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Why The Optimism?

by John B. Carlson

In spite of the recent recession, hopes for the New Economy have been little daunted. Surprisingly robust productivity growth during the recent downturn provides compelling new evidence that something truly fundamental is going on. This *Commentary* argues that advances in information technology, and their diffusion through the economy, are justifiable reasons for our optimism. Higher productivity growth is not an ephemeral phenomenon but one likely to persist for some time into the future, perhaps even accelerating further.

Rising productivity allows an economy to grow faster than its labor force and thereby increases living standards. A lot hinges on productivity's future trend growth rate. Small changes in assumptions about productivity growth, for example, have huge implications for budget forecasts and for the actuarial soundness of Social Security.

Despite a stagnant economy, U.S. workers produced 2 percent more for every hour they worked in 2001 than they had in 2000—equal to the average annual productivity increase over the past business cycle, but above the rate registered from 1973 to 1990 (see figure 1). Recent research suggests that productivity can grow even faster over the years ahead, with some economists projecting a range as high as 3 percent. (See Jorgenson, Ho, and Stiroh 2001 and Oliner and Sichel 2002 in the recommended readings).

Just four years ago, such projections would not have been taken seriously. The 1997 *Economic Report of the President*, for instance, projected a meager 1.2 percent annual productivity gain over a horizon of seven years. Given an additional assumption that hours worked would grow 1.1 percent, the economy was projected to grow at an average annual rate of 2.3 percent. The 2001 *Economic Report of the President* now assumes an average productivity increase of 2.1 percent a year over the next 10 years, allowing 3.2 percent output growth over the same period. Is the new-found optimism justifiable?

This *Economic Commentary* examines the prospects for continued strong productivity growth. First, we examine evidence that recent productivity gains are more resilient than first thought. We then identify and discuss the primary engine for the recent productivity surge. We also assess the basis for believing that this engine of growth has many miles left on it.

It's for Real

As measured productivity accelerated in the late 1990s, many economists questioned the sustainability of higher productivity growth. Some argued, for example, that the increase was largely related to the business cycle and hence a transitory phenomenon. They noted that productivity typically declines around business cycle peaks. These skeptics, who believed that the expansion was running on borrowed time, reasoned that productivity would eventually revert to a lower trend.

Data available since the recent business cycle peak, however, provide some important evidence on this issue. Figure 2 illustrates that productivity often falls in periods surrounding business cycle peaks. Even when productivity has not declined, its growth slows substantially relative to the average rate over the previous business cycle. The 2001 peak, however, was different. Although productivity growth slowed from its recent trend, it was substantially stronger than it had been around the peaks of previous expansions. The 1.4 percent productivity increase around the 2001 peak is even more impressive because it provides convincing evidence that the acceleration in productivity is more enduring than skeptics believed. (For an alternative analysis documenting the strength of productivity growth, see Bauer, Jensen, and Schweitzer 2001).

This new evidence is somewhat limited, however. Though it sheds light on the recent productivity trend, it tells us little about what to expect in the future. What basis is there for extrapolating higher productivity growth out over a longer-term horizon? What are the fundamentals behind this growth? Are they likely to persist? To answer these questions, we need to explore some factors that account for the recent productivity surge.

A Key Fundamental

Basic economic principles tell us that labor productivity—the ratio of output to an hour worked—can increase for several fundamental reasons. Clearly, productivity is enhanced when firms invest in more efficient equipment and structures. In some cases machines may substitute directly for a worker, while in other cases a new machine may help workers produce more. Productivity is also enhanced by more efficient ways of organizing production and by increased labor quality. Recent productivity gains have been driven largely, but not exclusively, by new and more efficient equipment, especially in the information

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technology (IT) sector. More importantly, the nature of these drivers suggests they will lead to comparable, if not even greater gains, in the future.

In 1965 Gordon Moore—the cofounder of Intel Corporation—observed that the number of transistors on a silicon chip had doubled every 18 months and was likely to continue to do so. This seemingly specialized engineering prediction turned out to be not only incredibly accurate and durable, but also profound in its economic importance. For the number of transistors on a chip roughly translates into computing power, and increasing computing power is the rare sort of technological advance that has spillover effects that generate other innovations.

