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Source: *Challenge*, SEPTEMBER/OCTOBER 1979, Vol. 22, No. 4 (SEPTEMBER/OCTOBER 1979), pp. 48-50

Published by: Taylor & Francis, Ltd.

Stable URL: <https://www.jstor.org/stable/40719797>

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## *Is Technological Unemployment Inevitable?*

Wassily Leontief

The effect of technological advance on employment has been debated for over 168 years, since desperate workers in the textile town of Nottingham, England, led by a certain Ned Ludd, wrecked newly invented knitting machines that they thought threatened their livelihood. The mill owners of course disagreed, and were supported by economists who proceeded to “prove” once and for all that unemployment caused by technology can be nothing but an illusion.

There were, however, notable exceptions, among them John Stuart Mill, who, after arguing first that workers displaced by machines in one line of production would necessarily find equally good employment opportunities in some other, later changed his mind and admitted that both the introduction of machines and their increase in numbers and efficiency could, indeed, depress the

aggregate demand for labor.

Thirty years ago, it took several thousand switchboard operators to handle one million long-distance telephone calls; ten years later, it took several hundred operators; and now, with automatic switchboards, only a few dozen or so are required. The productivity of labor—that is, the number of calls completed per operator—is increasing by leaps and bounds; it will reach its highest level when only one operator remains, and become infinite on the day that operator is discharged.

The usual measure of the “productivity” of labor is the total output divided by the number of workers or, even better, by the number of hours of work required for its production. The peculiar nature of this conventional measure, used in many official publications and referred to in public policy discussion, becomes clear if one tries to apply it, say, to de-

scribe and to assess the effects of the progressive replacement of horses by tractors in agriculture. By dividing the successive constant annual harvest figures by the corresponding gradually increasing number of tractors and alternatively by the steadily falling number of horses, we arrive at the paradoxical conclusion that at the time of transition, the relative “productivity” of tractors tended to fall while the “productivity” of horses replaced by them steadily rose. In fact, the cost effectiveness of horses, of course, diminished steadily as compared to that of the more and more efficient tractors.

Technological advance is uneven. Some sectors of the economy are more affected by it than others; some types of labor are replaced faster than others. Less skilled workers, in many instances but not always, are laid off first; skilled workers, later. Computers taking on the jobs of white-collar employees first perform simple mental tasks, then increasingly complex ones.

### *A change after World War II*

From the time that the steam engine was invented, successive waves of technological innovation have brought about an explosive growth of total output accompanied by rising per-capita consumption and, until the middle 1940s, a progressive shortening of the normal working day, working week, and working year. Although increased leisure (and for that matter cleaner air and purer water) is not included in

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the official count of goods and services used to measure the gross national product, it has certainly contributed greatly to the well-being of blue-collar workers and salaried employees. Moreover, the reduction of the average work week in manufacturing, from 67 hours in 1870 to 42 hours in the middle 1940s, combined with longer schooling, amounted to a large-scale withdrawal from the labor market of many millions of working hours. At the end of World War II, the situation changed. Successive waves of technological innovation continued to overtake each other as before, and the real-wage rate continued to go up, but the length of the normal work week today is practically the same as it was thirty-five years ago. In 1977, the normal work week (adjusted for growth in vacations and holidays) was still 41.8 hours.

This means that we have to face the prospect of technological unemployment's turning from its past benign "voluntary" state into a virulent involuntary phase. With this would come an inevitable increase in the social tensions resulting from the slowly but steadily increasing pressure of structural, as contrasted with passing cyclical, unemployment.

In complex systems like the modern economy, there is no such thing as a single cause of a problem. While without technological change there could, of course, be no technologically caused unemployment, neither would such unemployment exist if the total population, instead of growing slowly, began suddenly to shrink, or if workers agreed to accept lower and lower wages. Those who want the current population trends reversed are likely to proclaim that population growth is the actual cause of unemployment; those who would like to

see profits rise and wages go down can be expected to declare that high wages are its real cause. The remedy favored by the "keep your hands off the free market" libertarians is wage cuts brought about by systematic reduction of the power of trade unions, together with a curtailment of unemployment payments and welfare benefits.

While in many operations even dirt-cheap labor could not compete effectively with very powerful or very sophisticated machines, a drastic general wage cut would temporarily arrest the adoption of labor-saving technology. But unless the introduction of the cut was accompanied by specially erected barriers, the old trend would be bound to recur. Even a most principled libertarian might hesitate to have the wage question settled by cut-throat competition among workers under the continued pressure of steadily improving labor-saving machines.

Some advocates of full-employment policies have proposed that labor-intensive processes be given preference over labor-saving technologies. If administered persistently, such Luddite medicine would slow down technical progress and bring about difficulties even more menacing to the health of our economic and social system than the disease it was intended to cure.

