Protracted Frictional Unemployment as a Heavy Cost of Technical Progress

by

William J. Baumol*
Edward N. Wolff**

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*Director, C.V. Starr Center for Applied Economics, New York University; Senior Research Economist and Professor Emeritus, Princeton University; and Research Associate, The Jerome Levy Economics Institute.

**Professor of Economics, New York University and Research Associate, The Jerome Levy Economics Institute.

> "[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 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, pp. 19-20.

Neither neoclassical nor Keynesian economics displays much patience with the popular notion that technical progress of the labor-saving variety tends to swell the ranks of the unemployed. Those who believe that market forces tend automatically to bring the economy back, if not to "full employment," at least to a fairly sticky "natural rate of unemployment" seem inclined to believe that this process will wipe out any joblessness created by technical change, presumably with some modest delay. The Keynesian approach suggests (subject to some recent concessions to the notion of the natural rate of unemployment) that the level of employment can be adjusted by macroeconomic policy and that this is capable of undoing whatever joblessness labor-saving innovation may engender.

We will argue here that there is more substance to the public's fears that new productive techniques can threaten jobs than is acknowledged by these lines of analysis. We will suggest that when technical progress is a continuing process a speedup of change can have two profound employment effects. First, it can increase, perhaps materially, what used to be referred to as "frictional unemployment," thereby raising the natural rate of unemployment commensurately. Second, because of the sunk-cost attribute of the retraining of workers to enable them to use the constantly-emerging novel

techniques, speedup of technical change, rather than even-handedly leading to brief periods of unemployment to all of the workers affected, tends to single out three classes of workers, the ill-educated, the older former jobholders and women, particularly of childbearing age, either for declining relative wages or for protracted and possibly for lifetime unemployment.

There is, of course, a considerable body of writings on the social costs of economic growth. By and large it has emphasized the externalities generated by the growth process--crowding, damage to the environment, psychological tension, alienation and the like. It will be suggested here that the employment costs are arguably of at least comparable significance and that they must be taken into account more explicitly in any evaluation of a program dedicated to acceleration of economic growth.

We begin here with a brief discussion indicating how the sunk-cost outlays required for effective retraining can lead to longer average duration of unemployment when the pace of technical change increases. This discussion will be extended and somewhat formalized in section 4 of the article. But before that, we will review the data for the U.S. and other industrial countries showing, in particular, the trends in the length of joblessness. Third, we will digress to recapitulate the evidence on the human cost of protracted unemployment. It simply is not true that unemployment of one person for five years is in any sense the equivalent of unemployment of ten persons, each for six months. There is evidence, which seems to be unfamiliar to many economists, indicating that there is a high cost of lengthy unemployment in terms of divorce, mental illness, suicide, violence in the home and a variety of other forms that go well beyond the mere loss of income that results from joblessness. Finally, we will provide an econometric investigation of the influence of technological change upon the duration of unemployment.

1. SPEED OF TECHNICAL CHANGE AND THE NATURAL RATE OF UNEMPLOYMENT

First, let us consider briefly how increased technical change can lead to long-term elevation of the natural rate of unemployment. The term "natural rate" presumably refers to the level of unemployment, given flexibility of wages, toward which market forces will automatically move the economy. It is an unemployment rate below which public policy can drive the economy, but only in the short run and, even then, presumably at some cost in terms of inflationary pressure and other types of damage to the economy. Thus, the natural rate encompasses, among other varieties, the type of joblessness referred to as "frictional unemployment."

Frictional unemployment includes the job loss that results when a plant or a firm or an industry closes down because of a change in the terms of comparative advantage, technological obsolescence, and so on. Particularly during a period when Keynesian involuntary unemployment is negligible, the scenario associated with frictional unemployment of the types just described is that the jobless workers will require some brief period, perhaps a matter of weeks or months, before they can locate a new position.

In any event, it is easy to see that speed of technical progress will affect the magnitude of the rate of frictional unemployment. For this purpose we need merely recognize that technical progress is not a one-shot affair but is, rather, since at least the middle of the nineteenth century, a nearly-continuous process, with technology and products constantly undergoing modification and replacement. Now suppose, for clarity of exposition, that frictional unemployment is composed <u>only</u> of two elements: that attributable to worker relocation, and that ascribable to closing of business units (plants,

firms or industries). Assume that the rate of worker relocation is fixed, and compare two imaginary and otherwise identical economies: stationary economy S, in which there is absolutely no technical change and economy T, in which change is constant and rapid. It is clear that in the latter we can expect far more openings and closings of business units than in stationary economy, S. The opening of new business units in T is, of course, what keeps the jobs lost from any particular plant closing from becoming more than a temporary affair. Nevertheless, it remains true that frictional unemployment will be permanently and, very plausibly, substantially higher in T than in S, because the continuous flow of technical change means that job losses will also occur frequently, if not continuously. 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 the succeeding set of plant closings.

Two conclusions follow. First, that the constant creation and loss of jobs, even if the two occur at identical rates, do not simply balance out. The process stirs up job change and that takes time, contributing a net increase in frictional unemployment. We will see presently that even where there is a once-and-for-all change of this sort, it is apt to have enduring if not permanent detrimental effects. These seem inadequately taken into account in discussions of trade policy issues, as when reduction of barriers to trade between the United States and Mexico is judged to be favorable to one or the other of the countries if the number of jobs the process is expected to create even only marginally exceeds the size of the anticipated job loss. It simply is not true that a gain of 5,000 jobs constitutes full compensation for the loss of an equal number of positions.

Second, it should be clear that the more rapid an economy's rate of continuous technical change, ceteris paribus, the greater its level of

frictional unemployment and, hence, the higher its natural rate of unemployment will be. This follows directly from the argument that has just been offered, comparing the stationary economy with one undergoing continuing technological change. For the more rapid the rate of introduction of new techniques and new products the larger the number of plant openings and closings and other similar events that can be expected. Thus, the natural rate of unemployment is surely a monotonically increasing function of the economy's rate of technological progress. Here, it is important to keep in mind that because technical change is continuous, a speedup in its rate will raise the rate of frictional unemployment permanently, in effect increasing for the indefinite future the amount of transitory joblessness to be found in the economy.

2. TRENDS IN THE DURATION OF UNEMPLOYMENT

The available data indicate that, at least in the United States, the length of time during which a typical jobless person has spent "between jobs" has increased substantially and fairly steadily throughout the period since the Second World War. Figure 1a summarizes the most pertinent data provided by the Bureau of Labor Statistics (see Table 1 for data sources and methods). It indicates that over the 45 year period from 1948 through 1993 the average duration of the period of unemployment has more than doubled, and that the share of the unemployed composed of persons unemployed 27 weeks or more, that is, unemployed more than half a year (the longest period covered in the available data) has almost exactly quadrupled. As the graph shows, this trajectory is characterized by fluctuations of considerable magnitude. Nevertheless, using the conservative calculation based on a regression of the

natural logs of the data, we obtain a growth rate of nearly 1 percent compounded for average duration of unemployment, an annual growth rate of 1.7 percent in the proportion of the unemployed who were jobless 27 weeks or more, and an annual growth rate of 1.1 percent in the proportion unemployed 15 weeks or more (see Figure 1b). In nearly half a century this has, as we have seen, brought a substantial addition to the average duration of unemployment, and the proportion of those who suffer unemployment that is clearly protracted. By 1993, the share of the unemployed who were jobless for more than six months had exceeded 20 percent of the total.

As already noted, the problem of protracted joblessness is an international phenomenon. This is illustrated by the 1994 OECD data for 10 industrial countries reported in Figure 2a. These show, for each country, the percent of unemployed workers who had been jobless for a year or more. We see that the U.S., with its 12 percent figure, had the lowest incidence of long-term unemployment. Italy, Belgium and the Netherlands had the unenviable position of being at the top, with more than half of their jobless having been out of work for a year or more. These countries also have overall unemployment rates significantly higher than the U.S.

Figure 2b compares the percentage growth in long-term unemployment for the same 10 countries between 1975 and 1994. (While this graph is primarily concerned with growth, we have put in the levels for 1975 and 1994 for reference.) Once again, the U.S., with its 130 percent increase over the 19-year period, is near the bottom of the group. It is outstripped by Germany, with its 320 percent rise, and by Canada, France, the United Kingdom and Sweden, where long-term unemployment as a share of total unemployment rose by approximately 250, 245, 210, and 145 percent, respectively. Clearly, this is no minor phenomenon, and the U.S. is not its most badly damaged victim.

3. DIGRESSION: THE SOCIAL COST OF PROTRACTED JOBLESSNESS

It is at least arguable that much of the economic literature pays insufficient attention to the true social costs of unemployment, at least when the unemployment suffered by the individual is of long duration. Reading between the lines of discussions of the (possible) tradeoff between inflation and unemployment one comes away with the impression that a one-percent rise in the economy's inflation rate is perhaps about equally damaging to the public interest as a one-percent rise in the rate of unemployment.[1] It will be argued here that there is a rich and well-documented body of materials in the literature of sociology and social psychology that makes such an evaluation very difficult to accept. Though much of that literature makes little distinction between lengthy and brief unemployment it is reasonably plausible that a short spell of unemployment causes little lasting psychic or social damage. It is only when the unemployment goes on and on, and the worker begins even to suspect that he or she will never hold a job again, that suicide rates, stability of marriages, mental illness rates and other forms of damaging behavior begin to be affected significantly.

The main point is that the true cost of long-lasting unemployment probably goes well beyond the resulting loss of output for the economy and the corresponding decrease in the incomes of those who have lost their jobs. Thus, for example, Mallinckrodt and Fretz [1988] offer the following 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; or 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) (p. 281).

In addition, there is good reason to believe that unemployment is associated with crime and stimulates the growth of the underground economy more generally. It probably stimulates drug addiction as well as alcoholism.

Yet one must treat this inference with some caution because, it must be admitted that the empirical evidence is spotty and not always consistent. For example, difficult though it may be to believe, the statistics seem to suggest that a general rise in unemployment is associated with reductions in violent youth crime, though protracted unemployment do seem to be correlated with increased crime against property. It seems that there have in fact been few studies of the subject and that their results have not been consistent.

> Research on the relationship between youth crime and economic conditions has failed to produce a clear set of findings. Studies using both cross-sectional and time series age-specific arrest data from the Uniform Crime Reports have found both a positive relationship (Allan and Steffnsmeier, 1989; Fleischer, 1963; Phillips et. al., 1972; Smith et al., 1992) and a negative relationship (Gibbs, 1966; Glaser and Rice, 1959, Smith et. al., 1992) between crime and unemployment among youth. Singell (1967) used arrest data from Detroit (cross-sectional and longitudinal) and Danser and Laub (1981) looked at National Crime Survey data and found no significant relationship between unemployment and criminal activity among youth [Britt, 1994, p. 102.]

