FRBSF ECONOMIC LETTER

The Outlook for Productivity Growth:
Symposium Summary

This Economic Letter *summarizes several papers presented at the symposium "The Outlook for Future Productivity Growth" hosted November 14, 2008, by the Federal Reserve Bank of San Francisco's Center for the Study of Innovation and Productivity (CSIP). The papers are listed at the end and most are available online at http://www.frbsf.org/csip/research/symposium200811.pdf*

The goal of the symposium was to bring together leading experts in the field of productivity growth to present their recent research. The papers varied in their methodologies but came to somewhat similar conclusions that productivity is poised to grow at about 2% over the next several years, a pace similar to the postwar average but below the rapid growth rates achieved from the mid-1990s through the mid-2000s.

An overview of productivity growth

Productivity measures the amount of output per unit of input. One of the more common productivity concepts is labor productivity, a measure of how much output is produced per unit of human labor, usually expressed in terms of output per hour. Often, the phrase "productivity growth" refers specifically to labor productivity, and that will be the case in this *Letter* unless otherwise noted.

Labor productivity growth receives a lot of attention for several reasons. The first is that rising productivity is key for increasing the standard of living. Another reason is that labor productivity growth is an important determinant of the rate of overall economic growth. Therefore, the ability to predict productivity gains helps fiscal and monetary authorities prepare the economic forecasts they need to set policy.

Forecasting labor productivity growth has proven difficult, however, in part because such increases fluctuate greatly over time. For example, Figure 1 shows the average annual growth in labor produc-

Figure 1
Average long-term labor productivity growth
Nonfarm business sector
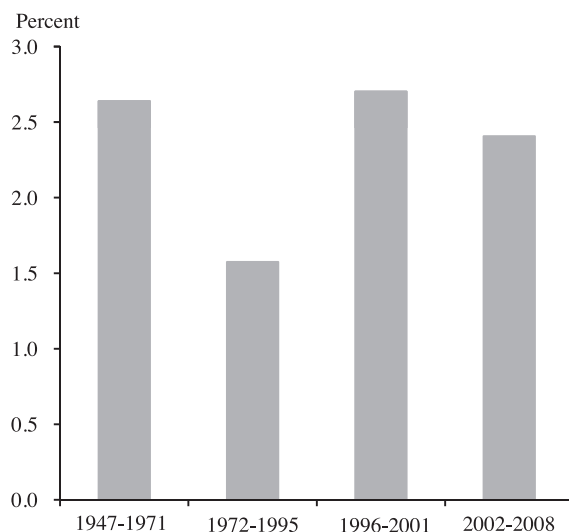
Source: Bureau of Labor Statistics.

tivity over several time periods. These productivity statistics are restricted to the nonfarm business sector, which makes up slightly more than three-quarters of all economic activity. For instance, from 1947 to 1972, labor productivity growth averaged 2.6% per year. A "productivity slowdown" began in the early 1970s, and from 1972 to 1995, productivity growth averaged only 1.6% per year. The cause of this sharp deceleration has been the subject of much debate and speculation.

Labor productivity growth accelerated in the mid-1990s and averaged 2.7% between 1996 and 2001. Many papers have been written about this productivity resurgence, often with a great emphasis placed on the role of the information technology (IT) revolution.

From 2002 to 2008, productivity growth averaged 2.4%. However, these average growth rates mask the extent to which growth fluctuated. As shown

in Figure 2, productivity growth can be quite volatile from year to year. For example, labor productivity growth averaged an extremely high 3.5% in the years 2002 to 2004 but slowed to an average of 1.4% over the period 2005 to 2007. More recently, productivity growth surged to 2.9% in 2008. A further complication is that productivity growth is often revised as better data become available. For instance, recent revisions lowered the estimates of average annual productivity growth by about ¼ percentage point from 2005 to 2007.

Modeling productivity growth

Given the difficulties in forecasting, the question remains: What is the outlook for future productivity growth? The papers presented at the symposium use different approaches for projecting future trends. Productivity growth depends on such factors as human capital (that is, the quality of the workforce, often measured by education) and the amount and types of physical capital, such as computers, motor vehicles, and buildings. Another important determinant is a variable known as total factor productivity (TFP), which gauges the efficiency of production, holding constant such inputs as labor and physical capital. For instance, if a factory becomes more productive by reorganizing its production line, but without changing its capital, then this would be an increase in TFP. Researchers have found that TFP plays a large role in overall productivity growth.

Several of the papers model productivity growth by developing complicated sets of equations to translate these factors into aggregate productivity forecasts. These sets of equations vary along many dimensions—including the number of sectors, the linkages between sectors, and judgments about how much emphasis should be placed on each factor—and each paper presents a different variation on this underlying model.

