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Productivity and Inflation

This Economic Letter *is adapted from remarks by Janet L. Yellen, President and CEO of the Federal Reserve Bank of San Francisco, delivered at the Economic Summit at the Stanford Institute for Economic Policy Research in Palo Alto, California, on February 11, 2005. (See www.frbsf.org/news/speeches/ for the full speech text.)*

Several recent developments have raised concerns about a productivity slowdown in the U.S. that could slow economic growth and boost inflation. For example, after soaring at the astounding rate of nearly 4½% in 2002, 2003, and the first half of 2004, nonfarm labor productivity growth slowed to around 1¾% in the third quarter of last year and to only ¾% in the fourth quarter. Moreover, during the last year, quality-adjusted computer prices haven't fallen as fast as they have for the past decade, which may signal some slowing of technological innovation in this sector. In addition, there is some industry opinion that the pace of software development is beginning to slow.

Though these developments give us ample reason to think seriously about what the future may hold for productivity growth, they should be viewed in perspective. For one thing, productivity growth rates are extremely volatile over periods as short as a few quarters, so we shouldn't make too much of the very recent data. More importantly, few economists expect the economy to continue to deliver rates as high as 4½%. Rather, there's some consensus that the *trend* growth rate of U.S. productivity is probably around 2½%. That is still a high number—nearly double what it had been during the quarter century before 1995—with the potential to enhance living standards dramatically if it is maintained in the decades ahead.

Why would a slowdown from the current trend rate likely boost inflation?

In theory, slower growth in trend productivity would have two counteracting effects. First, it would likely raise business costs for a time, because firms would face more rapid growth of unit labor costs. To offset the resulting squeeze on profit margins, firms would need to raise prices more rapidly. Eventually, increases in unit labor costs are likely to fall back toward previous slower rates as workers are forced to accept lower wage growth to compensate for their slower productivity growth. But during the adjustment period—which can last for a considerable period—there is upward pressure on inflation.

At the same time, slower growth in trend productivity would likely result in slower growth in aggregate demand, which might offset some of the upward pressure on inflation. Growth in consumer spending would probably weaken as lower business profits limit stock market gains, thereby reducing household wealth. More foresighted consumers might also reduce spending, perceiving that the prospects for growth in real wages are not as bright. Further, lower expected rates of productivity growth should restrain business investment by reducing the prospective return to capital.

The net impact of the two opposing effects of productivity growth on inflation is an empirical issue. My reading of the evidence suggests that the predominant medium-term effect of a slowdown in trend productivity growth would likely be *higher* inflation. This makes sense to me, as it would seem to be the counterpart to the reductions in inflation that occurred over the past decade, when rapid productivity growth aided the Fed in bringing inflation toward price stability.

So a key issue for inflation going forward is whether the trend growth rate of productivity will remain near its estimated rate of around 2½%. If so, core inflation seems likely to remain stable, near its current moderate pace. If productivity accelerates or decelerates, we could see inflation start to fall or rise relative to the 1½ to 2% rate that prevails today. My own view is that the risks surrounding the outlook for productivity are roughly balanced.

Prospects for productivity

To explain why I hold this view, let me start with a brief look at the sources of productivity growth since the surge began in the mid-1990s. There are three basic factors to consider. First is capital deepening—in particular, the pace at which the quantity of capital per worker rises over time. Second is improved labor quality, or human capital—that is, a better educated or more skilled workforce. Third is "multifactor productivity," or MFP, which essentially stands for all the gains in productivity that are not accounted for by either capital deepening or improved labor quality. It captures, more or less, the productivity gains that ultimately stem from innovation. For example, it would include not only the engineering and scientific knowledge that goes into new technology but also improved management processes, such as

"just-in-time" inventory management, as well as "creative destruction," whereby innovative firms expand market share at the expense of less innovative firms.

