for more government action to increase the supply of IT workers, but a similar case can

be made for government action to increase the supply of secondary school teachers as well. The United States needs to increase the supply and raise the quality of professionals across all fields.

Session 3. Short- and Long-Term Directions for Policy

Dimitri B. Papadimitriou (moderator)

Executive Director, The Jerome Levy Economics Institute

Robert D. Atkinson

Director, Technology, Innovation, and the New Economy Project, Progressive Policy Institute

Daniel T. Griswold

Associate Director, Center for Trade Policy Studies, Cato Institute

George M. Fishman

Chief Counsel, Subcommittee on Immigration and Claims, Committee on the Judiciary, U.S. House of Representatives

Robert D. Atkinson

A key reason why the issue of labor supply in the information technology industry is so difficult to deal with is that we do not have good information regarding labor supply and demand. In 1994 and 1995, before the Office of Technology Assessment was closed, it did a study of the use of information technology in the service sector. In the manufacturing sector productivity growth dipped in the 1970s but is now back up to about 3 percent a year—almost what it was in the early postwar period. But the United States continues to have overall productivity growth of less than 1 percent a year because the rest of the American economy (that is, about 80 percent of the economy), which includes the now large service sector, has only about 0.5 percent productivity growth per year.

When the Office of Technology Assessment did its report, it concluded that the manufacturing sector had used information technology to increase productivity, but other sectors had not yet done so. The American economy was poised for a transformation of sectors that deal with information and human transactions (such as going to the grocery store or checking into a hotel). There would be continuous growth of the IT industry as the U.S. economy moved through this transformation and more IT professionals would be needed.

Employment in the industry requires fundamental knowledge and skills. To be trained to be a computer programmer, a person must have strong literacy and math skills. What this means for policy is that we must think in terms of both short-term and long-term solutions to problems of labor supply.

For the short term, the Progressive Policy Institute proposes that, in order to fill current job vacancies, the United States should increase temporarily the number of H-1B visas, which allow highly skilled immigrants to enter the country for employment. The increase should not be permanent because in time Americans will gain the skills needed for IT jobs. We must also find a way to distinguish between people who are brought into the country to do relatively low-level programming tasks that American workers could be trained for in three or four months and those with higher skills that require more significant and sustained knowledge. Another short-term measure proposed by the Progressive Policy Institute is participation by businesses, educational institutions, and government in regional skills alliances for the development of training programs.

For the long term, we must work to reform primary and secondary education. Recent international tests show that American students rank near the bottom in math and science. The United States needs to develop and enforce rigorous national standards for schools and teachers. Competition among schools and charter schools (especially in math and science) should be encouraged in the public school system. We need to be more innovative in approaching math and science education. There has been a movement in the past 10 years to create math and science high schools, but generally in white and suburban areas. There is an opportunity here to combine math and

science education with support for disadvantaged urban minority and rural areas.

Policymakers also need to do a better job of involving the private sector in education. There are some innovative programs around the country in which technology companies support math and science education at primary schools and through scholarships at colleges. It is more costly for colleges to educate people in computer science than it is to educate them in the liberal arts. One reason is that it is more expensive for colleges to hire instructors in information technology fields because colleges must compete with the private sector for them. One solution that has been proposed for this problem of cost is for the federal government to increase funding for computer science and engineering fellowships, which could be matched by industry and academia and follow the student rather than be tied to a particular university.

Regional skills alliances should be encouraged. In regional skills alliances several firms in a region put up money that is matched by the public sector to develop training programs. About 99 percent of American firms are small; for example, the average size of an IT firm in Research Triangle Park in North Carolina is 50 employees. Small firms are focused on trying to get the next contract or trying to get the next upgrade out the door, not on training their workers. Even if they want to do some training, they are often not aware of how to do it or where to go for it. They do not have human resource departments with people who know how to develop training systems. When confronted with a skills shortage, the small firms have two options. One is to steal employees from each other and the other is to try to get the H-1B cap raised so that they can hire foreign workers. Training people in the skills they need for IT jobs would be a third option, and regional skills alliances can help them do this.

The proposal for regional skills alliances has three parts. First, the federal government would allocate \$50 million a year and run the program through the Department of Commerce. Money would be provided only to alliances of 10 or more firms. The firms need not be in the IT industry. Second, firms would have to put up at least a third of the money with the rest matched by the federal, state, and local governments. Third, firms would not be allowed to use regional skills alliances to train their executives. One suggestion for funding regional skills alliances was through money from a \$200 fee for H-1B visas applications. Unfortunately, this proposal has not gotten much support in Congress. Still, the Progressive Policy Institute hopes to see some government encouragement of regional skills alliances.

