

# A Primer on Productivity

by **Brian D. Dittenhafer**

One basic economic problem of society, and a primary cause of inflation, is that we try to do more than resources will allow. We want to put a stop to poverty, reduce pollution, increase housing, maintain military defense, and become self-sufficient in energy. We start lofty programs to accomplish these objectives but do not always realize the claims these make on the resources of the economy. Many people do not recognize that the resources available are not limitless but accumulate only gradually. When society's demands on resources grow faster than the resources available, the bidding results in higher prices for goods, or inflation. However, if the volume of goods and services available grows more rapidly, we can raise our demands upon the economy more rapidly. The primary source of growth in resources during the past twenty years has been growth in productivity. This article explains what productivity is all about, and how its growth is related to that of the resources in the economy.

## What is Productivity?

To economists, productivity refers to the relationship of output to the labor, materials, and machines (factor inputs) that are used to make the goods and services we consume. The ratio of output to factor inputs is a measure of total factor productivity, or the efficiency with which factor inputs are combined. If we were able to measure exactly how much each factor, such as labor, added to total output, we could calculate the contribution each factor makes to increasing total output. Economists refer to the ratio of total output to a single input as partial factor productivity. Exact measurement of partial factor productivity for the entire economy is impossible, but several economists have estimated the contribution which each factor (and other influences) has made to increasing output. For example, over the years, the amount of capital equipment per worker has increased and this has been a significant source

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of productivity growth. At the same time, the quality of that capital equipment has improved, and as old machines were removed, more efficient ones took their place. Thus, more machines as well as more efficient ones contributed to productivity growth and helped society produce more goods and services.

According to one estimate,<sup>1</sup> better utilization of men, materials, and machines has caused productivity to increase at an average annual rate of 2.3 percent during the postwar period. Estimates such as this are made after detailed and time-consuming study in an attempt to measure the precise contribution of each separate production factor. To obtain more current productivity estimates, a simpler process is used. We simply count the number of man-hours worked and use the total as a substitute, or proxy, for other measures of factor inputs into the economy. Current estimates of total output are also made on a routine basis, so it is relatively easy to estimate labor productivity by forming the ratio of real output to number of man-hours worked. There are technical problems in measuring both the labor input proxy and the total output proxy (see box); but, in general, output per man-hour provides a reasonable estimate of goods produced per hour of labor worked.<sup>2</sup>

### Why Does Labor Productivity Change?

The productivity growth rate changes from year to year and even from quarter to quarter. Influences on productivity growth can be classified as either short term (having quick impact on output and productivity) or long term (when more fundamental forces are at work). Short- and long-term forces are at work simultaneously, but the sudden changes in productivity growth rates graphically portrayed in Chart I provide evidence that short-term influences are powerful and can easily overwhelm long-term forces.

