

Roger W Ferguson, Jr: The productivity experience of the United States: past, present, and future

Remarks by Mr Roger W Ferguson, Jr, Vice-Chairman of the Board of Governors of the US Federal Reserve System, at the US Embassy, The Hague, the Netherlands (via videoconference), 14 June 2001.

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Thank you for inviting me to address this group of distinguished business and government leaders from the Netherlands. As always, the views I will be expressing are my own and are not necessarily shared by other members of the Board of Governors or of the Federal Open Market Committee.

You have asked me to set the stage for our discussion with a brief review of the extraordinary performance of the U.S. economy during the second half of the 1990s. From 1995 to 1999, real gross domestic product grew, on average, about 4 percent per year. This pace was significantly above that in the previous five years, and you would have to go back to the 1960s to find even closely comparable periods of consistently robust economic expansion. In this environment, the unemployment rate fell to 4 percent, and the underlying rate of price inflation slowed, on net, despite very high rates of resource utilization. Even the most optimistic forecasters could not have anticipated such a favorable confluence of economic events.

Productivity growth and cost reductions

So how did this confluence of positive events come about? The dominant force of late appears to have been a significant increase in the structural rate of productivity growth. Output per hour in the nonfarm business sector – a conventional measure of productivity – increased at an annual rate of almost 3 percent between 1995 and 1999, roughly twice the average pace that had prevailed over the preceding two decades. The most important explanation for this increase in the rate of productivity growth, I suspect, is longer-term structural changes arising from the boom in capital spending and the revolution in information technology. Let me turn to the evidence on this point.

Technological change and productivity growth

Bob Solow – the MIT economist who won the Nobel Prize in economics for his work on the theory of economic growth – once quipped that you can see computers everywhere except in the productivity statistics. A few years ago that situation began to change, and we now have strong evidence that the faster productivity growth our economy has experienced is, in fact, due partly to the information technology revolution.

Research by Federal Reserve Board economists Steve Oliner and Dan Sichel sheds some light on the sources of this faster productivity growth. The high (and rising) levels of business investment raised the amount of capital per worker and thereby boosted productivity. About ½ percentage point of the increase in productivity growth over the 1995-99 period can be attributed to this so-called "capital deepening," most of which reflected greater spending by businesses on computers, software, and communications equipment. The balance of the pickup reflected other factors, including technological innovations in the actual production of computer hardware and semiconductors as well as better management – perhaps assisted by these high-tech investments – of the nation's capital and labor resources. Oliner and Sichel estimate that the consolidated influences of information technology investments account for about two-thirds of the acceleration in productivity since 1995. This research supports the view that fundamental changes are under way in our economy.

What's so special about this capital?

That trend productivity has picked up and that high-tech investments are the source of the acceleration are important facts, but by now they are not new observations. Perhaps at this stage it would be useful to explore in greater detail this positive "shock" to the ability of our economy to

produce goods and services. What is so special about computers and other information technologies that they can have such a strong influence on our economy?

Let me highlight three special characteristics of high-tech equipment. First, computers and communications equipment depreciate at a very rapid pace. The current best estimate is that computers probably depreciate about 30 percent annually, although that estimate might be low, while other equipment probably depreciates at a rate of less than 15 percent annually. Therefore, computers are retired, on average, after three years, and the useful life for other equipment is about seven years. Firms must invest in computers at a faster rate than they do in other forms of capital just to maintain a given level of the capital stock. The rapid replacement of high-tech capital means that technological progress becomes "embodied" in the capital stock at a faster rate than is the case for longer-lived assets.

The second feature of high-tech equipment that sets it apart from other classes of capital is the sensitivity of demand to fluctuations in the cost of capital. For decades, economists have debated the magnitude of cost-of-capital effects on traditional capital goods. A past consensus was that the cost-of-capital effect was small and difficult to identify empirically. But a somewhat different conclusion has arisen lately when the same basic models of investment are applied to spending on computers alone. The latest research suggests that the demand for computers is quite sensitive to movements in the cost of capital. The combination of an apparently high price elasticity and a rapid decline in relative computer prices – 20 percent per year over the past decade – likely led to the boom in high-tech investment.

A third characteristic of some high-tech investment is the magnitude of external or spillover effects that it generates. Some high-tech equipment generates benefits not only to the owner of the machine but to other agents in the economy as well. I am thinking in particular about so-called network effects—the observation that four computers networked together are more than twice as valuable as two.

Supporting structural changes

The technological changes inspired by investments in computers have enhanced the ability of businesses to reduce their operating expenses. In many industries, investments in information technologies have helped firms to cut back on the volume of inventories that they hold as a precaution against glitches in their supply chain or as a hedge against unexpected increases in aggregate demand. Product development costs have probably also been reduced through the use of better computer hardware and software, and new communications technologies have increased the speed with which firms can share information – both internally and with their customers and suppliers.

Moreover, given intense competition and the resulting lack of pricing leverage, ongoing programs to reduce costs have become a key part of corporate strategies to maintain or improve profit margins. The focus on cost reduction has worked to head off the development of inflationary pressures in this expansion.

