Emerging Trends in the Information Technology Job Market: How Should the Public and Private Sectors Respond?

Testimony before the House Committee on Education and the Workforce, Subcommittee on Oversight and Investigations

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Thank you, Chairman Hoekstra, Representative Mink, and other members of the Subcommittee for inviting me to testify before the committee as part of your American Worker at a Crossroads Project and specifically on Emerging Trends in the High Tech Workplace. In this brief statement, I shall deal with three main questions:

1. How do trends in the overall US labor market relate to the information technology (IT) labor market?
2. What are the employment and wage trends among information technology workers? Do the available data point to a serious shortage of information technology workers?
3. How should the private and public sectors respond to the tight labor market for information technology workers and other highly trained workers?

The key points of the testimony are these:

- The tight labor market for IT workers is one aspect of the overall high demand for skilled workers in all industries. The demand for skilled workers has been rising faster than the supply, causing an increased wage premium for educated workers. Unemployment rates of college graduates are now at or below 2%.
- Still, the evidence is far from conclusive that IT occupations are experiencing a serious shortage. Although employment growth has been rapid among computer engineers, data base administrators, and computer support specialists, little job growth has taken place over the last eight years among computer programmers. Most importantly, the trends in real wages of computer scientists are not nearly as rapid as one would expect in a market attempting to adjust to a labor shortage.
- Workers enter the IT field from many fields; only a modest share of IT workers require computer science degrees; moreover, a very large share of those working in IT fields move to other fields frequently; if the industry managed to persuade a high share of incumbent workers to remain, they would face a less difficult task filling positions.
- The current tight labor market provides an opportunity to help all citizens to take advantage of the rising demand for skills. The expansion of job opportunities in the IT field should stimulate enhanced public-private initiatives to attract workers to the field through expanded training, the development of clear career pathways and skill standards, and the expansion of youth apprenticeships and career academies. In addition, the public sector should encourage collaboration between employers of IT workers and community colleges and other post-secondary institutions to create curriculum for use in medium-term and long-term programs that is well-tailored for IT careers.
- Government policy makers should be cautious about expanding the supply of IT workers by increasing the number of short-term immigrant visas. The H1-B program has serious structural flaws and there is no obvious reason to give special preference to one industry. Expanding immigration of highly skilled workers may well be a good idea independent of the IT job market question, but the immigrants should not constitute a separate class of workers with options limited only to selected employers.

The Overall Job Market Context

The success of the US economy in generating jobs and in reducing unemployment rates without inducing inflation is now well known. But we should remember that until recently, the consensus among macroeconomists and monetary policy experts was that unemployment rates below 5% would set off high and rising rates of inflation. So far, the supplies of labor materialized with little pressure on unit labor costs or

prices. Between January 1995 and January 1998, the number of jobs expanded by over 6 million, as over 5 million people joined the labor force and over 1 million left the ranks of the unemployed. The ability to fill these jobs without stimulating inflation is especially striking, given the fact that the economy has been generating mostly high-skill jobs. As Chart 1 shows, *nearly two out of three of the 17 million full-time jobs added since 1988 were in the professional, managerial, and technical occupations*. In 1988, these occupations accounted for only about on in four jobs. "Upskilling" is taking place not only in the US but in other OECD countries and it is not entirely a recent phenomenon. In 1950, only one of six US workers were professionals, managers, or technical workers; by 1996, the proportion had reached nearly one in three. In addition, skill requirements have been rising for jobs in middle and lower level occupations.

Many of the new jobs are in fields involving creativity and critical thinking. Jobs for actors, college professors, social scientists, reporters, and lawyers have jumped at double and triple the rate of increase of nonprofessional jobs. For example, jobs as college professors rose from 125,000 in 1950 about 850,000 in 1995.

Jobs in nonprofessional, nonmanagerial occupations are requiring increasing levels of skill and training. One study of 56,000 production workers found significant upgrading in the last decade. A New York State study of 1,400 job holders in 300 large and small businesses looked at the skills required in career positions not requiring a college degree, such as practical nurse, auto body repair, inventory clerk, and salad chef. The jobs required skills well beyond minimum competency levels, including many not emphasized in schools, such as having knowledge of a system and its interrelated procedures, reacting constructively to positive or negative criticism, working well as a team member, using information systems, setting priorities, and having good personal work habits. Results from a recent survey of over 3,000 employers in four US metropolitan areas showed that the vast majority of non-college jobs had tasks requiring skills not possessed by many inner-city workers. The tasks required skills and experience in the relevant occupation as well as general skills, such as writing paragraphs and working with computers.

While the educational attainment of the work force has expanded along with the rising job requirements, the growth in college completion slowed considerably over the last decade. Today, too many young people still lack the skills to perform well in the job market. Just over one in three young people between the ages of 25 and 34 earned any degree beyond high school. About 27% achieved the BA degrees while another 8% gained an AA degree. About one in five young people attended some college but never earned any degree. At the bottom end, 12% were high school dropouts and another 6% passed the General Equivalency Degree, but did not earn a high school diploma.

The evidence on test scores based on the National Assessment of Educational Progress tells a mixed story about 17 year-olds. On the one hand, science scores for 17 year-olds on the National Assessment of Educational Progress increased and math scores rose slightly, especially since the early 1980s. However, we have witnessed essentially no gains in the reading and writing scores of 17 year-olds or 11th graders.

