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Thinking and the Workforce

THE PROBLEMS WE FACE

This is a book about whether or not Americans are smart enough to make it in the twenty-first century. I would not write the book unless I was concerned. I am, and I am certainly not alone. The day I began writing it, in March 1991, a newscast reported a presidential commission's worry that the United States was losing leadership in the technologies that will dominate the twenty-first century. The news report reminded me of another commission that was worrying about the skills in the workplace of the future. That evening my university sponsored a talk by Ira Magaziner, who was subsequently to become a high-level policy advisor to President Clinton. Mr. Magaziner had chaired a third commission, worrying about the same thing!

As I busily gathered data and processed words, the concerns continued. President Clinton's successful 1992 presidential campaign made an issue of the need to retrain the American workforce to ready it for the demands of the high-technology workplace of the twenty-first century. In March 1994 the Clinton administration introduced legislation that the president described as changing unemployment programs from an emphasis on temporary assistance until the old job opened up again to permanent retraining for new jobs. In a sense, this book is an examination of the evidence behind President Clinton's concern. Is the American workforce ready for the next century? If not, what can be done about it?

The issue is usually stated competitively: "How can we stay number one?" It is not surprising that we think this way, because for most of the twentieth century leadership has meant military leadership. It makes sense to worry about being number one in a military confrontation.

This sort of thinking may not be appropriate in the future. Most serious thinkers believe that over the next 20 years the United States will face social and economic, rather than military, challenges (Halberstam, 1991). The historian Paul Kennedy (1987) has argued that the great empires before us—Rome, Spain, and Great Britain—lost their world dominance because they emphasized military power at the cost of economic and social dislocation. Kennedy, Halberstam, and others worry that America is repeating this error. While military might will not be irrelevant in the near future, it will not be as relevant as it was at the height of the cold war. One of the great strategic challenges we face is finding the proper mix between the military and domestic agendas.

Is being number one still relevant? Economic and social exchanges are more subtle than military confrontations. The element of competition is certainly present, as many of our corporations have found to their discomfiture. On the other hand, the "I win–you lose" aspect of military competition—in the jargon of academics, the zero sum game aspect—is muted. For example, the automobile industry competes with its Japanese counterpart, but the United States as a whole is not being threatened by Japan as a whole. And suppose that by some not unreasonable economic index, Swedes enjoy a "higher standard of living" than Americans. This is not a cause for national consternation. The real issue is whether or not the United States has enough wealth, distributed equitably enough, so that our citizens enjoy economically stable and socially productive lives.

Competitive indices, such as balance of payments accounts, and relative indices, such as children's proficiency in mathematics, are important. Indeed, this book contains more than enough of them for most readers. However, they are important as indicators of well-being rather than as points on a scorecard. Indices let us monitor potential problems in the creation and distribution of wealth. However, the indices are seldom crucial in themselves. We have to consider what they mean: Do we have problems and why? After we answer this question, we can explore answers to those problems.

Throughout the book, and especially in the first chapter, I am going to argue that we do have problems and that many of our problems and their solutions lie in the characteristics of our workforce.

A NATION'S WEALTH AND THE SKILLS OF ITS WORKFORCE

A country generates wealth internally, by production and prudent exploitation of natural resources. A country can also generate wealth

externally, by advantageous dealings with other nations. The accumulated wealth can be spent, either internally or externally, to purchase goods and services that improve the well-being of the citizens. How much accumulated wealth a country has to spend is more important than where it came from. As a bookkeeping device, countries monitor their balance of payment accounts to be sure that they are not overspending (which the United States probably is at present), but a country can safely maintain a negative trade balance for long periods, providing that the internal economy can generate the surplus to afford it.

Since this is not a treatise in economics, and I am certainly not an economist, I must connect this to psychology. Here is my argument.

Wealth is generated in basically two ways. One is by the direct sale of both renewable and nonrenewable natural resources that are available because of a country's location, such as oil, minerals, wood, and fisheries. Some "inheritances from nature" can be sold only once. Other natural resources, chiefly agricultural products, can, with proper management, be a steady source of income for a nation. In this case, location is likely to provide some advantage but not enough to keep competitors out if economic conditions change. The pineapple industry is a case in point: Hawaii's climate gave it an advantage for years, but the industry has now disappeared because of the development of more cost-effective plantations in Central and South America.

The second way wealth is generated is by adding value to a product or service. For example, in my home state of Washington the Boeing Aircraft Company adds value to metals, plastics, and rubber by assembling airplanes. Similarly, banking and accounting services add value to bank accounts by providing the communications network necessary for international credit operations. The people involved exercise their skills as they add value, they charge for these skills, and thus they acquire wealth.

In the last analysis all wealth from value-added operations depends on the skills of the people adding the value. *The wealth of a nation is therefore inextricably tied to the skills of its workforce.* Japan and Germany, two of the healthiest economies in recent history, illustrate this point. In terms of natural resources, both countries are poor. Their wealth comes from the skills of the German and Japanese people. These skills range from the industry of the worker on a production line to the talents of engineers, scientists, and management.

The United States will prosper if we find domestic and international markets for the skills of our people.

This is the point at which competition becomes relevant. In itself, I do not worry about the overall trade balance with Japan. I do worry

about the fact that two of the three best-selling cars in the American domestic market are made in Japan.[1] Why can't we compete in our own backyard?

In the short run, workforce skills are only one aspect of successful economic competition; local factors (e.g., government subsidies or trade barriers) have their influences. In the long run, though, workforce skills are a major factor. If country A and country B are competing over industry X, A will have an advantage if A's workforce offers better value for the dollar than does B's workforce.

To deal with these issues, we need to answer some questions about skills: First and foremost, what skills are going to be needed in the profitable economic sectors of the future? Second, at the absolute level, do we have these skills? Third, at the relative level, do we have these skills to the same extent, and at the same cost, as our likely competitors? Fourth, and finally, if the answers to the second and third questions do not leave us comfortable, what can we do about it?

The final question is the most important. In a world of rapid technological change, no workforce—ours, Japan's, Germany's, or anyone else's—has all the skills today that are going to be needed 20 years from now. Even more worrisome is that every workforce contains a substantial number of people whose skills may not be needed in 20 years. That is why there is so much talk about continuing education. When President Clinton and his advisers stress retraining, they are asserting three things; that there will be good jobs to be had, that many Americans are not now trained to fill them, and that those improperly skilled Americans can indeed be retrained for new and profitable work. To what extent is this optimistic view warranted?

These questions have been analyzed before, but usually from the viewpoint of the sociologist or economist. I am going to take a different view. Sociological and economical analyses are certainly useful to indicate what the problem is and what has to be fixed, but they do not tell us how the problem was created or what we can do to fix things. These questions are best answered by another branch of science, psychology.

This may sound surprising to those who think of psychology as primarily a therapeutic profession, designed to help people adjust to the world. In fact, the science of psychology ranges from studies of the neural mechanisms of learning in sea slugs to studies of the determinants of interpersonal attraction in young adults. Two subfields of psychology that will particularly concern us are *psychometrics* and *cognitive psychology.*

Psychometrics deals with the measurement of mental traits. This science developed the tests for intelligence, achievement, and personality that are now so widely used in schools, firms, and counseling of-

fices. For instance, the well-known Scholastic Aptitude Test, which is taken by most high school students applying to college, is a psychometric test. Psychometric tests can be used to measure the overall cognitive capacity of a population and to relate these capacities, as measured, to performance in the workplace. Many articles have been written on these topics. I have combined the findings of the articles with demographic projections, to estimate the abilities of the future American workforce. Insofar as I know, such a combined analysis has never been reported before.

Cognitive psychology deals with the processes of thought. In the context of this book, cognitive psychology and psychometrics are complementary sciences. Consider the relationship between scores on an intelligence test and performance in school mathematics. The psychometrician is interested in knowing what these correlations are in order to predict math performance from an IQ test. Once the statistics have been determined the psychometrician stops. The cognitive psychologist wants to know, in considerable detail, what mental steps a person takes when performing well in mathematics, and which of these steps are most crucial for success.

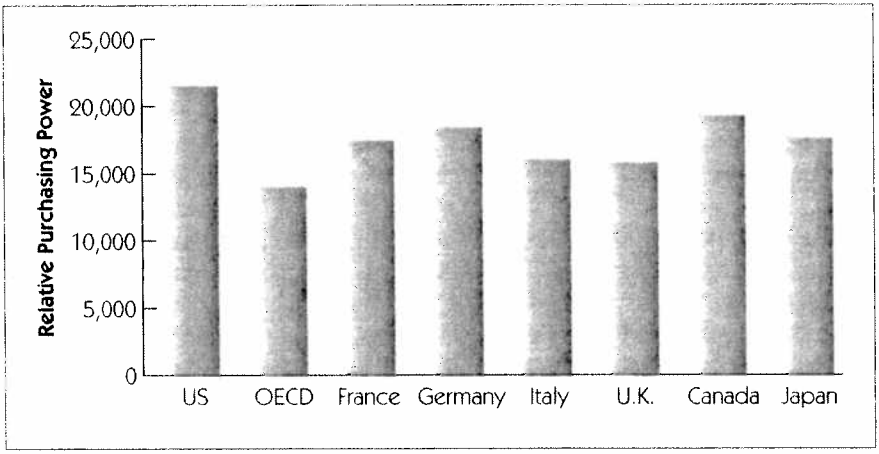
Cognitive psychologists proceed by developing general theories of how the human mind works and then applying these theories to particular situations, ranging from learning mathematics to operating machinery. In an analysis of the workforce, cognitive psychology complements psychometrics by asking what specific cognitive demands a particular work situation places on a person, and by determining how successful workers meet those demands. In the closing chapters of this book I will use findings in cognitive psychology to explain how changes in technology are changing the demands that the workplace makes on the worker, and I will speculate about what this means for training the workforce. The operative word here is *speculate.* Economists and sociologists have not hesitated to speculate about how the future will appear from their points of view. Insofar as I know, my attempt is the first such speculation based on psychology.

The remainder of this chapter takes a statistical view of the issues. Since statistics are dreary, I have relied on graphs and charts to present a picture of our position internationally, the composition of our workforce, its current cognitive competence, and the extent to which it seems prepared to cope with the twenty-first century.

Some International Comparisons

It is interesting to look at yourself from another person's perspective. When I lived in Australia, in the early 1960s, I read a book to my chil-

Figure 1.1 Relative purchasing power in the United States and selected countries. Source: U.S. Bureau of the Census (1993).



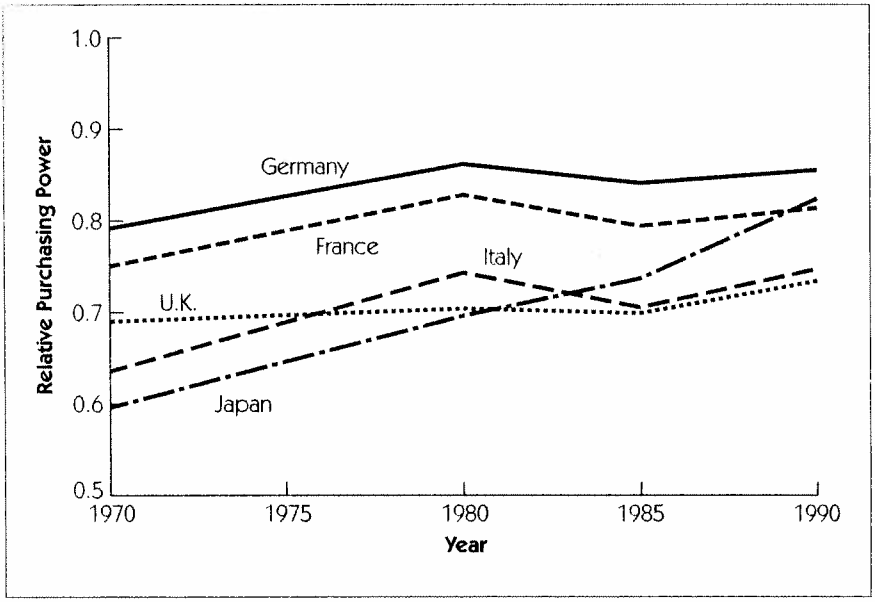
dren that told about how children lived all over the world. The chapter on the United States was entitled "The Richest Country in the World." While I was somewhat uncomfortable about having that aspect of my homeland stressed, I had no reasons to question the accuracy of the title.

