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# Public Policy Brief

## Side Effects of Progress

How Technological Change Increases the Duration of Unemployment

*William J. Baumol and Edward N. Wolff*

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# Summary

Research Associates William J. Baumol and Edward N. Wolff find that technological change has serious side effects in the labor market. As the pace of technological change increases, firms need to close to retool their factories more often and so have to lay off employees more often; firms also need to retrain workers or hire new workers with different skills. This means an increase in the number of workers who are between jobs, longer periods of unemployment between jobs, and perhaps permanent unemployment for those who are most costly to retrain, such as older and less-educated workers. With technology that is constantly changing and changing at an accelerating pace, there is not only a temporary increase in the level and duration of joblessness, but a long-term permanent increase in the rate of unemployment throughout the business cycle.

In this brief Baumol and Wolff focus more on the duration of joblessness than its level. They review data showing a worldwide trend toward longer duration. In the United States between 1948 and 1993 the average length of time a worker was between jobs doubled and the portion of the unemployed defined as long-term unemployed quadrupled. The increases were even larger in Europe.

The authors report on their investigation to sort out the effects of technological, institutional, and demographic variables on unemployment duration. Their statistical analysis, which shows that an increase in the rate of total factor productivity growth and an increase in investment in office, computer, and accounting equipment are closely associated with an increase in average duration of unemployment, provides strong support for their thesis that the duration of joblessness rises when the rate of technological change rises.

Baumol and Wolff review briefly some of the many serious social and psychological consequences of joblessness, the costs of which must be added to economic factors in order to calculate the total cost of unemployment. The authors point out that it is reasonable to assume that these consequences (such as suicide, illness, divorce, and criminal activity) intensify the longer a worker is unemployed.

Baumol and Wolff suggest some government actions that in combination could offset some of the side effects of technological change. First, increase the period of eligibility for unemployment insurance benefits to 39 weeks or a year. Despite the fact that the average duration of unemployment has more than doubled since the late 1940s, unemployment insurance benefits still expire after 26 weeks. Also, increase the income replacement rate of unemployment insurance. The increase in the duration and level of benefits can give unemployed workers adversely affected by technological innovation added time for retraining. Second, target job retraining programs at emerging technologies so that unemployed workers can acquire the requisite skills to meet the needs of employers and find suitable employment. Third, conduct research into the best way to improve the educational achievement of those most at risk for protracted or permanent joblessness—older workers and young, less-educated workers.

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# Preface

The economic news sounded good in early 1998: GDP growth was up to 5.4 percent and unemployment was down to 4.3 percent, the lowest in almost 30 years. But, what are some of the realities behind this news? A 4.3 percent unemployment rate translates into 5.9 million unemployed people. The average unemployment rate, adjusted for business cycle fluctuations, has slowly but steadily increased since the Second World War. Today's 4.3 percent unemployment rate is twice as high as it was in a peak year in the 1950s. Along with the increase in the level of unemployment there has been a persistent increase in the length of time a typical unemployed person is between jobs, an increase in the portion of total unemployed who are classified as long-term unemployed, and a decrease in the portion of unemployed persons who are covered by unemployment insurance.

Why does a dynamic, growing economy have a persistent long-term unemployment problem even in the best of economic times? Research Associates William J. Baumol and Edward N. Wolff have isolated one cause. Technological change, the engine of growth and economic progress, has the serious side effects of increasing the level and duration of unemployment. Technological change is constantly creating demand for new skills and making other skills obsolete. Many economists and policymakers have assumed that as long as technology creates as many jobs as it destroys, it will not increase the unemployment rate. But, according to Baumol and Wolff, that may be a hasty conclusion.

Although technology may not affect or may even increase the total number of jobs available, the fact that it changes the skills needed can increase the level and duration of unemployment. When a firm changes

technology, it may temporarily lay off workers while it closes to retool its facilities and it may permanently lay off workers with some skills and hire new workers with different skills. Some workers, particularly those who have the hardest time acquiring new skills, may be unable to take advantage of the new job opportunities and may face long-term unemployment. Changes like these can affect workers at all stages of the business cycle.

What can we do about it? The answer is not to decrease the pace of technological change. Technological change is by far the most important source of economic growth. Baumol and Wolff suggest ways to offset and reduce the costs of the increased duration of unemployment. Unemployment insurance benefits can be extended and increased to adjust to the reality that workers now tend to be between jobs more often and for longer periods. Government retraining programs can be specifically targeted at emerging skills. Research can be undertaken to find ways to improve the success of programs aimed at retraining the workers most at risk for protracted joblessness, the poorly educated young workers and older workers.

Baumol and Wolff's research should remind us that economic gains do not come without social costs. It would be unwise to hold back technology because of its side effects, but it would be equally unwise to do nothing to help workers who have been displaced by technology.

Dimitri B. Papadimitriou
*Executive Director*
July 1998

# How Technological Change Increases the Duration of Unemployment

> [In] Rotterdam . . . of the 50,000 jobless, 32,000 have been unemployed for more than a year, and many for more than three years. . . . More than 40% of the 17m[illion] unemployed in the European Union have been out of work for at least a year; a third have never worked at all. In the United States . . . only 11% of the unemployed have been looking for work for more than a year. (*The Economist*, July 30–August 5, 1994, 19–20)

An increase in the pace of technological change can have two profound side effects in the labor market. It can increase the rate and the average duration of unemployment. Because firms may not consider it cost-effective to retrain some types of workers to keep up with change, notably the less-educated and older employees, these workers may be jobless for long periods of time, with some of them perhaps never working again. If technological change causes workers to become unemployed more often and for longer periods of time, not only will the level of unemployment increase, but the "natural rate of unemployment," the hypothesized minimum sustainable rate of unemployment, will increase as well. Thus, the problem discussed here can cause sustained increase in the equilibrium rate of unemployment, which is more serious than a simple increase in the unemployment rate, which may be temporary.