Similarly, Britt's very recent study of unemployment and arrest series data from 1958 to 1990 for persons aged 16 to 19 found that:

> For violent offenses (homicide, rape and aggravated assault) as well as for property offenses (robbery, burglary and larceny), higher rates of youth unemployment are negatively associated with annual changes in the arrest rates of youth. Conversely, the lagged effect of youth unemployment is limited to property offenses, where annual changes in youth unemployment are positively related to annual changes in the arrest rates of youth for robbery, burglary and larceny, but negatively related to changes in the auto theft arrest rate [Britt, 1994, p. 99, italics in the original].

The data on some of the other consequences of unemployment have been explored more thoroughly and yield implications that are not quite so ambiguous as those for crime. But some of the results are nevertheless surprising. On the basis of an extensive survey of the literature, Warr [1987] reports:

> Studies at the individual level have mainly been cross-sectional, but longitudinal investigations are becoming more common. Significant effects of unemployment have been recorded for the three principal axes of affective well-being, and limited evidence is available in respect of competence, autonomy, and aspiration. Unemployment is in general seen to impair mental health, although this effect is not universal; indeed, a small minority of people show gains in mental health after losing their job.
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> Studies at the aggregate level have examined changes in communities and nations over a series of years. Aggregate time-series research into the relationship between unemployment level and mental hospital admission is generally inconclusive. Parallel studies of mortality rates have also yielded results which vary between investigators, although a growing body of research argues for a lagged relationship between unemployment and aggregate mortality, at lest in certain countries.
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> A longitudinal investigation of mortality at the individual level has suggested a disproportionate probability of death in the ten years following a period of unemployment. Other research has linked suicide to unemployment, at least in cross-sectional and aggregate analyses. Parasuicide [attempted suicide] has been found to be particularly common among people unemployed for long periods. In terms of health-related behaviors, it seems likely that smoking increases somewhat after job loss, whereas alcohol consumption remains on average unchanged. However, previously heavy drinkers may increase consumption after they have become unemployed.
>
> Research has shown that family strain is likely to increase as a result of a husband's unemployment, but findings in respect of child neglect and abuse are not yet clear. Divorce and unemployment levels have been found to be interrelated in one aggregate time-series investigation (Warr, 1987, pp. 207-8).

Despite the ambiguities in the study results, the conclusion from all this is that the true public-welfare costs of unemployment are probably much higher than is generally recognized in the textbooks of economics, and that the loss in GDP resulting from a given rise in unemployment constitutes a grotesque undervaluation of the true magnitude of the damage it inflicts, not only upon those directly affected but also upon the remainder of the population that must then live with the aggravated social ills and the heavy costs entailed in the generally ineffective means that are routinely used to contain them.

All this is dramatized by the fact that a one percent rise in unemployment is associated with, roughly, a 2 percent increase in joblessness among youths and an increase perhaps twice as great as this in unemployment rates among young black and Hispanic persons. It is magnified in this way in exactly those areas--the slums of the inner cities, and the nation's Appalachias--where the problems of crime, addiction and other equally critical problems are already at their most severe.

A second view that seems to have widespread currency among economists and in the press is that a change that destroys 5,000 jobs but creates 5,000 new jobs in their stead, while not quite neutral, is not inherently a matter for great concern. Here, we will suggest that such a view also greatly underestimates the resulting social costs, particularly if the result is a marked lengthening of the period of unemployment for a substantial proportion of those immediately affected. That is, if all of those who obtain the new jobs are persons that would otherwise have been unemployed no more than three months, for example, but the persons thrown out of work include a significant number who enter the ranks of the long-term unemployed, the result can hardly be considered even roughly neutral.

4. NUMBER OF LONG-TERM JOBLESS AND RATE OF TECHNICAL PROGRESS

Apparently, a disproportionate share of the long-term unemployed is made up of two groups--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 never held anything but dead-end jobs or jobs in the underground economy.

Though reality is always too complex to be characterized fully by any simple model, there is a rudimentary relationship that can help to account for the distressing phenomena that have just been described. For this purpose let us examine the decision of an employer who is considering whether to offer a job to an unemployed individual, i. Let us assume that technological change means that no person with all of the requisite skill and experience for peak performance on this job is available. Then, to prepare individual i for the job some period of training, either on the job or separate from it, will be required. This will constitute a sunk outlay, $S_i(E_i, \rho)$, which will vary with the individual's previous education and experience, summed up by the variable E_i, and where ρ is a variable that will be discussed presently. In return, the employer will expect a stream of net profit contributions from the worker for the t periods that she can be expected to remain at this firm. Assuming for simplicity (and with no loss of pertinent generality) that these are constant, we can write them as $R_i(E_i) - w_i(Ei)$ per period, where R_i is the revenue contributed per period by i and w_i is the wage payment she receives. Letting r be the pertinent interest rate (including suitable compensation for risk), so that the present value of this net payment in period s is $(R_i - w_i)/(1 + r)$,

then by the usual formula, the expected present value of this stream of contributions is $(R_i - w_i)[1 - v^{t+1}]/(1 - v)$, where

(1) $v = 1/(1 + r) < 1$.

Thus, the employer's expected net gain from the employment of i will be

(2) $\pi_i = [R_i(E_i) - w_i(E_i)][1 - v^{t+1}]/(1 - v) - S_i(E_i, \rho)$.

Here, writing S_{Ei} for $\partial S_i/\partial E_i$, we may postulate for the pertinent derivatives

(3) $S_{Ei} < 0$, $R_i' > 0$, $w_i' > 0$ and $R_i' - w_i' > 0$,

that is, an increase in the job seeker's education reduces sunk training cost, increases her marginal revenue yield as well as her wages, and increases her marginal profit contribution per period.[2]

Where this is leading should now be fairly obvious. First, it is clear that if S_i is large in comparison with the other terms in (2) then the entire expression will be relatively low, and may well be negative. This clearly can be a disadvantage to the ill-educated, who will be driven either to accept very low wages, or to suffer unemployment until and if changing conditions transform (2) into a positive number equal to that for a more educated individual, j. If customs, institutions such as the minimum wage, or the possibility that only a wage below the subsistence level will make (2) positive, then unemployment may be the only possible fate for individual i, and there is no reason inherent in the construct for this period of unemployment to be brief or even impermanent. Indeed, it even possible that S is so large for some unskilled workers that (2) will remain negative even at a zero wage, producing a corner solution entailing lifetime unemployment or employment in the underground economy, possibly involving criminal activity with attendant personal danger and low earnings.

The fact that, as noted in (1), $V < 1$, clearly means that (2) is a monotonically increasing function of t, the time that the employer can expect the new employee to remain with the firm. If the prospective employee is young, though subject to considerable uncertainty, the employer may consider it likely that t will be large for that person. But with an older job candidate the expected value of t is apt to be quite small, and very likely smaller than that for a younger job candidate. This means that if i is an older person, it is more likely that π_i in (2) will also be relatively small, making for lower wages or unemployment, just as in the case of the ill-educated job seeker. Similarly, if women, because they are of child-bearing age or for any other reason (including prejudice) are considered less likely than men to remain with the firm for any considerable period or are considered a greater risk in that regard, systematic downward pressure on wages or reduced employment opportunities may well result.

At this point it is convenient to turn our attention to ρ, the variable which has so far not been discussed. This variable is intended to represent the rate of technological progress, and we may postulate that

$$(4) \qquad S_\rho > 0, \quad S_{E\rho} < 0.$$

That is, speeding up of technical progress serves to increase the sunk cost entailed in retraining, other things being equal, and education serves to make the magnitude of that cost increment more moderate. This implies immediately that increased rapidity of technical progress will enhance the handicap facing the uneducated, the older job seekers and women. It will make matters more difficult for those who are poorly educated because the increase in the cost of retraining them to keep abreast of the newer techniques grows the more rapid and the more radical the changes in those techniques. The ill-educated

also suffer from a rise in ρ since they can offer no offset to the rise in their retraining cost stemming from increased rapidity of technical progress in the form of the negative cross-partial derivative of S with respect to ρ and E.

The obvious effect is increased unemployment or increased length of unemployment in those groups. There is also a second consequence. This is the effect on relative wages of persons in these groups that do get jobs. Given the level of employment, as determined by the combined influence of the natural rate of unemployment and macro policy, as we have seen, the demand for older, the female and the less-educated workers will shift downward, and that for the younger, more-educated male group will shift upward as ρ increases. But, given the supply functions of the four groups, that will put downward pressure on the wages of the older, the female and the less-educated workers and upward pressure on those of the remaining group. This will add to the rate of financial return to investment in education, as has indeed been happening in recent years. In addition, it will exacerbate inequality in income distribution, raising the earnings of the younger and more educated, at the expense of the poorly educated and of women workers, with the older group protected in the real world only through the exercise of their considerable political power, a phenomenon we must note even though it is beyond the scope of our argument or our model.

5. EMPIRICAL INVESTIGATION

A. Technological Variables. Our central hypothesis is that the average duration of unemployment will rise as the pace of technological activity increases. Five indices of technological activity will be used in this study.

The first is the rate of total factor productivity (TFP) growth, TFPGRTH, defined as:

$$(4) \qquad TFPGRTH = \hat{Y} - \alpha\hat{L} - (1 - \alpha)\hat{K},$$

where $\hat{Y}$ is the annual rate of output growth, $\hat{L}$ is the annual growth in labor input, $\hat{K}$ is the annual growth in capital input, and α is the average wage share over the period. This is the standard measure of technical change.

The second index of technological activity is the ratio of R&D expenditures to GDP. The third is the number of full-time equivalent (FTE) scientists and engineers engaged in R&D per 1,000 employees. There are two reasons why it is important to consider such a second and third R&D measure. First, because of its intangible nature, R&D activity is inherently difficult to measure. Second, industries may differ in terms of the capital intensity of their R&D, so that a manpower measure describes a different side of technological activity.

The fourth measure is investment in new equipment and machinery as a ratio to full-time equivalent employees (FTEE). This index is included to allow for the possibility that new technology may normally be embodied in new capital equipment and machinery. Standard measures of TFP growth do not adequately capture this effect. Because computers may play a particularly important role as transmitters of new technology, we use as our fifth index investment in computers (or, more specifically, office, computing, and accounting equipment, or OCA) per FTEE.

B. Institutional Variables. Institutional influences may also affect the duration of unemployment and therefore must be controlled for when performing the pertinent econometric analysis. We have singled out several such

variables. The first is the actual unemployment rate. As shown in Figure 3, the duration of unemployment is quite cyclical and appears to be strongly correlated with the overall unemployment rate. This is to be expected, since the higher the unemployment rate, the lower the probability of a jobless worker obtaining a job and, ceteris paribus, the longer the spell of unemployment.

The structure of the unemployment insurance (UI) itself may also have an important effect on the duration of unemployment. In particular, by reducing the cost to an individual of being jobless, the UI system may actually prolong the duration of unemployment for many workers (see, for example, Feldstein, 1974). The original architects of the UI system explicitly recognized this and argued, in fact, that the added security individuals had while unemployed would enable them to select a job more compatible with their skills and interests. Rather than settling on the first position offered, an unemployed person could continue his (her) job search until a better match and higher wages were provided. This, in turn, would prove socially beneficial, since better job matches should increase the national output by improving efficiency in the allocation of labor resources (see Haber and Murray [1966] for related arguments).