Things have changed. It is not clear what country is the richest in the world, but one thing is clear: The United States is certainly one of the richest. In 1990 the gross national product (GNP) was about $5.5 *trillion* (one thousand billion) dollars. The Japanese GNP was $2.9 trillion, West Germany's $1.5, and $7.0 trillion for all of Western Europe (Bureau of the Census, 1993). Of course, the absolute comparison does not take into account the size of the countries involved. If you simply divide GNP by the population, Germany and Japan are the richest countries, closely followed by the United States. But this does not take into account the cost of living in each country. A better method is to consider the gross domestic product (GDP) per capita, and then adjust this figure to a comparable currency unit, which takes into account both exchange rates and the cost of goods within each country. The results of this calculation are shown in Figure 1.1. The United States is the leader, by a slight margin.

"Who is first?" is hardly the point. We are clearly one of the richest countries in the world. Perhaps most important, we are by far the largest country with a high level of wealth per person.

What is a bit more disconcerting is that changes in our wealth are not keeping pace with changes in other countries. Figure 1.2 shows

Figure 1.2 Purchasing power relative to U.S. purchasing power. Selected countries. Source: U.S. Bureau of the Census (1993).



changes in income per capita during the 1980s in several leading countries, expressed as a fraction of U.S. income per capita. On this scale the figures for the United States form a straight, horizontal line. An upward tilting line indicates that a country is gaining in wealth per person, relative to the United States, while a downward tilting line indicates that the United States is gaining on the country. All the lines in the figure tilt upward. Average incomes are increasing faster in other countries than in ours—for both the economic giants, Germany and Japan, and for relatively weak economies, such as Italy and the United Kingdom.

Clearly, the United States lost ground during the 1980s. The recession and slow recovery of the early 1990s, coupled with political upheaval in Eastern Europe associated with the collapse of the Soviet Empire, have changed the picture somewhat. As of 1992 the GDP in the United States grew more rapidly than that of its major competitors (2.1 percent for the United States, compared to .8 for Germany and 1.5 for Japan). However, 1992 was the first time in years that the United States had gained the lead. Only time will tell how permanent the 1992 figures are.

Competitive figures are not important in themselves. There is no

supernatural law that says that Americans have to be the richest people on earth. The concern is that the figures may be symptomatic of a deeper malaise. Why has the United States fallen from the preeminence that it enjoyed only 25 years ago? And, more to the point, what can we do about it?

Reduced American dominance on the international scene could simply reflect a return to "normalcy." Most of the statistics that have been cited as evidence of America's decline begin with a baseline in the 1960s—that is, only 15 years after the end of World War II. In 1945 the economies of all our major competitors had been devastated by the war, while the U.S. economy was unscathed. What we may be seeing is a return to "more normal" times.

While this argument has something to recommend it, there is no sense in accepting it fatalistically. Of course, no nation is going to hold all the world's wealth. Indeed, such a situation would not be healthy. On the other hand, it is not clear that economic laws hold the United States in a particular place in the economic world, in the sense that the law of gravity holds the earth in its orbit. Why should we not compete for as good a living as possible, consistent with our long-term, enlightened self-interest in a generally prosperous world? We should assume that our competitors will do the same.

Excessive military spending is another favorite explanation for our decline. The 1950–1990 arms race with the Soviet Union cost trillions of dollars. Furthermore, as of 1994 it is clearly the intention of the United States to remain the paramount military power in the world. Whether our past investments in military power were wise ones or not cannot be known, since we do not know the consequences if they had not been made. There is a clear-cut evidence that in the future there will be a much more careful weighing of the costs and benefits of military solutions. Witness the careful distinction made in 1992–94 between intervention in Bosnia, which was seen as a risk of great cost for possibly little gain, and intervention in Somalia, where, whatever the outcome, the risk was relatively small.

The United States has also been accused of following monetary and tax policies that encourage short-term profit taking rather than long-term investment. Most economists direct this argument at the Republican administrations of the 1980s and 1990s. However, the trends that seem to be most bothersome go back further than 1980. While one deplores bad government policies (especially with the advantage of hindsight), the problems we are facing seem to be more deeply rooted in society itself.

In assessing our problems, we must realize that the distinction between the domestic and export markets is rapidly breaking down. Eco-

nomically, our borders leak. Reich (1991, p. 113) offers a succinct example. Suppose that an American purchased a Pontiac Le Mans from General Motors in 1990. The purchase price of $20,100 would be split the following ways:

South Korea: labor and assembly	$6,000
Japan: advanced components	3,500
Germany: styling, design	1,500
Southeast Asia and Japan: components	900
Great Britain: marketing	500
Ireland, Barbados, data processing	100
United States: residual	7,600

Almost two-thirds of the cost of the "American" car went out of the country. Indeed, as Reich notes, this figure is a minimum, since the $7,600 for the United States includes the profits sent to GM shareholders in foreign countries.

Reich's example illustrates an important point: Goods and services can be shipped all over the world quickly; people cannot. However, the workforce in one country, *if it is capable*, can quickly enter a competition with the workforce in another country. This idea is foreign to the thinking of only a few years ago.

The Movable Workplace

Throughout the nineteenth century and most of the twentieth century, people migrated to the places where the jobs were. The most notable example is probably the migration of Europeans to the factories and mills of North America in the late nineteenth century and early twentieth century. In a few cases, manufacturers sought out the workers and transported them. A century ago, at the same time that skilled workers were sailing from Europe to America, English manufacturers subsidized a "reverse immigration" of skilled workers from North America to England to introduce new technologies there (Rosenberg, 1982, pp. 19–20). Two hundred years earlier Peter the Great offered large inducements to Western craftsmen willing to settle in Russia. Today, offshore factories all over the world seek skilled workers.

Earlier migrations were relatively slow, not for transportation or technological reasons but for human reasons. People, especially people with families, do not lightly pick up and move from one land to another.

The means of production have no such emotional attachment to their birthplace. That is how technology has changed the game.

In the early days of the Industrial Revolution the location of a factory was determined by access to markets and raw materials, control by the ownership, and the availability of an appropriate workforce. The access and control factors dominated. Therefore, once a political entity acquired an industry the prize was seen as a more or less permanent one. In the 1950s Detroit thought of itself as the motor capital of the world—forever.

Modern technology has changed this. Decreased transportation costs make it easy to ship both raw materials and finished products around the globe. The rapid increase in worldwide communication facilities has similarly made it possible for the "central office" to be anywhere. We can fax a directive across a continent as easily as we can send it down the hall. As of 1994 it is technologically possible to have a conference in which the participants are thousands of miles apart. By the turn of the century, it will be economically feasible to do so.

Because of these technological changes, businesses can establish production facilities wherever they will be most profitable. Very much the same thing is true for services. As of 1994 British Air is a major shareholder in USAir. British Air has no concern about maintaining management control from London, any more than Ford USA is concerned about providing management services to its worldwide empire.

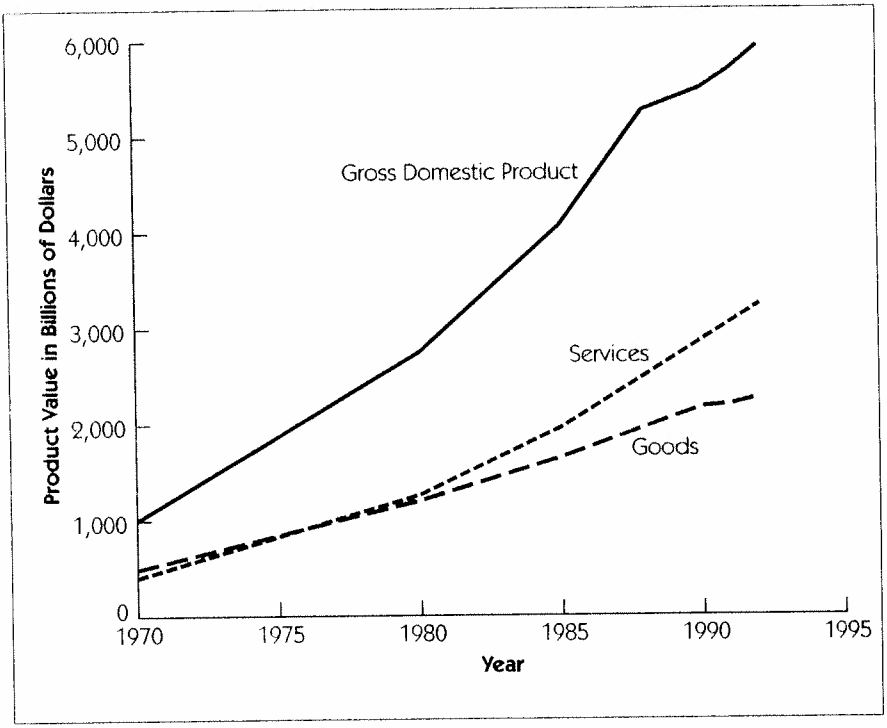
At one time company managers were reluctant to use their transport capability, because of implicit or explicit loyalties to the home country. Such loyalties are rapidly breaking down (Halberstam, 1991). Products that historically have been associated with particular nations are, in fact, often the result of an international assembly process.

The United States seems to be losing in the global exchange of goods and services. As has been widely publicized, we went from being a creditor nation in 1980 to being the world's largest debtor, a position that we have solidly held onto through the 1990s. In the short term, balance of payments accounts are influenced by international trading practices, tariff barriers, and a host of administrative reasons. In the long term, the prosperity of America rests on the skills of its people. We will look at these skills more deeply later in the book. First, we look at another indicator of economic health. Are we distributing our internal wealth in a way that leads to long-term social stability?

THE DISTRIBUTION OF PRODUCTION AND WEALTH

National wealth is not the only measure of a country's economic well-being. The majority of the citizens must share in both production and

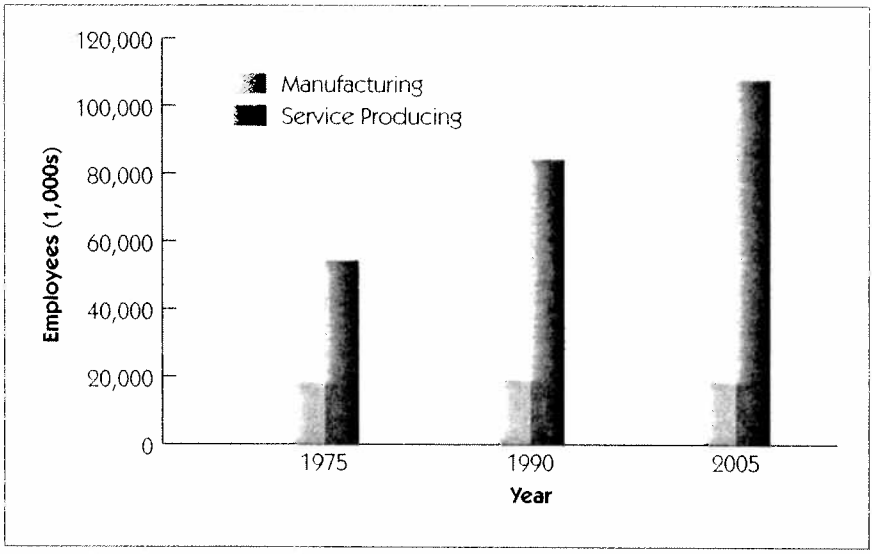
Figure 1.3 Trends in the relative values of goods and services. Source: U.S. Bureau of the Census (1993).



receipt of wealth. Otherwise the poor will resent the wealthy, and the workers will resent the shirkers—not a happy combination for a democracy. Let us look beyond the gross statistics to see how income and productivity are distributed within the country.