In saying that the level and duration of unemployment may be increased by accelerating technological change, we are emphatically not asserting that this is the only factor in such developments. Clearly, the character, magnitude, and duration of joblessness are affected by many factors—the structure of the unemployment insurance system, other elements of public policy, union power and behavior, international trade developments,

and a profusion of others. Even the role of innovation is more complex than a simple statement of our central argument suggests. For example, the severity of the consequences of innovations for employment tends to depend on the level of new skills and education the innovations require, and thus the average length of unemployment may well increase even when the pace of innovation remains the same. However, the evidence supports the conclusion that an increase in the pace of innovation (all else equal) will raise both the natural rate of unemployment and the average length of time during which an unemployed worker is "between jobs."

Our focus in this brief is less on the level of unemployment and more on its duration. We demonstrate how the cost of retraining can lead to longer average duration of unemployment when the pace of technological change increases and review the data for the United States and other industrial countries showing that there is a trend toward an increase in the length of joblessness. We also present the findings of our statistical analysis of the influence of technological change upon the duration. We review briefly some of the social consequences of unemployment. Finally we consider the policy implications of our findings. It almost goes without saying that society will not chose to slow down technical progress. However, a combination of greater retraining efforts and extended unemployment insurance benefits can offset many of the problems caused by rising unemployment duration. This may give unemployed persons both the means and the opportunity to acquire the requisite skills.

## The Natural Rate of Unemployment and the Pace of Technological Change

Consider, first, the effect of an increase in the pace of technological change on the level of unemployment in the economy, leaving to the next section its effect on the length of time an average unemployed worker will be between jobs. The "natural rate of unemployment" presumably encompasses both "frictional" and "structural" unemployment. Frictional unemployment is the period of joblessness before workers can find new positions after leaving or being laid off from a job. Structural unemployment is joblessness caused by the obsolescence of workers' skills. Both of these types of unemployment will be affected by the frequency with which plants close down either permanently or for a period

of reconstruction or retooling. An increase in the rate of technological change will increase the frequency with which plants close and thus will increase the portion of the labor force that is unemployed in any period. The continuous character of technological innovation is a central part of this scenario; since at least the middle of the nineteenth century both production techniques and products have been constantly undergoing modification and replacement.

An example can help describe the logic of the effects on level of unemployment. Assume that, initially, the rate of technological innovation is such that an average plant can be expected to need to close for redesign and retooling once every 50 years and that it will need to be closed for 1 year. If an employee of the plant is laid off during this period and is then rehired or, on average, takes 1 year to find a new job, technological change will have contributed 2 percent to the unemployment rate; that is, the employee will have been unemployed for 1 year in 50 (or 2 years in 100) because of the change. Now, consider a speed up in the rate of change so that the plant must be modernized every 25 years instead of every 50. If everything else remains as before, the contribution of technological change to unemployment will double to 4 percent. These numbers may not correspond even approximately to reality, but the conclusion is valid in general.

If we compare two otherwise identical economies, we can expect more openings and closings of business units in the more innovative economy than in the relatively stationary economy. The opening of new business units in an economy with rapid change keeps the jobs lost from plant closings from becoming more than temporary. Nevertheless, it remains true that frictional and structural unemployment will be permanently and, plausibly, substantially higher in an economy with rapid change than in an economy with slow change because the greater continuous flow of change means that job losses will occur more frequently. No sooner will one set of technologically unemployed find new jobs than they will be replaced by a new group of jobless, thrown out of work by a succeeding set of plant closings. The constant creation and loss of jobs resulting from technological change do not simply balance out, even if the two occur at identical rates. The process stirs up job change and that takes time, contributing a net increase in the natural rate of unemployment and one that is not transitory as long as the pace of change continues.

We turn now to a discussion of the relationship between the rate of technological change and the length of joblessness. The distinction between the level of unemployment and its duration is of considerable importance for the social consequences of unemployment. Even if the unemployment rate does not change, the duration of joblessness can vary substantially. The unemployment rate will be the same when 4 million workers are unemployed for three months on average during a year and when 1 million workers are unemployed for a full year. Yet the consequences of the extended period of joblessness for the mental state and behavior of the people without jobs and for the functioning of society can be significant.

## Duration of Joblessness and the Pace of Technological Change

An increase in the rate of technological change has three pertinent effects. First, as has been indicated, it increases the natural rate of unemployment. Second, it increases the relative cost of employing a person who is relatively expensive to retrain or who is less likely to increase revenue enough to make up for the cost of retraining. Third, because of the increased retraining costs for these workers, they may remain jobless for longer than workers more likely to be retrained by employers. Thus, the increase in the rate of change raises the share of jobless persons whose duration of unemployment is relatively long.

