ADD–ON 7A

OUTPUT AND PRODUCTIVITY GROWTH

Economywide output growth can increase the economic well–being of a nation's citizens. A key contributor to increases in output is economywide productivity growth. Just as we can measure the productivity of a firm, we can measure the productivity of an economy as a whole. An economy becomes more productive when it can produce more outputs using the same amount of inputs. In practice, economists who measure economywide productivity typically use gross domestic product as the output, or a related measure such as the value of private nonfarm business output.[1] They use measures of the aggregate capital stock and total labor hours as the inputs. More complex analyses might include separate measures of different types of capital, as well as adjustments for changes in labor quality due to changes in the average age, experience, or education of the workforce.

U.S. OUTPUT AND PRODUCTIVITY GROWTH

Between 1948 and the 1973 OPEC oil embargo, the U.S. gross domestic product grew at an annual rate of nearly 4 percent. From 1974 to 1995, however, U.S. output growth declined to under 3 percent per year. The slump in growth was not only disappointing, reducing the well–being of many U.S. citizens; it was also puzzling to many economists. Computer and related information technology had advanced dramatically during the period, but as Nobel laureate Robert Solow lamented in 1987, "You can see the computer age everywhere but in the productivity statistics."

The picture has changed dramatically since 1995, when the rate of growth revived. Between 1995 and 1999, the gross domestic product grew at a rate of just over 4 percent per year. For the first time, economists saw a major impact of computer and information technology on economic growth.

Figure 7A.1 shows the growth rate of nonfarm business output, and the factors contributing to it, during three periods: 1974–1990, 1991–1995, and 1996–1999.[2] Between 1974 and 1990, the annual growth in this output measure was only 3.06 percent. It dropped to 2.75 percent from 1991 to 1995. Then it exploded to 4.82 percent from 1996 to 1999.[3] The figure shows that most of this increase was due to three factors: an increase in information technology capital (computer hardware, computer software, and communications equipment), an increase in labor hours, and an increase in productivity, measured as the parameter A in a Cobb-Douglas production function. Growth in information technology

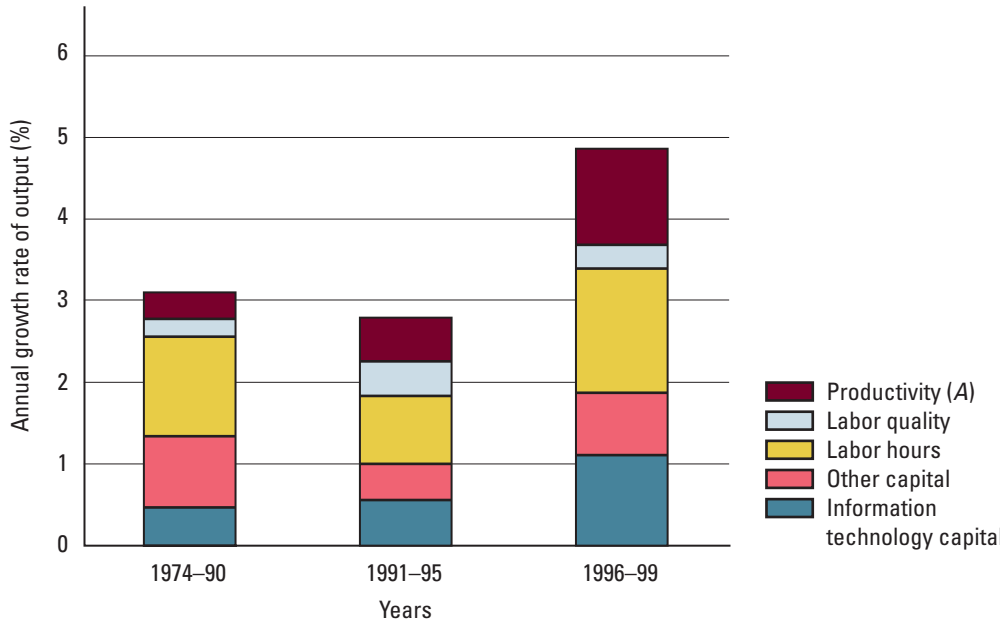
[1] Gross domestic product measures the dollar value of all domestically produced final goods and services; private nonfarm business output measures the dollar value of all final goods domestically produced by privately-owned nonfarm firms.

[2] Stephen D. Orliner and Daniel E. Sichel, "The Resurgence of Growth in the Late 1990s: Is Information Technology the Story?" *Journal of Economic Perspectives* 14, Fall 2000, pp. 3–22.

[3] Note that the overall rate of growth of nonfarm business output differs from the rate of growth of overall U.S. gross domestic product quoted above. However, the general patterns shown by these two different measures of output are similar.

Figure 7A.1

The Growth Rate of U.S. Nonfarm Business Output and Its Sources. The three bars show the total annual growth rate of U.S. nonfarm business output and its sources for the periods 1974–1990, 1991–1995, and 1996–1999.



capital went from contributing only 0.49 percent and 0.57 percent per year in output growth during 1974–1990 and 1991–1995, to 1.1 percent per year during 1996–1999. The reason was a dramatic increase in investments in information technology capital during the last period. Productivity (the parameter A in a Cobb-Douglas production function) grew at a rate of 1.16 percent per year during 1996–1999, compared to only 0.33 percent and 0.48 percent per year during 1974–1990 and 1991–1995.

Investments in information technology capital were only one of the ways that information technology contributed to growth. Firms in the information technology industries also became much more efficient at producing their outputs, contributing to the overall growth in productivity. Remarkably, despite representing only 2.5 percent of aggregate output, the computer and semiconductor industries were responsible for nearly half of the 1.16 percent annual growth in U.S. productivity from 1996–1999. The semiconductor industry experienced annual productivity gains of 45 percent in those years.

These productivity gains have had a dramatic effect on the lives of Americans. They helped to keep inflation in check during the economic boom of the late 1990s, allowing the Federal Reserve to avoid the kinds of "cooling" measures that it had used during such booms in the past. Some recent estimates suggest that productivity growth actually accelerated during the recession of the early 2000s. Whether such productivity gains will continue is unclear. It is a subject of great interest—and active debate—among economists.[4]

[4] For one view on the limits of computer technology to spur growth, see Robert J. Gordon, "Does the New Economy Measure Up to the Great Inventions of the Past?" *Journal of Economic Perspectives* 14, Fall 2000, pp. 49–74.