Stepped-up investment can certainly provide additional jobs for people who otherwise would be unemployed. However, under conditions of labor-saving technological advance, creation of one additional job twenty years ago might have required \$10,000; today, it would require \$20,000; and twenty years from now easily \$50,000 or more, even if inflation is controlled. A high rate of investment is indispensable to satisfy

the expanding needs of a growing society. But it can make only a limited contribution to a solution of the problem of involuntary technological unemployment, particularly since the greater the rate of capital investment, the higher the rate of introduction of new labor-saving technology.

In connection with the work in which we are presently engaged, a member of my research team had to visit a modern, recently constructed copper smelter. What he saw was a gigantic plant, the construction of which cost \$450 million dollars; the total labor force required to operate it consists of fewer than fifty men per shift.

One must conclude that it would be sensible to explore the possibility of resuming the interrupted process of the gradual reduction of the length of the labor day, labor week, and labor year—or even labor life.

### *Shortening work time*

Once, voluntary sharing of technological unemployment—that is, progressive shortening of work time—was accompanied by a steady rise not only of hourly wage rates and monthly salaries but also of total annual, and even lifetime, take-home income. It appears that because of the greatly expanded opportunities to replace labor by increasingly sophisticated machinery, the impersonal forces of the market will not favor this solution any more. But human beings are not horses; they can reason, and in our democratic society they can vote.

Up to the middle 1940s, American families chose, as their real income rose, to enjoy it not only through increased consumption but in the form of a shorter work week and more leisure. Without the increase in leisure time, the

educational and cultural advances that marked the first forty years of the twentieth century would not have been possible. Americans probably would have continued to absorb potential technological unemployment in this voluntary way had real wages risen during the next forty years even faster than they have.

Government policies designed to bring about a steady rise in real wages sufficiently large to induce workers and employers to resume continuous voluntary reduction in the length of the normal work week once could have been considered. Under present conditions, such policies would require so large an increase in labor's share of the total national income that there would be a decline in productive investment, and this would result in an unacceptable slowdown of economic growth. The other alternative policy consists of a two-pronged approach combining direct action toward progressive reduction in the length of the normal work week with income policies designed to maintain and steadily increase the real family income of wage earners and salaried employees.

We are already practicing such income policies by gradual changes in the structure of our tax system and through Social Security, medical insurance, welfare payments, and unemployment benefits. The system should be redesigned and expanded so as to reduce the contrast between those who are fully employed and those who are out of work. Let us remember the widespread European practice of paying supplemental benefits to wage earners who work less than the normal number of hours per week.

A reasonable and effective response to the incipient threat of

involuntary technological unemployment should aim at bringing about an equitable distribution of jobs and income without, however, obstructing technological advance even indirectly.

But would not the admittedly far-reaching measures proposed above contribute to inflation? This question is asked nowadays whenever people speak of better environmental protection or improved transportation, or simply of advancing the clock to summertime on June 1st instead of April 29th.

### *Inflation is a social problem*

The inflation that has been plaguing our economy and several—but notably not all—other advanced free market economies is, in my opinion, not primarily a technical economic problem but essentially a deapseated social one. While an effective combination of fiscal and monetary policies is indispensable for the effective management of a modern economy, their success is predicated not only on tacit mutual understanding, but on institutionalized day-by-day cooperation between business and labor.

West Germany—a country whose successful stabilization policies we envy—is usually thought of as an example of an ideal unregulated free-enterprise economy. In fact, the success of Chancellor Schmidt's anti-inflation policies is built on the firm foundation of institutionalized joint labor-capital participation in the management of German industry. The by-law requires that one-half of the Boards of Directors of large corporations represent the shareholders while the other half be elected by labor. Among the latter, most are elected by that corporation's own labor force;

but some—the outside labor directors—represent essentially the national trade union movement. In Germany, as in the United States, wage and employment questions constitute only a small part of the management problems which the corporate Board of Directors has to deal with. This means that employers and employees maintain a working contract at the very grass roots of German industry. That cannot but be of crucial importance from the point of view of determining the nature and implementation of agreements reached in national wage negotiations; across-the-board wage negotiations between the employers' organizations and unions are conducted in Germany on a national level.

In Austria, another country that successfully resists inflationary pressures, the institutional set-up is very similar to the German one except that the government plays a greater role in across-the-board negotiations between trade unions and employers' organizations. It does so by contributing rather detailed input-output types of projections of the economic outlook for some years ahead.

The economic, social, and political situation and the historical tradition in labor-management relationships in the United States are obviously different from Europe's. Therefore different institutional arrangements would have to be devised to bring about closer day-to-day cooperation between (organized) labor and management. But I have no doubt that without such cooperation, all attempts to contain inflationary pressures, through monetary and fiscal measures, by suasion or by legislation, even if they may succeed temporarily, are bound to fail in the long run.