Perhaps for these reasons, even with increases in years of schooling, the country still faces an extremely tight job market for the most educated. The unemployment rate of all college graduates has dropped below 2%, while the rate for high school graduates with no college was still nearly 5%. The average earnings gap between young college and high school graduates jumped from about a 25% to a 50% differential. Among workers at all ages over 18, the college wage premium rose from 41% in 1979 and 56% in 1995.

Although the widening pay differentials represent an unwelcome rise in inequality, a market in which employers willingly absorb skilled workers even at higher wage premiums is far more hopeful than the alternative. Were employers paying less for skill and having little use for extra skills, then educated workers could easily face academic unemployment or frustrations when their jobs require little of the capabilities they worked so hard to achieve. In this sense, we are fortunate that the new technologies are demanding more workers with knowledge and the ability to undertake lifelong learning. But now is a good time to take advantage of today's opportunities so that a broad segment of the work force benefit from the economy.

Trends in the Information Technology Labor Market

What does this general picture of rising demands for skill and tight job markets for the most educated mean for the information technology labor market? Are the employers facing serious shortages for workers in the IT occupations?

Before we look specifically at the IT field, it is important to establish what is meant by a shortage. A shortage can be said to exist when the number of jobs requiring a particular type of worker exceeds the quantity of such workers available at the going wage; and when the market is not adjusting rapidly to this imbalance. This second part is critical. Generally, free markets alleviate shortages through the price mechanism. When workers are scarce at current salaries, we expect employers to bid up wages, which both attracts workers into the field and deters the use of these more highly paid workers. Thus, in a shortage situation, we should observe rising employment and rising wages or some combination of the two. If the initial shortage is widespread and if additional supplies of qualified workers do not materialize, the effort to fill the job vacancies can stimulate inflation.

How do we know when the market is not adjusting? The answer is complicated. When there are many employers, labor market forces will generally raise relative wages enough to attract workers from other fields. In fields involving long lags between the onset of vacancies and the time it takes to train additional workers, rising demand for workers may initially raise wages without bringing additional supplies of workers. However, within a few years, the increased wages draw more workers into the field. A good example is the scientific and engineering occupations. The job market for natural scientists and engineers has fluctuated between large

reductions in demand in the mid-1970s to large increases by the mid-1980s to moderating patterns in the early and mid-1990s. When demand fell, so did relative wages, and ultimately the number of students choosing to graduate with an engineering or science degree. When salary premiums increased, as in the mid-1980s, the proportion of students entering the field increased. Thus, market forces generally respond to increases in demand, even in professions requiring lengthy training periods.

Now, let us turn to the IT field. The three primary census occupational classifications for IT workers are: computer systems analysts and scientists, computer programmers, and operations and systems researchers. Computer engineers work with the hardware and software aspects of systems design and development and often work in teams that design new computing devices or computer-related equipment. Software engineers design and develop both packaged and systems software. Database administrators work with database management systems software, reorganize and restructure data and are responsible for maintaining the efficiency of databases and system security. Computer support analysts provide assistance and advice to users, interpret problems and provide technical support for hardware, software, and systems. Systems analysts implement computer technology to meet the individual needs of an organization. Computer programmers write and maintain the detailed instructions that list in a logical order the steps that computers must execute to perform their functions.

Despite the extravagant claims of a shortage of IT workers, the indicators are mixed. The employment trends shown in Chart 2 reveal rapid growth in the computer systems analysts and scientists, but no growth in the other professions until last year. Employment in operations research has actually declined since 1988 and the total number of computer programmers remained at about 560,000 workers between 1988 and 1996, a time in which employment of all professionals expanded by nearly 30 percent. Only in 1997 do we observe substantial growth in the employment of computer programmers, as jobs increased by 11.6%. One may speculate that the source of the recent sudden jump in programmer positions is the demand by companies, governments, and other organizations to solve the problems linked to the year 2,000 bug. If so, we can expect additional short-term pressures on the job market for programmers this year and perhaps next year, but perhaps even reductions in demand in future years. Data from occupational employment surveys (OES) taken among employers confirm these trends. Employment of computer programmers barely increased at all, while jobs in the higher level fields rose rapidly.

In spite of weak employment growth in two of the three IT occupations, one might still argue that a shortage of workers prevented employers from hiring in these fields. In addition, shortages might have limited the expansion of jobs in the rapidly growing occupation of computer systems analysts and scientists. But, if serious shortages were taking place in any of these fields, we would expect market pressures to raise salaries for IT workers more rapidly than for other professional workers. In fact, the weekly wage patterns displayed in Chart 3 show no evidence of a market experiencing a shortage. Except for the 1996-97 period, real wages have been essentially flat since 1988, rising slightly above the slow growth in median wages experienced by professionals as a whole.