Productivity, measured in the value of output per worker per hour, has increased steadily since the end of World War II. However, there is a marked difference in productivity in the manufacturing and service industries. This is shown in Figures 1.3 and 1.4. Figure 1.3 shows the value of products of the goods and service industries since the 1970s. Goods and services contributed approximately equal value to the economy in the 1970s. The relative value of the service sector began to rise in the 1980s. In 1992 the value of services was about 1.4 times the value of goods. Figure 1.4 shows the employment figures, which tell a rather different story. The number of people involved in manufacturing has dropped slightly, while the number of people involved in services has almost doubled. These results are largely due to changes in technology, which permit us to do more things with fewer people. New tech-

Figure 1.4 Employment in manufacturing and services (2005 projected). Source: U.S. Bureau of the Census (1993).

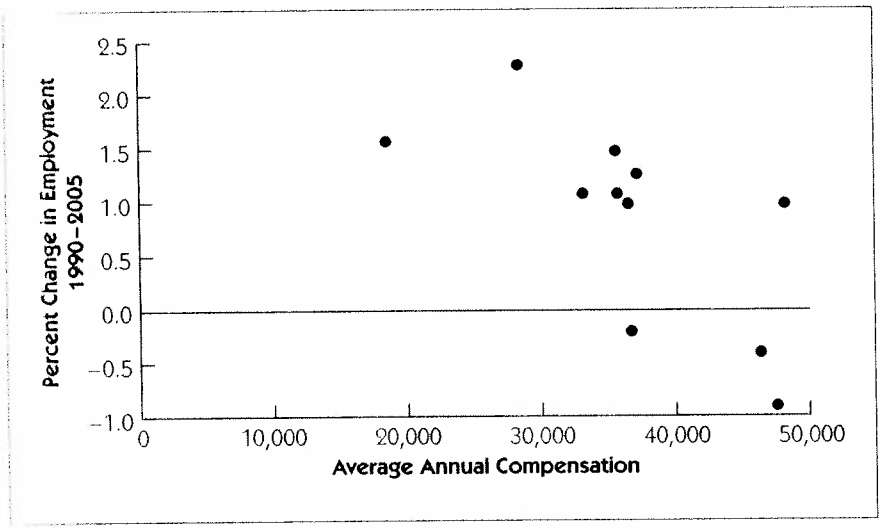


nologies have made their impact on both manufacturing and services, but the impact on manufacturing has been far greater.

Since manufacturing jobs generally pay better than service jobs, the result of this process has been that high-wage jobs are being lost, while low-wage jobs are being created. This trend is expected to increase. This is shown in Figure 1.5, which plots the expected growth in employment in selected occupations against the average 1990 income in each group. With some exceptions, the points drop as they move to the right. This indicates that high growth has been concentrated in low-paying jobs.

How did the end of the recession of 1990–1992 affect these trends? Although economic recovery began in late 1992, unemployment remained high. As of January 1994 the unemployment rate was estimated at 6.7%, a figure that would have been considered a recession 30 years earlier. The better-paying industrial jobs were particularly hard hit. Many jobs were permanently lost, either to competition or because employers had retooled so that they could make things with fewer people. In March 1994 the *New York Times* reported that in 1993, during a recovery from a recession, 615,000 jobs were eliminated. A *Times* quotation presents the reason in a nutshell: "Manufacturing employment is primarily governed by technology, and new technology requires half the number of people in product assembly every six years" (Laurence

Figure 1.5 The relation between annual compensation and projected changes in the number of jobholders in selected occupations. Source: U.S. Bureau of the Census (1993).



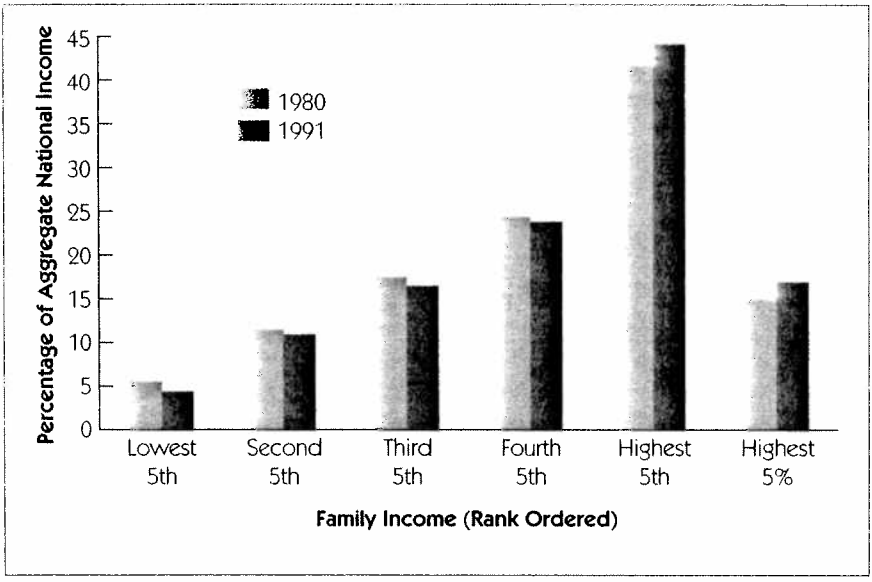
C. Siefert, AT&T VP for Manufacturing, *New York Times*, March 22, 1994).

Of course, new jobs were being created, but they were not good jobs. In 1989, 6 percent of the new jobs created were for temporary workers. In 1992, the first postrecession year, 26 percent of the new jobs were for temporaries. In 1993 that fell to "only" 15 percent. Skilled workers in manufacturing, laid off from $15 to $18 per hour jobs, were finding employment in the service industries at $6 to $8 per hour. The anecdotal reports and case studies are mirrored by statistics on earnings. The average weekly earnings in 1992, in constant dollars, were 7 percent below the figure for 1980 and 14 percent below the figure for 1970. This is not just a reflection of the 1990–1992 recession. Annual earnings for employees, again corrected for inflation, decreased in seven of the eight years from 1985 through 1992. We are dealing with a stable, long-term trend.

A small ray of light appeared by the end of 1994. Unemployment had fallen to below 6 percent, and there had been an increase in the number of new, high-paid jobs. Whether or not this represents a reversal of fortune or a minor blip in a long-term trend remains to be seen. Meanwhile, another, and perhaps more disturbing, trend has continued unabated.

Although the general trend has been loss of individual wealth the

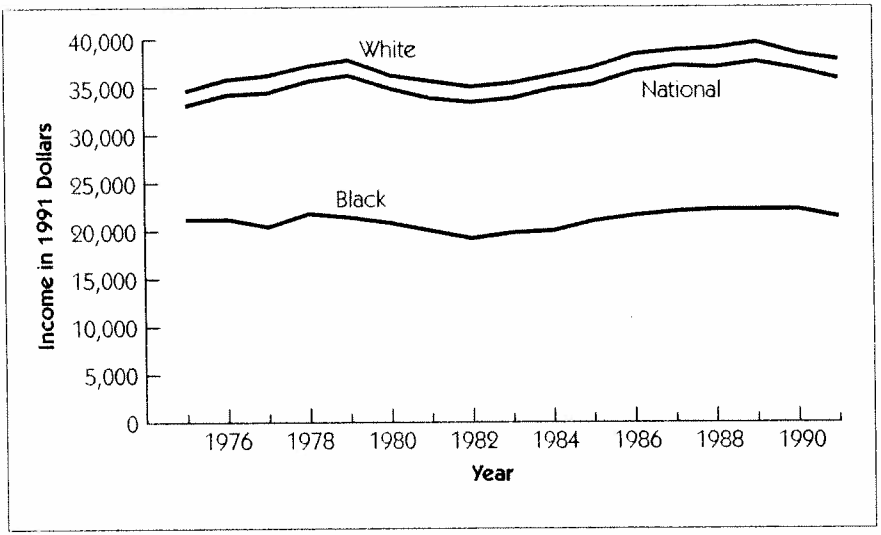
Figure 1.6 Distribution of national income by quintiles. Source: U.S. Bureau of the Census (1993).



losses have hardly been distributed equally. Figure 1.6 shows the percentage of income received by the lowest 20 percent of the population, the next highest 20 percent, and so on. The figure also shows the percentage of the national income received by the top 5 percent. Figures are shown for 1980 and 1991. If the relative income distribution over the population had been unchanged, the black and gray bars would be of equal height. They are not. Every group lost in its share of the national income, except the top 20 percent. Within that group, about half of the increment was due to a rise in the share of the wealthiest 5 percent.

The absolute figures on income illustrate these disparities even more dramatically. In 1980 the median income of families in the bottom 40 percent of the income distribution was (in 1991 dollars) $17,023. In 1991 it was $17,000—virtually unchanged. To gain some feeling for this figure, in 1991 a family of four with an income of $17,405 or less were defined as "working poor" (income of less than 125 percent of the poverty rate); 18.9 percent of all Americans fell into this category. By contrast, the median figure for families in the top 10 percent was $89,465 in 1980 and $102,824 in 1991, an increase of 15 percent (Bureau of Census, 1993, Tables 722, 735). The rich got richer, while the lower middle class and below stayed the same. In absolute terms there has been virtually no movement in the percentage of peo-

Figure 1.7 Trends in median family income, by ethnic status. Source: U.S. Bureau of the Census (1993).



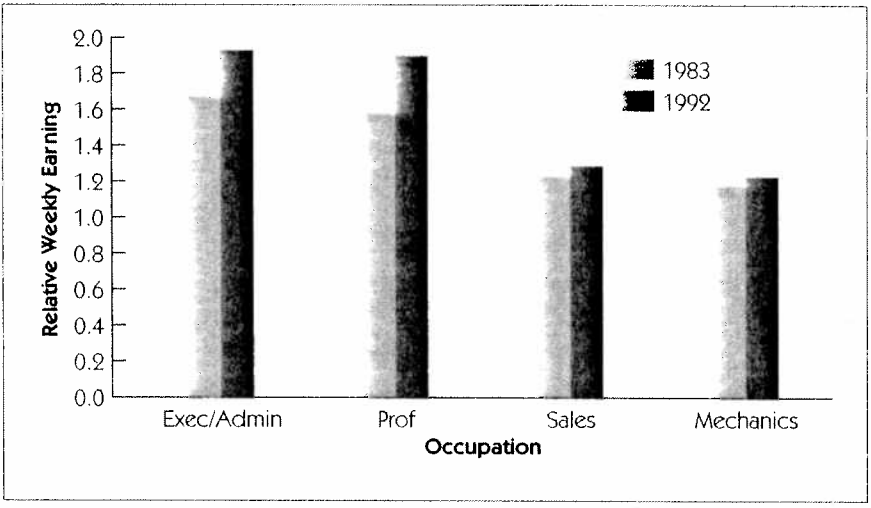
ple below the poverty level and below the working poor level since 1980. These figures have remained at the 13–15 and 17–19 percent levels.

