

Cato Institute Policy Analysis No. 68: Does More Technology Create Unemployment?

March 18, 1986

R. H. Mabry, A. D. Sharplin

R. H. Mabry is professor of finance at Clemson University. A. D. Sharplin is professor of management at Northeast Louisiana University.

Executive Summary

Each new generation brings the reemergence of many of the fears of the past, requiring the repetition of old explanations to put them to rest. Today there is a renewed concern that technological advancement may displace much of the manufacturing (and other) work force, creating widespread unemployment, social disruption, and human hardship. For example, in 1983 the Upjohn Institute for Employment Research forecast the existence of 50,000 to 100,000 industrial robots in the United States by 1990, resulting in a net loss of some 100,000 jobs.[1] Barry Bluestone, perhaps foremost among today's gloomy economists, is also worried about the future. He argues that "capital hypermobility" requires that America "reestablish the social safety net and extend the range of the regulatory system to make that net even more secure." [2] Harvard's Robert Reich completes the theme that government must act by arguing that America's industrial policy "is the by-product of individual corporate strategies whose goals may have little to do with enhancing the standard of living of Americans." He further states that our current industrial policy creates jobs that are "lower-skilled and routine, eventually to be replaced by robots and computers." [3]

What are we to make of all these claims and predictions and the rhetoric that surrounds them? Conservative economic thinkers tend to disparage persons who fear the rapid advance of technology by labeling them "Luddites." [4] This term is both unfair and inaccurate. The real Luddites, of the early 1800s, were uneducated working people who destroyed textile machinery and other symbols of advancing technology, which, despite their efforts, were to move the broad spectrum of humanity above the subsistence level for the first time. Today's proponents of economic activism are typically not of the working class and are usually quite well educated. Nobel laureate Wassily Leontief, who gave the keynote speech for the National Academy of Engineering at its 1983 symposium "The Long-Term Impact of Technology on Employment and Unemployment," cannot fairly be called a Luddite, yet he expressed concern about what he saw as technological advancement's undesirable distributional effects across income groups. [5]

In part, opposition to technology springs simply from a more or less visceral fear of scientism, which is often taken to imply the dehumanization of humankind. [6] Mainly, though, the warnings heard today are thoughtful and well intentioned, even if often in error or somewhat self-serving. Flatly in error are those that predict no more jobs for a very large sector of the population as a result of advancing technology, creating a massive problem of involuntary unemployment. It is not at all clear that a large number of jobs are about to be destroyed; even if they were, such long-run unemployment as would occur would certainly not be involuntary. Rather, it would take the form of even shorter workdays, shorter work-weeks, and fewer working members in the family, as it has throughout our history.

Some who correctly anticipate that technological change may produce short-run employment-adjustment problems overstate those problems. They also often fail to mention that the short-run unemployment that occurs is primarily the result of artificial imperfections--a lack of competition--in certain labor and product markets. The amount of short-run

unemployment created by advancing technology, as well as the amount of howling (or lobbying), is directly related to the degree of artificiality in the particular labor markets affected. It will be argued below that the workers harmed by technological advancement are those who have been receiving wages in excess of the amount they would receive in a fully competitive labor market. In other words, they have been receiving economic rent. It will be further argued that those workers remain unemployed when displaced by technology because they seek to regain their former employment or seek employment in another industry that pays excessive wages. In other words, they are unemployed because they are rent seekers. Finally, the effects of slow and rapid technological change will be discussed. The rate of change can serve as a basis for reasoned debate of some of the legitimate social concerns facing our society as a result of technological advancement, given the institutional imperfections already existing in the labor market.

Technological Advancement, Unemployment and Rent Seeking

In everyday language, "technological advancement" means some change allowing the production of more goods and services. The familiar connotative meaning of the term centers on the use of machines--new lathes, robots, computers, and the like. However, any better, faster, or more efficient way of producing is a technological advancement; better knowledge will suffice, even without a new tool or machine.[7] When one discusses the depreciation of human capital, which can be viewed as the natural obsolescence of job skills over time, the importance of plain human learning as a form of technological advancement becomes even more apparent. Technological advancement also implies an increase in standards of living, which may result from either greater output or more leisure while maintaining the same level of output. In short, "technological advancement" may be defined as any change in a production process leading to higher standards of living through increased output from the same amounts of resources or through the use of fewer resources to produce the same level of output.