The type of unemployment occasioned by the job search process is called search unemployment, which is a form of frictional unemployment. The UI system reduces the costs of remaining unemployed, so the reservation wage--the minimum wage a person is willing to accept--for those searching for a new job will be higher on average than without UI benefits. As a result, we can expect an increase in their average duration of unemployment. The higher the UI benefits, the longer will be the average unemployment spell. Most empirical

studies have confirmed a positive relation between the UI replacement rate (the ratio between the UI benefit and the previous wage) and the average duration of unemployment. Typically, an increase in the replacement rate of 0.1 is associated with a half week to week increase in the average duration of unemployment. All told, the UI system may cause covered workers to remain unemployed 16 to 31 percent longer than those not covered.[3]

Two other institutional factors that may affect the duration of unemployment are unions and the minimum wage. We would expect that a high rate of unionization will increase the duration of joblessness, since it will increase rigidities in the labor market, raise entry wages, and thereby decrease the probability of employers hiring new workers. A rise in the minimum wage may be expected to have the same effect, since it will truncate the distribution of entry wages and reduce the likelihood of employers taking on new workers.

C. Demographic Influences. One of the most notable changes in the postwar period has occurred in the demographic composition of the labor force. In the U.S. (and other OECD countries) there has been a rising rate of labor force participation of females and a decline in the labor force participation rate of older men. As a result, the gender composition of the labor force has been shifting over time toward females and away from males, particularly older men. Because the incidence of unemployment and labor force attachment differs among different demographic groups (unemployment rates have historically been higher for women than men and for younger workers than older ones), it is possible that these demographic changes may partly account for the rise in unemployment duration.

D. Descriptive Statistics. Panel A of Table 2 and Figure 4 provide descriptive statistics on the relation between average unemployment duration

and technological factors by period.[4] These variables are all based on economy-wide data, unless otherwise indicated. We have selected five periods, which roughly correspond to peaks in the business cycle (low points in the unemployment rate), since unemployment duration is closely correlated with the unemployment rate (that is, both are counter-cyclical). The mean duration of unemployment remained largely unchanged over the 1950s, 1960s, and 1970s, at about 11.5 weeks, then jumped to 14.6 weeks in the 1980s and to 15.6 weeks in the first half of the 1990s.

Of the five technology variables, the only one that is closely correlated with duration of unemployment is OCA investment per FTEE. Though it increased gradually from $6 (in 1987 dollars) per FTEE in the 1950s to $21 per FTEE in the 1970s, it jumped to $185 per FTEE in the 1980s and then to $522 per FTEE in the 1990s. In contrast, the ratio of R&D expenditures to GDP remained fairly constant over the four and a half decades, except for a fall-off during the 1970s. FTE scientists and engineers engaged in R&D per 1,000 employees increased at a rather constant rate from the 1950s to the mid-1990s, rising by more than 50 percent. Likewise, investment in total machinery and equipment per FTEE showed a rather constant increase from the 1950s to the mid-1990s, more than doubling over this time span.

TFP growth shows almost exactly the opposite pattern to the mean duration of unemployment. TFP growth was at its highest point in the 1950s and 1960s, at 1.6 and 1.8 percent per year, respectively, when unemployment duration was low. Annual TFP growth then fell to 0.7 percent during the 1970s, 0.5 percent during the 1980s, and 0.3 percent during the early 1990s.

Panel B of Table 2 and Figure 5 provide descriptive statistics on the relation between average unemployment duration and institutional factors by

period.[5] We have selected two features of unemployment insurance (UI) programs that are often alleged to affect the duration of unemployment. The first is the replacement rate. The higher this ratio between UI benefit and previous wage the longer we should expect unemployment spells to last. The second is the UI coverage rate, the percent of all employees covered by the UI system. Here, too, a positive relation should be observed between duration of unemployment and the coverage rate.[6]

Both the UI coverage rate and the UI replacement rate have been rising gradually over the postwar period, the former from 65 to 94 percent of employment and the latter from 38 to 47 percent of the average wage. Both series are roughly consistent with the general rise in unemployment duration, though neither shows a sharp break between the 1970s and the 1980s, as does unemployment duration. The unionization rate, on the other hand, has been falling rather steadily since the 1950s, from 24 to 16 percent, which should have led to falling jobless duration rather than rising duration. The minimum wage, after increasing between the 1950s and 1970s, from $3.60 per hour (in 1987 dollars) to $4.52, fell to an average of $3.33 during the 1990s. This trend, also, should have led to falling unemployment duration over the last 25 years.

Table 3 provides a breakdown of employment by gender and age group for the same five periods. Between 1950 and 1993, females as a percent of employed workers increased from 29 to 46, while men declined from 71 to 54 percent. However, the changes were not uniform over the various age groups. Young men (under age 25) fell from 8.8 percent of total employment in the 1950s to 8.1 percent in the 1990s. The share of men of prime working ages (25 to 54) in total employment declined from 46 to 39 percent. The biggest change was the

decline in the share of older men (55 and over) in total employment, from 13.3 to 7.1 percent. Among female workers, the only very substantial change is the share of females of prime working age in total employment, which surged from 20 percent in the 1950s to 33 percent in the 1990s. Moreover, this share shows a very sharp increase between the 1970s and 1980s, coincident with the big increase in mean unemployment duration.

Table 4 provides another side of the issue by showing the mean duration of unemployment by demographic group. We have used all the demographic details on unemployment duration published by the Bureau of Labor Statistics.[7] The results show that the rise in unemployment duration between the 1970s and 1980s was almost universal among demographic groups, with the average weeks of unemployment rising in the order of 3 to 4 weeks. However, more recently, between the periods 1980-89 and 1990-93, the picture is much more mixed, with the average duration of unemployment rising for some groups but not for others.

Another striking result is that the average duration of unemployment is considerably greater for older workers than younger ones. Among both men and women, the average weeks of unemployment rose almost monotonically with age. Moreover, between 1980-89 and 1990-93, unemployment duration increased for older workers (45 and over for men and 35 and older for women), whereas it declined for younger age groups. Partly as a result of this, the spread in unemployment duration widened between older and younger workers from the 1970s to the early 1990s. The difference in average time of unemployment between men aged 16 to 19 and men aged 55 to 64 increased from 10.8 to 17.1 weeks; the corresponding change for women was from 9.0 to 12.6 weeks.

There are also differences in unemployment duration among gender and racial groups, though they are not as pronounced as among age groups.

Unemployment duration has been higher for men than for women and this has widened over time, from 2.6 weeks (13.1 less 10.5) in the 1970s to 3.9 weeks in the early 1990s. The mean duration of unemployment has also been somewhat higher for black workers than white ones and has also increased modestly over time. The difference in average duration between black and white men rose from 1.4 weeks in 1970-79 to 1.7 weeks in 1990-93 and from 1.2 to 1.5 weeks between black and white women.

Differences by marital status appear to be less interesting. Single (never married) persons have experienced lower average unemployment duration than married or previously married (widowed, divorced, or separated) persons, though this may to a large extent reflect the fact that singles are, on average, younger than the latter group. Mean unemployment duration has been very similar for currently married and previously married men though it has tended to be lower for currently married women than previously married ones. This latter result, however, may simply reflect the greater likelihood that a married woman will drop out of the labor force after an extended period of unemployment than one who is widowed, divorced, or separated.

E. Regression Analysis. We turn next to multivariate regression analysis to try to sort out the effects of technological, institutional and demographic variables on changes in unemployment duration. We use two different data samples for the analysis: (1) aggregate data for the U.S., covering the period 1950-1995 and (2) industry-level data for the U.S., covering 8 major sectors and the period 1962-1993. The sectors are: (1) agriculture; (2) construction; (3) durable manufacturing; (4) non-durable manufacturing; (5) transportation and public utilities; (6) wholesale and retail trade; (7) finance, insurance, real estate, and service industries; and (8) public

administration. The aggregation scheme was dictated by the nature of the available unemployment duration data. Unfortunately, statistics on some of the variables are not available at the 8-sector level.

Our primary dependent variable is the (natural) logarithm of the average duration of unemployment. There are statistical problems associated with the use of mean unemployment duration as a dependent variable in a regression. The most serious is that the variable is based on a truncated distribution, since we can observe individuals only while they are in the midst of an unemployment spell. In the Current Population Survey (the source of these data), information on the length of unemployment is collected only from individuals who are unemployed at that time. As a result, these individuals have not completed their unemployment spells, so that the survey essentially interrupts spells that are still in progress (see Kiefer [1988] for an extended discussion of statistical problems associated with unemployment duration data). To avoid some of the pitfalls that beset duration data, most researchers have used the logarithm of duration as the dependent variable (see Devine and Kiefer [1991], Chapter 5). Alternative dependent variables are the percentage of unemployed workers out of work 15 or more weeks and the percentage out of work 27 or more weeks.

The first set of results, based on aggregate data, with the natural logarithm of the mean duration of unemployment as the dependent variable, are shown in Table 5. LNUIREPL, the natural logarithm of the UI replacement rate, has the predicted positive effect on unemployment duration. The higher the replacement rate, the longer unemployed individuals tend to search for a new job and, consequently, the higher the average duration of unemployment. The coefficient remains statistically significant at the five-percent significance

level in almost all specifications. However, the UI coverage rate (the percent of workers covered by the UI system) is positive, as predicted, but is statistically insignificant.

The minimum wage variable, MINWAGE87, has a negative coefficient in all specifications though the variable is not statistically significant in any. The interpretation is that as the minimum wage falls in real terms, entry wages for new jobs will also generally fall. Workers with a given reservation wage will thus have an increasingly difficult time finding jobs with wage offers above their reservation wage.[8] This interpretation receives additional support when the natural logarithm of the average weekly earnings of production and non-supervisory workers in the total private sector (LNMNEARN) is substituted for the minimum wage variable. The coefficient of LNMNEARN is also negative, though it, too, is not statistically significant (results not shown). Similarly, the unionization rate has a negative coefficient, though, again, not statistically significant (results not shown). The interpretation is similar. A decline in unionization is associated with falling wages, which decreases the chance of unemployed workers finding a job with a wage about their reservation wage.

Of the five technology variables, the only that is statistically significant is the annual rate of TFP growth (TFPGRTH). Indeed, TFPGRTH is positive in all specifications and significant at the one-percent level. Moreover, when it is included in the regression, the coefficient of LNUIREPL remains positive and becomes significant at the one percent level. The other four technology variables--(1) RDGDP: the ratio of total industrial R&D expenditures (company and federal sources) to GDP in current dollars; (2) SCI&ENG: full-time equivalent scientists and engineers engaged in R&D per

1,000 employees; (3) OCAFTEE: investment in office, computing, and accounting equipment [1987 dollars] per full-time equivalent employees; and (4) EQUIPFTEE: investment in total equipment and machinery [1987 dollars] per full-time equivalent employees--all have positive coefficients but have relatively low t-statistics.