Data from some private surveys indicate higher salary levels and higher rates of growth for IT workers, but public surveys show only modest growth. A survey conducted for the Information Technology Association of American (ITAA) by William Mercer indicated salary increase of nearly 20% and salary levels of well over $50 per hour (equivalent to about $2,000 per week). Unfortunately, the Mercer data are inconsistent with other private surveys as well with public data sources. A survey conducted by Deloitte & Touche Consulting Group revealed that salaries for computer network professionals rose an average of 7.4% between 1996 and 1997. Coopers and Lybrand found average salary increases at 500 software companies were 7.7% in 1995 and almost 8% in 1996. The wage rates and wage growth reported in the Mercer study are far higher not only than the CPS weekly earnings data but also than other private surveys and the BLS employer survey data. The Coopers and Lybrand study estimated that senior software engineers earned $63,000 annually, far below the rates listed in the Mercer study. The BLS occupational compensation survey data show median weekly earnings of under $1,000 per week for jobs at the middle occupational level of computer systems analyst. On an hourly rate, this works out to about $25 per hour, a figure well below the hourly earnings reported by Mercer for middle to high level IT occupations.

Recent employer-based data collected by the Bureau of Labor Statistics indicates wage rates close to the $25-30 figure. Data on the wages paid to computer scientists are available for specific metropolitan areas from the National Compensation Survey (NCS). The NCS data come from employer reports and careful classification by BLS field economists of employees into selected occupations. Using the NCS, we can report hourly compensation paid to computer scientists in several metropolitan areas. One interesting comparison is between wages of computer scientists, a profession said to be in shortage, and wages of teachers, a profession whose workers are often said to be underpaid. As Chart 4 shows, the mean rates of hourly compensation reported by employers for computer scientists and analysts in selected metropolitan areas are well above the wages paid to white collar but were generally below the wages paid to secondary school teachers.

Overall, despite considerable recent evidence of spiraling salaries for computer workers appearing in newspaper and journal articles (sometimes based on employer salary surveys), the data collected by the BLS for broad categories of IT workers through the end of 1996 show modest wage growth, evidence not consistent with rampant labor shortages. Certainly, the job market for IT workers is very tight, as is the market for highly skilled workers as a whole.

A recent study conducted by Virginia Polytechnic Institute (Virginia Tech) and reported jointly with the Information Technology Association of American (ITAA) argues the case for shortages of IT workers. The study surveyed 1,493 companies, of whom only 500 responded to the questionnaire. (This response rate is far lower

than what the Bureau of Labor Statistics is able to achieve.) On the basis of these responses, the Virginia Tech authors estimated that: 1) the core IT workforce is 3,354,000 in the programming, systems analysts, and computer engineering fields; and 2) that vacancies amount to 346,000 or approximately 10 percent of positions. In comparison to the data collected by the Census Bureau both from households and from employers, the Virginia Tech study vastly overestimates the size of the core IT workforce. In 1996, employers reported only about 1.5 million employees working in these fields. Households reported a substantially higher figure, about 2 million, in 1997. Neither figure is close to the 3.3 number projected in the Virginia Tech study.

A second problem with the study is its lack of perspective about the presence of vacancies. In any industry with a rising demand and/or high turnover, the presence of vacancies does not necessarily demonstrate a shortage of workers. A vacancy simply means the firm has an open position it has not yet filled. Vacancies as a proportion of employment will depend on the employers turnover rate, how long it takes to fill a vacancy, and the extent to which the company is growing. Even among employers not expanding at all and in markets where there are no shortages, vacancies can easily reach the rates reported. For example, a company expecting turnover of 30% per year and expecting to take four months to fill a vacancy will have vacancies equal to 10% of employment. If the employer is expanding, vacancies would run at an even higher rate than the 10% figure cited in the Virginia Tech study. For these reasons, the Virginia Tech figure tells us nothing about the presence of a shortage of IT workers, the duration of any shortage, or the reasons for the shortage.

Meeting Potential Future Shortages

Even if one could be assured that there is no immediate shortage of IT workers, is there reason to be concerned about future shortages, that future demands will outstrip future supplies.?

Indications of Projected Job Growth. The Bureau of Labor Statistics projects rapid rates of employment growth between 1996 and 2006 in IT occupation as follows: computer engineers, 235,000; data base administrators and computer support specialists, 240,000; systems analysts, 520,000; and computer programmers, 129,000. In the fields other than computer programming, the growth is estimated at about 1,000,000 new workers over ten years, or about 100,000 per year. Although the numbers constitute very high percentage growth, the absolute number of openings in these fields is approximately the same as projected combined openings among registered nurses and therapists. The additional 1 million job openings in the IT fields other than computer programming represents about 12% of the 8.3 million openings projected for professionals and about 8% of 13.5 million openings among professionals and managers.

Pool of Potential Applicants. Whether the robust demand for computer specialists will outstrip supply depends partly on the ability of the industries employing IT workers to attract new entrants and to retain existing workers. In examining this question, we should recognize that the pool of potential applicants extends well beyond individuals with degrees in computer science. Note in Chart 5 that among the 1992-93 cohort of college graduates, only one-third with jobs in computer science or programming jobs had degrees in computer science or information science. Nearly as large a share came from majors in business management (28 percent). Students with engineering degrees accounted for 12 percent of new graduates working in IT fields. At the same time, nearly half the computer science graduates entered jobs outside the computer field. The picture is similar for all workers in the computer and information science field. Data from a National Science Foundation study reveals that of the 1.2 million college graduates employed in 1993 in several information technology fields (computer sciences and operations researchers, computer programmers, computer science professors, software engineers, and hardware engineers), only about 31% had degrees in computer science. The largest other majors were business degrees (19%), engineering degrees (10%), math (9%), and a variety of social science degrees (8%). In the case of computer programmers, about 76,000 or 38% of the 200,000 employed in the field had computer science degrees. Another 13,000 had electrical, electronic, and computer degrees. Still, over half the working programmers with BA degrees earned their degrees in non-computer related fields.