Firms believe it is not cost-effective to retrain older or less-skilled workers, either because the retraining costs are higher or because the workers will not be on the job long enough or will not be productive enough for firms to recoup the costs of retraining. Firms, therefore, prefer to replace these workers with younger, more-educated workers, who may be higher paid but whose retraining cost is not as high. This preference (combined with the reduction in overall level of employment) not only leads to an increase in the share of the unemployed labor force made up of workers with high retraining costs, but it also threatens them with permanent unemployment or at least a long period of job search before they are able to find a new job. Of those who suffer long-term unemployment, two groups are most affected. A disproportionate share is made up of older workers whose place of employment moved or closed down or simply

underwent substantial job trimming and younger people in depressed urban and rural areas, particularly members of minority groups with characteristically low incomes, many of whom have had inferior education and have never held anything but dead-end jobs or jobs in the underground economy.

The most important relationships in this analysis can be explained with a simplified example. Suppose the wage of an unskilled worker is $9,000 per year and the cost of retraining is $4,000, while a skilled worker costs $30,000 in wages and $6,000 in retraining. If retraining is required every two years, the average yearly cost to the employer of an unskilled worker is $11,000, that is, $9,000 in wages plus $2,000 in retraining (half of the $4,000 required every two years). The cost of a skilled worker is $33,000 ($30,000 in wages plus $3,000 in retraining costs). This means that a skilled worker costs the employer three times as much as the unskilled employee, which implies the employer believes a skilled worker is three times as productive as an unskilled worker.[1] Now suppose there is an acceleration of innovation so that retraining is required once a year. Assuming no change in wages, the annual cost of the unskilled worker rises to $13,000 ($9,000 + $4,000) and the annual cost of the skilled worker rises to $36,000 ($30,000 + $6,000). Now the cost of a skilled worker is less than three times the cost of an unskilled worker, meaning that unskilled employees are relatively more expensive than they used to be. If this is so, firms will try to hire more skilled and less unskilled workers.[2] If many employers are facing a similar situation, unskilled workers will be more likely to lose their job and will find it more difficult to find another job.

In other words, as the frequency with which workers need retraining increases, a higher percentage of those who are fired will be unskilled, and it will take those workers longer than before to find reemployment. This is clearly a way in which increased rapidity of technical change can add to the average duration of unemployment, even without taking into account the frequency with which such change increases the need for superior worker skill and education, thereby reducing still further the relative value of an unskilled worker.

The same basic story is repeated for older workers. They may be harder to retrain than young, educated workers because they may have become set in their ways and because their education predates the latest

technical developments. In addition, being closer to retirement age, older workers offer the employer a briefer stream of revenues and dimmer prospects of recouping the retraining costs (cf. Becker 1975).

There is the likelihood that some of these workers who become unemployed may remain permanently jobless or find new employment only after a considerable lag. They will face a time between jobs well above their previous average and probably higher than the former average for the labor force as a whole. With the unskilled and older workers constituting a greater proportion of the unemployed and with their time between jobs increased, the average duration of unemployment for the economy must rise.

The unskilled and older workers whose jobs are threatened may be willing to accept low wages as an alternative to unemployment. However, if wages are sticky because of customs, institutions such as the minimum wage, the possibility that only a wage below the subsistence level will be low enough to open up job opportunities, or any other reason, then unemployment may be the only possible outcome for these individuals, and there is no reason for this period of unemployment to be brief or even temporary. Indeed, it is possible that the cost of training will be so high for some unskilled or older workers that it will not pay to hire them even at a zero wage, causing lifetime unemployment or employment in the underground economy.[3]

We again would like to emphasize that the mechanism we have outlined is not the only influence that can lead to lengthening of the period of joblessness. Our story provides conditions sufficient but hardly necessary to yield that result. For example, as already remarked, increased complexity of new products and processes can be at least as disadvantageous to unskilled or older workers as sheer acceleration of technological change in general. This is important to keep in mind in evaluating the mechanism in light of recent empirical evidence. Recent developments may justifiably raise the question of how one can reconcile this mechanism for the growth in the duration of employment with the fact that in much of the industrial world the growth of total factor productivity has declined materially since the decades immediately following the Second World War, apparently implying that technological change has slowed.[4] It will emerge from our statistical analysis that the major reason for the

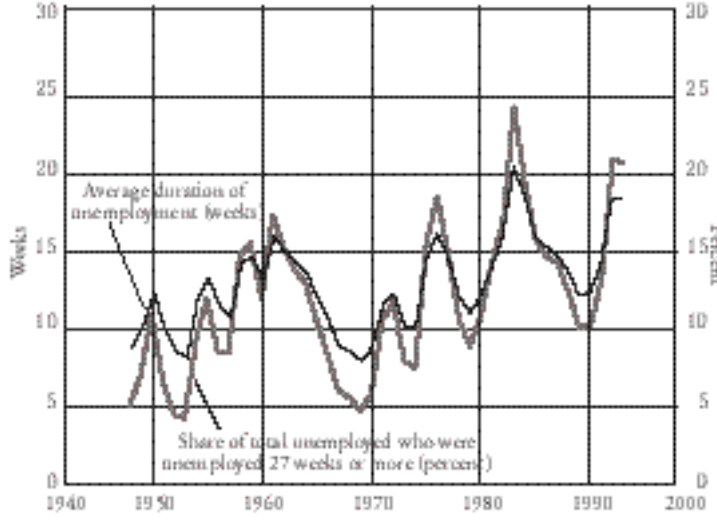
growth in the duration of unemployment is the incredible growth in computerization over the last quarter century.