Daniel T. Griswold

The evidence indicates that there is a shortage of information technology workers, but there are not many conferences asking if there is a shortage of steel or wheat or good cappuccino or housing. In most markets in the United States such a question never comes up. It did come up about 20 years ago with oil, but that problem went away in the early 1980s, around the time the price of oil was deregulated. Whenever there is a shortage, a lot of people talk about market failure. This is a legitimate concept, but equally legitimate is the concept of government failure. With regard to labor supply in the information technology industry, the problem appears to be due to government failure.

Government has placed an arbitrary cap on the labor supply by limiting the use of high-skilled immigrants by U.S. industry. Under the H-1B visa program the government allows industry to import only a set amount of labor input. Government cannot be relied on to plan for and accommodate future labor supply needs. Government is as incapable as anyone of projecting the future demands of something as complicated as the U.S. economy.

A short-term solution to the labor shortage in the IT industry is simply to raise the cap on H-1B visas. High-skilled immigrants benefit the U.S. economy far more than they harm it. We would not have the high-tech industry that we have today without the contributions of foreign-born engineers. Twelve percent of the high-growth, high-tech firms in the United States are founded by immigrants, yet immigrants are slightly less than 10 percent of the general population. One-fifth to one-fourth of the patents issued in the United States are issued to foreign-born engineers and designers. Of 40 Westinghouse science talent search winners, 16 are either foreign born or the children of foreign-born immigrants.

Immigrants are overrepresented at the bottom of the skill scale, but they are also very overrepresented at the top in the United States today. Thirty percent of the Ph.D. scientists in research and development and one-quarter of the physics professors at universities are foreign born. Many companies want immigrants not just because they may

perform tasks better than Americans, but because they perform tasks that Americans simply cannot. Many H-1B workers are hired by companies that train them in the corporate culture and then send them back overseas to become heads of regional offices. The benefit is that immigrants have the knowledge of the language and culture of the countries in which the regional offices are located.

Immigrants also benefit low-skill industries. Were it not for immigrants, many industries in the United States would simply not exist. One example is the garment industry. It has been shrinking over the years, but without immigrants it would be gone. These immigrants are not taking jobs from Americans; they are keeping industries afloat.

The National Academy of Sciences did a comprehensive study that was requested by the U.S. Commission on Immigration Reform. The study showed that the typical immigrant—across all educational levels and over the lifetime of the immigrant and his or her children—provides a net present value to the government budget of \$80,000. Immigrants tend to be a burden when they first arrive, but over time their salaries rise and eventually exceed those of native-born Americans. If one considers only those immigrants who have an education above high school, the value to the government rises to \$198,000. If the H-1B visa cap were raised by 35,000, the financial health of governments—federal, state, and local—would improve by \$7 billion each year that these immigrants are allowed into the country.

Both the House and the Senate proposed bills to raise the H-1B visa cap, but the provisions in the House bill designed to protect American workers are dangerous. These provisions require that companies search for an American worker for each job and that they not displace any American worker if they do hire a foreign-born worker. A business must document to the Labor Department how long it searched and the qualifications of the people it turned down for the job. It must show that the foreign-born worker it hired had special skills needed by the company and that no American worker with substantially equivalent qualifications, experience, and skills was laid off any time in the six months before or the three months after the H-1B worker was hired.

It will be difficult for businesses, or anyone, to show that somebody has substantially equivalent qualifications and experience in a speciality occupation. If the Labor Department is involved, there will be a paperwork nightmare for businesses and they simply will not hire H-1B workers. These protections for American workers are unnecessary. There has been only one case in the last eight years in which the Labor Department found that an American worker was displaced by an H-1B worker.

Opponents to increasing the H-1B visa cap argue that not only do immigrants replace native-born workers, they undercut the wages of native-born workers. But highly educated foreign-born workers earn slightly more than their native-born counterparts; they do not undercut wages when they earn more. Also, the costs—two to five months of red tape, legal bills, and relocation costs—add up to a \$10,000 to \$15,000 premium for hiring a foreign-born worker; H-1B workers do not represent cheaper labor to an employer.

It is not just the government cap on the labor supply that is harming the information technology industry. Another government failure is the educational system. The United States has an Internet economy served by a K-12 school system that is out of step with modern reality. Fundamental reform of the educational system is needed. Competition needs to be injected into the school system. This can be done through the promotion of charter schools, tuition tax credits, and privately funded school voucher systems. These reforms could also be applied to higher education. The United States needs an educational system that is as flexible, efficient, and effective as the high-tech industry.