A reasonable forward projection would suggest that employers could well meet the expected demand so long as they retain a high share of the existing stock of IT workers and continue to draw on BA and AA graduates with degrees in fields other than computer science. My projections, noted in Chart 6, indicate that the expected flows from colleges and universities should come close to meeting the expected demand.

Newly Emerging Training Opportunities. Proprietary schools as well as colleges and universities offer training for IT workers in moderate skill positions. Interviews with officials at three proprietary schools in the Washington, DC area report high growth in enrollments and very high placement rates among those who complete the program. Many of the courses last about 4-5 months and equip workers to take jobs in computer programming in such languages as C++ and JAVA, as computer technicians, and network administrators. The tuition typically ranges from $1,000 to $5,000. The schools are open to students of any background. No prior programming or network experience is necessary. Although the quality of the graduates from these programs is uncertain, there are certification exams in some of the relevant fields. A recent Washington Post story described proposed legislation going through the Virginia House that would provide community colleges with funding to tailor courses to specific industries in the information technology field. Cooperating companies apparently believe that they can fill many of their positions with people trained in the community college system. The story points out how four year universities are also gearing up to meet the demand for IT workers.

While sketchy, the evidence from training programs and emerging post-secondary programs suggests that workers with reasonably good academic skills can gain access to IT professions in a relatively short period of time. On the other hand, these programs are unlikely to serve as the source of workers in the most advanced IT professions.

Public and Private Responses to Tight Labor Markets for Skilled Workers

Before choosing a response, we must wisely consider what we want to accomplish. Those advocating a policy of expanding temporary visas do so as a means of addressing a serious labor shortage. Unfortunately, the data do not suggest the labor market is substantially tighter in the IT fields than for other skilled occupations. Second, past experience suggests that actions to reduce a shortage often end up producing a surplus in the future. Some professions, including engineers, have been subject to boom and bust cycles. When demand has been robust, salaries have increased and government subsidies have expanded, thereby stimulating a large increase in the supply of engineers. Unfortunately, often just as new entrants have joined the engineering work force, demand for engineers declined. The combined impact of the expansion in supply and the reduction in demand has sometimes led to an enormous glut of engineers. Ironically, a policy of expanding immigrant visas for IT positions is potentially counter-productive because it can increase uncertainty and reduce the incentive to enter the field. Prospective US students may choose not to prepare for the IT field if they see that foreigners will gain easy access to visas simply by entering an IT occupation.

Do we then do nothing and leave it to the markets to adjust? In my view, the answer is no. The key issue is how more of our citizens can take advantage of the welcome demand for skilled workers and obtain good jobs. In this context, one benefit of today's tight labor market for all workers and for IT workers is the impetus to private-public efforts to expand and improve training, to attract new workers to fields requiring significant skills, and to retain existing workers. A good example of a collaborative private-public initiative is the Applied Information Management (AIM) Institute in Omaha, Nebraska. AIM has brought industry and higher education together in ways that expand the sources of labor. In addition to promoting continuing education, AIM has developed internships and curriculum and has worked to attract high school students to IT careers. For several IT occupations, training is readily available for those who wish to enter the field and the courses can be completed in well under one year. While no doubt market imperfections exist, the capacity to train mid-level IT workers is expanding rapidly. It is important that we promote those efforts and avoid policies that reduce the incentives of employers to undertake sensible long-term strategies that can widen access of American workers to good jobs.

Using School-Career Initiatives Effectively. Public and private programs could attract some prospective entrants into the field when they are young enough to make adequate preparation in schools and on the job for advanced work in computer science. Currently, few students in high school are aware of what it is that computer scientists do, what academic skills are required, the challenges and activities on the job, and what the economic rewards are. Companies and even governments as employers could promote internships and apprenticeships for high school and college students to give them a taste for the skills required and the content of the jobs in IT careers as well as allowing students to learn whether they like or dislike the field. Simply making the career ladders transparent and giving students a chance to work and learn at the same time can be very effective. The Autodesk Foundation is spearheading an effort that includes coordinating internships across the entire San Francisco Bay area not only in the IT field but in others as well. Internships provided by the Autodesk Corporation itself achieved benefits that apparently outweighed the costs during the internship period. These internship experiences are likely to spur many young people to obtain the necessary training to enter high level IT positions.

The government could encourage private firms, the school systems, and foundation officials to work together to expand these opportunities. Some of these efforts have been promoted and funded in part through the School-to-Work Opportunities Act (STWOA) of 1994. Although the 1994 School-to-Work Opportunities Act (STWOA) encourages new combinations of work-based and school-based learning toward the achievement of occupational certifications. it has been almost entirely a decentralized effort, with too minimal a role for the national government or other national institutions. We have little in the way of national or even regional standards. We have set no national targets, certainly none that carry consequences. The results are so far uneven.