The United States has been plagued by a persistent disparity in income across demographic groups. Figure 1.7 shows the median family income in constant dollars for the nation as a whole, and for black and white families for the period 1970–1989. In spite of major social efforts to improve the situation, the median family income of a black family was 61 percent that of a white family in 1970, 58 percent in 1980, and 58 percent in 1990. For Hispanics the relevant figures are 69 percent, 67 percent, and 63 percent. The poverty level figures reflect the same trends. In 1980, 32.5 percent of all blacks and 25.7 percent of all Hispanics were below the poverty level. In 1990 the figures were 31.9 percent and 28.1 percent.[2]

The increasing disparity in income extends to both blue-collar and white-collar jobs. Blue-collar workers have been particularly hard hit. In 1972 craft workers received, on the average, 98 percent of the wages of professional and technical employees. In 1987 the figure was 73 percent. Clerical wages dropped from 68 to 54 percent of the professional-technical earnings, and retail sales wages from 65 to 46 percent (Commission on the Skills of the American Workforce, 1990).

The disparities in earnings between workers and "top management"

Figure 1.8 Weekly earnings of selected occupations relative to the weekly earnings of machine operators. Source: U.S. Bureau of the Census (1993).



have widened dramatically. Figure 1.8 shows the relative salaries for four different occupations; executives and administrators, professionals (physicians, lawyers, accountants), sales personnel, and mechanics. Figures are shown from 1983 to 1992. If you wanted a raise in pay, it was clearly better to be an administrator than a mechanic. Some recent figures are even more dramatic. From 1989 to 1990 the average income of an American worker, not corrected for inflation, increased a little less than 5 percent. The average increase for corporate executives was 8 percent.[3] Preliminary figures for the years following the 1990–1991 recession suggest that the situation has gotten even worse. In some cases major industries have asked for wage concessions from employees while paying executives more than a million dollars a year.

Numerous commentators (e.g., Reich, 1991) have maintained that this degree of disparity in wealth is neither appropriate nor healthy for our society. The United States is not approaching the extremes of wealth and poverty seen in some third-world countries, such as India or the oil-producing Arab states. That comparison is not relevant. We are developing greater disparities of wealth than are seen in the industrial nations of Europe and Asia.

Technologies that sharpen the difference between the productivity of highly skilled and less skilled workers redistribute job opportunities in Germany and Japan in exactly the same way that they do in the United States. Advances in robotics offer equal unemployment opportunities! Several European countries are experiencing social problems

because of selective rates of high unemployment. Even Japan has had to compromise its vaunted reputation for high employment by forced retirements. Clearly the difference between us and our competitors is not in the challenges we face.

We and our competitors do differ in our overall social response. The United States and, to a somewhat lesser extent, the United Kingdom, provides minimal social support for the unemployed. Therefore, when a relatively well-paid worker is laid off, he or she has a powerful incentive to accept a new job at lower wages. Several of the continental European countries offer superior welfare support systems. Predictably, these countries are experiencing higher levels of unemployment, ranging to nearly 20 percent in Spain. In effect, these countries place a larger cushion under the poor, at the expense of the rich and, for that matter, the moderately affluent. For instance, 1991 payroll tax rates for social security programs averaged 19.3 percent in the United States, 24.44 percent in Japan (which also has extensive retirement systems and company-financed benefit programs), 36 percent in Germany, and 55 percent in Italy. As is well known, income tax rates are also much more progressive in other industrialized countries than they are in the United States. This system of transfer of wealth does reduce the disparity between the poor and the affluent. However, it is not a perfect solution. There is increasing evidence that the cost of social support systems is becoming an increasing economic burden on the European countries. In any case, it is unlikely that the United States could politically adopt the European solution, because of strongly held beliefs that government social programs are inherently wasteful, and that government interventions in the distribution of wealth stifle individual inventiveness and productivity.

The statistics tell us something about who is or is not finding work. But who are these people, and how well are they prepared for work?

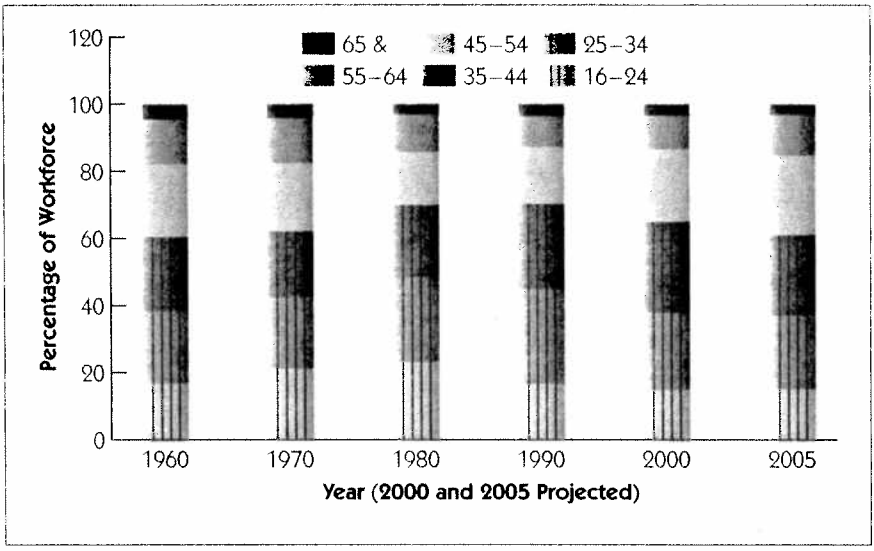
SOME DEMOGRAPHICS OF THE AMERICAN WORKFORCE

In 1990 the American civilian workforce contained 125 million people.[1] By the year 2000 it is expected to grow to slightly over 141 million workers (Johnston and Packer, 1987), but it will not just be an expansion of the same workforce.

The workforce is aging. The median age of the population of the United States was 26 in 1930 and 28 in 1970, not much of a change. By the year 2000 the median age will be 36 (Johnston and Packer, 1987).

The change in the workforce age distribution is shown in detail in Figure 1.9, which displays progressive changes in the composition of the workforce from 1960 to its projected state in 2000 and 2005. The

Figure 1.9 Age distribution of the U.S. workforce, 1960–2005. Source: U.S. Bureau of the Census (1993).



American workforce at the turn of the century will not be dominated by workers over 55. In fact, the percentage of workers in this group actually decreases. There will be a substantial increase in the percentage of workers in the 35–54 age range, at the expense of lowered percentages of workers under 35.

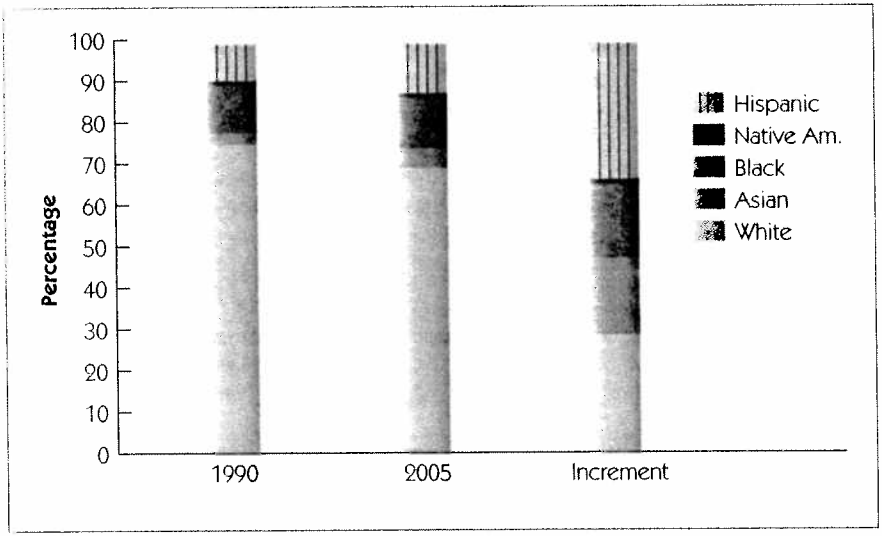
This trend is likely to have a major impact on the availability of psychological skills. Older workers are not simply more or less intelligent than younger workers. The old and the young have different cognitive skills. There is a predictable shift toward more knowledge about how things are done, coupled with a reduction in the speed with which new ideas are grasped (Salthouse, 1990). Thus, aging increases the value of a workforce when the workplace is static, but it may decrease the value of the same workforce if the methods and technology of the workplace are changing.

There has been a good deal of discussion about the increased feminization of the workforce. Statistically this will be a fairly small effect. The present workforce is about 45 percent female; this is expected to increase to 47 percent by 2000. What may change, but what is much harder to predict, is the sort of jobs that women hold.

The third trend is a change in ethnic constitution, away from the present dominance of whites. The changes are complex.

Figure 1.10 shows the ethnic distribution of the population in 1990

Figure 1.10 Percentage of workforce and percentage of increment of workforce in various ethnic groups, 1990 and 2005. Source: U.S. Bureau of the Census (1993).



and the projected distribution in 2005. Clearly, there is little change in the overall distribution. The picture is quite different if one looks at the ethnic distribution of increments in subpopulation sizes. This is shown in the right-hand column of Figure 1.10. Although the population as a whole will still be predominantly white, the increment to the population will be split approximately evenly between Asians and non-Hispanic whites and then minority groups. Hispanics will be the most rapidly expanding group. This reflects both a high birthrate, relative to the rest of the population, and anticipated immigration from Central and South America.

Immigration is one of the "wild cards" in the projections. The Office of Technology Assessment (OTA) pointed out that immigration accounted for 22 percent of the growth in workers in the United States in the period 1980–1987 and projected that immigration would have an increased impact on workforce growth in the next 10 years.[5] Immigrants are a mixed group: Some immigrants to the United States contribute at the very top of the workforce, in sciences and the professions. Most immigrants, however, are poorly educated compared with the U.S. workforce, and about one in six does not speak English (Office of Technology Assessment, 1990). Even those who do speak English often have only marginal skills, especially with the written language (Kirsch, Jungeblut, Jenkins, and Kolstad, 1993). Thus, the immediate impact of

increased immigration is on the lower-paid, less desirable jobs. The long-term impact is virtually impossible to assess.

Another trend is a change in mobility. By world standards, the American workforce is unusually mobile; Americans change jobs frequently compared with workers in other industrial nations. Job changing is closely related to age . Younger workers change jobs much more often than older workers. This is understandable. On the one hand, older workers are more likely to be occupying permanent, relatively well-paid positions, hence, have less incentive to change. On the other hand, older workers and their families tend to have firmer ties to their community and are therefore less able to change locations. As has been argued, accelerated technological changes are clearly decreasing job stability and accordingly increasing pressures on workers to be mobile. For instance, in early 1994 there was a fairly good market nationwide for machinists and electricians, but an excess of these skills in Los Angeles, Kansas City, and Seattle, due to reductions in employment associated with fluctuating demand and technological changes in the aerospace industry. Unfortunately, the increased pressure to be mobile is not accompanied by an increase in ability to move. Older workers are more likely than younger workers to have working spouses, school-age children, and economic ties to their communities.

COGNITIVE CHARACTERISTICS OF THE WORKFORCE

In the last economic report of his administration (1993), President Bush claimed that the American worker is the most productive in the world. Whether or not this is correct depends on how productivity is defined, but, as we have seen, the American worker, averaged over the entire economy, is certainly one of the most productive in the world. Productivity can be obtained in two ways: by the skills of the workforce or by capital investment in technologies that reduce the need for large numbers of workers, but increase the productivity of the individual worker on the job. Thus, the cognitive skills of the workforce depend upon the competence of the workforce in managing the machinery it has. The greater the skills of the workforce, the less incentive management has either to invest in new technologies or, more frighteningly, to seek a new workforce.