George M. Fishman

The public attitude toward the H-1B program was very different two or three years ago when the media was broadcasting stories about companies firing Americans and replacing them with immigrants brought into the United States under the visa program. The negative view of the visa program caused businesses to worry that Congress would crack down on it. That made it easy for federal officials to get businesses to compromise on the program and to accept provisions that they would not lay off Americans to hire immigrants. Now there is a more favorable view of the H-1B program because it is seen as a solution to the problem of a labor shortage. The threat to American labor through abuses of the H-1B program, however, has not necessarily gone away, even though it is no longer on the front pages of newspapers.

Proposals protecting American workers, which should have been adopted before but were not, are now before Congress. The first proposal is that visas be limited to three years rather than the current six. Limiting the term of the visas gives the government the option of reviewing the labor market and reducing the number of immigrant workers by not renewing visas should there be considerable growth in the number of Americans graduating with computer science degrees by 2001.

The General Agreement on Tariffs and Trade limits the ways in which the United States can alter the H-1B program, but it does allow the United States to add two provisions to the program and these are included in the current House bill. First, when hiring an H-1B worker, a company cannot displace an American worker with substantially equivalent qualifications, experience, and skills; second, a company must make a good faith effort to recruit an American worker before petitioning to hire an H-1B worker. These provisions have already failed in the Senate.

Employers argue that the provisions would significantly lengthen the time it would take to get an H-1B visa, but, in fact, these provisions do not change the basic set up of the H-1B program. It still allows companies to get employees quickly without having to prove anything to the government in advance. It is only if a complaint is filed after a company hires an H-1B worker that the Department of Labor will review the hiring. Unless a complaint is filed, there is no government check on what companies do. If a company is found guilty of violating the provisions, there are penalties. After a conviction a company is subject to random inspections for five years. Also, if a company's workforce is more than 15 percent H-1B workers, the company can be inspected by the Department of Labor at any time.

Companies argue that the provisions interfere with their right to hire whomever they want. But this is not an issue of private property rights or a business right, but rather it is an issue of foreign workers. Immigration is a privilege not a right. A citizen who asks to bring a relative into the country or a business that asks to bring an employee into the country is asking the federal government for a privilege. There is no preexisting right of contract or of private property to bring someone in from overseas. Therefore, it is fair for the government to request that citizens and firms earn the privilege. Under these proposed provisions, companies are asked to earn the privilege by showing that the American labor force will not be hurt if foreign workers are brought in.

Participants

Robert D. Atkinson is director of the Technology, Innovation, and the New Economy Project at the Progressive Policy Institute. The project is intended to make policymakers aware of changes in the economy and the need for policies that reflect these changes. Before joining the institute, Atkinson was executive director of the Rhode Island Economic Policy Council, a nonpartisan organization made up of representatives from the private sector, organized labor, higher education, and government. At the former Congressional Office of Technology Assessment, he directed a report on the impact of the information technology revolution on America's urban areas and co-authored reports on technology, productivity, and the service sector; economic impacts of defense downsizing; and environmental regulation and industrial competitiveness. Atkinson has testified frequently before Congress and has published extensively on economic development and technology policy. He received a Ph.D. from the University of North Carolina.

John H. Bishop is chair of the Department of Human Resource Studies at the New York State School of Industrial and Labor Relations, Cornell University. Previously, he was director of the NIE-funded Center for Research on Youth Employability and associate director for research at the National Center for Research in Vocational Education. Bishop has served on many advisory committees, such as the Job Training Partnership Experiment Advisory Committee and the Education Committee of the Competitiveness Policy Council. He has written extensively on education reform; the impact of the quality of education on the productivity of individuals and nations; the impact of the hiring, training, and promotion policies of business on incentives for students to study and schools to set high standards; the determinants of and payoffs to employer training; and the effectiveness of

institutions that match workers and jobs. Bishop received a B.A. from Oberlin College. After two years in the Peace Corps in northern Nigeria, he received an M.A. and a Ph.D. from the University of Michigan.

Lauren Brownstein is workforce education program manager at the Information Technology Association of America (ITAA). As the director of initiatives to address the shortage of information technology workers in American industry, she brings together leaders in government, academia, and industry to create new partnerships for recruiting and training the information technology workforce and coordinates the research, consulting, and outreach activities of ITAA's Workforce and Education Committee. Brownstein has taught and administered a variety of outreach and education programs, working with the United Jewish Appeal, the B'nai B'rith Youth Organization, the National Building Museum, KIDSNET, and the DC Public Schools. She received a B.A. from the University of Virginia and an M.A. from George Washington University.

George M. Fishman is chief counsel to the Subcommittee on Immigration and Claims of the Committee on the Judiciary, U.S. House of Representatives. Previously, he was legislative counsel to the House Republican Policy Committee, legislative counsel to U.S. Representative Henry J. Hyde (R-Ill.), and attorney adviser at the U.S. Department of the Interior. Fishman received a B.A. from the University of Illinois and a J.D. from the University of Michigan Law School.