The meaning of "unemployment" is more difficult to establish. The Labor Department reports as unemployed those persons without jobs who are seeking employment, even though the jobs they seek do not exist and other jobs do. This definition obviously stacks the cards. For example, a union electrician who is not working is classified as unemployed even though he is not willing to accept available employment in non-union electrical work at 75 percent of union scale. This can be taken to an extreme. Almost all of us are either not earning as much as we would like to earn or not working at the job we would most prefer. If we chose not to work while waiting for something better, we would all be unemployed.

Consequently, the most useful definition of an "unemployed" person is someone who is willing and able to work at market wage rates but is denied the opportunity to do so. The type of unemployment relevant to this discussion is involuntary unemployment, the inability to find work even when all alternative occupations and wage rates are taken into account. One should note that leisure time, what some might call "voluntary unemployment," is a desirable object of economic progress.

The definition of unemployment given above is not meant to define the problem away. Clearly, there was involuntary unemployment during the 1930s and there may be some today. However, it is meant to exclude, for example, the automobile worker displaced by a machine or by other means who will not accept work for some period of time at lower wages elsewhere or in other occupations when jobs are available. This person is a rent seeker. Rent is earned by a worker who receives wages above those that would be paid in a competitive market. The difference between the actual wage and the competitive alternative wage is the rent. "Economic rent," then, is the extra income received by workers (or other factors of production) above the income required to obtain their services by meeting their costs and at least equaling their possible returns from their next-best employment opportunity.

In a sense, we are all rent seekers: we all attempt to obtain some degree of monopoly power so that our wages will be above the competitive norm. Most of us do not succeed, but some groups of workers do. Automobile assembly-line workers, whose tasks are learned in a matter of weeks, often receive far more than they could earn in alternative, non-unionized firms or industries. Many government employees, typically protected by civil service work rules, occupy positions for which many applicants would vie at far lower salary levels. Hundreds of applicants often queue up for just one or two civil service openings. Workers who receive economic rent are willing to expend resources, money, time, and energy to hold on to that rent, a significant point to remember.

Rent is an involuntary subsidy obtained by one group at the expense of others, since wages must be lower in occupations not enjoying monopoly power (and, hence, not enjoying rents) than the wages that would be paid under conditions of free entry into all occupations. If, suddenly, there were free entry everywhere, wages would fall in the protected industries as workers were drawn in and wages were bid downward, while wages would rise in the unprotected industries from which workers would be drawn. Thus, the elimination of economic rents through the elimination of monopoly power not only contributes to economic efficiency but is equitable as well.

Technology and Unemployment in the Long Run

As noted above, many labor leaders, business executives, labor researchers, and politicians continually predict dire consequences from technological advancement. Such predictions are perennial, but they never seem to come to pass. For example, during the last wave of technological nervousness in the 1960s, a national commission was formed to study the problem of coming widespread unemployment and make recommendations for coping with it. It concluded in 1966 that given the pace of technological change, "there is no ground for complacency." [8]

Resolving the apparent paradox between the obvious historical benefits of technological advancement and the constant predictions of impending doom or, at least, significant human suffering from dislocation requires a separation of time frames and a reminder of some basic economic truths. [9] One such truth is that the major, long-run economic goal in any society is the advancement of its standard of living. Throughout history, technological advances have made more goods and services available with less effort, from the first prehistoric bone fishhooks to today's laser holography machines used to read product codes at grocery checkout counters.

As noted earlier, improvements in standards of living may take two forms, or a combination of both. Output for the same employment may rise, yielding higher per capita output and consumption, or hours worked to produce the same output may fall. The evidence--more food, clothing, and television sets per person as well as the absence of twelve-hour workdays and six-day workweeks--suggests that gains from technological advancement have been taken historically as a combination of higher output and fewer inputs, but not involuntary reductions in inputs. Lured by increasing per capita output (reflected in higher real pay) and released by technology from household drudgery, women have entered the labor force in increasing numbers. On the other hand, the participation rate of men has decreased. [10] Surely, if productivity continues to be enhanced through technology, both men and women will choose more goods and services as well as earlier retirement, prolonged education, and more leisure time. It is a dream of most people to be able to have the same or greater consumption ability while working only 20 hours per week or not working at all. Technological advancement is the essential element in reducing the burden of scarce resources.