One reason that TFP growth may have such a strong positive correlation with the mean duration of unemployment is that it exhibits the same cyclical fluctuation over time as unemployment duration (see Figure 6). In specifications (4) and (5), this problem is controlled for to some extent by the use of autoregressive estimation techniques. In order to remove some of the additional cyclical component of unemployment duration, we also regressed LNMEANDUR on LNUIREPL, TFPGRTH, and the actual unemployment rate. In this case also, the coefficient of TFPGRTH remains positive and significant at the one-percent level (results not shown).

The demographic variables do have a significant effect on unemployment duration. After some experimentation, we found that the best fit is provided by the inclusion of the following three demographic variables: (1) percent of total employees in age group 16-19; (2) percent of total employees in age group 20-24; and (3) the percentage of total employees who are men in age group 25-54 (see specifications 6 and 7). These three variables are significant at the one-percent level in five cases and at the five-percent level in the sixth case. The percent of teenagers in total employment has a negative coefficient, most likely reflecting the transitory nature of teenage employment. If they become unemployed, they are very likely to drop out of the labor force. On the other hand, the other two variables each has a positive coefficient. A plausible reason is that workers aged 20 to 24 and male workers

aged 25 to 54 will tend to remain in the labor force when they become unemployed and continue to search for a new job.[9]

The "goodness of fit" of all these regressions is quite high, with R^2-statistics of 0.72 or above. The best fit is provided by specification (7), which includes LNUIREPL, TFPGRTH, and the three demographic variables as regressors.

The same regressions were also performed with two other 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, shown in Table 6, are almost identical to those reported in Table 5.

Next, we repeated the same analysis using our eight-sector industry sample. All variables were available for each of the eight sectors, with the exception of the UI coverage rate, the UI replacement rate, and the minimum wage. For these variables, we used the value for the aggregate economy. Moreover, because of the high degree of serial correlation in our variables, each variable was converted into first-difference form (the difference between the observation in period t and the observation in period t-1).

The results, shown in Table 7, generally confirm our previous findings. The first difference in the natural logarithm of the (aggregate) UI replacement rate has a positive coefficient, which is highly significant. The first difference of industry-level TFP growth is also positive and highly significant. In these regressions, the coefficients of the UI coverage rate, the unionization rate, and the minimum wage are all insignificant. Similarly, the coefficients of R&D intensity, the number of scientists and engineers per employee, and investment in OCA as a ratio to FTEE are all generally positive but insignificant.

Data on the gender and age composition of industry employment are available only for the period 1976 to 1993. Of these variables, the only one that is statistically significant is the percentage of employees in age group 16-19, which, as before, has a negative coefficient. The failure of the other demographic variables to be significant may be attributable to the short time period covered by these variables. Dummy variables for sectors were also included in the regression (with the exclusion of manufacturing). However, these variables were statistically insignificant, both individually and as a group.

Table 8 shows the results of the last set of regressions, in which we again use the aggregate data but employ as the dependent variable the mean duration of unemployment for individual age groups. The results support one of our major hypotheses, that older age groups will be more adversely affected by technological change than younger ones in terms of length of unemployment spells. Among men, the coefficient of TFP growth for age group 55-64 is 10.4 -- more than double the value of the coefficient for any other age group, and has its smallest value, 2.6, for age group 16-19. The coefficient of TFP growth ranges from 3.8 to 4.8 among age groups 20-24 to 45-54. Among women, the coefficient of TFP growth is again lowest for the youngest age group (16-19 years), with a value of 2.46, and highest for the oldest age group (55-64 years of age), with a value of 4.91. The coefficients for the intermediate age groups range from 3.11 to 4.90. The coefficient of TFP growth is significant at the one percent level in all specifications except two, where it is significant at the five percent level. Among all men, the coefficient of TFP growth is 4.2 and among all women, 4.1, indicating that a one percentage <u>point</u> increase in TFP growth is associated with about a 4 percent decline in the average duration of unemployment.

Another pertinent result is that the only other technological or institutional variable that is statistically significant in these regressions is EQUIPFTE, the average annual investment in equipment and machinery (in 1987 dollars) per FTEE. Moreover, this variable is significant only for the younger age groups and has a negative coefficient (results are shown for only those cases in which the variable is significant). This set of results suggests that younger age groups are favored by new technology embodied in new equipment. An additional investment of $1,000 (in 1987 dollars) in machinery and equipment per FTEE will reduce the average spell of unemployment among young workers by about 20 percent.[10]

6. CONCLUDING REMARKS: ON THE REAL COSTS OF UNEMPLOYMENT

The duration of unemployment has risen rather dramatically over the last half century. The mean duration of unemployment has approximately doubled between the early 1950s and the mid-1990s, with most of the increase occurring since the early 1970s. The percentage of unemployed workers out of work 15 or more weeks more than doubled over the same period, while the percentage of the unemployed out of work 27 or more weeks tripled. We also found that the rise in unemployment duration between the 1970s and the early 1990s was almost universal among demographic groups, with the average weeks of unemployment rising generally about 3 to 4 weeks.

Another striking finding is that average weeks of unemployment rise almost monotonically with age. Moreover, between the 1970s and early 1990s, the spread in unemployment duration widened sharply between older and younger male workers -- from 10.8 to 17.1 weeks between teenagers and those aged 55 to 64.

Our econometric results are generally consistent with the central thesis of our paper, that the duration of unemployment increases when the rate of technological change rises. Moreover, the results support a second hypothesis that technological change will more adversely affect older than younger workers in terms of duration of unemployment. TFP growth bore a much stronger positive relation to length of unemployment among older men than younger men and a somewhat stronger relation among older than younger women. Moreover, duration of unemployment is negatively related to investment in new machinery and equipment per FTEE but this effect is significant only for younger workers. These results are consistent with the argument that firms are reluctant to invest in the new training associated with new technology for older workers because of the shorter pay-off period or, perhaps, because of the greater difficulty of retraining older workers ("you can't teach an old dog new tricks").

We also found, like other researchers, that the UI replacement rate has a strong (positive) influence on the duration of unemployment. Demographic variables also have a strong influence on the duration of unemployment. In particular, the proportion of total employment in age group 16-19 is negatively related to unemployment duration, while the proportion in age group 20-24 and the share of total employment consisting of men in age group 25-54 have a positive bearing.

Somewhat paradoxically, the sharp increase in unemployment duration observed over the last 20 years or so was not found to be attributable to an acceleration in the pace of technological change, since TFP growth has slowed down since the 1960s. Rather, an increase in the UI replacement rate appears to be the most important influence. However, this should not be interpreted to

mean that UI benefits have been steadily increasing in real terms. In fact, they rose by 44 percent in constant dollars from 1950 to 1983 but have since been virtually unchanged. Rather, the increase in the replacement rate seems rather to have resulted primarily from a fall in average weekly earnings, which declined by 21 percent in real terms between 1973 and 1995.

Demographic changes in the composition of employment also appear to have contributed to the rising duration of unemployment. Teenagers as a proportion of total employment fell from about 6 percent in the early 1950s to 4 1/2 percent in the mid-1990s. Since this share is negatively related to unemployment duration, the relative decline in teenage share of jobs would serve to increase the average duration of unemployment. The same effect is produced by the decline in the share of older workers (age 55 and over) in total employment from approximately 17 percent in the early 1950s to 12 percent in the mid-1990s. In contrast, the rise in the share of workers aged 20-25 as a share of total employment, from 9 to 10 1/2 percent from the early 1950s to the mid 1990s, served to increase the average unemployment duration. The only countervailing influence is that of the decline in the share of prime-age male workers (age group 25 to 54), from 47 to 40 percent over this period, which should have helped to reduce mean unemployment duration.

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NOTES

* Director, C.V. Starr Center for Applied Economics, New York University; and senior research economist and professor emeritus, Princeton University. ** Professor of economics, New York University. The authors are deeply grateful to the Jerome Levy Economics Institute of Bard College for their generous support of this work, to Graeme Hunter for his excellent research assistance, to Alan Blinder for his very helpful comments, and to Sue Anne Batey Blackman for her invaluable assistance.

[1] We recognize that it is dangerous and probably unfair to characterize in such broad and general terms a vast literature produced by a very large number of writers with greatly different political views. There are, undoubtedly exceptions, and we are confident that many of our colleagues will not dissent markedly from the conclusions on the true costs of unemployment that follow. Nevertheless, even if the preceding sentences in the text do exaggerate matters, it seems to us that a dispassionate evaluation will concede that we are not far off the mark.

[2] These relationships are similar to some posited by Gary Becker in his model of on-the-job training, in his Human Capital.

[3] See Marsten (1975), Ehrenberg and Oaxaca (1976), Hammermesh (1977), Welch (1977), Classen (1979), Solon (1979), Barron and Mellow (1981), Moffitt and Nicholson (1982), Feldstein and Poterba (1984), Meyer (1990), Katz and Meyer (1990), and Devine and Kiefer, 1991, Chapter 5, for a fairly complete review of the literature.

[4] Some of the variables in Figure 4 are rescaled to fit on the Y-axis.

[5] Some of the variables in Figure 5 are also rescaled to fit on the Y-axis.

[6] A third parameter of the system, the maximum number of weeks of UI benefits, varies too little over the postwar period (39 weeks in some deep

recession years and 26 weeks in all others) to be of much interest here.

[7] Unfortunately, for the purposes of this analysis, unemployment duration by educational group is not available.

[8] The results are almost identical when the natural logarithm of the minimum wage in 1987 dollars is used instead of MINWAGE87 in the regression.

[9] In contrast, the coefficients of the percentage of workers aged 55 and over and the percent of workers who are women in age group 25 to 54 are all negative but statistically insignificant. The results do suggest that these groups tend to drop out of the labor force when they lose their job.

[10] Regressions run by gender and race group do not show very sizable differences in results. The coefficient of TFP growth, for example, varies from 3.7 for black females to 3.9 for black males, 4.0 for white females, and 4.3 for white males. Differences in results among marital groups are also not very substantial.

Table 1
Variable Definitions and Data Sources and Methods

1. Mean duration of unemployment and the percent of unemployed workers who are unemployed for 27 weeks or more or 15 weeks or more. Source: Council of Economic Advisers, *Economic Report of the President, 1996*, (United States Government Printing Office, Washington, DC: 1996). Table B-40, page 326. The data were originally tabulated by the Bureau of Labor Statistics.

Mean duration of unemployment by demographic group is computed from: Bureau of Labor Statistics, *Employment and Earnings*, (Washington, DC: United States Government Printing Office), various years.

2. The civilian unemployment rate. Source: Council of Economic Advisers, *Economic Report of the President, 1996*, op. cit, Table B-38, p. 324. The data were originally tabulated by the Bureau of Labor Statistics.

3. R&D expenditures include company, federal, and other sources. Source: National Science Foundation, *Research and Development in Industry*, (Arlington, VA: National Science Foundation), various years.