## Trends in the Duration of Unemployment

The duration of unemployment has risen rather dramatically over the last half century. The mean duration of unemployment approximately doubled between the early 1950s and the mid 1990s, with most of the increase occurring since the early 1970s. Between the 1970s and the early 1990s the rise in unemployment duration was almost universal among demographic groups, with the average weeks of unemployment increasing generally about 3 to 4 weeks (Table 1). Average weeks of unemployment rose more among older workers, so that the spread in unemployment duration between older (ages 55–64) and younger (teenage) male workers widened sharply, with the difference increasing from 10.8 to 17.1 weeks.

Figure 1 summarizes pertinent data provided by the Bureau of Labor Statistics (see Baumol and Wolff 1998, for details on data sources and

**Figure 1** Trends in Duration of Unemployment, United States, 1948–1993




*Source:* U.S. Bureau of Labor Statistics, *Employment and Earnings* (Washington, D.C.: Government Printing Office, 1977–1994); *Handbook of Labor Statistics* (Washington, D.C.: Government Printing Office, 1985), Bulletin 2217, Table 15.

**Table 1** Mean Duration of Unemployment by Demographic Group, Period Averages

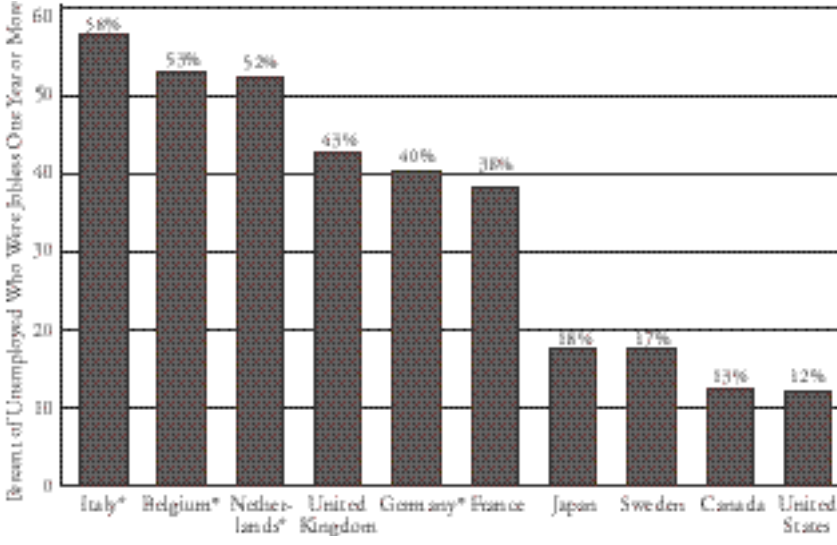
| | 1970–1979 | 1980–1989 | 1990–1993 |
|---|---|---|---|
| Men | | | |
| All men | 13.1 | 17.1 | 17.2 |
| 16–19 years | 8.3 | 9.3 | 8.5 |
| 20–24 years | 11.6 | 14.5 | 12.6 |
| 25–34 years | 14.0 | 18.3 | 17.0 |
| 35–44 years | 16.8 | 21.1 | 20.3 |
| 45–54 years | 18.0 | 22.7 | 24.1 |
| 55–64 years | 19.1 | 23.8 | 25.6 |
| 65 years and over | 21.0 | 19.3 | 24.5 |
| Women | | | |
| All women | 10.5 | 12.4 | 13.3 |
| 16–19 years | 7.5 | 7.8 | 7.5 |
| 20–24 years | 9.5 | 10.8 | 9.5 |
| 25–34 years | 10.8 | 12.9 | 13.2 |
| 35–44 years | 12.1 | 14.7 | 16.0 |
| 45–54 years | 13.9 | 16.1 | 18.1 |
| 55–64 years | 16.5 | 17.8 | 20.1 |
| 65 years and over | 18.2 | 15.6 | 19.6 |
| White, 16 years and over | 11.7 | 14.4 | 15.2 |
| Men | 12.8 | 16.6 | 16.9 |
| Women | 10.2 | 11.6 | 12.9 |
| Black, 16 years and over | 12.8 | 17.0 | 16.6 |
| Men | 14.2 | 19.3 | 18.6 |
| Women | 11.4 | 14.6 | 14.4 |
| Men, 16 years and over | | | |
| Married, spouse present | 14.8 | 19.4 | 19.6 |
| Widowed, divorced, or separated | 14.4 | 20.9 | 20.3 |
| Single (never married) | 11.2 | 14.3 | 14.3 |
| Women, 16 years and over | | | |
| Married, spouse present | 10.6 | 12.2 | 14.0 |
| Widowed, divorced, or separated | 10.9 | 15.4 | 15.7 |
| Single (never married) | 9.4 | 10.9 | 11.2 |

*Source:* U.S. Bureau of Labor Statistics, *Employment and Earnings* (Washington, D.C.: Government Printing Office, 1977–1994); *Handbook of Labor Statistics* (Washington, D.C.: Government Printing Office, 1985), Bulletin 2217, Table 15.

methods). The graph indicates that over the 45-year period from 1948 through 1993 the average duration of unemployment more than doubled and the share of the unemployed composed of persons unemployed 27 weeks or more (the longest period covered in the available data) about quadrupled. Both trajectories are characterized by extreme fluctuations, but, based on a conservative calculation, the duration of unemployment grew at a rate of nearly 1 percent per year and the share of the unemployed who were jobless 27 weeks or more grew at an average rate of 1.7 percent a year. In nearly half a century these changes added substantially to the average duration of unemployment and the proportion of those who suffer unemployment that is clearly protracted. By 1993 the average duration had grown from about 8 to about 17 weeks and the share of long-term unemployed had grown from 5 percent to over 20 percent of the total unemployed.