Developing Career Pathways. In the IT field and in others as well, it is important to develop clear career pathways for young people to see and feel. Expanding the school-to-work approach would involve creating more Career Academies and youth apprenticeships in several fields, including the computer field. Career Academies are usually schools within schools oriented around a career theme. As students move through their last 2-3 years of high school, they stay with their own teacher, take extra courses in the theme field, learn directly from industry staff, and go on internships. Students in schools that focus on an occupational area often do better than other students and certainly have higher satisfaction with school and work and stimulate students to learn more about the industry and its requirements. Often, such Career Academies have close links with industry. Students would hear industry leaders pointing out the shortage areas and the rewarding careers in the IT field. One example is the Computer Academy within Oakland Tech High School. Students within the school not only learn about computer hardware and software but they gain valuable work experience. As volunteers working with donated equipment, they are able to earn their own computers as well as produce enough computers to use in classrooms in their own school as well as throughout the Oakland school district. It would greatly enhance not only the learning by students but also their sense of accomplishment if this approach were replicated in high schools all over the country.

Integrate Work and School-Based Learning. Equally if not more critical are efforts to integrate work-based and school-based learning. A few states, notably Michigan, Maine, and Wisconsin, use the youth apprenticeship approach, which as in the German dual system, has students and employers agree to a program of school-based and work-based learning to achieve a well-designed and broad occupational certification. This approach motivates students not only with strong incentives to learn for future jobs but also for what they

produce today in a work context. Young people want to be able to demonstrate they can accomplish something that has value. Workplaces are better able to provide these experiences than schools. In addition, youth apprenticeship does more to connect young people with natural adult mentors, to lessen the chance of a mismatch between training and career positions, and to increase the likelihood that students will learn current practice rather than old approaches. Certification can reduce the uncertainty concerning the skills a worker obtains and thus increases the portability and the market value of the training. A natural mentoring process often arises at the workplace in apprenticeship situations. This type of mentoring can teach young people the value of learning, the informal skills required in the field, and the maturity needed for a good life.

Encourage Business-Government Partnerships. A few state governments have worked with employer groups to define certifications, curricula, and testing. The largest effort in the youth apprenticeship field is taking place in Wisconsin, where 16-20 occupational standards have been developed in collaboration between the state government, community colleges, and associations of employers. Already, the state has over 1,200 apprentices in fields such as financial services, health services, printing, auto technology, and biotechnology. Initial results from Wisconsin's youth apprenticeships, as in printing, demonstrate high levels of success. Unfortunately, youth apprenticeship has developed slowly in most areas. The virtual abandonment of a national role has weakened the ability to develop national or regional occupational standards.

Public-private partnerships could disseminate information to employers on the benefits of training and of supplying student internships or apprenticeships. Many skill certifications already exist, but they are often narrow and might well induce workers not have the flexibility to adapt to future trends. Modernizing and coordinating the current certification system would help workers understand what he or she needs to learn contribute to enter the field and would help firms recognize the capabilities of those achieving a certification.

Encourage Employer-Sponsored Training. Another approach is to stimulate additional company-sponsored training. There is evidence that company spending on training is going up. However, one deterrent to additional spending is the legitimate fear that spending money on general training for a worker today might yield little benefit if the worker leaves the job market or moves to a competitor. One way to reduce the uncertainty companies face about their ability of companies to recoup training costs would be to have workers sign a pledge to pay back the firm for training expenses in the event the worker moves to another firm. Before implementing a policy on this subject, it is important to determine why such approaches are not used extensively today. What are the barriers that currently face firms attempting to implement such an approach? Is it the potential difficulty collecting from movers? If so, perhaps a third party could assist firms and workers in formulating and finalizing such agreements.

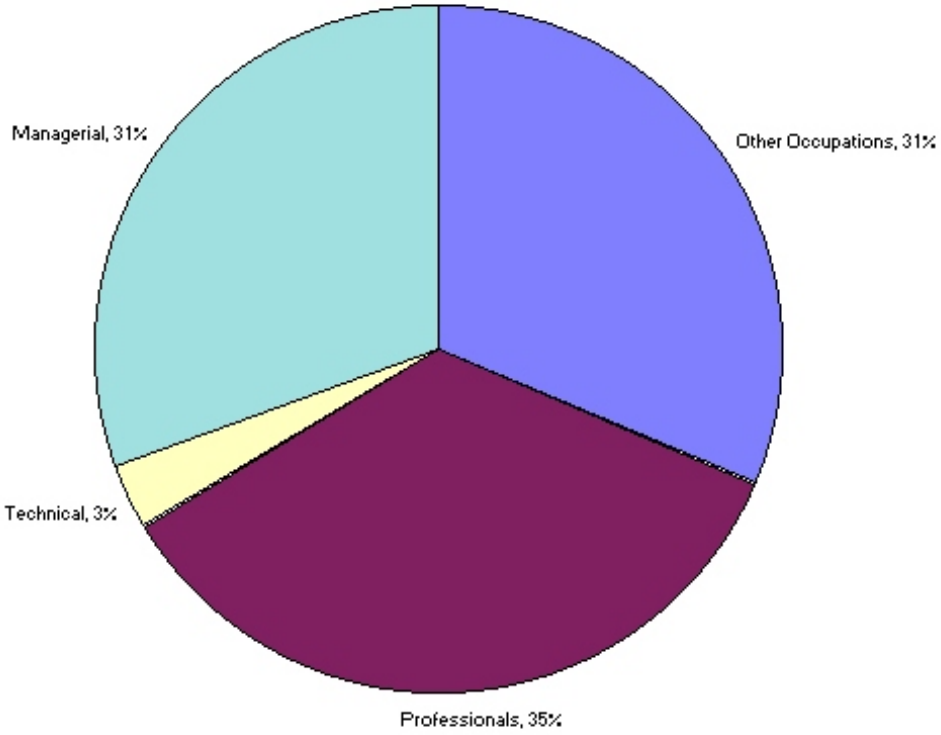
Improve Academic Achievement in the K-10 Grades. For the school-to-career initiatives to succeed, we must improve academic achievement of students in the K-10 grades. One important direction for reform is the establishment of clear standards, examples of what is meant by meeting the standards, and methods of assessing competencies that do not lend themselves to teaching to a test. A promising effort in this direction, financed in part with Federal grants from the National Science Foundation, is the New Standards Project developed by the National Center for Education and the Economy. This project has created standards in math, science, language arts, and applied learning for the 4th, 8th, and 10th grades. The applied learning standards are especially interesting because they require students to develop specific projects that demonstrate problem-solving, teaching and working with others, self-management, communication, and use of computer technologies. For example, meeting the problem-solving standard requires students to plan an event, design a system, or improve a system, students would typically work toward achieving other standards as well, including those in academic subjects.