4. Full-time equivalent (FTE) scientists and engineers engaged in R&D. Source: National Science Foundation, *Research and Development in Industry*, (Arlington, VA: National Science Foundation), various years.

5. Gross non-residential fixed capital. Sources: John C. Musgrave, "Fixed Reproducible Tangible Wealth in the United States: Revised Estimates," *Survey of Current Business*, Vol. 71, No. 1, January, 1992, pp. 106-137; "Fixed Reproducible Tangible Wealth in the United States," *Survey of Current Business*, Vol. 74, No. 8, August, 1994, p. 56.

6. Full-time equivalent employees (FTEE). Sources: U.S. Bureau of Economic Analysis, National Income and Product diskettes, 1959-88; U.S. Bureau of Economic Analysis, *National Income and Product Accounts of the United States: Vol. 2, 1959-88*, (Washington, DC: U.S. Government Printing Office), September 1992; *Survey of Current Business*, Vol. 71, No. 4, January, 1992, p. 66; and *Survey of Current Business*, Vol. 76, No. 1/2, January/February 1995, p. 76.

7. Gross Domestic Product (current and 1992 dollars). Source: Council of Economic Advisers, *Economic Report of the President, 1996*, op. cit, Tables B-1, B-2, and B-9.

8. Investment in office, computing, and accounting equipment [1987 dollars] and investment in total equipment and machinery. Source: U.S. Bureau of Economic Analysis, Diskette of Detailed Investment by Industry. (Received January 1996).

9. Employees covered by Unemployment Insurance. Sources: Council of Economic Advisers, *Economic Report of the President, 1996*, Table B-41, page 327; Council of Economic Advisers, *Economic Report of the President, 1984*, Table B-36, p. 262. Employment is for age 16 and over.

11. Average weekly UI benefit check. Sources: Council of Economic Advisers, *Economic Report of the President, 1996*, Table B-41, page 327; Council of Economic Advisers, *Economic Report of the President, 1984*, Table B-36, p. 262.

12. Average weekly earnings of production and non-supervisory workers, total private sector. Sources: Council of Economic Advisers, *Economic Report of the President, 1996*, Table B-43, page 330; Council of Economic Advisers, *Economic Report of the President, 1984*, Table B-39, p. 265.

13. Minimum wage. Source: U.S. Bureau of the Census, *Statistical Abstract of the United: 1995* (115th edition), Washington, DC, 1995, Table 681, p. 436.

14. Consumer Price Index. Source: Council of Economic Advisers, *Economic Report of the President, 1996*, Table B-56, page 343.

15. Percent of labor force covered by unions. Source: Bureau of Labor Statistics worksheets. Estimates for 1983-1995 are annual averages from the Current Population Survey. Estimates for 1950-83 are the annual average number of dues paying members reported by labor unions. Data exclude numbers of professional and public employee associations.

16. Employment by gender and age. Sources: 1950-1974. U.S. Bureau of Labor Statistics, *Handbook of Labor Statistics*, (United States Government Printing Office, Washington, DC: 1985), Bulletin 2217, Table 15. 1975-1993. US Bureau of Labor Statistics, *Employment and Earnings*, (United States Government Printing Office, Washington, DC: 1977-94). January issues, various years. Figures are based on annual averages for household data.

Table 2

Mean Unemployment Duration and Mean Values of Technological And Institutional Variables by Period[a]

A. Technological Variables

Period	Mean Duration of Unemployment (Weeks)	Ratio of R&D Expenditures to GDP [%]	FTE Sci. & Eng. Engaged in R&D per 1000 Employees	OCA Investment per FTEE[b]	Equipment Investment per FTEE[b]	Annual Rate of TFP Growth [%][c]
1950-60	11.4	1.95	4.01	0.006	1.96	1.56
1960-69	11.7	1.97	4.81	0.007	2.54	1.75
1969-79	11.5	1.56	4.32	0.021	3.46	0.65
1979-89	14.6	1.83	5.47	0.185	3.80	0.47
1989-95	15.6	1.93	6.43	0.522	4.35	0.29

B. Institutional Variables

	Mean Duration of Unemployment (Weeks)	Percent of Employees Covered by UI	UI "Replacement Rate" [%][d]	Members as Percent of Labor Force	Minimum Wage in 1987 Dollars
1950-60	11.4	64.9	38.4	24.4	3.59
1960-69	11.7	73.2	40.1	22.6	4.46
1969-79	11.5	82.6	41.6	21.1	4.52
1979-89	14.6	92.6	43.5	18.0	3.73
1989-95	15.6	93.9	47.2	16.0	3.33

a. See Table 1 for variable definitions and sources and methods.

b. In thousands of 1987 dollars per employee. Private sector only.

c. Uses FTEE and gross non-residential capital stock, for the private sector only.

d. The UI "replacement rate" is computed as ratio of average weekly UI benefits to average weekly earnings, total private nonagricultural employees.

Table 3

Mean Unemployment Duration and the Percentage Distribution of Total Employment by Gender and Age and by Period[a]

	Mean Duration of Unemployment (Weeks)	Percentage Distribution of Total Employment								
		Male				Female				
		16-19	20-24	25-54	55+	16-19	20-24	25-54	55+	Total
1950-60	11.4	3.4	5.4	46.4	13.3	2.6	3.8	20.3	4.8	100.0
1960-69	11.7	3.9	6.2	42.7	12.2	3.0	4.4	21.4	6.1	100.0
1969-79	11.5	4.5	7.4	38.6	10.3	3.7	6.1	23.3	6.0	100.0
1979-89	14.6	3.4	6.9	37.8	8.1	3.1	6.1	28.9	5.6	100.0
1989-95	15.6	2.6	5.5	39.2	7.1	2.4	5.0	32.7	5.4	100.0

a. See Table 1 for variable definitions and sources and methods.

Table 4

Mean Duration of Unemployment by Demographic Group[a]
(Period Averages)

	1970-79	1980-89	1990-93
Men			
All Men	13.1	17.1	17.2
16 to 19 years	8.3	9.3	8.5
20 to 24 years	11.6	14.5	12.6
25 to 34 years	14.0	18.3	17.0
35 to 44 years	16.8	21.1	20.3
45 to 54 years	18.0	22.7	24.1
55 to 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 to 19 years	7.5	7.8	7.5
20 to 24 years	9.5	10.8	9.5
25 to 34 years	10.8	12.9	13.2
35 to 44 years	12.1	14.7	16.0
45 to 54 years	13.9	16.1	18.1
55 to 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

a. See Table 1 for variable definitions and sources and methods.

Table 5
Regressions of the Mean Duration of Unemployment (MEANDUR)
On Institutional, Technological, and Demographic Factors[a]

Independent Variables	Specification (1)	(2)	(3)	(4)	(5)	(6)	(7)
Constant	-1.99	-1.89	-1.12	-8.29**	-7.30**	-11.06*	-16.09**
	(0.98)	(0.82)	(0.53)	(3.58)	(3.09)	(2.10)	(4.07)
LNUIREPL	1.22*	1.14	1.12*	2.88**	2.70**	1.89*	3.12**
	(2.23)	(1.69)	(2.06)	(4.68)	(4.38)	(2.33)	(4.87)
UICOVER		0.002					
		(0.42)					
MINWAGE87			-0.128		-0.068		
			(2.01)		(1.16)		
TFPGRTH				4.34**	4.04**		4.29**
				(5.27)	(4.92)		(5.63)
%EMP1619						-23.64**	-16.20**
						(3.79)	(3.46)
%EMP2024						26.25**	23.52**
						(3.31)	(4.04)
%MAL2554						12.52*	13.03**
						(2.44)	(3.54)
R^2	0.73	0.72	0.75	0.83	0.83	0.76	0.88
Adj. R^2	0.71	0.69	0.72	0.81	0.81	0.73	0.86
Std. Err.	0.131	0.134	0.127	0.102	0.102	0.122	0.089
DW stat.	1.86	1.84	1.90	1.81	1.85	1.83	1.83
No of Obs	44	43	43	42	42	43	43
Est. Tech.	AR(2)	AR(2)	AR(2)	AR(2)	AR(2)	AR(1)	AR(1)
ρ_1:	1.03**	1.04**	1.03**	1.03**	1.06**	0.67**	0.66**
ρ_2:	-0.41**	-0.42**	-0.43**	-0.25	-0.29		

a. Dependent variable is LNMEANDUR: the natural logarithm of the mean duration of unemployment. t-ratios (absolute values) are shown in parentheses below the coefficient. The sample is based on aggregate data for the U.S. economy. Key:

LNUIREPL: Natural logarithm (LN) of the UI "replacement rate", defined as the ratio of the average weekly UI benefit check to the average weekly

earnings of production and non-supervisory workers, total private sector [percent].

UICOVER: The ratio of the number of employees covered by Unemployment Insurance to total civilian employment [percent].

MINWAGE87: The minimum wage deflated by the Consumer Price Index (1987 = 100).

TFPGRTH: Average annual percentage rate of total factor productivity growth [see equation 4].

%EMP1619: percent of total employees in age group 16-19.

%EMP2024: percent of total employees in age group 20-24.

%MAL2554: the percentage of total employees who are men in age group 25-54.

AR: Autoregressive process. (1) First-order: $u_t = \epsilon_t + \rho_1 \cdot u_{t-1}$ (2) Second-order: $u_t = \epsilon_t + \rho_1 \cdot u_{t-1} + \rho_2 \cdot u_{t-2}$, where u_t is the error term of the original equation and ϵ_t is a stochastic term assumed to be identically and independently distributed.

See Table 1 for data sources and methods.

* Significant at the five percent level (2-tail test).
** Significant at the one percent level (2-tail test).

Table 6
Regressions of the Percent of Unemployed Workers Who are Unemployed for 15 or More Weeks or 27 or More Weeks On Institutional, Technological, and Demographic Factors[a]

Independent Variables	Dependent Variable %UNEMPL15	%UNEMPL27	%UNEMPL15	%UNEMPL27
Constant	-399.9**	-202.7**	-758.7**	-379.3**
	(5.67)	(4.82)	(6.12)	(4.45)
LNUIREPL	113.32**	57.4**	132.5**	67.0**
	(6.05)	(5.11)	(6.53)	(4.80)
TFPGRTH	136.6**	110.9**	125.0**	103.9**
	(5.62)	(6.80)	(5.18)	(6.28)
%EMP1619			-380.1*	-300.5**
			(2.70)	(3.16)
%EMP2024			839.1**	474.4**
			(4.68)	(3.89)
%MAL2554			531.4**	260.3**
			(4.79)	(3.47)
R^2	0.77	0.81	0.85	0.86
Adj. R^2	0.76	0.79	0.83	0.84
Std. Err.	3.30	2.14	2.76	1.89
DW stat.	1.85	1.68	2.06	1.86
No of Obs	43	43	43	43
Est. Tech.	AR(1)	AR(1)	AR(1)	AR(1)
ρ_1:	0.86**	0.79**	0.63**	0.61**

a. t-ratios (absolute values) are shown in parentheses below the coefficient. The sample is based on aggregate data for the U.S. economy. Key (also see footnotes to Table 5):

%UNEMPL15: Percent of unemployed workers who are unemployed for 15 or more weeks.