Protracted joblessness is an international phenomenon. Organization for Economic Cooperation and Development (OECD) data show that, of 10 industrialized countries, the United States had the lowest incidence of long-term unemployment (defined as joblessness for 52 weeks or more), at 12 percent (Figure 2). Italy, Belgium, and the Netherlands had the unenviable position of being at the top, with more than half of their job-

**Figure 2** Long-Term Unemployment as a Share of Total Unemployment, 10 OECD Countries, 1994



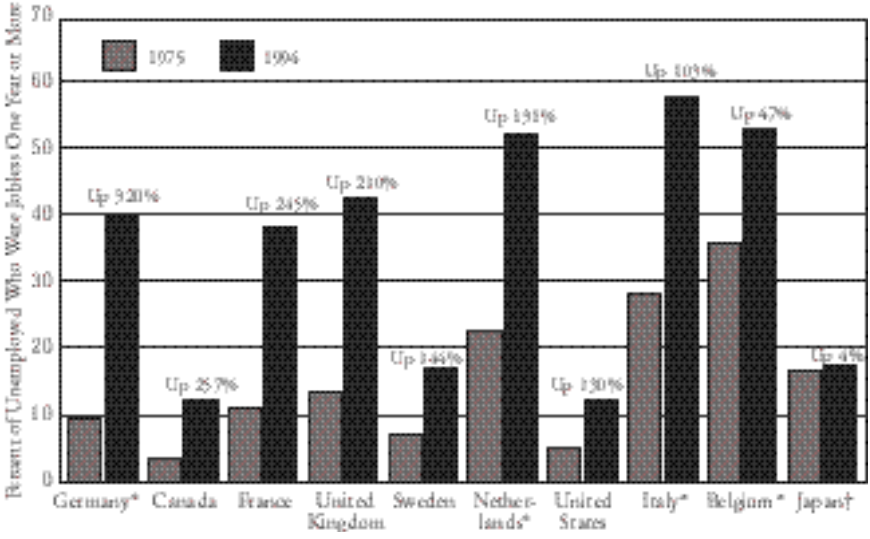

*1993 data.

*Source:* OECD, *Employment Outlook,* July 1995, 219.

less out of work for a year or more; these countries also had overall unemployment rates significantly higher than the United States.

Figure 3 compares the percentage growth in long-term unemployment as a share of total unemployment for the same 10 countries from the mid 1970s to the mid 1990s. Once again, the United States, with its 130 percent increase, is near the bottom of the group. It is outstripped by Germany at the top, with its 320 percent rise, and by Canada, France, the United Kingdom, and Sweden, with approximately 257, 245, 210, and 144 percent, respectively. Clearly, this is no minor phenomenon, and the United States is not its most badly damaged victim.

**Figure 3** Growth in Long-Term Unemployment as a Share of Total Unemployment, 10 OECD Countries, 1970s versus 1990s




*1993 data.

†1979 data.

*Source:* OECD, *Employment Outlook*, July 1995, 219.

## Effects of Technological Variables on Unemployment Duration

We carried out a statistical analysis to sort out the effects of technological, institutional, and demographic variables on changes in unemployment duration.[5] The analysis is based on aggregate time-series data for the

United States, covering the period 1950 to 1995. Since the pace of technological change is itself almost impossible to observe directly, we used five alternative indexes to measure technological activity: the standard rate of total factor productivity (TFP) growth, the ratio of research and development (R&D) expenditures to gross domestic product (GDP), the number of full-time equivalent scientists and engineers engaged in R&D per 1,000 employees, investment in new equipment and machinery per full-time equivalent employee (FTEE), and investment in office, computing, and accounting equipment (OCA) per FTEE.

The institutional factors included the presence of unions, the minimum wage, and three aspects of unemployment insurance: the percentage of all employees covered by unemployment insurance; the replacement rate, or the ratio between unemployment benefits and the average previous wage; and the percentage of unemployed workers receiving benefits (no benefits may be due to failure to meet eligibility requirements, exhaustion of benefits, or not being covered by unemployment insurance). The demographic factors included the gender, age, and racial composition of the labor force.

The results provide strong support for the central thesis of our paper, that the duration of unemployment increases when the rate of technological change rises. The mean duration of unemployment remained largely unchanged over the 1950s, 1960s, and 1970s, at about 11.5 weeks; it then jumped to 14.6 weeks in the 1980s and to 15.6 weeks in the first half of the 1990s. All five technology indicators turn out to be positively correlated with unemployment duration (see Table 2). A 1 percentage point increase in the annual rate of TFP growth is associated with a 12 percent increase in the mean duration of unemployment. This result is particularly striking given that the simple correlation between TFP growth and unemployment duration is small and that the two move cyclically in opposite directions. Computerization is the most significant factor and has the strongest effect. An increase of $1,000 (in 1987 dollars) of OCA investment per employee is associated with a 53 percent increase in the mean duration of unemployment. The other technology variables—R&D intensity and number of scientists and engineers engaged in R&D—were positively correlated, although they were not statistically significant.