A second basic economic truth is that wants are unlimited. Whether narrowly defined as unlimited material wants or broadly defined to include leisure and altruistic pursuits, the fact of unlimited wants assures that technological advancement will continue to occur and that involuntary unemployment cannot be a long-run consequence of such advancement in a free economic system. It is the explanation for the fact that we have not already run out of job opportunities, given the tremendous improvements in efficiency that have taken place since the agricultural revolution. Because of unlimited wants, people in the future will still be fully employed to the extent they choose to be, even if there is a headlong rush to automate and mechanize industry in this decade and beyond.

Any potential unemployment problem, then, is not inherent in technological advancement, which is beneficial in the long run. There may be short-run problems when resource markets are less than perfectly competitive (and these will be considered below), but markets will eventually adjust to eliminate any involuntary unemployment resulting from technological advancement.

In addition, more efficient production techniques will be used when they become available in a free system, especially in today's global economy. The Japanese have shown that if we hold back technology, as in the American automobile and steel industries, we will have to pay the price through market-induced spurts of disemployment when artificial trade barriers fall or labor restrictions are reduced. Despite the lesson, we may be on the verge of repeating the error. While Americans debate the pros and cons of using robots, Japan has established supremacy in robot manufacture and use. [11] Unless we refuse to trade with other nations and thereby lower our overall standard of living, we will again experience short-run unemployment problems when our industries are forced by the competition to use robots.

While the history of technology presents no cause for alarm, some claim that the current period of automation of the U.S. automobile and basic-metals factories is a special case. Pessimistic statements abound. In 1961, Walter Buckingham predicted, "There are about 160,000 unemployed in Detroit who will probably never go back to making automobiles--partly because automation has taken their jobs." [12] Interestingly, 300,000 new jobs were created in the four years immediately following Buckingham's remark. Further, business leader John Snyder stated in 1965 that "automation is a major factor in eliminating jobs in the United States at the rate of more than 40,000 a week." [13] Nineteen years have elapsed since then, or 988 weeks, which should mean some 30.5 million lost jobs. However, not only has total employment grown dramatically, but manufacturing employment has grown very steadily, though not strongly.

It is worth repeating that the long-run focus of concern should be production, or increasing total output per capita (with leisure time viewed as an output), rather than employment, just as the focus in business should be profit rather than sales. A firm that tries to maximize sales can easily meet that goal by cutting prices and raising advertising expenditures, only to go bankrupt in the process. Similarly, a society focusing on employment can easily reach full employment by destroying all construction equipment and building its roads with people equipped with shovels--and suffer a drastic drop in its standard of living.

Thus, the long-run effect of technological advancement on unemployment is the opposite of that suggested by the "dire prediction" group. It is only technological improvement that enables employment to take place at higher-than-subsistence levels of output. Returning to a hunting-and-gathering economy would assure full employment, but only at reduced population levels, lower total employment, and subsistence living standards. Arresting technological advancement now, while the population continues to grow, would also assure full employment only at ever-declining standards of living.

Technology and Unemployment in the Short Run: Distributional Effects and Rent Seeking

While technological advancement over the long run does not lead to unemployment problems, but rather is the engine for higher standards of living with either more or less employment at the discretion of individuals, short-run problems may certainly arise from technological advancement if there are imperfections in labor and product markets. If there are no such imperfections, technological advancement in a given industry will not lead to prolonged or significant unemployment.

With perfectly competitive markets, technological advancement in one industry simply releases labor resources for other uses, in that industry or in another. Will jobs be available in other industries? Yes. Several scenarios demonstrating this principle are possible in completely free markets. First, when technical change lowers costs in a given industry, the competitive firms comprising that industry must lower their prices, generating larger sales and an even greater need for employment. In this case, employment goes up, not down, and with the increased competition for workers, wages rise in all industries capturing some of the value of the technological change for workers.

Second, when technical change in a given industry is labor saving, but its downward effect on product prices does not result in larger quantities sold sufficient to provide the same amount of employment in the industry as before the change, then temporary unemployment occurs. However, jobs are available elsewhere in competitive markets. If nothing else, wages are bid down enough in other industries to absorb the released labor. But the savings in the industry where the advancement occurs must also be taken into account. Either more money goes to remaining workers in that industry, so that they raise the demand for other products, thus enabling the released labor to be employed in other industries without lower wages; or product prices are lower in the automated industry, so that consumers can buy the same amount and have income left over to demand more products from other industries, again enabling the released labor to be employed in those expanding industries without lower wages.