Looking to the Future

We have much room for optimism about the potential job market of the future. The demand for skilled workers is likely to continue to expand, not only in the information technology field but in other fields as well. However, for our citizens to take full advantage of these hopeful trends in the job market, they must be better prepared. Individuals and parents must do more to help themselves. But our institutions must respond as well. Today's tight job market for skilled workers is a perfect time to expand significantly our public-private partnerships through skill standards, internships and apprenticeships, career academies, and other training approaches. It is also the time for public and private schools to work toward higher educational standards for our young people. This combination of approaches offers the best way of attaining not only our long-term economic goals but our social goals as well.

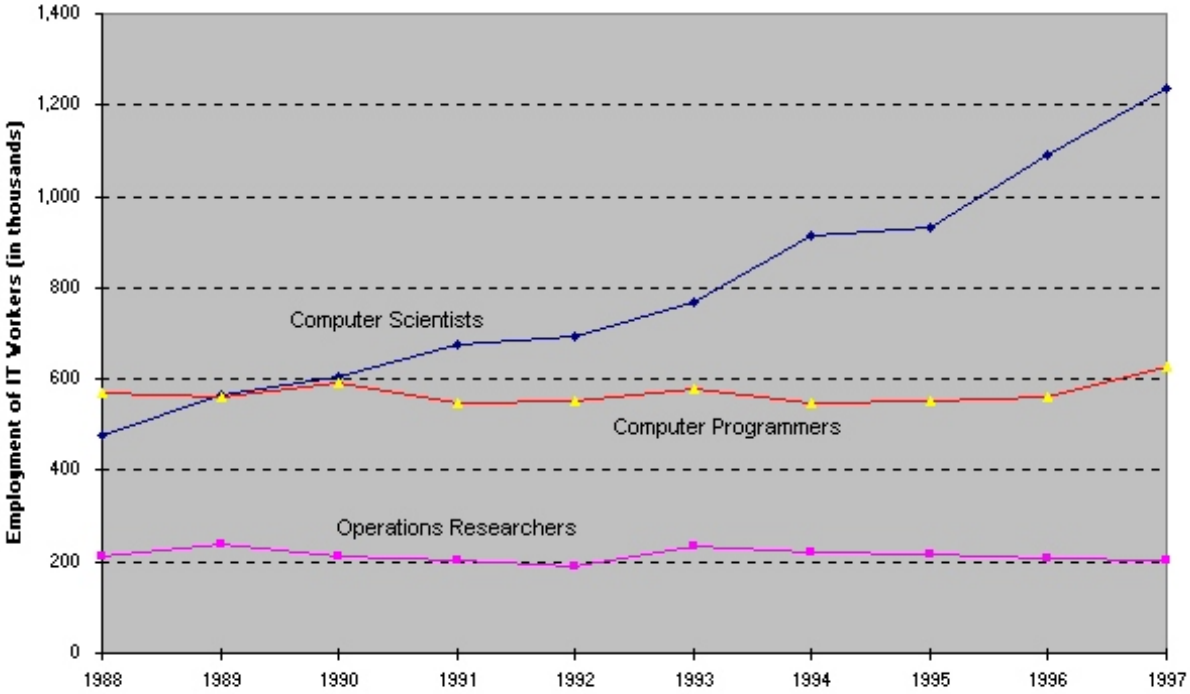
Tables, Charts & Graphs

Chart 1: Proportion of New Full-Time Jobs In the U.S. in the Professional, Managerial, and Technical Occupations: 1988-1996