**Table 2** Mean Duration of Unemployment and Mean Values of Technological Variables by Period

| | 1950–1959 | 1960–1969 | 1970–1979 | 1980–1989 | 1990–1995 | Correlation with Mean Unemployment Duration[a] |
|---|---|---|---|---|---|---|
| Mean duration of unemployment (weeks) | 11.4 | 11.7 | 11.5 | 14.6 | 15.6 | |
| Ratio of R&D expenditures to GDP (%) | 1.50 | 1.97 | 1.56 | 1.83 | 1.89 | 0.30 |
| Number of scientists and engineers engaged in R&D per 1,000 FTEE | 4.01 | 4.81 | 4.32 | 5.47 | 6.30 | 0.40 |
| OCA investment per FTEE (thousands of 1987 dollars) | 0.006 | 0.007 | 0.021 | 0.185 | 0.522 | 0.54 |
| Equipment investment per FTEE (thousands of 1987 dollars) | 1.96 | 2.54 | 3.46 | 3.80 | 4.35 | 0.49 |
| Annual rate of TFP growth (%)[b] | 1.56 | 1.75 | 0.65 | 0.47 | 0.29 | 0.23 |

*Note:* For details on data sources and methods, see William J. Baumol and Edward N. Wolff, "Speed of Technical Progress and Length of Average Interjob Period," Working Paper no. 237, The Jerome Levy Economics Institute, 1998.

[a] The correlation coefficient is computed on the basis of 36 observations (annual data 1950–1995), except for the ratio of R&D expenditures to GDP (1953–1994) and scientists and engineers engaged in R&D (1957–1994).

[b] Uses FTEE and gross nonresidential capital stock, the private sector only.

*Source:* Authors' calculations from:

Council of Economic Advisers, *Economic Report of the President* (Washington, D.C.: Government Printing Office, various years).

John C. Musgrave, "Fixed Reproducible Tangible Wealth in the United States: Revised Estimates," *Survey of Current Business* 71, no. 1 (January 1992).

———, "Fixed Reproducible Tangible Wealth in the United States," *Survey of Current Business* 74, no. 8 (August 1994).

National Science Foundation, *Research and Development in Industry* (Arlington, Va.: National Science Foundation, various years).

*Survey of Current Business* 71, no. 1 (January 1992); 76, no. 1-2 (January-February 1995).

U.S. Bureau of Economic Analysis, *National Income and Product Accounts of the United States*, 2 (Washington, D.C.: Government Printing Office, 1959–1988); National Income and Product diskettes.

U.S. Bureau of Labor Statistics, Detailed Investment by Industry (January) diskette, received 1996.

The results for the other variables in the study reinforce the significance of the technology variables (see Tables 3 and 4). The percentage of all employees covered by the unemployment insurance system, the ratio of average unemployment insurance benefits to the average previous wage,

**Table 3** Mean Duration of Unemployment and Mean Values of Institutional Variables by Period

| | 1950–1959 | 1960–1969 | 1970–1979 | 1980–1989 | 1990–1995 | Correlation with Mean Duration of Unemployment[a] |
|---|---|---|---|---|---|---|
| Mean duration of unemployment (weeks) | 11.4 | 11.7 | 11.5 | 14.6 | 15.6 | |
| Employees covered by UI (%) | 64.9 | 73.2 | 82.6 | 92.6 | 93.9 | 0.49 |
| UI replacement rate (%)[b] | 33.4 | 34.9 | 36.5 | 36.2 | 36.7 | 0.35 |
| UI insured coverage rate (%)[c] | 53.3 | 47.1 | 47.8 | 36.8 | 35.2 | 0.39 |
| Union members as percent of labor force | 24.4 | 22.6 | 21.1 | 18.0 | 16.0 | –0.56 |
| Minimum wage (in 1987 dollars) | 3.59 | 4.46 | 4.52 | 3.73 | 3.33 | –0.34 |

*Note:* For details on data sources and methods, see William J. Baumol and Edward N. Wolff, "Speed of Technical Progress and Length of Average Interjob Period," Working Paper no. 237, The Jerome Levy Economics Institute, 1998.

[a] The correlation coefficient is computed on the basis of 36 observations (annual data 1950–1995), except for UI insured coverage rate (1967–1993).

[b]Ratio of mean UI weekly benefit to mean weekly wage.

[c]Ratio of insured unemployment to total unemployment.

*Source:* Authors' calculations from:

Committee on Ways and Means, U.S. House of Representatives, *1994 Green Book* (Washington, D.C.: Government Printing Office).

Council of Economic Advisers, *Economic Report of the President* (Washington, D.C.: Government Printing Office, various years).

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**Table 4** Mean Duration of Unemployment and Percentage Distribution of Total Employment by Gender, Age, and Period

| | 1950–1959 | 1960–1969 | 1970–1979 | 1980–1989 | 1990–1995 | Simple Correlation with Mean Duration of Unemployment[a] |
|---|---|---|---|---|---|---|
| Mean duration of unemployment (weeks) | 11.4 | 11.7 | 11.5 | 14.6 | 15.6 | |
| Percentage distribution of total employment | | | | | | |
| Male | | | | | | |
| 16–19 years | 3.4 | 3.9 | 4.5 | 3.4 | 2.6 | –0.51 |
| 20–24 years | 5.4 | 6.2 | 7.4 | 6.9 | 5.5 | 0.07 |
| 25–54 years | 46.4 | 42.7 | 38.6 | 37.8 | 39.2 | –0.31 |
| 55 years and over | 13.3 | 12.2 | 10.3 | 8.1 | 7.1 | –0.52 |
| Female | | | | | | |
| 16–19 years | 2.6 | 3.0 | 3.7 | 3.1 | 2.4 | 0.26 |
| 20–24 years | 3.8 | 4.4 | 6.1 | 6.1 | 5.0 | 0.19 |
| 25–54 years | 20.3 | 21.4 | 23.3 | 28.9 | 32.7 | 0.56 |
| 55 years and over | 4.8 | 6.1 | 6.0 | 5.6 | 5.4 | 0.01 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | |

[a] The correlation coefficient is computed on the basis of 36 observatons (annual data 1950–1995).