Thus, while some unemployment may occur when there is technological advancement in competitive markets, it is both temporary and a natural consequence of the ability to change jobs freely. It is certainly not a social problem requiring any sort of government action. There is an unemployment problem in the short run only when markets are not freely competitive. The interesting point is that most labor markets and product markets that are restricted or are not competitive in some way are imperfect precisely because of past and current government action.

In light of the definition of "economic rent" given above, the reason that rents earned by workers cause unemployment in the short run is really quite straightforward. If workers receive some \$22 per hour (as they do in the auto industry, counting benefits) when the comparable figure in similar jobs is \$12, then it is difficult for those workers to accept the \$12 alternative when they are laid off for any reason, including a technological advancement that allows the industry to produce the same output with fewer workers. These workers remain unemployed for longer periods than they otherwise would because they hope to obtain employment again at the noncompetitive, higher wage rate to which they are accustomed. They are rent seekers, and the rent they seek is the \$10 difference between their alternative competitive wage and the wage formerly obtained through some degree of monopoly power in the original labor market.

It is important to understand at this point that rents cannot be obtained by workers unless there is monopoly power in both the labor and product markets of an industry. A strong union that raises wages above the competitive level in a firm that faces competition in its product market will soon drive the company out of business. On the other hand, restrictions in the selling market--tariffs on imported goods, for example-- will do workers little good without some monopoly power over hiring. In order to raise wages, workers must be able to restrict employment or limit entry into the particular labor market, which is most conveniently accomplished in manufacturing settings through unions. It should be added that firms in an industry and their trade groups also actively support workers' efforts to obtain rents if these efforts are aimed at restricting competition in product markets, thus helping the firms to earn rents, too. This is what happened in the automobile industry, for example. Further, successful rent seeking is possible only with the help of government enforcement. Hence, a partnership is forged between labor and industry management, with the help of a new "visible hand"--government.

It is no small matter that the rents obtained by workers through labor- and product-market restrictions provide a strong and perverse incentive for the industry to develop and employ new labor-saving technology. Knowing that, unions must retard technological advancements, often seeking government help in doing so. The partnership between labor and industry managers may begin to fall apart if wages are pushed higher than the restrictions in the product market can support through above-competitive product prices. In order to continue paying wages that include rents, firms and labor must continually press for added monopoly restrictions in the product market. In the auto industry, for example, more tariffs and quotas must be requested from government "to save auto jobs."

Government intervention leads to an even larger problem. Additional restrictions, protecting ever-higher prices and wages, lead to two reactions that ultimately cause the demise of the labor-industry partnership that the rent seekers have formed. First, American markets present themselves as increasingly attractive targets for foreign competition. Japanese manufacturers, for instance, knew they could make better cars and steel products at far lower cost than their American counterparts. In the 1970s, Japan began to press for reductions in U.S. tariffs and quotas, using their considerable bargaining power as importers of U.S. farm and other products.

Second, American consumers begin to realize that they are paying prices well above competitive levels and no longer support their labor and industry brethren in the halls of Congress. Consequently, product barriers begin to fall, as they did in 1981 for the auto and steel industries. At that point, the industries could no longer pay the same rents to workers as before and began to renegotiate wage packages downward and match foreign competitors' use of technology. While "voluntary quotas" in the automobile industry remained in effect until 1985, the industry is now on a path toward fuller international competition, the use of appropriate new technology, and perhaps the use of much less labor. Though more capital will be used relative to labor, it is possible that sales will expand enough to employ the same amount of labor as before, or perhaps more, in the long run. There will be some short-run unemployment, however.

Further complicating the problem is the fact that when the artificial barriers protecting either the workers (industry-wide bargaining) or the products (trade restrictions) in an industry do break down, there is likely to be a great deal of unemployment all at once. While sizable unemployment ought to make it apparent to workers that they cannot all obtain jobs paying their former rents, and thus should make the adjustment period go more quickly as workers accept lower-paying jobs, many of them will persist in seeking rent-paying jobs anyway. Large numbers of rent seekers band together to reverse the situation, doing so at the expense of other workers and of consumers in general. These workers are fully supported by workers who remain in the affected industry, usually through their unions, who fear they may lose their rent-paying jobs, too. It is important to bear in mind that the sum of these rents is large and that each

individual has the incentive to spend up to the value of his share to preserve or regain his rent-paying job. That is why major lobbying efforts can be mounted to get government to reestablish trade restrictions or to uphold such labor-market restrictions as industry-wide bargaining agreements.