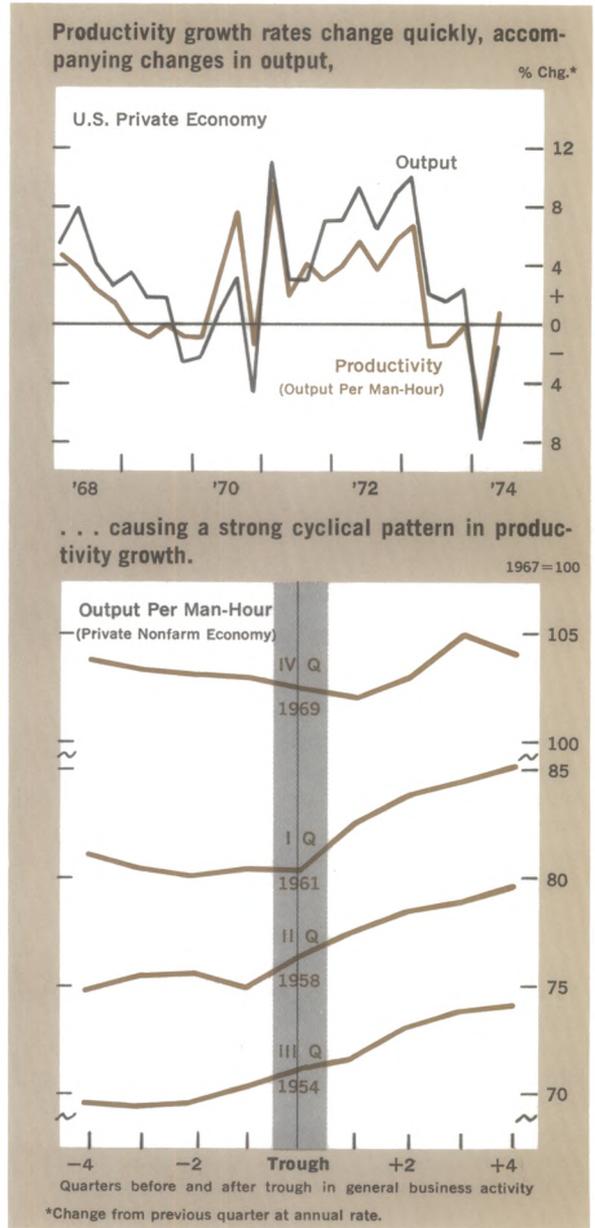
#### Short-Term Influences

Labor productivity usually declines during a business slowdown and increases during business expansions (see Chart II). In a business slowdown, employment usually declines, but not as much as production. Some workers lose their jobs; but many skilled individuals, who would be difficult or expensive to replace if they were laid off, are retained even when they are not needed for current production. Output declines more than man-hours worked, causing output per man-hour to decline. Partially offsetting

<sup>1</sup>John W. Kendrick, *Postwar Productivity Trends in the United States, 1948-1969*, National Bureau of Economic Research, New York, 1973, p. 39.

<sup>2</sup>Throughout the rest of this article, unless otherwise stated, the term "productivity" refers to output per man-hour as measured by the U.S. Department of Labor, Bureau of Labor Statistics.

## CHARTS I & II



this decline is the general tendency of employers to release less efficient workers first and to rehire them last. Therefore, when employment declines, the general quality of the work force increases. Further offsetting the productivity decline during a business downturn is the shortening of the average workweek. Working fewer hours, employees are generally less fatigued and work faster, increasing output per man-hour.

During a business expansion, output grows more rapidly than employment, and man-hours worked are spread over many more units of output. Therefore, as output increases, average productivity

## SOME MEASUREMENT PROBLEMS

On a practical level, the measurement of output per man-hour is more complicated than simply dividing the total of real output by the number of man-hours worked. Only two of the many problems of measuring productivity change are mentioned, but they serve to illustrate the nature of others which exist in measurement of productivity.

The U. S. Department of Labor, Bureau of Labor Statistics (BLS), collects and compiles the output per man-hour data for the national economy. In these measures, output per man-hour is the ratio of the real value of goods and services produced to man-hours of all persons employed, including proprietors and unpaid family workers. The BLS uses man-hours paid rather than man-hours worked as the measure of labor input. The differences between the two concepts is small, but probably widening because of the trend toward more paid vacations, sick leave, and holidays.

Another problem is encountered in calculating

output. The measure of output used is the real Gross National Product (GNP) originating in the private economy. Economists identify useful output by observing what people are willing to buy. Accordingly, real GNP is the final market value of goods and services produced in the economy expressed in dollars of constant purchasing power. The market criterion introduces a fundamental bias into productivity calculations, because market price does not measure nonmarket benefits which contribute to society's well-being. A vivid example is available in pollution-control equipment expenditures. These do not result in greater output of marketable goods and, therefore, do not improve productivity. In fact, since they probably lower capital available for directly productive machines, pollution-control expenditures probably lower the long-run output and productivity growth rates. But few would deny that spending for pollution control contributes to real income by improving the quality of life.

also increases. Acting to offset these productivity gains, to some extent, is the hiring of new workers who are relatively inefficient during the training period before they become fully integrated into the work force. Lengthening the work week also increases worker fatigue, reducing productive capacity.

### Long-Term Influences

While short-term changes in total productivity over a year or two are generally caused by ups and downs in output and employment, the factors affecting long-term productivity are more basic and occur more slowly. In a general sense, these factors are the amount of equipment that can be used efficiently (capital), the quality of that equipment (technology), the quality of the labor force using that equipment (education and training), and the efficiency with which production factors are combined (resource allocation).

Researchers generally agree that, during the postwar period, more capital has contributed between 20 and 30 percent to growth in total productivity and that improvements in the quality of the labor force, largely the result of education and training, have accounted for another large chunk. Estimates of the contributions of better education and training to total productivity growth range from 10 to 30 percent. Estimates differ because it is difficult to separate and measure the effects of a larger quantity of a factor input as opposed to a higher quality of that input. For example, it is

difficult to isolate the effects of quantity and quality when a growing firm installs one new machine for two of lesser quality. Estimates also vary with the number of sources of economic growth analyzed by the researcher. For example, the greatest contribution to total productivity is generally credited to technology, the result of new discoveries and new techniques for increasing output. However, technology's contribution is usually not measured directly but is estimated as the unexplained growth in production after all other factors are taken into account. Most researchers agree that both improvements in labor force quality and technological advances are dividends on society's investment in education. Increases in research and development expenditures result in inventions of new techniques and more efficient ways of production. (Chart III shows how one prominent researcher has determined the major sources of long-term total productivity gains.)