It is doubtful that in 1965 many people could appreciate the significance of that important observation—now known as Moore's Law. Few people had any tangible connection to the advances in computing power. Personal computers had not been invented. The early gains from electronic computing power were embodied in large, expensive "mainframe" computers and applied to very specialized applications done largely at universities and large corporations, in the defense industry, and at the Census Bureau.

The advent of the personal computer changed things dramatically, illustrating concretely how computing power could be applied to a wide variety of purposes, and thus highlighting the economic salience of Moore's Law. Those of us who made the transition from electric typewriters to early PCs and then to their modern counterparts gained a clear insight into the efficiencies of increased computing power. Does anyone remember the slide rule—a necessary device for engineering students as late as the early 1970s? The development of the Internet provides yet another world-transforming gain from IT.

The economic importance of IT, while now tangible to us all, has only recently become obvious in the economy as a whole. In 1987 Nobel Prize winning economist Robert Solow observed, "You can see the computer age everywhere but in the productivity statistics." Even in the early 1990s there was no statistical evidence that productivity had accelerated in the aggregate economy. In the late 1990s we saw why this was so—the IT sector was not yet big enough to matter. By the second half of the decade, however, this would change. The IT sector expanded throughout the economy, and productivity accelerated sharply.

Oliner and Sichel (2000) estimate that during the period 1974 to 1990, the IT capital sector accounted for only 3.3 percent of the income earned in the economy but still contributed 0.5 percentage points to economic growth. In the late 1990s, they estimate that the IT sector expanded to 6.3 percent of income earned and but contributed 1.1 percentage points to economic growth. It is important to note that as IT's share of income increased 91 percent, its contribution to growth increased 124 percent. This extraproportional effect occurred because productivity gains in the IT sector were so much higher than in the rest of the economy. Thus, as the IT share grew, overall productivity accelerated.

Can Productivity Continue to Accelerate?

Productivity could accelerate further if Moore's Law continues to hold and advances in computing power continue to diffuse throughout the economy. The prospects for Moore's Law seem very promising. At a recent conference of chipmakers, Intel's current CEO Craig Barrett predicted that it would hold for another 15 years. Is this credible? The 37-year track record seems to dictate that the burden of proof be on the doubter. Moreover, computing power actually accelerated in the late 1990s as Intel sped up its product cycle—introducing new chip designs every two years instead of every three.

But Moore's Law doesn't have to hold for productivity to accelerate. Even if the pace of computing power growth slows, average productivity can grow faster if IT's share of the economy grows sufficiently fast. Of course, just having more computing power available doesn't mean that it will be effectively and usefully employed. There must be some reason to believe that households and businesses will adopt the new technology and thereby embed the productivity gains in the economy as a whole.

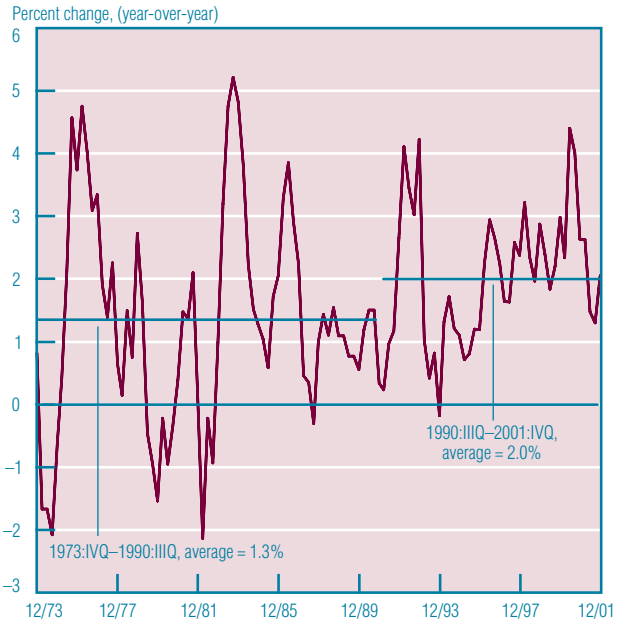
Delong and Summers (2002) offer one reason that IT's share of the economy will likely grow. They note that IT goods are what economists call "luxury" goods. As households become wealthier, they allocate an increasing share of their expenditures on such items. HDTVs, broadband Internet connections, and other such items will increasingly be added to the shopping lists of American households, especially if prices continue to fall. Falling prices allow greater penetration into smaller budgets. As IT's share of spending increases, income grows faster, which in turn causes IT's share to increase further—a virtuous cycle.