Many of the cries for government intervention in the economic system undoubtedly come from rent seekers who promote the interests of one or another of America's pluralities against the interests of society as a whole. Farmers and their lobbyists, using such nice words as "parity," call for continued price supports, loan subsidies, and cash or in-kind payments for withholding crop land from production. Other groups are said to be on welfare when they receive payments for not producing. Economic studies done for the Associated General Contractors of America by Georgetown University's Douglas Brown and by Data Resources, Inc., "prove" that increasing government spending on construction would increase long-term employment and output.[14] Automobile, steel, and textile industry executives--supported by workers, labor unions, and suppliers, with whom they share the rents they extract from society--want import quotas and tariffs. In general, these groups know that their efforts to get a larger slice of the American pie necessarily make that pie smaller. The pie shrinks not only because such efforts consume resources that could be better spent in the production of goods and services, but because government--broadly construed--does respond, creating rents and causing resources to be misallocated. Of course, most economists consider such government responses ill advised.

Beyond the question of efficiency, many believe such specialized intrusions by government violate the constitutional rights of Americans to equal treatment under the law. Consider the following case. An amendment to the Fair Labor Standards Act in 1942 allowed the development of regulations that over time made New England's cottage textile industry less feasible. These regulations imposed several burdensome restrictions, effectively prohibiting certain types of knitting in the home, for example. The regulations were successfully opposed in 1984, however, on the basis that they set an unacceptable precedent.[15] Opponents of the regulations argued before the Supreme Court in *Breen v. International Ladies Garment Workers' Union* that if textile unions received constitutional protection against competition from families working in their homes, then any other industry might demand similar protection. Perhaps commercial picture framers could shut down family picture-framing enterprises operating from garages.

It is important to note that opposition to such restrictive laws is not usually successful. One of the main arguments for government protection of various industry segments today is the claim that markets, especially labor markets, are not free and that each group therefore has a right to the same protections and resulting subsidies its competitors receive. Joseph Schumpeter recognized the insidious nature of this kind of thinking and forecasted that it would inevitably destroy capitalism as we know it.[16]

Technological Advancement and the Depreciation-of-Human-Capital Argument

Schumpeter argued that innovation drives any capitalist economy.[17] He also noted that innovation is a process of "creative destruction," in which new capital equipment renders old capital equipment obsolete. Implicit in Schumpeter's writings is the idea that technological advancement can also make human skills obsolete or at least depreciate them significantly.

Much of the fear of human-capital depreciation may be grounded in the recent massive layoffs in the U.S. automobile and steel industries. In both cases, oligopolistic structures, coupled with government-supported multi-company collective bargaining and trade barriers, restrained innovation for many years. Companies were able to saddle American consumers with the rents they paid workers and themselves. They were also able to pass along the costs of using suboptimal combinations of labor and machines, namely, too few machines and too much labor for the given output level.

The automobile makers met their comeuppance in 1981 and 1982, when circumstances required them to take giant steps toward optimality. The lowering of trade barriers (though softened by "voluntary" quotas in their place), the decreased demand for U.S. cars caused by high interest rates and high fuel costs, and the targeting of U.S. markets by Japanese producers resulted in extensive layoffs of workers and large losses for the "big four" automobile producers. As noted earlier, the companies began to recover by automating aggressively, by bargaining away some of the rents they had been paying, and by continuing to request and get some important protection. A similar sequence of events

occurred in the steel industry.

When technological advancement is incremental, as it usually is when forms of monopoly power do not inhibit it, such disruptions do not occur. In an economy where huge rents are allowed to exist--nearly half of a typical automobile worker's income is clearly economic rent--there is the continual threat that market forces will cause those rents to be eliminated rapidly or, as happened in the automobile industry, cause the replacement of much of the human capital with physical capital. Persons who oppose technological advancement on this basis argue that it is inequitable to allow market forces to depreciate human capital. Taken to an extreme, of course, that view would negate all innovation.