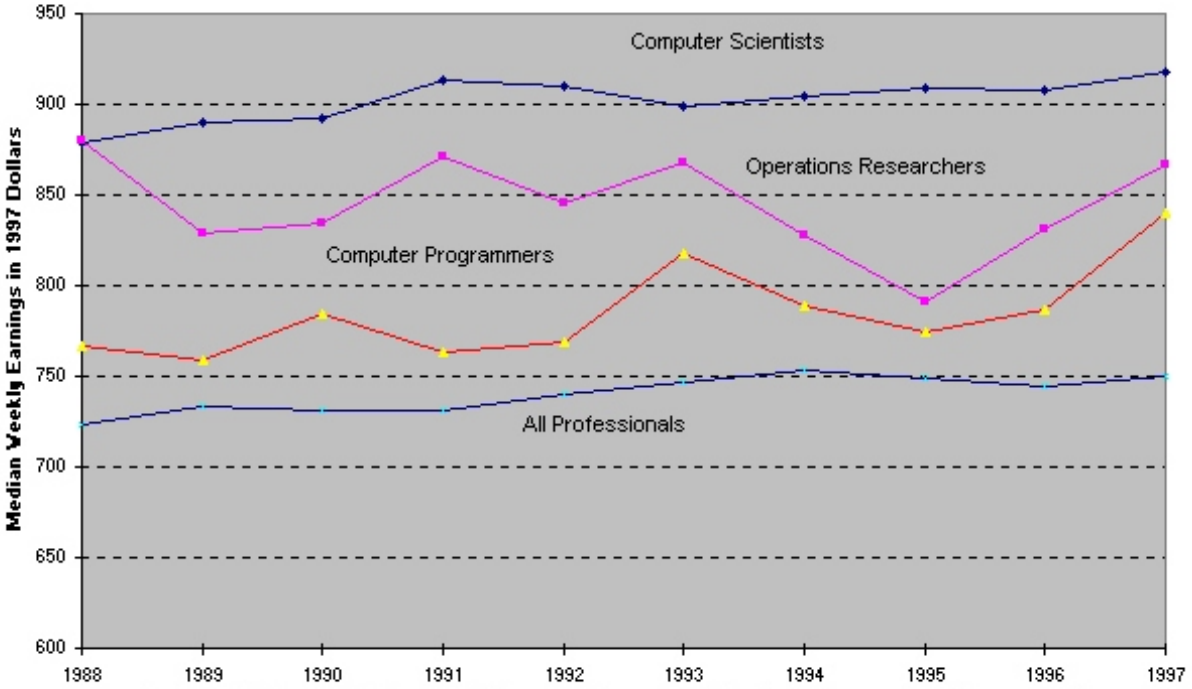
Source: Urban Institute Tabulations from *Employment and Earnings* , January 1990 and January 1997.

Chart 2: Employment Trends of Information Technology Occupations: 1988-1997



Source: Employment and Earnings, January 1989-January 1998, US Bureau of Labor Statistics.

Chart 3: Real Median Weekly Earnings of Workers in Information Technology Occupations: 1988-1997



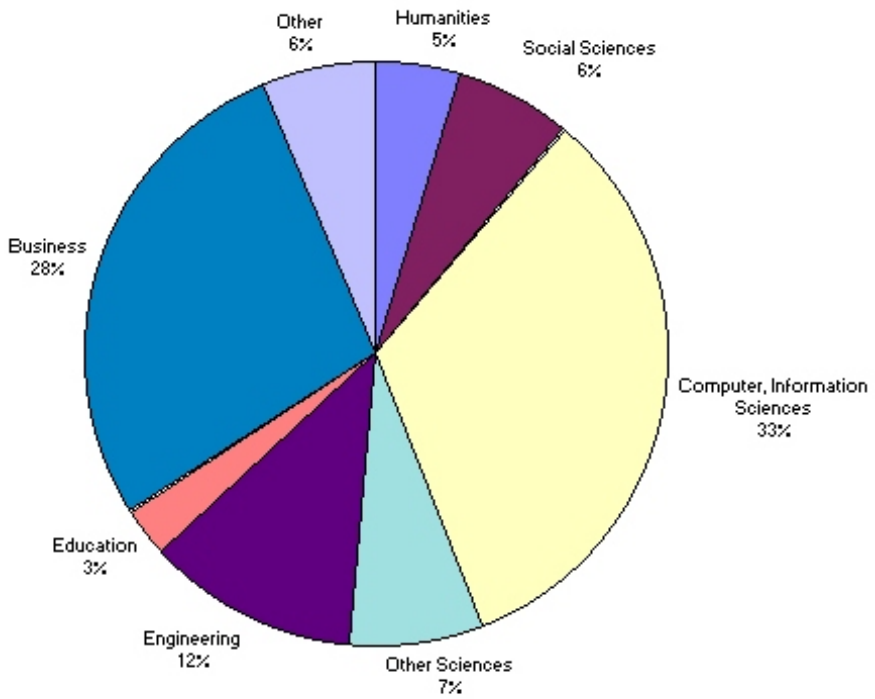
Source: US Bureau of Labor Statistics, Employment and Earnings, January 1989-January 1998. The earnings data are deflated by the GDP implicit price deflator.