%UNEMPL27: Percent of unemployed workers who are unemployed for 27 or more weeks.

* Significant at the five percent level (2-tail test).
** Significant at the one percent level (2-tail test).

Table 7
Regressions of the Duration of Unemployment:
Results Based on Eight-Sector Sample[a]

Independent Variables	Dependent Variable DLNMEANDUR	DUNEMPL15	DUNEMPL27
Constant	0.02	-0.24	-0.04
	(1.69)	(0.77)	(0.87)
DLNUIREPL	2.05**	94.5**	46.7**
	(4.47)	(7.24)	(4.51)
DTFPGRTH	0.91*	15.6**	22.4**
	(4.01)	(3.80)	(4.19)
R^2	0.15	0.20	0.12
Adj. R^2	0.15	0.20	0.12
Std. Err.	0.152	4.78	3.79
DW stat.	1.81	1.92	1.97
No of Obs	184	248	248
Est. Tech.	OLS	OLS	OLS

a. t-ratios (absolute values) are shown in parentheses below the coefficient. The sample is based on data for eight sectors of the U.S. economy: (1) agriculture; (2) construction; (3) durable manufacturing; (4) non-durable manufacturing; (5) transportation and public utilities; (6) wholesale and retail trade; (7) finance, insurance, real estate, and service industries; and (8) public administration. Key:

DLNMEANDUR: First difference of the natural logarithm of the mean duration of unemployment.

DUNEMPL15: First difference of the percent of unemployed workers who are unemployed for 15 or more weeks.

DUNEMPL27: First difference of the percent of unemployed workers who are unemployed for 27 or more weeks.

DLNUIREPL: First difference of the natural logarithm (LN) of the UI "replacement rate". [This variable is available only for the total economy.]

DTFPGRTH: First difference of the average annual percentage rate of total factor productivity growth [see equation 4].

* Significant at the five percent level (2-tail test).
** Significant at the one percent level (2-tail test).

Table 8

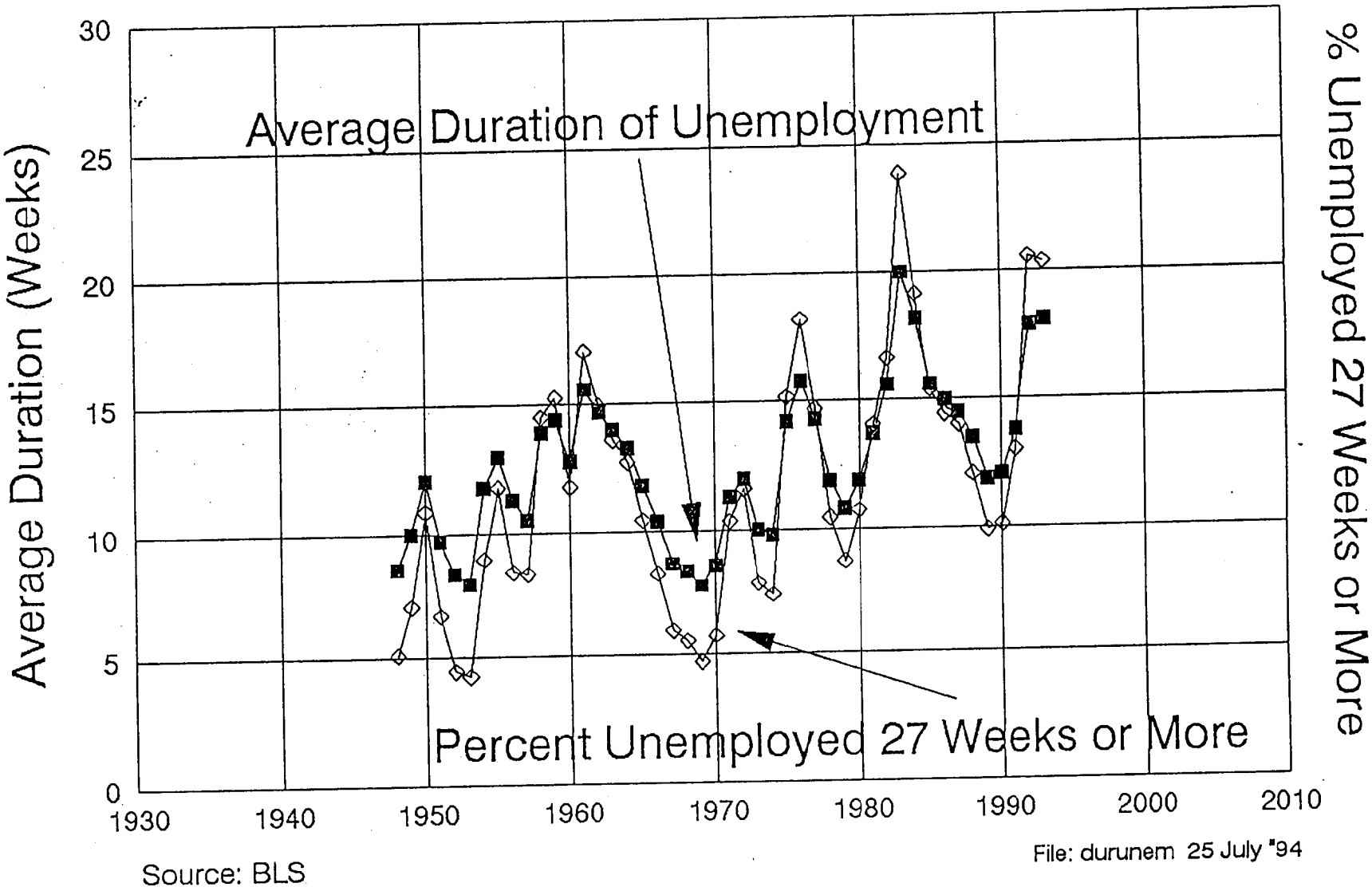
Regressions of the Mean Duration of Unemployment by Age Group On Institutional and Technological Factors[a]

Demographic Group	Independent Variables				R^2	Adj. R^2	Std. Err.	DW Stat	No. of Obs
	Constant	LNUIREPL	TFPGRTH	EQUIPFTE					
Men by age group:									
16-19 years	-6.25#	2.22*	2.58**		0.73	0.66	.089	2.04	22
	(2.02)	(2.73)	(3.03)						
16-19 years	-1.76	1.22	2.09*	-0.174#	0.77	0.70	.083	2.10	22
	(0.55)	(1.54)	(2.58)	(1.93)					
20-24 years	-6.65#	2.44*	4.27**		0.80	0.75	.101	2.04	22
	(1.95)	(2.70)	(4.52)						
20-24 years	-2.47	1.56#	3.82**	-0.223*	0.84	0.80	.092	1.98	22
	(0.73)	(1.83)	(4.47)	(2.21)					
25-34 years	-6.99*	2.59**	4.83**		0.83	0.79	.091	2.13	22
	(2.22)	(3.10)	(5.55)						
35-44 years	-0.31	0.87	4.02**		0.86	0.82	.079	2.07	22
	(0.11)	(1.25)	(5.10)						
45-54 years	-5.11*	2.16**	4.36**		0.90	0.87	.067	2.13	22
	(2.27)	(3.64)	(6.73)						
55-64 years	-4.43	1.99*	10.42**		0.80	0.74	.131	1.82	22
	(1.32)	(2.25)	(6.70)						
Women by age group:									
16-19 years	-5.00	1.85*	2.46**		0.67	0.60	.082	2.09	22
	(1.70)	(2.40)	(3.00)						
16-19 years	-0.17	0.78	1.81*	-0.191*	0.75	0.67	.074	2.25	22
	(0.07)	(1.17)	(2.45)	(2.33)					
20-24 years	-6.43*	2.31**	3.11**		0.78	0.73	.087	2.04	22
	(2.16)	(2.93)	(3.91)						
20-24 years	-2.11	1.35	2.62**	-0.183#	0.82	0.77	.081	2.13	22
	(0.67)	(1.74)	(3.47)	(1.98)					
25-34 years	-8.58*	2.93**	4.90**		0.82	0.78	090	2.10	22
	(2.82)	(3.64)	(5.43)						
25-34 years	-5.02	2.20**	4.45**	-0.207*	0.86	0.82	081	2.21	22
	(1.74)	(3.05)	(5.99)	(2.27)					
35-44 years	-4.19	1.81*	3.83**		0.82	0.77	.095	1.92	22
	(1.44)	(2.35)	(3.38)						
45-54 years	-7.85*	2.81**	4.04**		0.79	0.75	.102	2.17	22
	(2.31)	(3.11)	(4.01)						
55-64 years	-0.76	0.96	4.91**		0.86	0.83	.081	2.07	22
	(0.34)	(1.62)	(5.87)						

Figure 1a:

Trends in Duration of Unemployment

U.S., 1948-1993



Source: BLS

File: durunem 25 July '94

Fig 1b Duration of Unemployment, 1950–95

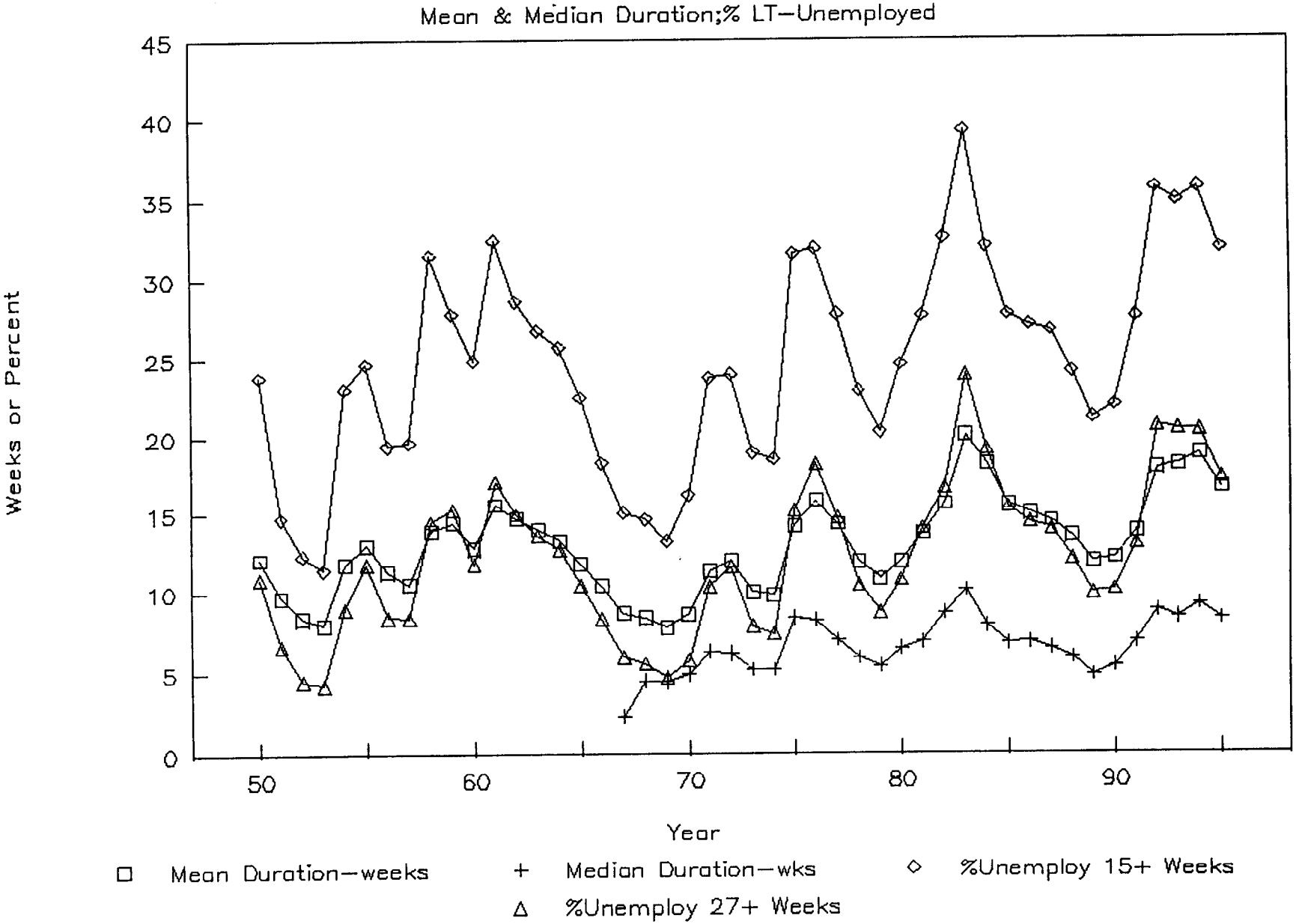
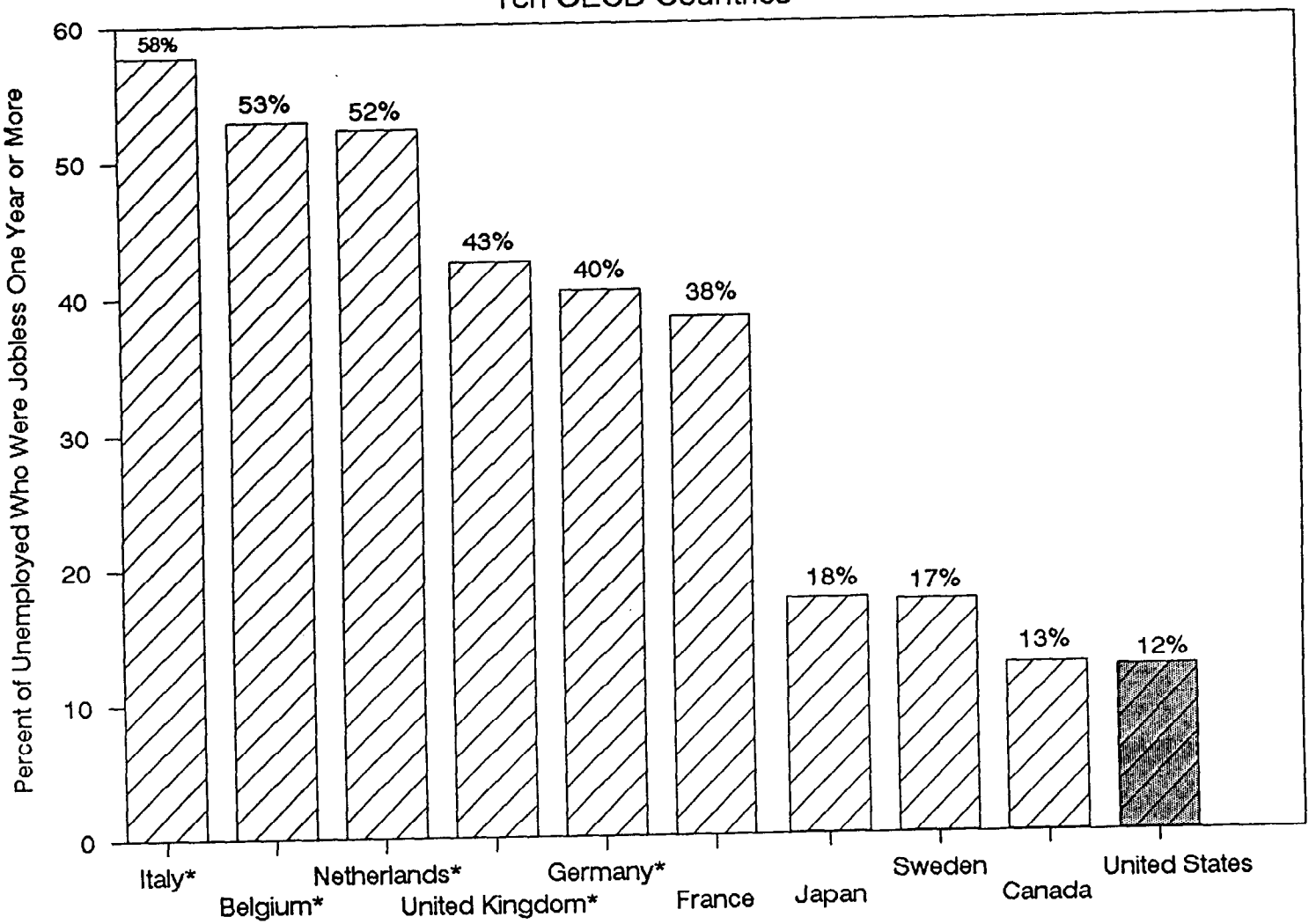


Figure 2a

Long-Term Unemployment as a Share of Total Unemployment, 1994

Ten OECD Countries



* 1993 data.

Source: OECD, July 1995.

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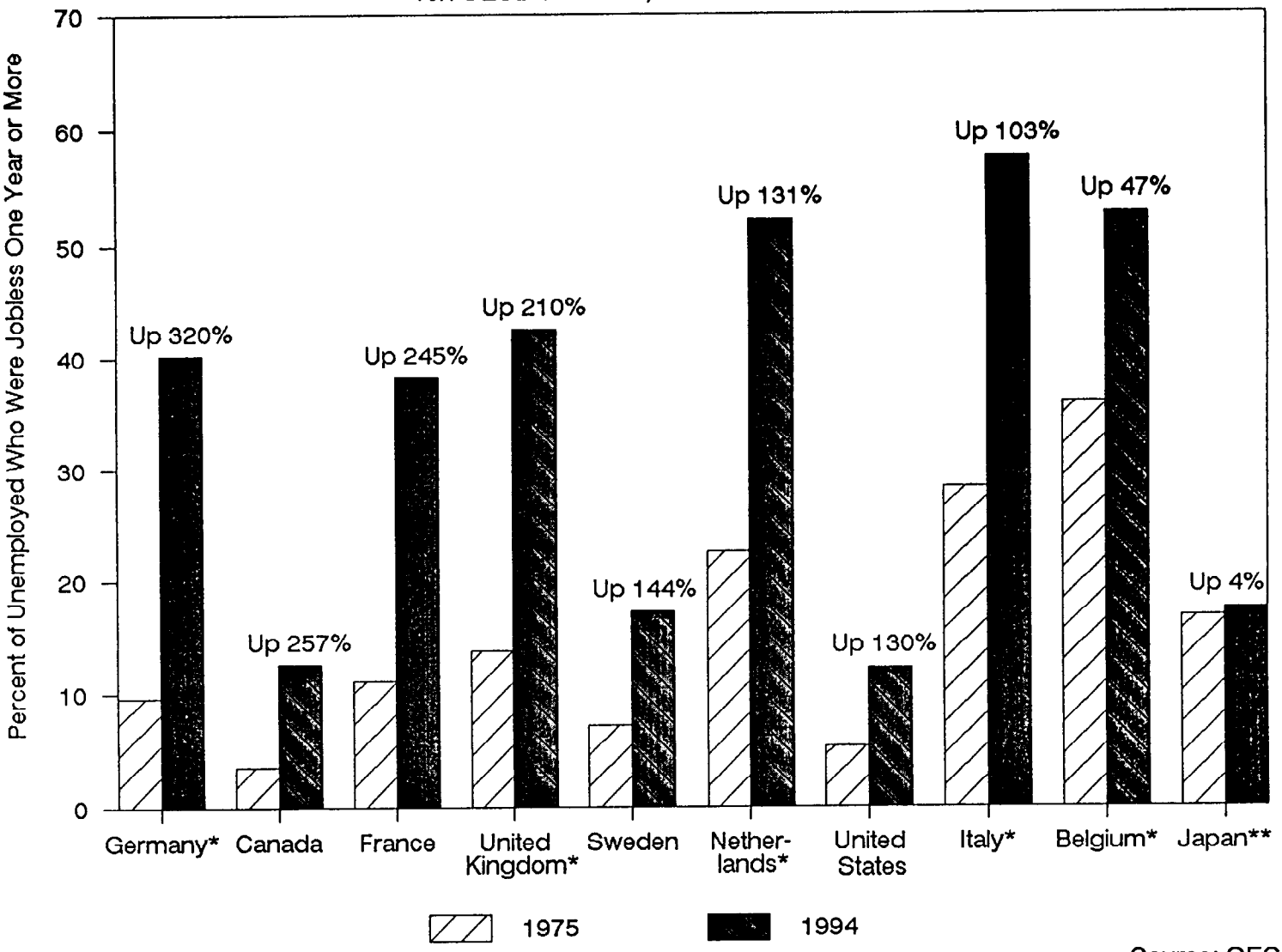
Figure 2b

Growth in Long-Term Unemployment as a Share of Total Unemployment

Ten OECD Countries, 1975 versus 1994*



* For asterisked countries, 1993 data.

** For Japan, 1979 data.

Source: OECD.