Even in its milder forms, the argument is insidious. As in the auto industry, restrictions on free markets, including labor markets, produce upheavals that serve as the pretext for further restrictions. In fact, because labor continues to demand its rents, with government support but now without the previous level of protection in the product market, it may be that the capital-labor equation has been altered to overly favor capital. With high wages and less protection to enable industry to pass the cost of these rents on to consumers, industry now must use even more capital to replace labor than if government allowed wages to fall to competitive levels. It is now apparent that there is and will be less employment in the automobile and steel industries because of government intervention-- its support of union bargaining--in these markets. Harvard professor William Abernathy provides strong anecdotal evidence for this point, stating in 1983 that "Ford Motor Company to be as efficient as Japanese auto firms . . . [can] afford to keep only half the 256,000 American employees it had in 1978." [18] Such a large shift, if it does indeed occur, would not have been necessary had there not been a closed system and payments of rent in earlier periods. Nor would the decline in Ford employment be so extensive now if wage levels were allowed to return to competitive levels without rents. Past government intervention has been helpful only to those who received rents the past two decades.

Technological Innovation and the Structural-Unemployment Argument

As previously noted, a major premise of Barry Bluestone's argument for an expanded "social safety net" and other government intervention in markets is the so-called hypermobility of capital. Bluestone suggests that firms be made to bear the social costs of moving plants from high labor-cost areas to low labor-cost areas. He and others assert that mergers, which often lead to greater company rationalization and hence to plant closings, should be restrained.

In this case, the social costs relate primarily to the attachment of workers to certain locales. For example, a person laid off in Caterpillar's recent retrenchments in the Peoria area typically has a house that is largely paid for, children in school, and a learned dependency on the social structure of Peoria. While a job may be available for the individual in another state, he might be unwilling to move to take advantage of that job. He is therefore said to be "structurally unemployed," although by our definition he is not involuntarily unemployed at all.

Another form of "structural unemployment" occurs when the jobs available in a certain area do not match the talents of those who wish to be employed. As mentioned earlier, some believe that this kind of unemployment may exist throughout the economy (in which case it is indistinguishable from human-capital depreciation) because of rapid technological advancement. However, Richard Riche, Daniel Hecker, and John Burgan note that there is little evidence that society will become computerized and robotized overnight. [19] As economic theory predicts, individuals are making decisions that address the problem of structural unemployment as, or even before, it occurs. Essentially left to their own devices, young persons are becoming computer literate; there is also a greater concern for teaching science and mathematics in the schools. Moreover, market forces are causing personnel theory and practice to take account of the need to retrain and limit the displacement of mature workers. [20] Only when technological advancement is held back in non-competitive markets, as it has been in the automobile and steel industries, are short-term structural effects likely to be great enough to be a problem when the day of reckoning actually arrives.

The Real Costs of Technological Advancement-- Absorbing Rapid Change

Economists summarize social costs and benefits in the phrase "expected utility." With any economic or social change there are almost always some who lose (their expected utility declines) and some who gain (their expected utility increases). If the change creates a net increase in expected utility, however, then it can be said to be for the better because aggregate welfare is higher.

A legitimate question concerning advancing technology is whether the adjustment costs for individuals--moving to new jobs, retraining, and the like--are higher than the gains in output (or leisure) made possible by technological change. Of course, this question is likewise relevant in the simple competitive environment (without assuming technological advancement), in which businesses routinely open and close as markets seek to produce goods and services at lowest cost and deliver them in a convenient way to consumers. There are obvious costs to this process, but the benefits outweigh the costs in the aggregate, or the particular competitive movements would not continue to occur.

However, some people argue that technological change, particularly rapid technological change, is a different case. The displacements produced by rapid technological change even in markets not characterized by monopoly power and economic rents are said to represent social costs that are greater than the potential benefits of the new technology.

Consider the following example. Suppose a new piece of technology increases output with the use of less labor. In competitive markets, it is clear that the relocation costs for adversely affected individuals will be low because other jobs will be obtained relatively quickly and at similar wages. However, those making the changeover will still bear some costs and a lowering of their expected utilities. Are the net expected utilities greater, when all individuals--consumers, owners, and others--are considered? The answer is generally yes. But it could be no, particularly if the pace of technological change is very rapid. The thesis of Alvin Toffler in *Future Shock* is more realistic than that of Aldous Huxley in *Brave New World*, in that it is the rate of technological change, not the state of technological development, that creates the problem. Robots doing all our work might be fine, given time to adjust our workweek to zero.