*Source:* U.S. Bureau of Labor Statistics, *Employment and Earnings* (Washington, D.C.: Government Printing Office, 1977–1994); *Handbook of Labor Statistics* (Washington, D.C.: Government Printing Office, 1985), Bulletin 2217, Table 15.

and the percentage of unemployed workers receiving benefits all had a positive, but not statistically significant, relationship with mean unemployment duration. The minimum wage and the presence of unions were both negatively correlated with mean unemployment duration, but were not statistically significant when TFP and OCA were included in the analysis. The percentage of teenagers in total employment was negatively correlated with mean unemployment duration, probably because if teenagers become unemployed, they are likely to drop out of the labor force. Thus, many of the factors often pointed to as causes of increasing unemployment duration are not as statistically significant as the rate of technological change.

The results also support our second hypothesis that technological change affects older workers more adversely than younger workers in terms of duration of unemployment. The correlation between TFP growth and length of unemployment rose with the age group (from zero correlation for the youngest to 0.22 for the oldest). The same is true of computerization. The coefficient of OCA investment rose directly with age and is actually negative for the youngest age group (indicating that it reduces their duration of unemployment). Results are similar for females.

Controlling for the overall unemployment rate proved essential. As shown in Figure 1, the duration of unemployment is quite cyclical. It is strongly correlated with the overall unemployment rate. The higher the unemployment rate, the lower the probability of a jobless worker's obtaining a job; therefore, all else equal, the higher the overall rate, the longer the spell of unemployment.

We repeated the statistical analysis with two additional dependent variables: (1) the percent of unemployed workers who are unemployed for 15 or more weeks and (2) the percent of unemployed workers who are unemployed for 27 or more weeks. The results are similar to the previous results. Technological change and computerization are correlated with an increasing portion of workers unemployed for more than 15 or 27 weeks, implying that, taking other factors into account, an increase in the pace of change significantly increases both the unemployment rate and the average duration of unemployment.

These results are consistent with the argument that firms are reluctant to invest in the training for older workers and unskilled workers associated with new technology. To identify the sources of the sharp increase in unemployment duration observed over the last 25 years or so, compare 1971 and 1994, two years at about the same stage of the business cycle. Over this period mean unemployment duration increased by 66 percent (from a low of 11.3 weeks at one point in 1971 to a high of 18.8 in 1994). By far the greatest effect, according to the statistical analysis, was contributed by the increase in OCA investment per employee over this period, from virtually zero to a high point of $860 (in 1987 dollars).

## Social Consequences of Unemployment

There is a rich and well-documented body of materials in the literature of sociology and social psychology that describe effects of unemployment not widely mentioned in the economic discussions. They indicate that joblessness has a variety of consequences, such as increased suicide, divorce, psychosomatic illness, and criminal activity, whose social cost must surely be added to the forgone output that results from unemployment.

Though much of the literature makes little distinction between lengthy and brief unemployment, it is reasonable to assume that a short spell of unemployment causes little lasting psychological or social damage. However, when the unemployment goes on and on and the worker begins to fear that he or she will never hold a job again, various forms of socially damaging behavior may emerge.

A quote from Mallinckrodt and Fretz (1988, 281) provides a summary of the evidence:

> The devastating impact of job loss on physical and mental health has been summarized in several reviews of empirical investigations (Dooley and Catalano 1980; Gordus, Jarley, and Ferman 1981). Job loss has been linked to increased rates of suicide (Hammermesh and Soss 1974; Pierce 1967), diagnosed cases of mental illnesses and increases in both inpatient and outpatient use of mental health services (Barling and Handal 1980; Brenner 1973; Frank 1981), increased alcohol abuse (Pearlin and Radabaugh 1976; Smart 1979), more external locus of control (Parnes and King 1977), lowered self-esteem (Perfetti and Bingham 1983), and severe depression (Landau, Neal, Meisner, and Prudic 1980). Some unemployed workers, depending on their attributional style, respond to the uncontrollable aversive event of job loss with learned helplessness behaviors, namely, depression and a lowered self-concept, that can immobilize job seeking efforts (Cohn 1978; Feather and Davenport 1981).

The more ambiguous evidence on the relationship between unemployment and crime is discussed in Britt (1994).

## Policy Implications

What can the government do to offset the side effects of technological progress? How can it lighten the burden on the unemployed, make it easier for them to find and hold jobs, and reduce the duration of unemployment?

Two changes in the unemployment insurance system could help the unemployed during extended periods of joblessness. First, and foremost, consideration should be given to increasing the 26-week cap on unemployment benefits to 39 weeks or a year. The growth in unemployment duration has caused the number of workers who are still unemployed after their benefits have been exhausted to grow by two-thirds (as a proportion of the total unemployed population) from 1975 to 1995. The exhaustion of benefits has been the major cause of the decline in the percentage of unemployed workers who receive unemployment benefits, which fell from a peak of 62.3 percent in 1975 to 35.7 percent in 1995. The benefit period now is extended under extraordinary circumstances (such as a deep recession) and only temporarily, but given the rising duration of unemployment, it seems appropriate to write the extension into legislation and make it permanent.