Daniel T. Griswold is associate director of the Cato Institute's Center for Trade Policy Studies, where his responsibilities include research, writing, and speaking on trade and immigration issues; commissioning papers; and arranging events on related policy issues. Before joining Cato, he was editorial page editor of the *Colorado Springs Gazette Telegraph* and was press secretary for former U.S. representative Vin Weber (R-Minn.). In addition to his publications for the Cato Institute, his writings include articles for such publications as *Journal of Commerce*, *The Wall Street Journal*, *Baltimore Sun*, and *National Review*, and he appears frequently on radio and television talk and news programs. Griswold received a B.A. from the University of Wisconsin and a master's degree in the politics of the world economy and a diploma in economics from the London School of Economics.

Carlotta Cooke Joyner is director of Education and Employment Issues at the Health, Education, and Human Services Division of the U.S. General Accounting Office. She supervises the design and implementation of studies on the quality of early childhood, elementary, and secondary education programs, youths' and adults' access to higher education and employment training, employers' efforts to locate qualified job candidates, and the quality of the nation's workplaces. At the GAO she has also worked in the area of health care delivery, and prior to joining the GAO, she was involved in basic psychology research and evaluation of state and local education programs at Vanderbilt University and Pennsylvania State University. Joyner received a B.A. from Wake Forest University, an M.A. from the George Peabody College for Teachers of Vanderbilt University, and an M.S. and a Ph.D. from Pennsylvania State University.

Robert I. Lerman is director of the Human Resources Policy Center at the Urban Institute and professor of economics at American University. Before joining the institute, he served as chair of the Department of Economics at American University. He has worked on reforming the nation's income maintenance and employment and training programs as a staff economist for the congressional Joint Economic Committee and the Office of the Assistant Secretary for Policy, Evaluation, and Research at the U.S. Department of Labor. Lerman has published extensively and has testified at congressional hearings on welfare programs, income inequality, child support, youth employment programs, fatherhood and family structure, trends in the information technology labor market, and school-to-career issues. He received a B.A. from Brandeis University and a Ph.D. from the Massachusetts Institute of Technology.

Dimitri B. Papadimitriou is executive director of the Levy Institute, executive vice president of Bard College, and Jerome Levy Professor of Economics at Bard. He has been a visiting scholar at the Center for Economic Planning and Research (Athens, Greece) and a Wye fellow at the Aspen Institute. He is a member of the Competitiveness Policy Council's Subcouncil on Capital Allocation. Papadimitriou and Levy Institute senior scholar L. Randall Wray are currently engaged in research to assess the effects of the aging of the population on the labor market in light of the slow growth in labor force participation. Papadimitriou is general editor of The Jerome Levy Economics Institute book series and editor of and contributor to several books in the series, including *Stability in the Financial System* and *Financial Conditions and Macroeconomic Performance: Essays in Honor of*

Hyman P. Minsky, edited with Steven M. Fazzari. He is a member of the editorial board of the *Eastern Economic Journal*. Papadimitriou received a B.A. from Columbia University and a Ph.D. from New School University.

John Sargent is senior technology policy analyst at the Commerce Department's Technology Administration, the federal agency charged with working in partnership with the private sector to develop, coordinate, and advocate national policies that maximize technology's contribution to U.S. competitiveness, economic growth, the creation of high-wage jobs, and the improvement of living standards for all Americans. As adviser to the Commerce Department's undersecretary for technology, Sargent conducts policy analyses, writes reports and congressional testimony, and reviews science and technology documents prepared by the Executive Office of the President and federal agencies. Sargent is also acting public affairs director for the Partnership for a New Generation of Vehicles, a cooperative research effort by the federal government, Ford, Chrysler, and General Motors to develop the technologies needed to produce family cars capable of 80 miles per gallon. Sargent received a degree in systems engineering from the University of Virginia.

Frances M. Spring is an assistant director of the Levy Institute, where she has overall responsibility for public information and is the general editor of the Public Policy Brief, Highlights, and Policy Notes series. She is currently working with Resident Scholars Oren M. Levin-Waldman and George W. McCarthy on a national survey of hiring practices among small firms as part of an analysis of the role the private sector can play in welfare reform. Before joining the Levy Institute, Spring worked at a private firm as a consultant to public and private sector entities on issues of tax policy, economic development, and education finance. She also taught economics at the University of Michigan at Flint and Michigan State University. Spring received a B.B.A. from Eastern Michigan University and did graduate work at Michigan State University