In general, people expect to receive increasing benefits from ever-greater output as the rate of technological development speeds up. At low rates of technological advancement, perhaps 2 or 3 percent a year, there may be other social benefits in addition to increased physical output. For example, young persons can find new challenges and opportunities that are not available in a no-growth or very slow growth situation. Further, at low rates of change, the rent-seeking elements of society are in less conflict. Rent seeking is easier because only a relatively small number of people are required to retrench at a given time and because the rents can be paid out of the expanding economic pie. Also, social attitudes tend to be more optimistic and cooperative when the economy is advancing. At low rates of technological advancement, almost all perceptions are positive and advancement is everywhere hailed as valuable.

However, many fear that at some significant rate of technological change, perhaps 20 or 30 percent, both individuals and institutions will be unable to adapt rapidly or avoid high social-adjustment costs. For example, when William Schroeder received an artificial heart at the Humana Hospital in Louisville, Kentucky, in 1985, there were calls to slow the pace of such innovations so that ethical and legal considerations could be debated and appropriate policies and laws established. When robots replaced many already laid-off automobile workers in the Detroit area, there was fear that crime and vandalism would increase. The prediction of Bluestone and others that technology might create an economic duality in society by eliminating the middle class causes some to expect social disruption if technology moves too fast. The assertion of Wassily Leontief that the invisible hand of the marketplace is becoming obsolete could, if widely believed, result in an abandonment of the capitalist principles that account for America's progress to date. In a nutshell, the argument that the prospect of extremely rapid technological change can lower expected social utilities for much of society is based on two concerns: first, that technology will breed unemployment and social disruption; and second, that the fear of rapid technological change may be used to justify government intervention, making the social allocation of resources less efficient.

If the rate of technological change is very high, perhaps the social disutilities it creates may reduce the appeal of the added output benefits. However, those who oppose the current rate of technological change must prove that it creates disruptions, costs, and unhappiness of such a magnitude as to actually outweigh the output/leisure benefits being generated. They must also show that the social disutilities being created now at the current rate of technological change could not be reduced greatly by first eliminating rent-seeking situations in the economy. Most of the current trauma, if it is that, is being undergone by those workers who have lived--and continued to live--in an artificial environment of rents, fostered by government.

Conclusions

In the late 1950s, A. W. Phillips hypothesized a negative relationship between wage-rate inflation and unemployment rates.[21] Recent work on the so-called Phillips Curve, like that by Santomero and Seater, suggests that there is no such long-run tradeoff.[22] While Phillips at least had empirical evidence, although not a very satisfactory theoretical foundation, to support his idea, the new idea that technology must be traded off against employment in the long term is unsupported both empirically and theoretically. Those who argue that the production of more goods and services with fewer inputs will produce long-term unemployment are wrong--and, thankfully, few in number. As Nathan Rosenberg pointed out in testimony before a congressional committee on technology and unemployment, our present employment difficulties lie elsewhere "than in the sphere of technology-generated unemployment." [23]

Most of today's believers in restricting technological advancement base their case on short-term distributional effects. Their apparent sincerity and eloquence may convince the governmental jury to assess damages against society. But the damages will be punitive, not compensatory. The "tort" for which producing Americans might be forced to compensate its "victims" is the fostering of a system in which individuals, by and large, receive the products of their own labors rather than those of their neighbors'. History may yet record that Schumpeter was right when he wrote:

A situation may well emerge in which most people will consider complete planning as the smallest of all possible evils. They will certainly not call it Socialism or Communism, and presumably they will make some exceptions for the farmer, the retailer, and the small producer; under these circumstances, capitalism (the free enterprise system) as a scheme of values, a way of life, and a civilization may not be worth bothering about.[24]

If the proven benefits of a free economy are lost to posterity, it will be, as Schumpeter said, "with sufficient help from the public sector"[25] and because those who promote the true interest of society in the matter give up in frustration.

FOOTNOTES

The authors acknowledge the encouragement and assistance of the editor, an anonymous reader, and Richard B. McKenzie, professor of economics at Clemson University presently on leave at the Center for the Study of American Business, Washington University, St. Louis. The opinions expressed in this study are solely those of the authors.

[1] "Distress Inevitable as Robots Replace Low End of Workforce," *International Management* 38 (July 1983): 3-4.