In an ambitious study, Jorgenson and Vu project not only productivity growth in the United States but also overall economic growth for over 100 countries. In previous work with a variety of coauthors, Jorgenson has emphasized the role of IT in productivity growth, particularly for understanding the U.S. increase in the mid-1990s. When thinking about how IT affects productivity, Jorgenson and Vu emphasize productivity growth within the IT sector itself (that is, how productive the U.S. is at manufacturing IT goods) and within sectors that use IT, such as the financial

Figure 2
Labor productivity
Nonfarm business sector, year-over-year percent change
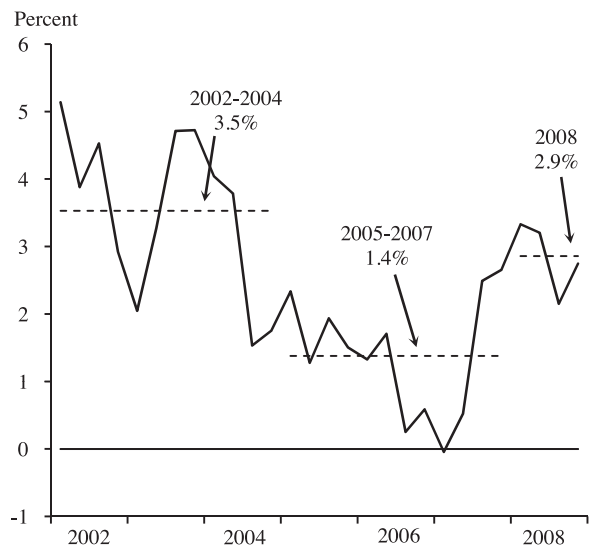
Source: Bureau of Labor Statistics.

services industry. An important assumption in their framework is the pace of technological change in the IT sector. According to several measures, technological progress in the IT sector appears to have accelerated beginning in the mid-1990s continuing through the early 2000s. This technological progress boosted labor productivity greatly in the computer, semiconductor, and communications-equipment industries. The authors then show that in the 2000s the strong rate of growth was sustained by fast increases in productivity in sectors of the economy that were heavy IT users, such as financial services. This analysis suggests that productivity growth depends on technological progress in the IT sector, the size of the IT-producing sector, and the extent to which IT is adopted in other sectors of the economy.

According to Jorgenson and Vu, U.S productivity growth should continue at about a 2 to 2.5% pace over the next five years, based on the assumption that technological progress in the IT sector will increase at a rate close to its historical average, not at the higher rate witnessed during the latter half of the 1990s. At the same time, productivity should grow rapidly in sectors such as health care and education that have not fully reaped the gains from IT.

Oliner and Sichel, in an update to Oliner, Sichel, and Stiroh (2007), also examine the relative im-

portance of various factors for past productivity growth. They emphasize what is known as "intangible" capital, which is widely acknowledged to play an important role in productivity but can be difficult to measure. When examining economic and productivity growth, economists often measure physical capital. But firms also possess intangible capital, which can include such assets as firm-specific organizational structure, brand equity, and knowledge created by research and development. Using measures of intangible capital based on the work of Corrado, Hulten, and Sichel (2006), Oliner and Sichel show that growth in intangible capital helped boost productivity growth in the latter half of the 1990s but had a dampening effect on productivity growth in the 2000s.

The authors employ a complicated steady-state model with five sectors, including four IT sectors and another sector representing the rest of nonfarm business. The model relies on roughly 30 parameters to project future productivity growth, yielding a wide range of estimates, but with a midpoint of around 2%, on par with those produced by Jorgenson and Vu. Oliner and Sichel's estimates depend on certain key assumptions, such as the rate of technological change in the IT sector and TFP growth in the remaining portion of the nonfarm business sector.

Basu and Fernald address not only productivity growth, but also a broader concept of potential output. Although the definition of potential output growth can vary, it is often meant to be the sum of the sustainable growth in labor, such as the growth that occurs through an increasing population, combined with productivity growth. Potential output is often taken into account when discussing monetary policy, for example, to identify when the economy is growing faster or slower than its "potential." The Basu-Fernald model has two sectors, one producing investment goods (capital) and another producing consumer goods. The authors demonstrate the importance of technological change that drives down the price of capital goods, akin to the discussions of the price of IT goods by both Oliner and Sichel, and Jorgenson and Vu. The Basu and Fernald model produces labor productivity growth of about 2% in equilibrium, close to projections in the other two papers.

More judgment-based views
of future productivity growth

Gordon also examines potential output growth by focusing specifically on productivity. He argues that the high rates of productivity growth from the mid-1990s to the mid-2000s were an extreme event not likely to be repeated, a view shared by the other authors. The share of IT investment in GDP was abnormally high in those years because of the synergies between computers and communications equipment as the Internet grew explosively. Additionally, Gordon argues that those IT applications that yield the greatest increases in productivity have already been implemented, and future advances in IT will likely yield lower efficiency gains than those seen in the past. He is less convinced than Jorgenson and Vu that the health and education sectors will experience large productivity gains in the future. He projects future productivity growth closer to the rates seen from 1987 to 1997 and 2004 to 2008, about 1.7%, slightly lower than the estimates provided in the other three papers.

Summary

Given its importance, it is not surprising that many sophisticated methods have evolved to forecast productivity growth. Authors at the "Outlook for Future Productivity Growth" symposium offered a consensus view centered around 2% productivity growth in the years ahead, with some arguing that 2% is conservative and others maintaining that 2% is optimistic.

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References

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Oliner, Stephen D., Daniel E. Sichel, and Kevin Stiroh. 2007. "Explaining a Productive Decade." *Brookings Papers on Economic Activity* 38(2007-1) pp. 81–152.

Symposium papers

Basu, Susanto, and John G. Fernald. "What Do We Know and Not Know About Potential Output?"

Gordon, Robert J. "The Slowest Potential Output Growth in U.S. History: Measurement and Interpretation."

Jorgenson, Dale, and Khuong M. Vu. "Projecting World Economic Growth: The Contribution of Information Technology."

Oliner, Stephen D., and Daniel E. Sichel. "Explaining a Productive Decade: An Update."

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