Oliner and Sichel (unpublished updates of 2002) analyzed U.S. productivity, looking at the period from 1996 to 2001, when productivity rose to nearly 2½% a year, as well as the period from 2002 to 2004, when labor productivity rose at an annual rate of almost 4¼%. They found that the initial mid-1990s acceleration in labor productivity reflected in about equal parts an increased contribution of capital deepening and an increase in MFP, with little, if any, change in the contribution from worker skill improvements. But the results for the period from 2002 to 2004 were noticeably different. This period, of course, was the worst of the "investment bust," when business investment actually receded. The study's results suggest that, over those years, a further acceleration in MFP accounted for *more* than all of the acceleration in labor productivity.

Some recent studies suggest that the explanation of the strength of MFP growth lies in information technology (IT), where the pace of technological innovation is clearly quite rapid. But IT's role in the last few years appears to be different from its role in the late 1990s. In that period, studies tend to find that MFP gains in the *production* of IT contributed substantially to the overall pickup (e.g., Jorgenson and Stiroh 2000 and Oliner and Sichel 2000; but see also Basu et al. 2001). In addition, firms invested heavily in new (and steadily cheaper) IT, boosting capital deepening in industries that used IT intensively.

But for the more recent period, studies tend to find that the MFP acceleration is more broad-based across industries that *use* technology—not confined to the IT-producing sector (e.g., Oliner and Sichel, updates of 2002 and Jorgenson et al., 2004). Sectors that *produce* IT, especially semiconductors, have actually contributed somewhat less to MFP growth in the 2000s relative to the late 1990s.

A mechanism that may explain the continued rise in MFP in sectors that use IT is that firms are learning new and better ways to use the technology they already have in place to become more productive. Indeed, some evidence suggests that the extraordinarily high rates of investment in high-tech equipment during the second half of the 1990s actually *reduced* measured productivity growth over that period (Basu et al. 2001). The reason is that firms had to divert resources from current production and use them instead for installing the new capital and learning how to use it. If firms continue to increase their proficiency in using the technology they already have, this could help keep productivity growing at a robust pace.

Moreover, a fundamental way that IT enhances productivity is by allowing firms to reorganize workplace operations, a process that takes time. For example, consider Wal-Mart and other "big-box" stores, whose new approaches to workplace organization have dramatically affected retail and wholesale productivity. According to Sam Walton, he benefited in the 1980s and 1990s from knowledge he gained in the 1960s and 1970s, when he flew around the country visiting competing discount stores and attending IBM conferences (Walton and Huey 1992).

Formal studies (e.g., Brynjolfsson and Hitt 2000, David and Wright 2004, Bresnahan and Trajtenberg 1995, and Helpman and Trajtenberg 1998) that look at IT as a "general purpose technology"—that is, one with broad applicability across the economy—also suggest that it can take time to reap the benefits of technology, since firms have to make substantial complementary investments in learning, reorganization, and the like. For example, Brynjolfsson and Hitt (2003) look at a sample of 527 large U.S. firms from 1987 to 1994. They find that the benefits of computers for output and productivity rise over time and can take at least five to seven years to be fully realized. Basu et al. (2003) find that industries with faster growth of IT capital in the 1980s or early 1990s had faster MFP growth rates in the late 1990s, suggesting that firms in those industries were undertaking unobserved investments in organizational capital, which then paid off after a long lag in terms of measured productivity. More generally, innovations in IT appear to have led to co-invention and co-investment in other sectors, such as retail trade.

Other studies in this literature find additional reasons for a lag between the acquisition of new technology and the payoff in terms of output and productivity. For example, the benefits of IT used by one firm, such as successful new managerial ideas, are often adapted and adopted by other firms, a process that takes time (for a discussion, see, for example, Bresnahan, undated). For the latter firms, it may be easier and cheaper to innovate by watching what other firms are doing, rather than inventing some new organizational change themselves, because they learn by analyzing the experimentation, the successes, and, importantly, the mistakes of others.

These analyses make me fairly optimistic about productivity growth going forward. It seems unlikely that the business learning and reorganization that we hear about and that the academic literature emphasizes has suddenly disappeared. My sense is that busi-

nesses are still learning what new technologies can do for them.