[2] Bluestone's arguments are summarized in Richard J. Seltzer, "Impact of Technology on Employment Probed," *Chemical and Engineering News*, August 1, 1983, pp. 23-24.

[3] Robert B. Reich, "Collusion Course," *New Republic*, February 27, 1984, pp. 18-21.

[4] See, for example, Bruce Bartlett as quoted in Lawrence J. Curran, "Revisiting the Luddites," *Byte* 19 (January 1984): 4-6; and Michael Brody, "Breaking the Luddites: Reactionary Unions Everywhere Are Losing the Battle Against Change," *Barron's*, December 12, 1983, p. 9.

[5] See "Science and the Citizen," *Scientific American* 251, no.3 (September 1984): 82.

[6] See Ludwig von Bertalanffy, *Robots, Men and Minds: Psychology in the Modern World* (New York: George Braziller, 1967), p. 114.

[7] For example, when Frederick Taylor, often called the father of scientific management, taught Henry Knolle to load steel billets at three times the previous rate while expending the same effort, a technological advance was achieved similar to that realizable through a correspondingly efficiency-enhancing mechanical innovation. See Daniel A. Wren, *The Evolution of Management Thought*, 2d ed. (New York: John Wiley & Sons, 1979), p. 139.

[8] National Commission on Technology, Automation, and Economic Progress, *Technology and the American Economy*, Vol. 1 (Washington, 1966), p. 3.

[9] Bartlett presents a good discussion of this point in Curran, pp. 4-6. He notes on page 4, "There is, of course, not a scrap of evidence in either theory or history to suggest that technological development won't increase employment and

real incomes today just as it always has."

[10] Howard N. Fullerton, Jr., and John Tschetter, "The 1995 Labor Force: A Second Look," *Monthly Labor Review* 106 (November 1983): 5.

[11] Robert Eckelmann, *A Study of the Competitive Prospects of the U.S. Robotic Industry* (Washington: Office of International Sector Policy, International Trade Administration, Department of Commerce, March 16, 1983), p. 12.

[12] Walter Buckingham, *Automation--Its Impact on Business and People* (New York: Harper and Row, 1961), p. 17.

[13] Snyder is quoted by Garth L. Mangum in *The Manpower Revolution: Its Policy Consequences* (New York: Doubleday, 1965), p. 56.

[14] Douglas M. Brown, *Construction/Investment Spending: An Engine of Economic Growth* (Washington: Associated General Contractors of America, 1983); Data Resources, Inc., *America's Infrastructure: Effects of Construction Spending* (Washington: Associated General Contractors of America, 1984).

[15] *Supreme Court Proceedings* 53 (July 1984-June 1985): 3059.

[16] Joseph A. Schumpeter, *Capitalism, Socialism, and Democracy*, 3d ed. (New York: Harper and Brothers, 1950).

[17] *Ibid.*, p. 83.

[18] Abernathy is quoted by Charles P. Alexander in "The New Economy," *Time*, May 30, 1983, p. 63.

[19] Richard W. Riche, Daniel E. Hecker, and John U. Burgan, "High Technology Today and Tomorrow: A Small Slice of the Employment Pie," *Monthly Labor Review* 106 (November 1983): 51.

[20] See especially Charles Bruno, "Labor Relations in the Age of Robotics," *Datamation* 30, no. 3 (March 1984): 179-82; Edward M. Knod, Jr., Jerry L. Wall, John P. Daniels, Hugh M. Shane, and Theodore A. Wernimont, "Robotics: Challenges for the Human Resources Manager," *Business Horizons* 27 (March-April 1984): 38-46; and Herman Z. Levine, "Robotics and Technology: How to Manage Technostress," *Personnel* 61 (July-August 1984): 51-52. All of these articles indicate that the robotics revolution will actually be an evolution that poses no threat.

[21] A. W. Phillips, "The Relation Between Unemployment and the Rate of Change of Money Wage Rates in the United Kingdom, 1861- 1957," *Economics* 25 (November 1958): 283-99.

[22] Anthony M. Santomero and John J. Seater, "The Inflation-Unemployment Trade-Off: A Critique of the Literature," *Journal of Economic Literature* 16 (June 1978): 523.

[23] "Technology, Employment and Unemployment," *Research Management* 26 (November-December 1983): 4.

[24] Schumpeter, p. 424.

[25] *Ibid.*, p. 425.