But how are we to assess workforce skills? Traditionally this has been done by determining the amount of education that workers have, on the not unreasonable assumption that the more educated people are, the more skilled they are. While this is a valid argument, it is not entirely correct. Marshall and Tucker (1992) offer an instructive analogy to the engineering distinction between *design standards* and *perfor-*

Table 1.1 Educational Levels Attained by the Present U.S. Workforce

	Not High School Graduate	High School Graduate	College (one year or more)
Total	18.2%	39.6%	42.1%
Whites	15.8	39.8	44.4
Blacks	22.7	42.4	34.4
Hispanics	39.0	33.5	27.4

Source: Office of Technology Assessment (1990), Table 1-3.

Note: Totals are extrapolations based on OTA estimates of ethnic groups in the workforce.

mance standards. A design standard specifies how a product is to be made, while a performance standard specifies what the product must be able to do when it is used. Marshall and Tucker argue that the same distinction applies to education. Requiring that all U.S. citizens attend school until age 16 is a design standard. Requiring that all high-school graduates be able to summarize the argument in a newspaper editorial is a performance standard. Following Marshall and Tucker, we must distinguish between the design standards used to prepare entrants in the workforce (and to maintain their skills once they are in the workforce) and the performance standards that educated workers are expected to meet.

Workforce capabilities are usually expressed in terms of education level. The United States does very well, relative to the rest of the world, in terms of percentages of its citizens who have graduated from high school or have attended college. However, there are major causes for concern because educational qualifications, like wealth, are not spread equally across our population.

Table 1.1 presents the statistics for education levels attained by the present workforce and for the three major ethnic groups (whites, blacks, and Hispanics). As the table shows, the workforce as a whole is relatively well educated. Although comparable figures are not available worldwide, I suggest that the percentages are quite high compared with other countries. However, there are obvious disparities between ethnic groups.

In order to estimate the future workforce, we need to look at present enrollment in the schools. Table 1.2 compares enrollment rates in high schools and postsecondary education in seven industrialized countries. The United States is one of the leaders insofar as high school enrollment is concerned, and the leader, by a considerable margin over Europe and Japan, in postsecondary (college and university) education.

Table 1.2 School Enrollees

	Canada	France	Germany (West)	Italy	Japan	United Kingdom	United States
High school	106	99	104	79	96	84	96
Beyond high school	70	40	33	31	31	25	72

Source: National Center for Education Statistics (1993), Table 385.

Note: 1990 Enrollment ratios in high school and post-high school programs in selected countries. The enrollment ratio is the number of enrolled students divided by the number of people in the appropriate age group in the population. For post-high school education, the age group used is the number of people in the 20–24 age range.

The latter figure is a bit misleading, however, because the U.S. figure includes enrollees in vocational training courses. In Germany and Japan comparable education is often provided by employers.

Table 1.2 shows enrollment in educational institutions, rather than completion. Figure 1.11 shows the high school dropout rates for the

Figure 1.11 Percentage of dropouts from high school in the population of 16–24-year-olds. Source: National Center for Educational Statistics (1993).

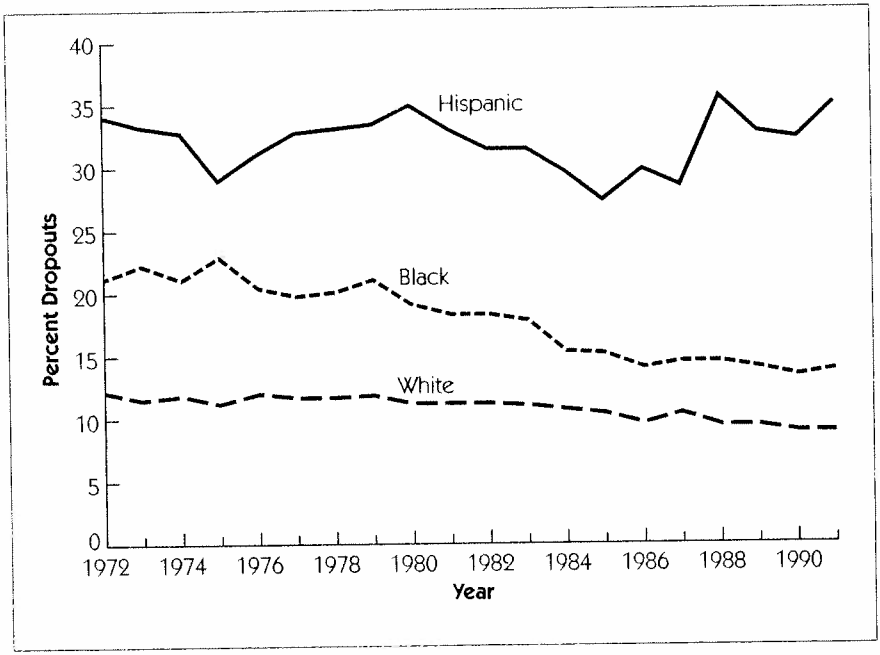


Table 1.3 Percentage of College and University Degrees Granted to Members of Various Ethnic Groups, as a Percentage of Total Degrees Granted

Degree	White	Black	Hispanic	Asian and Other	Alien
Bachelor's	83.6	6.0	3.4	4.2	2.7
Master's	77.7	4.9	2.6	3.7	11.1
Doctor's	65.7	3.1	1.9	4.1	25.2
M.D., D.D.S., LL.B., or similar	84.4	5.0	3.5	5.7	1.7

Source: National Center for Education Statistics (1993).

Note: Data from 1990–91.

United States from 1972 to 1991.[6] Overall the dropout rate has decreased from about 13 percent to just under 10 percent. As is well known, dropout rates are higher for the larger minority groups than they are for whites and Asian Americans. The dropout rate for black students is declining, but the dropout rate for Hispanics remains high. This is particularly discouraging because Hispanics are the most rapidly growing ethnic group in the United States.

Higher education figures also show a marked discrepancy between ethnic groups. Table 1.3 shows the distribution of degrees to members of different ethnic groups in 1989–1990. Among our largest minorities, blacks and Hispanics, half as many degrees were granted as would be expected on the basis of their percentage of the population. The discrepancy grows greater the higher the degree and the more technical the field. In 1990–1991, 4,164 Ph.D. degrees were granted in the physical sciences, 103 to blacks and Hispanics combined and 1,326 to nonresident aliens.

Direct Indicators of Competence

As educators frequently say, and students occasionally hear, the point of education is not to get a degree, it is to learn something. How cognitively proficient is our highly educated workforce? There are three ways to assess workers' cognitive capabilities. One is to ask employers whether they think that their workforce performs adequately. Another way to proceed is to determine whether employers pay higher wages to more highly educated employees. Finally, cognitive competence could be measured directly, by testing people in the educational or workforce systems. Each of these methods has its advantages and drawbacks. Interestingly, each produces a somewhat different picture.

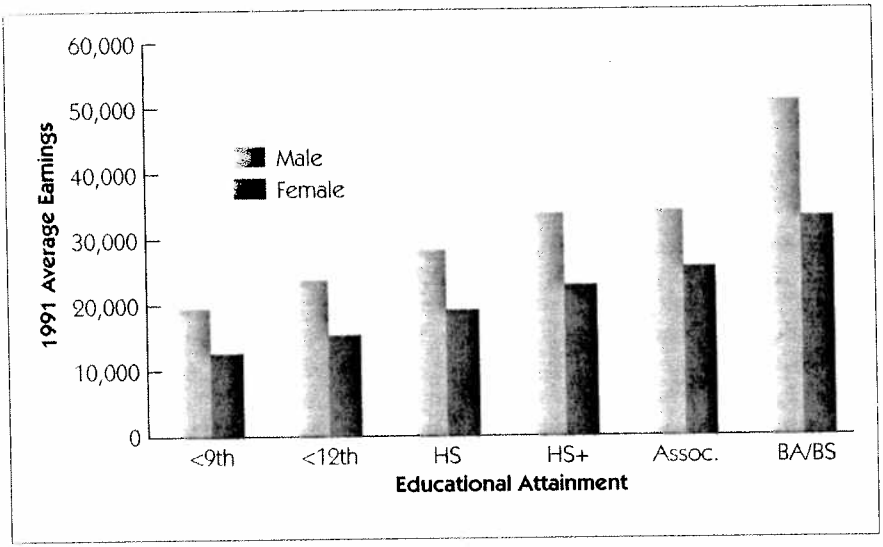
Over the past 10 years there have been numerous surveys of employers' attitudes about the entering worker. Indeed, the oldest of the surveys that I shall cite, the National Academy of Sciences report (1984), began by apologizing for yet another educational report. The NAS report, and three subsequent commission reports (Commission on the Skills of the American Workforce, 1990; U.S. Department of Labor, Education & Commerce, 1988; Secretary's Commission on Achieving Necessary Skills, 1991) all reached the same three conclusions:

1. Members of the entering workforce are generally deficient in basic skills in language use (reading, writing, speaking) and in mathematics. A few large companies have instituted training programs to decrease these deficiencies.
2. Employees ought to have better "learning" or "problem-solving" skills. These are rather vaguely defined as the ability to adjust to new situations, solve problems, and so on.
3. New entrants to the workforce lack a number of interpersonal skills, such as disciplining themselves to meet time commitments, being motivated to do a better than minimally necessary job, working with others, and presenting a good face to the public. These nonintellectual skills will be referred to collectively as a "work ethic."

Findings from these surveys have generated what might, at best, be described as a panic reaction. In 1989 the journal *Human Capital* put the "sky is falling in" argument neatly in a cover headline, which asked, "Is U.S. future held hostage by nation's poor schools?" The headline introduced articles by various business executives and economists, who argued that (1) the nation's educational system is a mess, (2) the only hope is that business either intervene in the schools directly or assume responsibility for education in the workplace, and (3) U.S. working practices must be reorganized to take advantage of the cognitive skills of the workers. *Human Capital* is by no means alone in its concern. Similar articles appear regularly in the *Wall Street Journal*, *Fortune*, and many other business magazines.

Employers are clearly unhappy. It is not clear, though, whether they feel that the schools have deteriorated from previous good performance or whether work demands have changed. When pressed, few employers cited serious shortages of qualified workers, with the exception of the craft trades and a large number of fairly low-paid jobs that have traditionally been performed by women (secretaries, nurses, nurse's aides, etc.). Most employers viewed the work ethic problem as more serious

Figure 1.12 Annual earnings as a function of educational attainment. Source: National Center for Educational Statistics (1993).



than cognitive skills problems. However, employers in high-technology industries such as IBM and Motorola dissented. These employers expressed more concern over cognitive qualifications (Commission on the Skills of the American Workforce 1990).

What are we to make of these reports? The work ethic problem is virtually impossible to evaluate on the basis of subjective reports. Employers have been complaining for generations that employees do not work hard enough. On the other hand, it would be possible to determine objective indices of workforce ethic, such as absenteeism. Zuboff (1989) has pointed out that this has been a problem since the nineteenth century. We simply do not have adequate data to make a comparison across time.

Although employers seem to denigrate education, and especially the high school diploma, the same employers do pay higher wages for higher education. Figure 1.12 shows the 1991 median income for male and female full-time workers, by educational level. Men and women are shown separately because women generally occupy lower-paid jobs than men do. Income and education are closely associated. The median income of a person without a high school diploma was about half of the median income of a person with a college degree. In spite of all the jokes, it pays to be educated.

Figure 1.12, together with some other statistics in this section,

shows that some of the inequalities in rewards received by different ethnic groups are due to differential distributions of educational rewards. Society is paying relatively more to better-educated people, especially at the college level and beyond. The higher one goes up the educational ladder, the greater the disparity between the number of whites and Asians versus blacks and Hispanics. It is also true that, in general, blacks and Hispanics without college educations receive less than comparably educated whites and Asians.