Still another factor responsible for productivity growth has been the reduction in hours worked in low efficiency sectors and the increase in hours worked in high efficiency sectors. In the U. S. economy, this effect has been most noticeable in the shift of labor out of farming. The actual amount of output per man-hour is lower in agriculture than it is outside farming, although the growth rate in productivity has been faster on the farm.

### Making the Pie Bigger

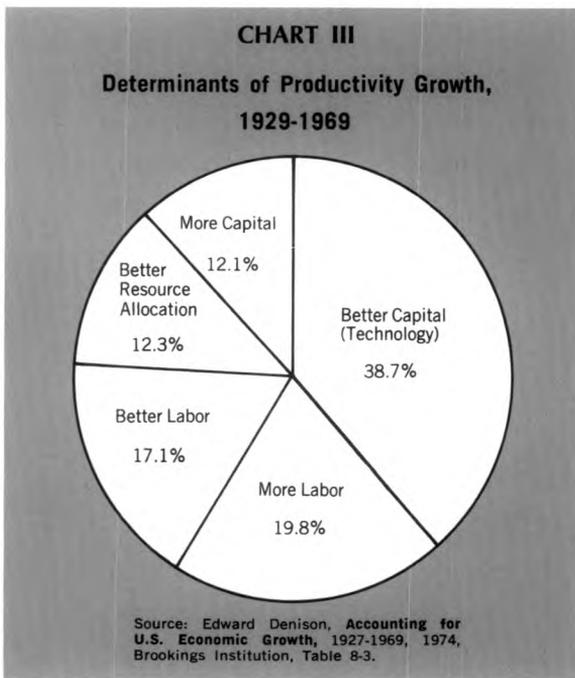
Is productivity growth the only thing which

increases the total amount of goods and services available in the economy? The answer is "no"; there are several other factors at work generating growth in total output and thus increasing the output pie. For example, variations in the length of the work-week and changes in the proportion of people of working age who are employed can alter total output without affecting output per man-hour. However, increases in productivity have been the largest factor contributing to growth in total output of goods and services. In fact, productivity growth is a prime determinant of the economy's potential output.

### What is "Potential" Output?

Potential output is the total of goods and services which could be produced if labor and other resources of the economy were "fully utilized." By fully utilized, we mean the amount of capacity utilization that one could expect to accompany reasonable price stability. To judge future growth in potential output, the President's Council of Economic Advisors made a calculation based on past growth in hours worked and in output per man-hour. The Council currently estimates potential output to be growing at 4 percent annually.<sup>3</sup> This is derived from combining the estimated labor force growth rate of 1.8 percent per year with a 0.3-percent decline in average annual work hours and a 2.5-percent increase in output per man-hour ( $1.8 - 0.3 + 2.5 = 4.0$ ). Productivity growth is extremely important, then, in increasing potential output and the income pie. Obviously, this is a rather crude calculation, and the results must be used with caution. However, estimating growth in potential output in this way gives a rough idea of how fast total output is growing and serves as a guide to policy. For example, we would expect that if combined government and private demands on the economy were growing at a rate above 4 percent for a sustained period, there would be upward pressures on prices. That is the kind of price increase economists call demand-pull inflation, because it results from society's attempt to use more resources than are actually available.

<sup>3</sup>"The United States Economy in 1985," *Monthly Labor Review*, Bureau of Labor Statistics, December 1973. Since 1962 when the original estimates were made, the rate of growth in output potential has changed, but the system of estimating it has not. From 1962 through 1965, output potential was estimated by the Council to be growing at a rate of 3.75 percent per year. From the fourth quarter of 1965 to the fourth quarter of 1969, it was estimated to be growing at a rate of 4 percent per year; and from 1969 through 1973, the estimate was a 4.3-percent annual rate of growth.