Chart 4: Hourly Compensation of all White Collar Workers, of Computer Scientists/Analysts, and of Secondary School Teachers, As Reported By Employers in Selected Metropolitan Areas: 1996 and 1997

		Average Hourly Compensation of:				
Month of Survey	Metropolitan Area	All White Collar Workers	Computer Scientists/ Analysts	Secondary School Teachers	Wage Gap, Teachers vs. Computer Scientists	Percent Wage Gap, Teachers vs. Computer Scientists
Feb-97	Charlotte-Gastonia-Rock Hill, NC	$18.27	$27.78	19.55	($8.23)	70.4%
Jan-97	Columbus, OH	$16.97	$23.10	27.68	$4.58	119.8%
Dec-96	Dallas-Fort Worth, TX	$18.69	$26.11	22.54	($3.57)	86.3%
Apr-97	Dayton-Springfield, OH	$16.81	$24.72	26.55	$1.83	107.4%
Dec-96	Denver-Boulder-Greeley, CO	$18.79	$28.90	24.08	($4.82)	83.3%
Jan-97	Detroit-Ann Arbor-Flint, MI	$20.40	$27.53	36.18	$8.65	131.4%
Mar-97	Hartford, CT	$22.21	$25.66	36.29	$10.63	141.4%
Jan-97	Minneapolis-St. Paul, MN-WI	$19.95	$26.29	28.19	$1.90	107.2%
Sep-96	New Orleans, LA	$15.80	$26.68	20.32	($6.36)	76.2%
Feb-97	NY-Northern New Jersey-Long Island	$23.10	$33.08	41.45	$8.37	125.3%
June-July 1996	Rochester, NY	$17.26	$21.39	36.07	$14.68	168.6%
Mar-97	St. Louis, MO-IL	$17.65	$23.91	26.98	$3.07	112.8%
August-July 1996	Salt Lake City, UT	$14.74	$24.37	23.04	($1.33)	94.5%
Feb-97	Washington-Baltimore, DC-MD-VA-WV	$19.33	$25.68	28.45	$2.77	110.8%
	Unweighted Averages	$18.57	$26.09	$28.38	$1.89	109.7%

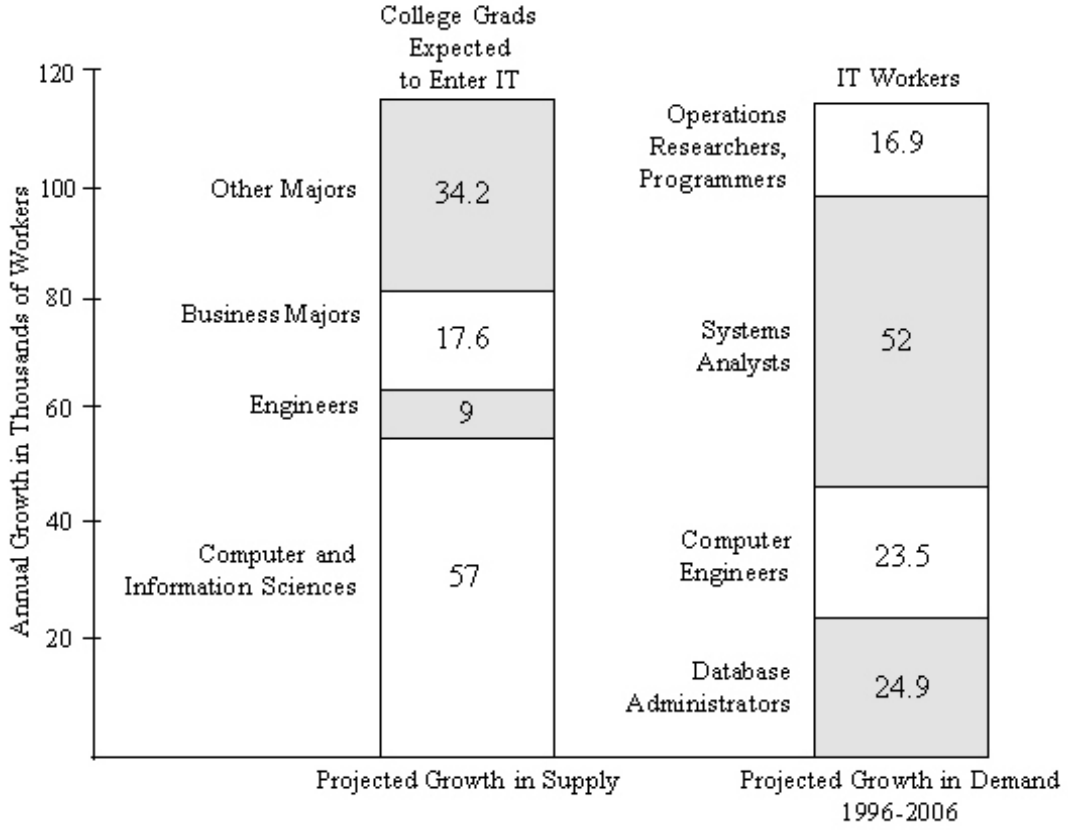
Source: Urban Institute tabulations based on data compiled using the National Compensation Survey off the Bureau of Labor Statistics Website

Chart 5: BA Degrees of College Graduates Entering Computer-Related Occupations



Source: Urban Institute, 1998, tabulations from *Baccalaureate and Beyond: Longitudinal Study*, US Department of Education

Chart 6:
Expected Annual Demand for IT Workers and Annual Sources of Supply



Other Publications by the Authors

- Robert I. Lerman