The fact that education increases with income is not in itself a denial of employers' contentions that the educational system is failing, especially at the high school level. In the last few years the constant-dollar income of "lower-level" employees, without college experience, has decreased. Evidently employers are either exporting low-skill jobs, eliminating them with automation, or devaluing those jobs that require lower levels of skill (Wegmann, Chapman, and Johnson, 1989). What is startling is that "lower level of skill" now seems to mean lacking at least some college education.

The evidence suggests that the American higher education system produces a pretty good product. Foreigners appear to agree with this contention, since our colleges and universities import far more students than we export, especially at the graduate level. Insofar as student preparation is concerned, the problem does not seem to lie with the colleges and universities, but with the elementary and high school (K–12) system. In order to take a closer look at the problem, let us examine some results of the third way to assess cognitive capabilities, by directly testing what people can do.

In 1992 the Educational Testing Service (ETS) conducted an extensive survey of adult literacy (Kirsch et al., 1993). Over 13,000 U.S. residents were interviewed. The sample was carefully selected to make it possible to extrapolate the results to the population as a whole. The tests themselves were designed to reflect the ways in which language and cognitive skills are used in everyday life. Three types of skills were examined: reading newspapers and instruction-like material; using documents, such as a bus schedule or a government form; and using quantitative skills, varying from balancing a checkbook to determining the interest on loans.

For purposes of reporting, test scores were grouped into five levels. Level 1 tasks required test takers to locate a single clearly stated fact in a newspaper article or balance a checkbook. Level 5 tasks, by contrast, required them to draw inferences from information presented in articles, use documents in a sophisticated way, or solve reasonably complex arithmetical problems. *Almost half the population performed at Levels 1 and 2.* Performance at this level indicates an ability to under-

stand things that are directly and clearly stated, but not to use information in any creative or integrative way.

Members of minority groups did particularly poorly. Depending only slightly on which test was examined (prose, documents, or quantitative skills), about 15 percent of all whites tested, 40 percent of blacks, over 50 percent of Hispanics, and about 30 percent of Asians and Pacific Islanders performed at Level 1.

As the ETS report points out, levels of quantitative and literacy skills are closely related to education. In general, minority group members are less well educated than whites. This is especially true for older adults and for immigrants. When educational level is taken into account, the difference in mean scores of whites versus blacks and Hispanics drops to about half its level, but is still substantial. (The white–Asian difference is unchanged.) Since minority group members are becoming a progressively larger percentage of the U.S. population, improvement of their cognitive skills must be a matter of national priority.

What is perhaps most discouraging was evidence of deterioration in skills of the groups containing younger entrants to the workforce. The 1992 results for workers aged 21–25 can be compared with results of a comparable survey taken in 1985. The 1985 examinees, on the average, outscored the 1992 examinees by 10 or more points on all three tests of skills.

What is the status of people who are still in school, but who will be in the workforce during the next 10 to 15 years? The National Assessment of Educational Progress (NAEP) program, which tests basic skills in large samples of schoolchildren at various ages, provided most of our data. Since we are concerned with the workforce of the near future, we are especially interested in high school students' performance in reading and mathematics.

NAEP reading test results are presented in terms of mean or median scores. Carroll (1987) has suggested the following interpretation of the numbers.

1. Basic. Can read stories in third grade readers and follow simple labels and instructions. (NAEP score 200)
2. Intermediate. Can read simple popular magazines. (NAEP score 250)
3. Adept. Can read most newspaper stories and popular novels. (NAEP score 300)
4. Advanced. Can read newspaper editorials at the *New York Times* level. Generally the level expected of graduating college students. (NAEP score 400)

Figure 1.13 Percentage of students reading at or above indicated reading levels. Source: National Center for Educational Statistics (1993).

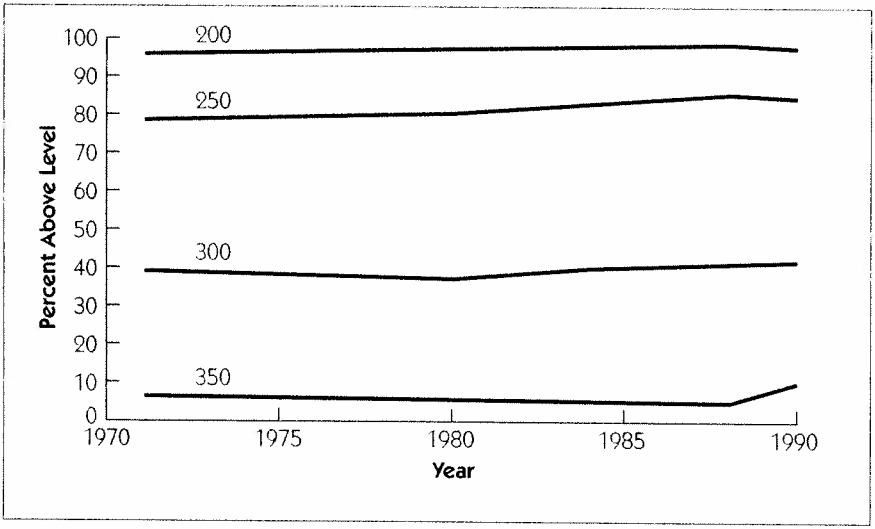
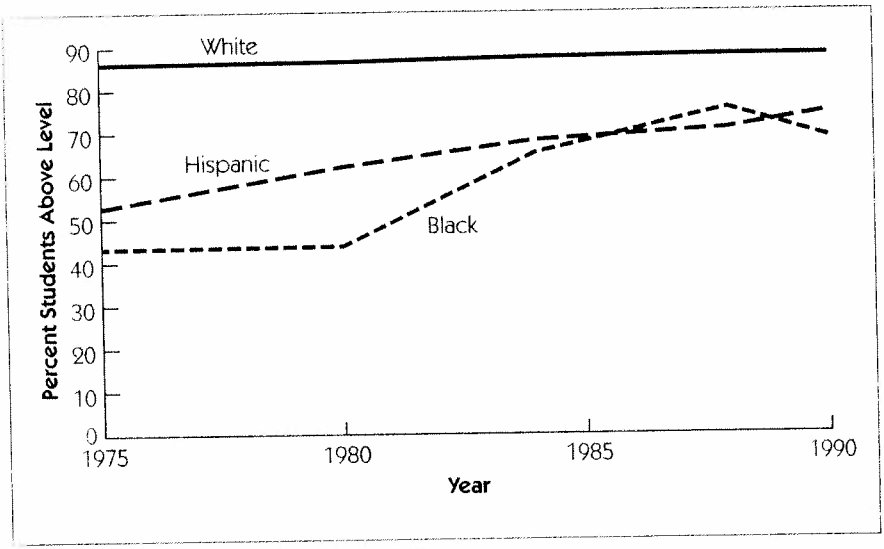


Figure 1.13 shows NAEP reading assessments for 17-year-old students between 1975 and 1990. In spite of great concern over "why Johnny can't read," there has obviously been little improvement overall. However, focusing on the overall picture masks some important details. Figure 1.14 shows the percentage of students reading at Carroll's intermediate level, which is probably the minimal level of competence needed in a job beyond entry level. The data are shown separately for whites, blacks, and Hispanics. Two trends are immediately apparent: while blacks and Hispanics still come out of the K–12 system less well prepared than whites, the gap has been reduced dramatically. About 50 percent of the black and Hispanic 17-year-olds were reading at the intermediate level in 1974–1975. Fifteen years later over 70 percent were at that level.

Unfortunately, there has been little change in the percentage of readers at the adept and advanced skill level. In fact, the percentage of readers at the advanced level has declined slightly. It is not clear whether or not this is a problem. As Carroll points out, we do not know what percentage of very good readers we need, because we do not have a good idea of how much essential reading (manuals, directions, legal instructions, and the like) is written at the adept level or above, nor do we know how many people need to understand this material.

Mathematical ability is generally considered a necessary cognitive

Figure 1.14 Percentage of students above NAEP intermediate reading level, by ethnic status. Source: National Center for Educational Statistics (1993).



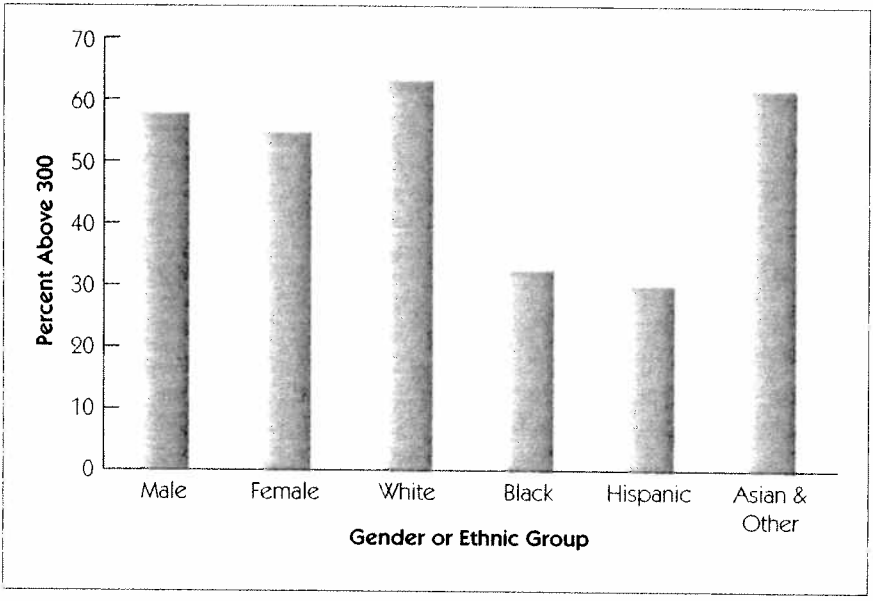
skill second only to reading. NAEP mathematics scores have been grouped as follows:

1. Basic. Can do arithmetic operations. (NAEP score 250)
2. Moderately complex. Can use fractions and percentages and understands simple geometric concepts. (NAEP score 300)
3. Advanced. Can use mathematical reasoning to solve multistep problems and can use algebra. (NAEP score 350)

Figure 1.15 shows the percentage of 17-year-old students scoring 300 or more on the 1990 NAEP test. The data are shown separately for males and females and for various ethnic groups.

A great deal has been written about male-female differences in mathematical ability. More extreme proponents of a difference sometimes seem to write as if women, generically, "can't do math." The low point in this debate may have been reached in 1992, when the Mattel Corporation marketed a talking Barbie doll that complained that "math class is hard." The facts are more complex. As Figure 1.15 shows, 17-year-old males do very slightly better than females. Some of this difference is because girls tend to take fewer high school mathematics classes than do boys, but that is not the whole story. On the average, males

Figure 1.15 Mathematics proficiency (percentage above NAEP 300 level), by gender and ethnic group, 1989–1990. Source: National Center for Education Statistics (1993).



outscore females at every level of mathematics education. For instance, males who have taken precalculus or calculus courses averaged 347 on the NAEP mathematics test, compared to 341 for females with equivalent training.

The mathematics skills of black and Hispanic students lagged markedly behind those of whites and Asians. The difference is considerably larger than the male-female difference. Like the male-female difference, ethnic differences remain after taking the amount of mathematical training into account. This is consistent with the observation that black and Hispanic students are underrepresented in the more technical fields of higher education, which place a premium on mathematics skills.

The data presented so far have focused on all high school students. Figure 1.16 shows changes over time in the Scholastic Aptitude Test (SAT) scores achieved by college-bound high school seniors. Proficiency dropped from the 1960s until the late 1970s, rebounded slightly, and dropped again. The 1991 and 1992 mathematics scores were the lowest ever.