### How are Labor Productivity and Pay Related?

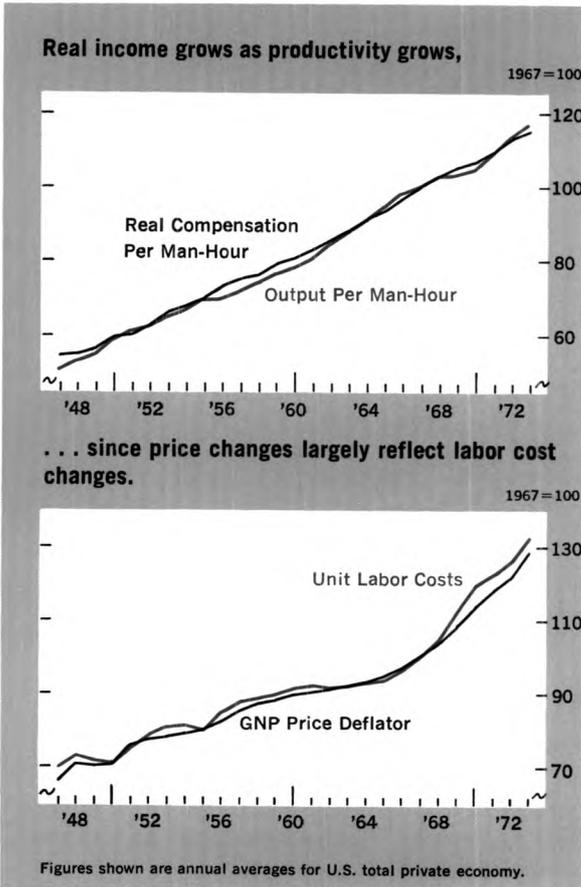
Workers know what they get paid per hour or year, and their employers must value labor input in much the same manner. In a competitive economy, no one is hired unless the amount earned from the sale of his output exceeds the wage paid to him.<sup>4</sup> The money obtained by selling the individual's output ultimately determines his wage. Thus, there should be a direct link between output per man-hour and wages and salaries.

### Why Does Real Income Grow?

Workers have shared in the benefits of the nation's steadily increasing productivity. Chart IV shows that real income (that is, compensation adjusted for rising prices) has gone up almost steadily and that compensation closely parallels the growth of output per man-hour. This long history of nearly parallel growth in productivity and compensation is no accident. Productivity increases allow more goods to be produced, making possible gains in real income. This increase can occur directly through

<sup>4</sup>The use of capital goods is also based on a time concept, and no capital good will be employed unless its expected rate of return exceeds its cost per unit of time. Of course, in marginal productivity theory, any factor input will be employed until the cost of employing it and the revenue derived from employing it are equal.

CHARTS IV & V



wage increases or indirectly through governmental programs.

Wage and salary increases larger than productivity gains have resulted in higher prices (see Chart V). Notice how closely prices, measured by the GNP price deflator, follow the trend of unit labor costs. This relationship is not surprising because unit labor costs are calculated by dividing average hourly compensation by output per man-hour. Unit labor costs increase whenever compensation rises faster than productivity. Labor costs are the largest portion of production costs. Therefore, when unit labor costs rise and all else remains unchanged, the price of whatever is produced also rises. This puts upward pressure on the general price level, and the inevitable result is cost-push inflation.<sup>5</sup> For employees who have received pay increases, the impact of higher prices is cushioned by the rise in

<sup>5</sup>There are other sources of cost-push inflation, but wages are the source of increases in costs most people think of first. In fact, cost-push inflation can be caused by an increase in the price of any factor used in production.

pay; they may even gain in real income. However, for those who did not gain an increase, the rise in prices causes a decline in real income because their money buys fewer goods and services.

Real income of employees and society in general can increase even if their actual pay does not. There are periods when unit labor costs fall because productivity rises faster than compensation. When this happens, employers have the opportunity to charge lower prices for their products or to raise profits. Thus, in a perfectly competitive economy, productivity gains would be widely shared among many different segments of society. Productivity gains would lower costs, and competition would force goods to be sold at a price equaling the cost of production.

In reality, however, not all wages and prices are set in a competitive market. Many workers and employers have a degree of monopoly power in their markets, and the gains from productivity are not usually distributed by lowering prices. Instead, workers usually try to increase their wages to the full extent of productivity gains. If they get the better of the bargain, the result usually shows up in higher costs, which employers—if they have enough market power—can recover by raising prices. If workers get the worst of the bargain, productivity gains show up mostly in profits. However, all members of society could benefit if labor and management acted as they would in a perfectly competitive economy and used productivity gains to lower prices rather than raise wages or profits. If all employers and workers did this, prices would fall and, barring other changes, everyone would be able to buy more with the same amount of money. Then even persons on fixed pensions could obtain direct benefits from the education and research to which they had contributed during their working years. Distributing productivity gains in this manner seems more equitable than the current situation, where groups with the greatest economic and political strength make economic gains relative to the rest of the population.

**Conclusion**

Increased efficiency in the use of resources is the ultimate source of increased output per person and the major source of growth in the economy. The most important resource in our economy is labor, and increases in the quality of labor have been an important source of increased output per man-hour worked. But whatever the source of growth in the future, the only path to increased real income and higher living standards for everyone is clearly through increased productivity. A more productive economy allows society to divide a larger pie rather than have different sectors attempting to gain larger slices of the same pie and see the supposed gains vanish in inflation. ■