Remarks by
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The United States is currently confronting a set of forces pulling us in divergent directions. The rapid acceleration of computer and telecommunication technologies, can reasonably be expected to appreciably raise our productivity and standards of living in the twenty-first century certainly, and quite possibly in some of the remaining years of this century.

In the short run, however, the fallout from rapidly changing technology has created a marked degree of uncertainty and insecurity among a significant segment of our work force.

It should not be surprising to find that when the stock of plant and equipment with which most Americans have to interact in their day-by-day job routines is turning over rapidly, human skills are subject to obsolescence at a rate perhaps unprecedented in American history.

Almost six years ago I stressed to this Association the dramatic trends toward an ever increasing conceptualization of our Gross Domestic Product, the substitution, in effect, of ideas for physical matter in the creation of economic value.

This afternoon I should like to update and extend the implications of these extraordinary forces which are driving the American economy. The roots of increasing conceptualization of output lie deep in human history, but the pace of such substitution probably picked up in the early stages of the industrial revolution, when science and machines created new leverage for human energy. Nonetheless, even as recently as the middle of this century, the symbols of American economic strength
were our output of such products as steel, motor vehicles, and heavy machinery—items for which sizable proportions of production costs reflected the value of raw materials and the sheer manual labor required to manipulate them. Since then, trends towards conceptualization have focused today’s views of economic leadership increasingly on downsized, smaller, less palpable evidence of output, requiring more technologically sophisticated labor input.

Our radios used to be activated by large vacuum tubes; today we have elegantly designed pocket-sized transistors to perform the same function—but with the higher quality of sound and greater reliability that consumers now expect. Thin fiber optic cable has replaced huge tonnages of copper wire. Advances in architecture and engineering, as well as the development of lighter but stronger materials, now give us the same working space but in buildings with significantly less concrete, glass, and steel tonnage than was required in an earlier era.

The process of conceptualization in output, seems to have accelerated in recent decades with the advent of the semiconductor, the microprocessor, the computer, and the satellite. These technologies have become especially significant since my visit in 1989. Under the circumstances, it has puzzled many of us that the growth of output as customarily measured has not evidenced a corresponding pickup. Of course, output may not be measured correctly. Indeed, the financial markets are suggesting that we increasingly expense items which should be
capitalized and hence underestimate the growth of our GDP and productivity. But it also is possible that some of the frenetic pace of change is wheel spinning--changing production inputs without increasing output--rather than real advances in productivity.

A number of commentators, particularly Professor David of Stanford University, have suggested that much of the wheel spinning, if that is what it is, reflects the extended time it typically has taken to translate a major new technology into increased productivity and higher standards of living. It may be that the big increases in productivity growing out of the introduction of computers and communications equipment still lie ahead. Past innovations, such as the advent of electricity or the invention of the gasoline-powered motor required considerable infrastructure before their full potential could be realized.

Electricity, when it substituted for steam power late last century, was applied to production processes suited to steam. Gravity was used to move goods vertically in the steam environment and that could not initially change with the advent of electric power. It was only when horizontal factories, newly designed for optimal use of electric power, began to dominate our industrial system many years after electricity's initial introduction, that productivity clearly accelerated.

Similarly, it was only when modern highways and gasoline service stations became extensive that the lower cost of motor vehicle transportation became evident.
It is possible that the computer-telecommunications revolution is too new to as yet fundamentally improve standards of living overall.

Moreover, to be fully effective, innovations also require a considerable amount of human investment on the part of workers who have to deal with these devices on a day-to-day basis. On this score, I sense that we still may not have progressed very far, relative to potential. Compared to the facility with which the average citizen handles another complex device—the automobile—most workers and consumers still appear to possess only rudimentary skills when it comes to making computers do what is wanted of them. Mass acceptance and full exploitation of computer technologies—the analogue of what was accomplished in making cars that were affordable, standardized, and easily operated—probably still lie ahead.

In the meantime, we have a situation in which there are some serious mismatches between the skills of workers and technologies that have changed considerably and still are advancing rapidly, and these mismatches are affecting pay differentials between the skilled and the unskilled. As conceptualization of output has moved apace, the relative economic value of intellectual skill has clearly increased. During the past fifteen years, for example, the earnings of college graduates have increased relative to those who are high school graduates, and, in turn, high school graduates have continued to open up their advantage over those who are high
school dropouts. In fact, a significant minority of our labor force has experienced real wage decreases, and this development surely is one factor in the unease that is all too prevalent, as well as in the apparent stretching of the distribution of incomes in recent years.

Exaggerating this income dispersing trend is the growing evidence of what is being called a "winner take all society" in which the best in any activity tends to take an increasingly larger share of a market.

The best actors, the best basketball players, the best business innovators, earn far more than average. The reason is that the major advances in telecommunications technologies have allowed any skill a far wider market than a generation ago. New visual communications allows talent to offer their services throughout the world. Who wants second best when the best is available at nearly the same price? Who buys the records of the fourth or fifth best tenors in the world singing an aria from Don Giovanni? The few top performers take most of the market. A century ago, such performers could not readily compete outside their localized area.

Fortunately, the rapidly changing technologies have engendered an increased degree of competitive intensity which may very well cap, and perhaps reverse, the trend toward winner-take-all and other forces increasing income dispersion.

Once proud hi-tech firms are being upended by new technologies developed by upstarts. But even the latter are
lately looking over their shoulders at other upstarts with still newer technologies. The outsized rewards to high skills induce others to emulate them, and hence staying at the top has become ever more precarious. More generally entrenched economic advantage is being increasingly challenged by a global competition which shows no signs of abating.

In addition, we must be alert in coming years to the need to improve the skills and earning power of those who appear to be falling behind. In the long run, better child-rearing and better schools are essential. But in the shorter run, on-the-job training is a critical necessity—to overcome the educational deficiencies of all too many of our young people, and to renew the skills of workers who have fallen behind the rapidly rising curve of technological change. It has become quite apparent that many firms have concluded that it makes more sense to invest in such training than to bid up wage scales in a zero-sum competition for the existing limited pool of well-qualified workers. As a bottom line, though, workers in many kinds of pursuits probably had better look forward to a lot of hard work acquiring and maintaining the skills needed to cope with a rapidly evolving economy. The notion that early education could be crafted to support the needs of one's lifework, is rapidly changing. Education is increasingly becoming a lifetime activity. Over time, as workers acquire new skills and as computer applications continue to become evermore user friendly, the present income mismatches should diminish.
To be sure, the most visible force of recent change, the continuous downsizing of microprocessors, and hence computer and telecommunications equipment, may increasingly encounter physical limits. But almost as surely, new technologies, not now visible, will emerge.

We can anticipate change to be pervasive and, if competitive forces are allowed free rein, and our fiscal problems resolved, we can expect ever higher living standards for all Americans.

Will Americans adjust to a frenetic pace of change and allow it to happen? While we have in the past, and almost surely will in the future, it is important that we recognize that adjustment is not automatic. We have episodes in recent human history where, for example, pressures of change were not easily absorbed and people chose what appeared to be a greater degree of security rather than competitive challenge. Competitive forces, especially those driven by technological change, create uncertainty and dislodgment, but they also bring with them an enhanced quality of living and the increased economic abundance so necessary to confront the problems that exist in societies throughout the world.