Figure 1.17 shows ethnic group differences in SAT scores in 1991. The picture is similar to the picture obtained from the NAEP tests.

Figure 1.16 SAT scores of college-bound high school seniors. Source: National Center for Education Statistics (1993).

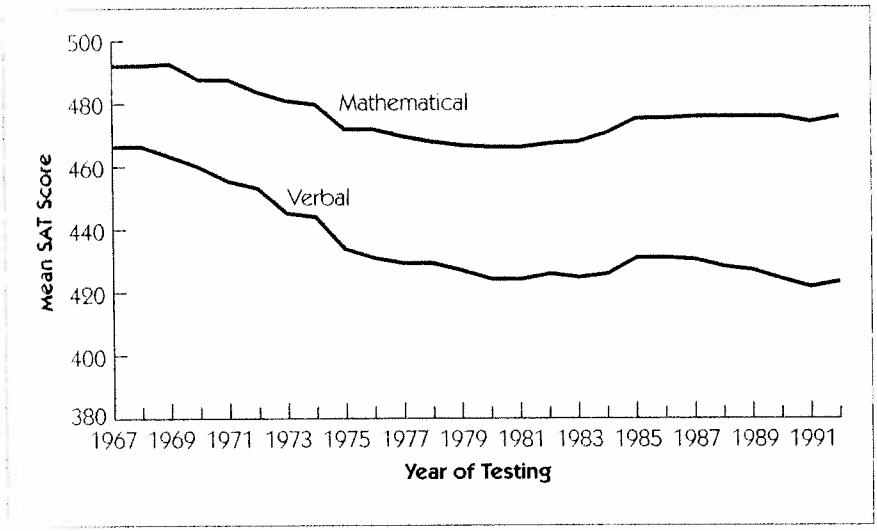


Figure 1.17 SAT scores, by ethnic groups, 1992. Source: National Center for Education Statistics (1993).

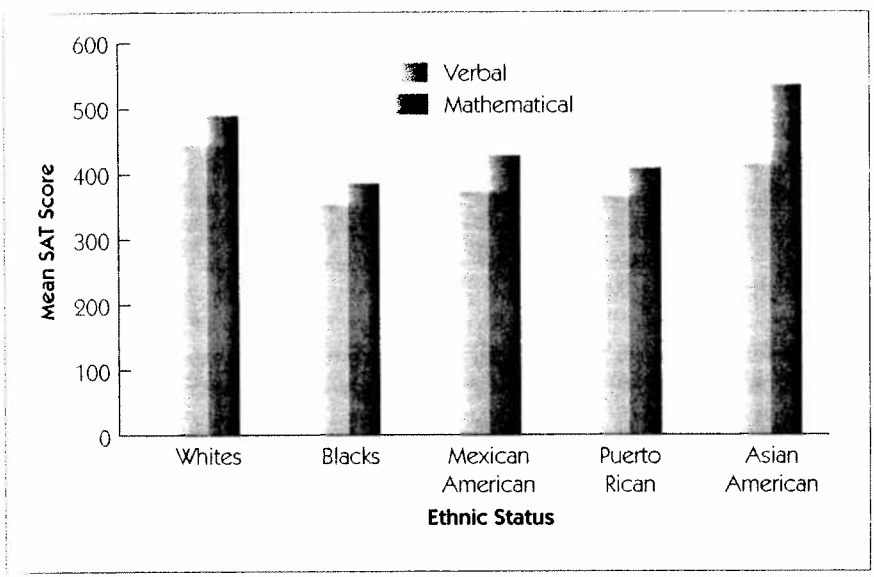
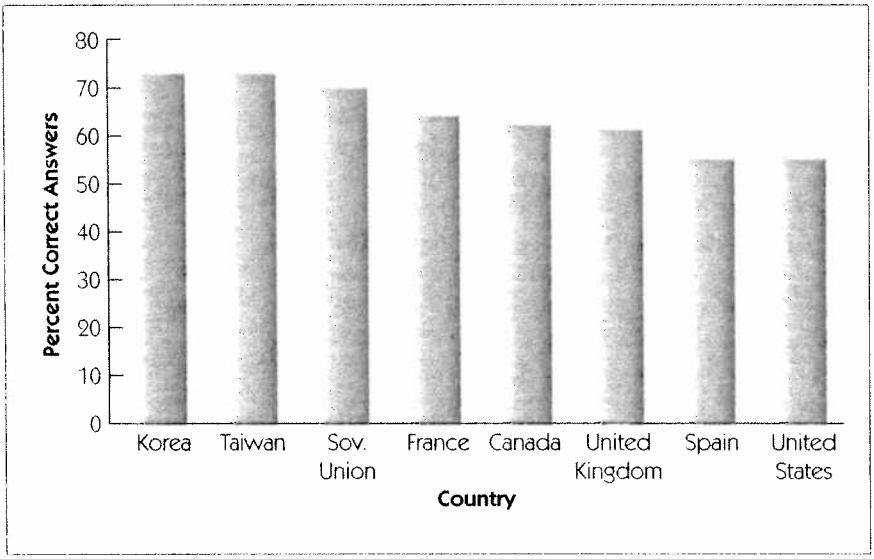


Figure 1.18 Performance of 13-year-olds on a standard mathematics test, 1992. Source: National Center for Education Statistics (1993).



Blacks and Hispanics do markedly worse than whites and Asians. Asians show a marked superiority in mathematics but have lower verbal scores that are intermediate between the scores of whites and other ethnic groups.

Where do we stand internationally? Reading scores cannot be compared because students read different languages. Mathematics scores can be compared, and the United States does not do very well. In 1981 an international comparison of mathematics knowledge in both 13-year-olds and twelfth graders found that the United States ranked last compared with Japan, Canada, France, and the United Kingdom. In 1992 a larger survey of 13-year-olds found that the United States had moved up a bit. We were tied for last place with Spain (Figure 1.18).

Ideally, we should compare U.S. twelfth graders in 1992 with foreign twelfth graders, as was done in 1981. Unfortunately, the data are not available, but it is doubtful that things have changed. The U.S. internal statistics indicate that while we have made progress, we have made little progress in improving the work of our better students. There is no reason to believe that foreign countries have slipped backward.

CHANGES IN THE NATURE OF WORK

What skills will be in demand in the coming workplace? This is a difficult question to answer, because the forecast depends upon what as-

sumptions are made, how much, and how rapidly, technological changes will impact upon the workforce. As a result, well-informed prognosticators have reached different conclusions.

Workforce 2000 (Johnson and Packer, 1987), a widely publicized forecast, concluded that the American workplace would have a need for highly skilled craft workers and technicians, that is, more highly skilled blue-color positions. The *Workforce 2000* report and several that followed it (Commission on the Skills of the American Workforce, 1990; Office of Technology Assessment, 1990; Secretary's Commission on Achieving Necessary Skills, 1991) argued for major expansions of education programs designed to prepare Americans for a highly automated, decentralized workplace. They argue that the jobs will be present and that it is up to the educational establishment, broadly conceived, to provide appropriate workers. The same spirit permeates President Clinton's 1994 proposals to shift unemployment relief from a support system designed to provide temporary relief to laid-off workers until their old jobs reopen to a training system to prepare the unemployed for new jobs that are supposedly waiting for them.

Other prognosticators, and many newspaper articles describing failures of employment recovery following the 1990–1991 recession, reached a much more pessimistic conclusion. They question whether or not the new jobs are there at all. These writers argue that jobs are becoming "deskilled," in the sense that tasks formerly done by people are being turned over to automated "smart" machines. The result is that there are a few good jobs designing the machines, and a large number of low-paid jobs, in which a person essentially works under the direction of a machine.

Retail clerking provides a good example. A few years ago retail clerks had to be able to do elementary arithmetic calculations, rapidly and accurately, in order to make change. Today the computer in the cash register handles the arithmetic. In many stores all the clerk has to be able to do is hold a barcode scanner over the goods being sold and to recognize the denomination of the bill offered in payment. If the customer chooses to pay by credit card, the clerk does not even have to do that (Hartman, 1987). To the extent that such scenarios are correct, people will not move from one good paying job to another, they will be laid off from a good paying one and have to accept a lower rate of pay.

There are some discouraging statistics indicating that the de-skillers may be correct. Referring back to Figure 1.5, we have already seen that job growth is slowest, and in some cases is actually negative, in those sectors of the economy with the highest hourly wages. Some larger-scale statistics support this conclusion. With some fluctuations, U.S.

unemployment rates generally went down from 1980 (9 percent) to 1993 (6.9 percent). Median income in constant dollars dropped by about 10 percent over the same period. As a matter of elementary economics, when a commodity decreases in supply its price goes up *unless some alternative commodity appears that fulfulls the same need* and thus decreases demand. That is what has happened to U.S. domestic labor. Over the past 15 years labor has faced increasing competition from foreign labor, due largely to changes in technology that make offshore manufacturing and service supply economic, and from increased productivity per worker, due to automation. Both of these trends are being driven by changes in technology rather than by governmental actions or tariff changes. It is unlikely that there is any way to slow the trends. If a useful device can be built, someone will build it.

Let us take a closer look at these trends, by examining a few cases. The first is a contrast between two companies that are widely considered dominant in their fields: Microsoft Corporation, the world's largest computer software firm, and the Boeing Corporation, the world's largest manufacturer of airplanes. While both companies operate worldwide, their major production facilities are located within a few miles of each other, in the Seattle region, so local factors are more or less constant. Both companies can be considered "high technology," but Microsoft is in a rapidly growing field in which the basic production workers, programmers, and system designers are highly educated. Boeing is a heavy manufacturing concern, and the basic production workers are well-paid blue-collar machinists and electricians.

In 1993 Microsoft expanded its worldwide employment to something over 13,000 people. Boeing laid off 20,000 workers in the Seattle region alone and appears to be stabilizing at a workforce of about 70,000 in its Seattle facilities. Even as it contracts, Boeing makes more new hires than Microsoft.

By generalizing this contrast, we gain some insight into why different projections come up with different pictures of the future. The optimists and the pessimists are looking at related but different trends. Should you look at where the largest number of jobs is going to be, or where the fastest growing professions are? The largest number of jobs will be in fields where there are already a large number of jobs. These, in general, are relatively unskilled jobs with fairly low educational requirements. (There are some striking exceptions.) The jobs with high growth rates, although perhaps also low in absolute numbers, are generally associated with expanding technologies and high skill requirements.

These remarks can be given some content by examining some statistics on the projected growth rates from 1985 to 2000 for the 225 occupa-

tions providing the most jobs, as of 1985 (Wegmann, Chapman, and Johnson, 1989). These occupations were sorted five times to determine (1) the occupations with the most jobholders; (2) the occupations showing the largest number of new jobs, based on a 1985–2000 projection; (3) the occupations with the highest growth rate over the same period; (4) the occupations with the most job losses; and (5) the occupations with the highest loss rates. Table 1.4 shows the top ten jobs after each of these sortings.

First let us look at the ten occupations that will provide the largest total number of jobs. These tend to be jobs with rather limited career development: food services, retail sales, chefs and cooks, janitors. The only exceptions are personnel jobs and executives, an occupation that contains a highly varied set of jobs. If we look at the ten occupations expected to provide the most number of new jobs, only three—general managers, registered nurses, and general engineers—require considerable formal education beyond high school. The message is clear. If we look at the largest total number of jobs that will be available, we find that they are concentrated in occupations where the requirements of job holding are either rather low or can be lowered by technology, as in the case of retail clerks. By the inevitable laws of supply and demand, salaries will be reduced.