There are other reasons to expect the new technology to be drawn further into the economy. First, IT is what is known as a general-purpose technology—meaning that efficiencies gained are not solely embodied in the production of IT equipment but are more generally transmitted throughout other sectors of the economy such as automotive, housing, retail, and so on. Today with PCs, engineers and architects conduct "what if" experiments with computer-assisted-design programs that make them much more productive. Researchers in pharmaceutics use similar computer-assisted experiments to generate new drugs at a faster pace. Retailers have exploited new IT technologies to organize their distribution systems more efficiently. The result has been that firms that have moved quickly to exploit the new technologies have increased market share, inducing an acceleration in productivity of the retail sector.

One interesting approach to assessing the degree to which firms will invest in new technology is developed by Cummins and Violante (2002). They assess the potential returns that firms stand to gain from investing in new technology. Their approach calculates a "technology gap"—a measure of how much more productive new machines are compared to the average machine currently employed. They show that firms are spurred on to invest more rapidly when the technology gap widens. By their estimates, the gap has increased substantially over the past decade. In 1975, for example, they estimate that the average technology in use was 15 percent less productive than the best practices available at the time. By 2000, however, the gap widened to 40 percent, despite the huge increase in investment during the 1990s.

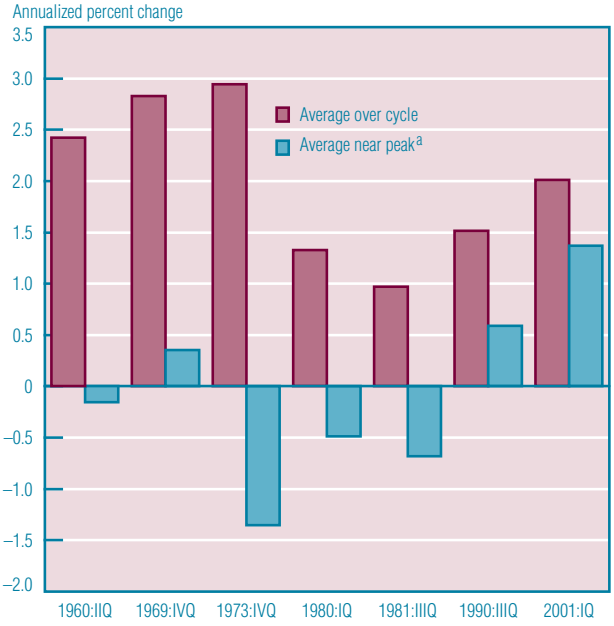
This analysis bodes well over the near term. One of the hallmarks of the New

FIGURE 1 PRODUCTIVITY GROWTH



SOURCE: U.S. Department of Labor, Bureau of Labor Statistics.

FIGURE 2 PRODUCTIVITY GROWTH AROUND BUSINESS CYCLE PEAKS



a. Annualized percent change from two quarters before a business cycle peak to two quarters after it.
SOURCE: U.S. Department of Labor, Bureau of Labor Statistics.

Economy is that firms are limited in their ability to make price increases stick. Firms can maintain or increase their market shares only by becoming more productive and inducing customers with lower prices. Competitive pressures thus give firms strong incentives to invest in more efficient technologies, which, in the case of IT, are becoming less costly. In many cases, it will not be a matter of choice but one of survival.

Some Concluding Thoughts

When Gordon Moore first observed the pace at which computer chips were shrinking, few if any could appreciate its profound economic significance. It wasn't obvious in the productivity statistics even as recently as five years ago. Today, computers are everywhere, even in the productivity numbers. Now we can say with some confidence that the recent IT revolution has been an important component driving the acceleration in productivity. We can even say that higher productivity growth is not an ephemeral phenomenon but one likely to persist for some time into the future, perhaps even accelerating further.

We would be remiss in not offering a caveat. Although the basis of the surge in productivity is now better understood and documented, we cannot know what surprises the future might bring. With so much at stake, it is human nature to want to believe that the best outcome will occur. Oliner and Sichel (2002) remind us, however, that current estimates of the productivity trend might best be thought of as structured guesses. Even with that in mind, we have good reasons be optimistic.

Recommended Reading

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