HAVE COMPUTERS MADE US MORE PRODUCTIVE?

A PUZZLE

by Adam M. Zaretsky

For many Americans, the proliferation of the personal computer has transformed the workplace more than any other innovation. Over the past 15 years or so, this transformation, sometimes called the “Information Revolution,” has caused many firms to rethink their organizational structures and management procedures. The Information Revolution is also commonly credited with creating huge gains in workplace productivity, which, in turn, have led to higher wages.

The catch, though, is that these huge gains in productivity have not shown up in the national data. Rather, year-over-year gains in overall productivity—measured as output per hour of all persons in the business sector—have failed to suggest that anything unique was occurring in the workplace during this business expansion relative to previous expansions (see top half of chart). In 1996 and 1997, for example, output per hour increased about 2 percent a year; in 1995, it declined 0.1 percent. In fact, since the end of the 1990-91 recession, productivity growth has so far peaked at 3.3 percent in 1992. After the 1981-82 recession, productivity growth peaked at 3.2 percent in 1983. In the 1950s and '60s, in contrast, growth rates above 4 percent were quite common.

The Missing Pieces

The absence of huge productivity gains has created what economists call the productivity paradox. Basically, the paradox is that the official statistics have not borne out the productivity improvements expected from new technology. The United States is not unique in this respect. As economists Erwin Diewert and Kevin Fox have observed, there has been a “measured productivity slowdown in industrialized countries in the last 25 years, the very time when we would have expected to see large increases in productivity growth due to rapid technological change.”

So, what happened?

Part of the explanation is that there have been payoffs to firms from computer investment, but these payoffs are hard to measure. For example, Zvi Griliches has argued that in measuring productivity, “[c]omputer investment has gone into our ‘unmeasurable sectors,’ and thus its productivity effects, which are likely to be quite real, are largely invisible in the data.”

A different argument, advanced by Paul David, compares the onset of computers with the advent of electricity, which took about 40 years before its impact on productivity was observed. Jack Triplett counters that the rapid fall in the price of computing power indicates a different diffusion process for computers than for electrification, making the analogy weak. He writes: “In the computer diffusion process, the initial applications supplanted older technologies for computing. Water and steam power long survived the introduction of electricity; but old pre-computer age devices for doing calculations disappeared long ago.”

Another explanation for the paradox—put forth by David Romer in 1988—is that, because investment’s share of GDP is relatively small, large changes in investment translate into only small changes in output. And since computers represent a modest part of total investment, huge increases in computer investment result in only meager increases in measured output and, hence, measured productivity. Diewert and Fox believe this analysis doesn’t work for computers because they are inherently different from other types of capital. They write: “[C]omputers can be used to control other capital (and labor), so that the other capital (and labor) is used more efficiently, for example, the management of a warehouse, or coordinating the movement of trucks and airplanes.” In other words, computers may actually substitute for other capital—including human capital—thereby replacing, rather than adding to, some of the productivity gains.

Is This Where It's Been Hiding?

The productivity paradox has not affected all sectors of the economy, though. U.S. manufacturing, for instance, has experienced relatively strong annual productivity growth over the past few years (see bottom half of chart). In fact, output per hour in this sector has grown more than 4 percent a year since 1995—a sustained rate of increase unequalled since the end of World War II. Perhaps, then, the expected productivity gains are more isolated than anticipated, occurring mostly in those sectors that are extremely capital intensive, like manufacturing.

What hasn’t accompanied this relatively strong growth in manufacturing productivity, however, is a commensurate increase in real wages. While output per hour has been growing at more than 4 percent a year, real compensation per hour at manufacturing firms has been growing at less than 1 percent a year. It wasn’t until the beginning of 1998 that year-over-year growth in real compensation per hour spiked up to almost 4 percent.

This leads to yet another conundrum, since traditional labor market theory predicts that productivity gains should drive wage increases. Why? Because theory says workers should receive a wage that exactly compensates them...
for their added value to total output, otherwise known as their marginal revenue product. This is calculated by determining how much output workers can produce in an hour—their marginal product—and then figuring out how much extra revenue that output will bring the firm—its marginal revenue—hence the term, marginal revenue product. The chain of events, then, would be: investment in computers leads to increases in output per hour (higher productivity), which, in turn, leads to higher wages. For the U.S. manufacturing sector, the chain appears to be holding, although the last link seems weaker than the first. Perhaps, then, investment in computers and information technology has had other, not as easily observed, outcomes.

Hidden Consequences

This is exactly the proposition that David Autor, Lawrence Katz and Alan Krueger examined in their 1997 article, they argued that the rapid spread of computer technology in the workplace may explain as much as 30 to 50 percent of the increase in the growth rate of demand for more-skilled workers since 1970. The three economists found that the demand for college-level workers grew more rapidly on average from 1970 to 1995 than from 1940 to 1970. This increased demand was initially met with a sufficient supply of college-educated workers. That supply slowed at the beginning of the 1980s, however, eventually causing a shortage that led to a widening of the wage gap between those with and without college degrees.

An even more striking finding by the authors was that industries displaying the largest increases in skill requirements—legal services, advertising and public administration, for example—were the biggest users of computers. This is exactly the productivity paradox as originally defined by Robert Solow, who noted in his now famous essay, "We Have Seen the Future and It Does Not Work," that "the rapid spread of technology has had other, not as easily observed, outcomes."

ENDNOTES

1 See Diewett and Fox (1998). Like Diewett and Fox, all of the people cited in this article are economists. 2 See Griliches (1994). 3 See Black and Lynch's (1997) study for a list of industries and the authors' measures of skill requirement and computer investment.

FOR FURTHER READING