The picture changes if we look at occupations that are showing the highest growth rates, albeit not the greatest absolute number of jobs. With one exception, security guards, these are jobs that either require high-level intellectual skills or that require skill in dealing with people. The most sought-after employees, system analysts and computer scientists, are the high priests of the new technology. Most people in these fields have at least a bachelor's degree, and advanced degrees are common. Registered nurses, another rapidly growing occupation, receive years of formal training in biological sciences and have to learn to manipulate the formidable technology of modern medicine.

Real estate agents and managers, two other rapidly growing occupations, provide an interesting case. Realtors and managers deal with people. Face-to-face interactions are perhaps the hardest information exchanges to automate. What is more, they provide an interesting example of a skill with an unusual distribution in the population. Everyone has this skill to some degree, but there seem to be very wide individual differences in the extent to which each of us can go beyond the basics. Virtually any two people who speak the same language can talk to each other and carry on a conversation that defines automation, but good salespeople and successful politicians are few and far between.

The last two columns in Table 1.4 show which jobs are being lost. With one exception, college and university faculty,[7] job losses, in both

Table 1.4 Projected Growth for U.S. Occupations

1 Occupations with Most Employees	2 Occupations with Most New Jobs	3 Occupations with Highest Growth Rates
Food service workers	Food service workers	Systems analysts
Retail sales clerks	Retail sales clerks	Computer programmers
Personnel related jobs	Chefs and cooks	Service sales representatives
Secretaries	Registered nurses	Health service workers
Chefs and cooks	Janitors	Security guards
Janitors	General managers and executives	Computer operators
Truckdrivers	Cashiers	Electrical/electronics
General managers and executives	Truckdrivers	repairs and service workers
General clerks	General clerks	Real estate agents
Cashiers	General engineers	Registered nurses
		Receptionists

4 Occupations with Most Job Losses	5 Occupations with Highest Loss Rate
Farmers	Textile machine operators
Typists and word processors	Farmers
Clothing workers	Data entry key operators
Moving equipment operators	Machinists
Textile machine operators	Typists and word processors
Data entry key operators	Moving equipment operators
Metalworkers	Clothing workers
Machinists	Metalworkers
College teachers	College faculty
Quality control inspectors	Quality control inspectors

absolute and relative terms, are concentrated in fields where automation has reduced the number of people needed to produce a product or provide a service. Consider typists, an occupation that was once a first step toward better-paid office jobs. They are being automated out of existence. The modern word-processing program is so simplified that even general managers and executives can use it.

I referred earlier to a series of articles in the *New York Times*, written in March 1994, about how the new technologies were selectively impacting upon the higher-paid blue-collar jobs. The *Times* articles made their case by anecdotes, describing how different families were coping with their new situations. A common trend ran through these articles: surprise. The people who lost their jobs had thought that it never would happen to them. In fact, this was naive. The problems of today were quite predictable. In fact, Table 1.4 is based on projections from statistics gathered by 1985. Highly paid blue-collar jobs are at risk for two simple reasons. First, the technology is there. Second, the higher paid the worker, the greater is the incentive to design a machine that can do the worker's job, either alone or when operated by a less-skilled worker.

The workplace is not just shrinking or contracting; it is changing. The change is partly a change from highly paid manufacturing to lower-paid services. It is also a change in the sort of services that are required. Robert Reich, President Clinton's Secretary of Labor, has referred to this trend as the "growth of the symbol analyst" (Reich, 1991). Within the service sector, the demand for physical services, such as barbering or lawn mowing, have roughly grown with the society. The explosive growth has come in information processing rather than physical services. This does not mean information processing, narrowly defined as something to do with computers and communication. Advertisers, stockbrokers, and newspaper reporters process symbols rather than people or things.

The increase in Reich's symbol analysts has been going on for a long time. In a perceptive book, Katz (1988) has documented a steady growth in information services, relative to the rest of the economy, since 1860, with a sharp acceleration from 1940 to 1980. The pace has not slowed since then. Table 1.5 shows the distribution of the workforce in some selected occupations in 1980 and 1992. The table also shows relative changes, such as the ratio of the number of workers in the occupation in 1992, compared to the number in 1980. Computer-related information processing and legal services, quintessential symbol manipulating industries, exhibited the highest growth rates. Service occupations that do not primarily involve symbol manipulation, such as the hotel industry, grew faster than the workforce as a whole, but did not grow as rapidly as Reich's symbol analyst occupations did.

Table 1.5 Growth Rates for the Workforce, Manufacturing, and Selected Service Occupations (1980–1992)

Occupation	Jobs, 1980 (thousands)	Jobs, 1992 (thousands)	Relative Change, 1980–1992
Workforce	90,406	108,437	1.20
Production of goods and services	20,285	18,190	.90
Financial and realty	5,160	6,672	1.29
Computer and data processing	304	817	2.69
Legal	498	906	1.82
Advertising	153	232	1.52
Education	1,138	1,716	1.51
Hotel industry	1,076	1,597	1.48
Personal services	818	1,107	1.35

Source: Bureau of Census (1993).

If anything, these figures understate the extent of the shift. Manufacturing itself has changed, so that the people counted as being in industrial plants may be symbol analysts themselves.

If anything, Table 1.5 understates the dominance of Reich's symbol analyst. Within the production industries, symbol processing has become increasingly important. The Industrial Revolution moved people away from providing the physical energy needed to transform objects, but they still had to provide the perceptions that guided the machinery. Now they provide abstract information that a smart machine uses to guide its own cutting and mixing tools. A single example, Toshiba, the Japanese electronics manufacturer, employs 4,000 in its plant at Ome, Japan; 500 are blue-collar workers, and 3,000 are engineers and scientists (Zuckerman, 1991). All 4,000 of these workers can be counted as being "in manufacturing," but very few of them are involved in the physical manipulation of products.

Customizing the Product

The Toshiba example provides a bridge to a final comment about changes in the nature of work.

When Henry Ford first began producing a production-line car, the Model T, he is supposed to have said, "The customer can have any color he wants, so long as it's black." This apocryphal quotation very

much captures the spirit of the industrial age. Production and, to a lesser degree, services were oriented toward making high volumes of standardized products. Top management decided, on a one-shot basis, what most customers wanted, and that is what customers were offered.

As of 1993, the Ford Motor Company offered its customers more than 50 different colors, depending on the model. If a customer is willing to wait two or three weeks, a car can be customized in nearly any way one desires.

The computerization of manufacturing is a key element in the move toward customization. Computer-driven "smart machines" make it possible to design and implement relatively low-volume, tailor-made product runs. Flexibility in responding to the needs of the customer has become more important than delivering a standard product. Therefore, the task of deciding how a product should be made (or a service should be delivered) cannot be planned ahead, the way Henry Ford did. In fact, the task may be passed on to workers on the line, who design their own working procedures as they develop the product.

The shift from high-volume production to low-volume problem solving has created a demand for workers who understand how their job fits into the big picture. This is a great departure from the earlier role of the industrial production worker. Charlie Chaplin's 1930s classic film *Modern Times* begins with the Little Tramp hard at work in a factory, tightening bolts. Tightening bolts on what? We never learn, and the tramp never knows. His job is to keep up with the production line (he doesn't), tightening the bolts on unidentified pieces of metal. Chaplin's factory was rigidly hierarchical: The foreman told the Little Tramp what to do and he did it, more or less. In real life Henry Ford ran his operation in much the same way. Today, Japan, Europe, and, more slowly, the United States are all moving toward factories in which the workers are organized into work groups. (The Ford Motor Company has been an industry leader!) The work groups distribute jobs among themselves and monitor their own output. Quality control inspectors are on the loser's list in Table 1.4. The production line workers do not need them any more.

The change from an assembly line to a working team has profound implications for the psychological demands on the workers. Recall that when managers were asked what they wanted from the workforce, "problem-solving skills" and "work ethic" were high on their list of requirements. These are vaguely defined skills, but nevertheless real ones.

SKILLS FOR THE FUTURE

When we look at the current work situation more closely we find two contradictory trends. The psychological demands of work are changing.

"Smart machines"—the computer and all of its relatives—have decreased the demand for skilled blue-collar labor and increased the demand for symbol analysts who can talk to machines on their own terms. The move toward tightly interconnected service systems and toward a society of specialists has increased the need for people who can facilitate person-to-person and person-to-machine transactions. At the same time, the smart machines insist on low level services from human beings whom they, the machines, will direct just as a cashier is told now just how to make change. This demand creates jobs but not good jobs.

The future workforce can meet the demands of the smart machines, but perhaps not in a way that makes us comfortable. The people whom the machines direct will need some facility in reading and mathematics, if only to be able to respond to the machine's direction. For instance, a modern cashier must know how to fill out a credit slip! Our educational system has done a good job of training people for such tasks. Absolute illiteracy and incompetence in elementary mathematics, which were major problems as late as the 1960s, have largely disappeared.

Obviously we are not satisfied with an educational system that trains people to respond to machines. We want a system that trains people to control machines. Our educational system is failing to produce the sort of quality workers that we need, a problem that appears to be particularly acute with respect to blacks and Hispanics, who will be an increasingly larger part of the working population. Nor are we making effective use of the quality workers in the workforce already in jobs. When senior workers are displaced, they typically find jobs that are considerably less desirable than their old jobs (Podgorsky, 1988). Since senior workers are the breadwinners that future generations depend on, we must try to minimize costly dislocations.

All this has been said before. All I have tried to do is to leaven the statistics with some psychological remarks. The real question is, "What are we going to do about it?" Both the problem and the solution have political, economic, sociological, and psychological dimensions. I am going to concentrate on the psychological ones. Why?

One of the major advances in academics in the last 20 years has been the development of *cognitive science,* an interdisciplinary area of study that encompasses both the design of machines that, in a nontrivial sense, can think, and the study of how people act when they, in an equally nontrivial sense, have to think. The following chapters are an attempt to apply what we have learned in cognitive science to an analysis of the workforce. First I shall try to define the dimensions of the problem, by looking at how cognitive skills are distributed in the pres-

ent workforce and by predicting how those skills are going to be distributed in the workforce just after the turn of the century. Then I will ask what sort of cognitive characteristics are going to be demanded, by projecting trends about machines, rather than trends about people. The results will be discomfiting, but we do not have to accept them.

My second step will be to consider what can be done to improve things. Modern cognitive psychology, one of the branches of cognitive science, has a great deal to say about how we can train the workforce of the future, if we have the will to do so. In the closing chapter I will outline what cognitive science has to say about how we might improve education: in the K-12 system, in the universities and colleges, and throughout lifelong professional education.

NOTES

1. The three best-selling automobiles in 1993 were, in order, the Ford Escort, the Honda Accord, and the Toyota Camry.
2. U.S. Bureau of the Census, 1992.
3. *New York Times*, March 22, 1991.
4. The Economic Report of the President, 1991.
5. The OTA prediction was developed prior to passage of the North American Free Trade Act. The impact of a virtually open border with Mexico is hard to assess. It could increase immigration by reducing attempts to regulate the flow of migrants, or it could decrease immigration, by creating greater economic opportunities in Mexico.
6. The percentages shown in Figure 1.11 conflict with the widely reported figure of a 25 percent dropout rate, nationwide (*New York Times*, July 27, 1991). Paradoxically, the same agency provided both figures. The 25 percent rate appears to be based on the number of students who do not graduate with their high school class. Figure 1.16 counts students who return to graduate, or who obtain general education diplomas, as having completed high school.
7. Academics may be surprised to find their profession listed as losing jobholders, since several forecasts show that there will be many new openings in the next 10 years. The disparity is due to the unusual age distribution of the present faculty workforce. Faculty were recruited intensely in the 1960s. This cohort is now approaching retirement age. Job openings in higher education during the 1990s will be for replacements, not for new positions.