Monetary policy

We know that with the federal funds rate at 2½%—only about 1% or a bit less above the inflation rate—the current policy stance remains accommodative. Over time, the degree of accommodation will have to diminish, with policy reverting toward so-called "neutral" for inflation to remain well contained. It's uncertain exactly what the neutral range is, but a common estimate is 3–5%. The FOMC has stated for some time that, with underlying inflation remaining low, policy accommodation can be removed at a pace that is likely to be measured. In fact, the Committee raised the rate by 25 basis points at each of the last six meetings. However, it should be obvious that the closer the actual rate gets to the neutral range, the more carefully the Committee will need to consider each successive increase. In other words, the pace of removing policy accommodation must, in reality, depend on how economic activity and inflation actually develop. Moreover, these developments themselves could affect the Committee's judgment concerning the momentum in aggregate demand or supply and thus the real federal funds rate corresponding to a neutral policy stance.

If the pace of economic activity accelerates and labor market slack erodes more quickly than expected—or if some of the upside risks to inflation materialize—it would probably be appropriate to remove accommodation more rapidly. If, alternatively, the expansion falters or we experience some of the downside inflation risks, there are likely to be more opportunities for the Committee to pause. Of course, the Committee could be confronted with more difficult choices if output growth and inflation moved in opposite directions. In any event, risks to both growth and inflation abound. However, I agree with the Committee's judgment, reiterated in its February 2 statement, that the upside and downside risks are currently balanced.

Janet L. Yellen
President and Chief Executive Officer

References

Basu, S., J. Fernald, N. Oulton, and S. Srinivasan. 2003. "The Case of the Missing Productivity Growth: Or, Does Information Technology Explain Why Productivity Accelerated in the United States but not the United Kingdom?" NBER Macroeconomics Annual.

Basu, S., J. Fernald, and M. Shapiro. 2001. "Productivity Growth in the 1990s: Technology, Utilization, or Adjustment?" *Carnegie-Rochester Conference Series on Public Policy* 55, pp. 117–165.

Bresnahan, T. Undated. "The Mechanisms of Information Technology's Contribution to Economic Growth." Prepared for presentation at the Saint-Gobain Centre for Economic Research.

Bresnahan, T., and M. Trajtenberg. 1995. "General Purpose Technologies: 'Engines of Growth?'" *Journal of Econometrics* 65(Special Issue, January) pp. 83–108.

Brynjolfsson, E., and L. Hitt. 2000. Beyond Computation: Information Technology, Organizational Transformation, and Business Performance. *Journal of Economic Perspectives* 14(4) pp. 23–48.

Brynjolfsson, E., and L. Hitt. 2003. "Computing Productivity: Firm-Level Evidence." Sloan Working Paper No. 4210-01, eBusiness@MIT working paper No. 139 (June).

David, P., and G. Wright. 2004. "General Purpose Technologies and Surges in Productivity: Historical Reflections on the Future of the ICT Revolution." Stanford University, Working Paper 04-008.

Helpman, E., and M. Trajtenberg. 1998. "Diffusion of General Purpose Technologies." In *General Purpose Technologies and Economic Growth*, ed. E. Helpman. Cambridge, MA: MIT Press.

Jorgenson, D., M. Ho, and K. Stiroh. 2004. "Will the U.S. Productivity Resurgence Continue?" FRB New York *Current Issues* (December) pp. 1–7.

Jorgenson, D., and K. Stiroh. 2000. "Raising the Speed Limit: U.S. Economic Growth in the Information Age." *Brookings Papers on Economic Activity* 1, pp. 125–211.

Oliner, S., and D. Sichel. 2000. "The Resurgence of Growth in the Late 1990s: Is Information Technology the Story?" *Journal of Economic Perspectives* 14, pp. 3–22.

Oliner, S., and D. Sichel. 2002. "Information Technology and Productivity: Where Are We Now and Where Are We Going?" FRB Atlanta *Economic Review* (Summer) pp. 15–44.

Walton, S., and J. Huey. 1992. *Sam Walton: Made In America.* New York: Bantam Books.

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