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Fig 3 Duration of Unemployment, 1950–95

and Civilian Unemployment Rate

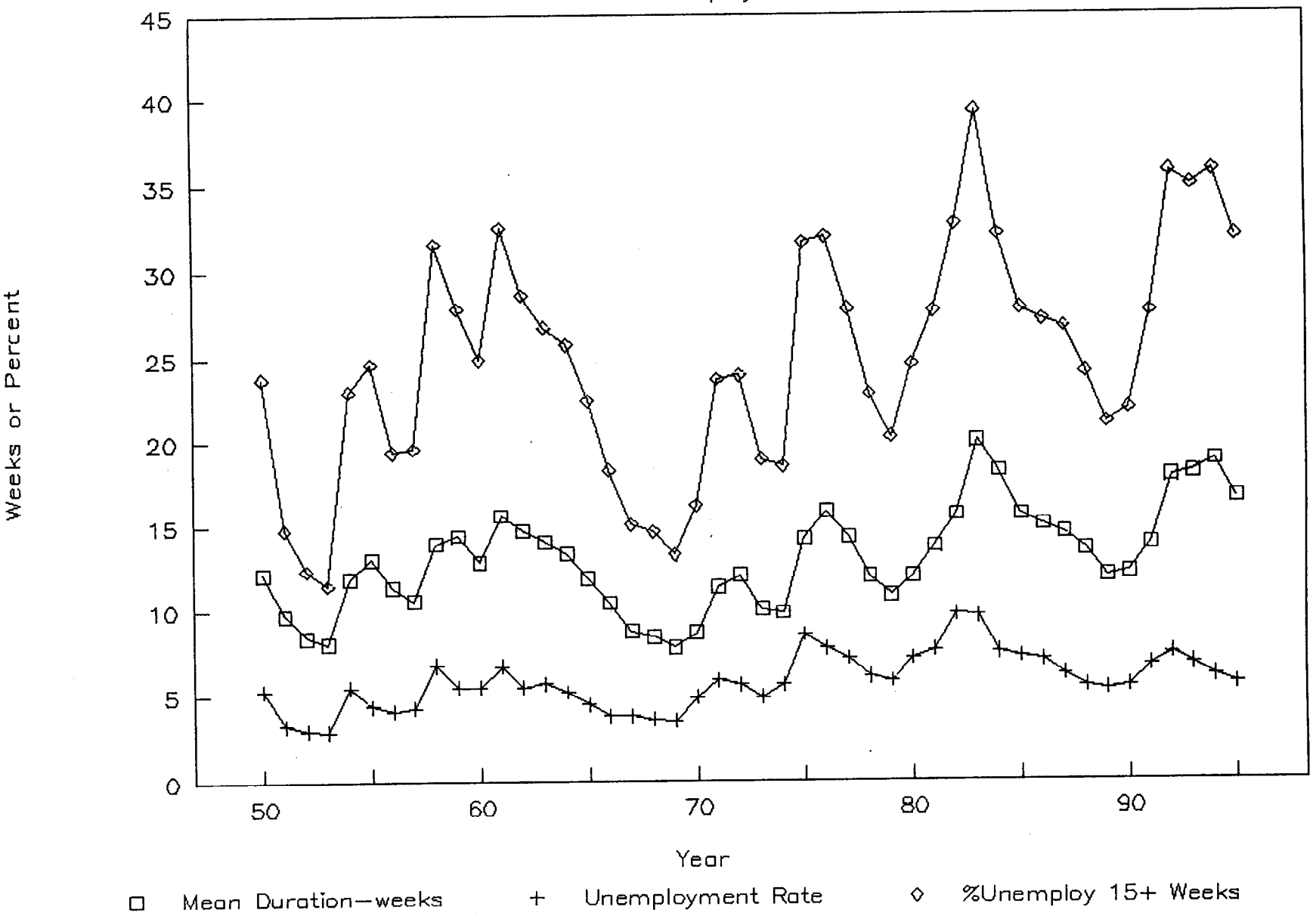

Fig 4 Mean Duration Unemploy (months)

and Technology Indicators by Period

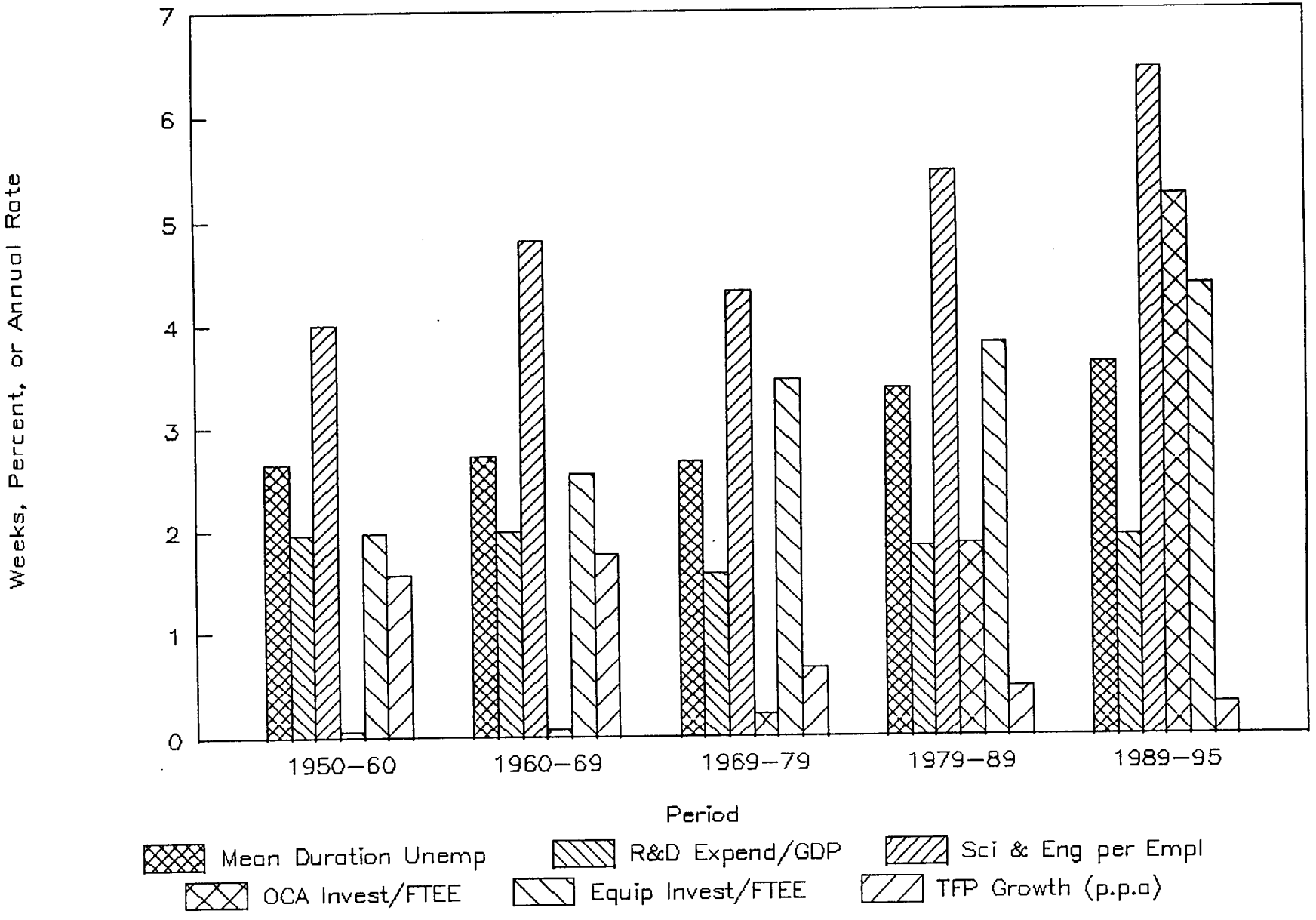

Fig 5 Mean Duration Unemploy (months)

and Institutional Variables by Period

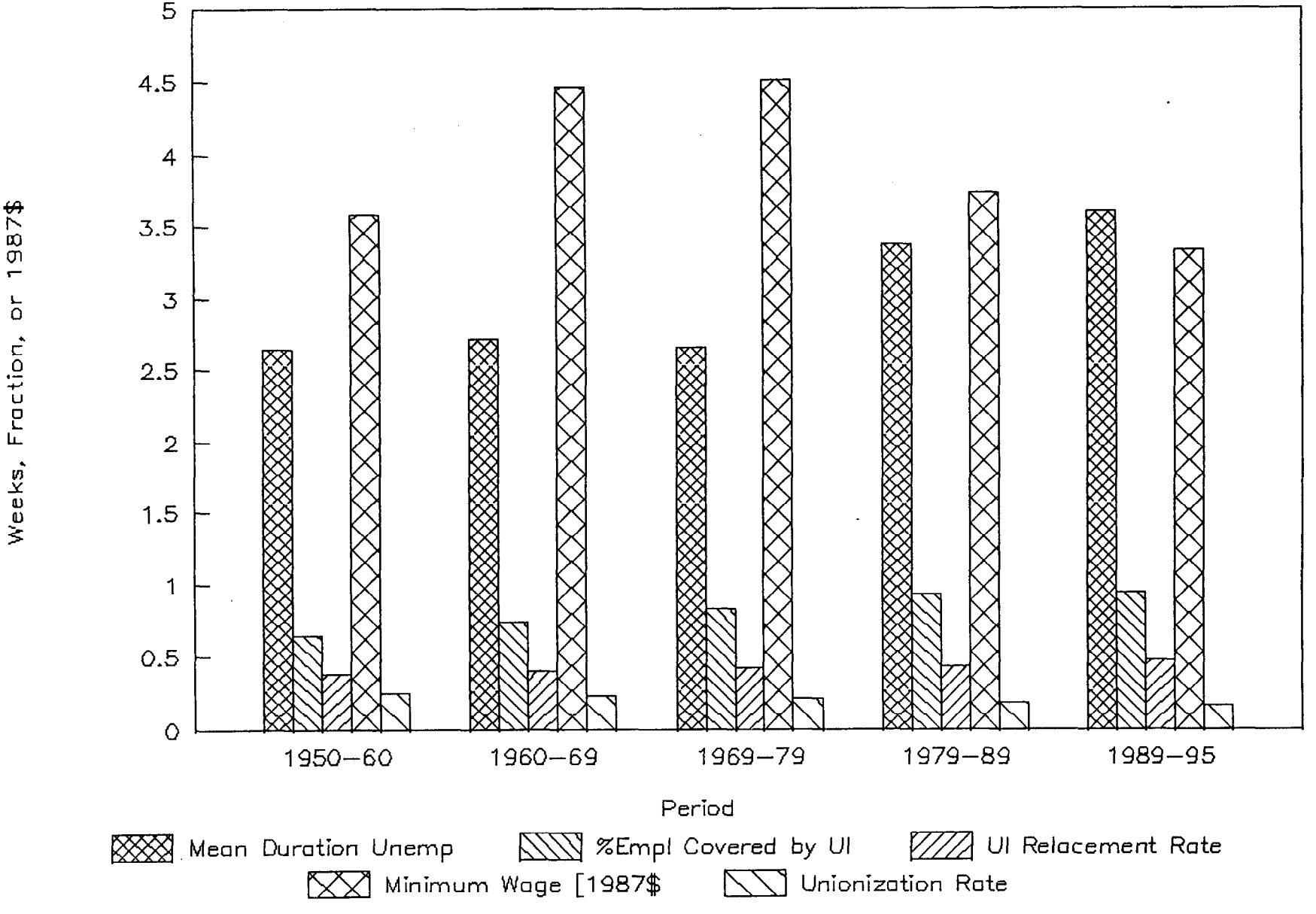

Fig 6 Unemployment Duration, TFP Growth

and Civilian Unemployment Rate, 1950–95