Second, there is good reason to increase the unemployment insurance replacement rate. It has not budged over the last quarter century; the rate in 1995, 36.5 percent, is the same as it was in 1970. In addition to the trend of increased unemployment duration, there has been a trend of declining real wages over this period, which has caused real unemployment insurance benefit levels to fall. It is therefore appropriate to increase the unemployment insurance benefit formula to provide higher real benefit levels.

An objection might be raised that increasing both the length and level of unemployment insurance benefits might cause people to choose to remain on unemployment longer and therefore it would make the problem of unemployment duration worse rather than solving it. The argument goes that by reducing the cost to an individual of being jobless, the extra amount of unemployment coverage will generally prolong the duration of unemployment for many workers. The original architects of

the unemployment insurance system explicitly recognized this and countered that the added security individuals had while unemployed would enable them to select a job more compatible with their skills and interests. We believe that this is the case and feel that the extra coverage might give unemployed workers adversely affected by the introduction of new technology added time for retraining and acquiring new skills. Moreover, it should be stressed that the secular rise of unemployment duration over the last two decades cannot be attributed to rising unemployment benefits or length of coverage, since these have not risen over this period.

To shorten the duration of unemployment, increased government participation in retraining programs is needed. Acceleration of the obsolescence of skills with the increased pace of technological change, especially in the areas of computer and information technology, means that many unemployed workers have been left without the requisite skills to find suitable employment. As we have seen, younger, poorly educated workers and older workers are most likely to be unschooled in the new technology. Government training efforts have a long history of limited success, but part of the reason for this is that little of the retraining has been targeted to emerging technology. A targeted retraining program promises to be more effective than one aimed at old and, in many cases, obsolete skills.

Another more specific issue should be addressed: the problem of aiding the workers who are most at risk—poorly educated young people and older workers who are unable (or are suspected of being unable) to keep up with the job demands of technological progress. We must confess that we can give much less concrete policy recommendations on this issue. The sad fact is that little is known about what works to improve the educational achievements of these groups. In this area, so crucial for the general economic welfare, an extensive search of the literature turns up a shocking lack of systematic evidence. It is, of course, to be expected that academics will recommend further research, but in the case of educational methods that are effective in improving the prospects of at-risk workers, the recommendation is thoroughly justified, and appropriate programs of research can and must be designed.

It should be recognized that educators have formulated promising modifications of current teaching approaches, and the adoption of these modifications should be encouraged as an interim measure until more systematic evidence and analysis become available. Incentives that help reduce dropping out, rewards to students and teachers for improved student performance, revision of curricula to make them more pertinent to prospective employment, and curricula designed to develop flexibility in students so that they will adapt more easily to changing job requirements are some of the steps that have been recommended by thoughtful educators. The fact that the less-educated, younger workers are so seriously affected by technological change leads to the conclusion that improving education is the approach that is most likely to have substantial and lasting results. Research is needed, but there are enough ideas and sufficient experience in the area to make a reasonable start. Indeed, a program of systematic research carefully coordinated with such initiatives may provide the best opportunity for expansion of knowledge on the subject.

The prescription for older workers is similar. Adult education can prepare them to adapt to technological change and help mitigate the fear of departing from long-followed work programs and practices. There is evidence that older persons can be helped to acquire the flexibility required for adaptation to change and that inflexibility on their part is as much a response to social prejudices as to the physiological and psychological effects of aging. Also, since older workers' job problems are related to employers' preconceptions, perhaps, in addition to education, incentives for the provision of jobs to older workers should be considered.

If greater retraining efforts are coupled with longer unemployment insurance coverage and higher benefits, unemployed persons will have both the means and the opportunity to acquire the new skills. The combined effect may be not just to aid workers who suffer joblessness because of technological change but to offset rising unemployment duration in this country.

## Notes

1. If the skilled worker was more than three times as productive as the unskilled worker, the employer would hire more skilled and fewer unskilled workers. If the skilled worker was less than three times as productive as an unskilled worker, the employer would hire more unskilled and fewer skilled workers.
2. Of course, the substitution will be far from complete; skilled workers will not take over the jobs of ditchdiggers and dishwashers. But there are jobs where the difference between slightly less skilled and slightly more skilled workers is marginal, and there we can expect a change in relative wages to make a substantial difference. The example obviously also assumes some stickiness in relative wages. Otherwise, the wages of the unskilled workers might fall sufficiently to offset the decline in the demand for them, although the usual supply-demand model leads us to expect that a wage fall will moderate the rise in unemployment of the unskilled but not offset it altogether.
3. All of this will, incidentally, add to the financial return to investment in education, as has been happening in recent years. In addition, it will exacerbate inequality in income distribution, raising the earnings of younger and more-educated workers at the expense of older and less-educated workers.
4. Our own judgment is that the rapid growth of total factor productivity (TFP) in the 1950s and 1960s is ascribable to a considerable degree to the rapid productivity growth made possible by recovery of economies ruined by depression and war. Such economies, working with skills, knowledge, and experience already available, can achieve a spectacular rate of growth of productivity with little technical change. Predictably, such a process will end once the ruined economies have been resuscitated, and the rate of growth after that point is bound to slow materially. In addition, there tends to be a lag in reaping the benefits of at least some major innovations, as some observers believe is true of the contribution of computers to TFP growth. Thus, one can conclude that the slowdown in TFP growth need not imply a slowdown in the rate of technological change.
5. Here we report briefly on our findings. For details of the study and results, see Baumol and Wolff (1998).

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