Productivity and the current macroeconomic setting

As you are aware, the United States is experiencing a period of subpar growth. For the last three quarters, the annualized growth rate has been 1¼ percent, which is well below the trend rate of growth that many think our economy can sustain. During this period, productivity grew at an annual rate of about 2½ percent during the second half of 2000 and declined at an annual rate of 1¼ percent during the first quarter of this year. This slowing in productivity growth has led a number of observers to ask whether the acceleration of productivity of the latter part of the 1990s was a cyclical phenomenon, which was bound to come to an end when the economy slowed, or a structural one. Cyclical forces, such as the inability of businesses to add to their payrolls as rapidly as they would have liked in response to the rise in demand, probably played some role in these productivity gains. In addition, some enthusiasts made overly optimistic statements about the benefits of these newer technologies. However, I believe that the answer to the question is that most of the growth in productivity was structural, or trend, and not cyclical. We should also be mindful that even during the period between 1995 and 2000, productivity increases on a quarterly basis fluctuated; the trend increase that is so clear now did not progress unabated.

Two fundamental factors lead me to be cautiously optimistic that the much of the improvement in productivity is likely to be sustained. Notable advances in microprocessors, or semiconductors, have

been key to the enhanced productivity growth that we have experienced. Semiconductor industry experts indicate that the improvement in performance described by "Moore's Law," which predicts that the capacity of chips will double every 18 to 24 months, continues to hold true. My understanding from conversations with, and announcements by, leaders of the semiconductor industry is that later this year or early next year chip manufacturers plan to begin using larger wafers, allowing them to reduce costs by 30 percent. They also plan to adopt thinner circuit lines, which will allow the manufacturers to etch more transistors on a single chip.

A second reason to expect that much of the improvement in productivity growth is trend and not cyclical is that businesses indicate in their words and their deeds a commitment to improving productivity and maintaining costs by substituting capital, mainly IT capability, for labor. Overall growth of the economy has slowed to a pace between 1 percent and 2 percent at an annual rate for the most recent three quarters. However, investment in equipment and software has held at relatively high levels and is still sufficient to maintain relatively rapid growth of capital services. Moreover, end-use demand for communications services seems to remain strong. Since the early 1990s, the volume of data sent over networks in the United States has doubled each year, and there is no reason why that trend should abate.

The role of government policy

You will have noted that I have not mentioned the role of government policy in creating a higher rate of trend productivity growth. As a policymaker, I'd like to think that well-executed monetary and fiscal policies – each focused importantly on their respective long-run goals – played some role in creating economic conditions that fostered noninflationary economic growth. It is important to note, however, that although sound policy undoubtedly helped create the conditions for growth, macroeconomic policy cannot create growth itself. Only businesses and consumers can do that.

The economy of the United States has also benefited from past actions by the government to deregulate industries. The more intense focus on the removal of unnecessary government regulation started more than twenty years ago, during the Administration of President Ford, and gathered momentum during the Carter years. Deregulation has altered the business landscape by allowing – indeed forcing – businesses to focus more clearly on a more competitive marketplace with fewer constraints and increased flexibility. Again, as with macroeconomic policy, a policy of deregulating industry cannot create greater potential growth, but it can create the conditions under which such growth might occur.

A third way in which the government and the private sector together have assisted the process of technology adoption is by fostering a highly flexible system of education and training that focuses on both theoretical and practical skills. In part because of the rapid changes in technology, today's students and workers no longer expect to keep a job for life, and they are keenly aware that, throughout their careers, new skills will be required for advancement. Employers, too, recognize the value added by developing human capital to complement their fixed capital. Thus, the United States has experienced a demand for educational services catering to participants at various stages in life.

The demand for skill development and upgrading has been met in a number of ways – through on-the-job training, at so-called corporate universities, and in a range of public and private institutions of higher learning. Surveys conducted by the U.S. Department of Education show that participation in adult education programs expanded over the past decade, with 46 percent of all adults reportedly having been engaged in an adult education program in 1998-99. In part because much of the training is work-related, the rates of participation are positively related to formal educational attainment. The trend toward lifetime learning also shows through in the enrollment statistics for higher education. Today, more than 20 percent of the students in U.S. institutions of higher education are age 35 or older, up from less than 15 percent in 1985. In part, this increase has been fueled by the rising number of part-time students and of enrollees at two-year colleges. The latter group of schools, in particular, has lowered the cost of education for working students with night and weekend courses and with the development of contracts with employers to provide skill training. Another way to meet the needs for skill training in coming years will involve distance learning. In 1995, one-third of U.S. institutions of higher education reported some use of distance education – two-way or one-way videos, on-line connections, and the like. Another one-fourth planned to offer courses in the subsequent three years, with an eye to targeting workers seeking re-certification or skill updating.

In addition, the U.S. government influenced the increase in productivity growth by supporting the early development of what later became known as the Internet. In the mid- to late 1960s the Department of Defense's Advanced Research Projects Agency (ARPA) created a small network, ARPANET, which was intended to promote the sharing of computers among researchers in the United States. In 1969, ARPANET connected the first four university participants, and researchers on those campuses created the first hosts of the ARPANET. Over time, this process of linking computers evolved into the Internet. Importantly, much of the work of creating the standards that drove the early creation of the Internet was led by the private sector, both commercial and academic.

Finally, the federal government is reported to be an active user of the Internet to sell its products, including financial products. A recent study indicates that the government of the United States made \$3.6 billion of transactions over the web in 2000, which was significantly larger than the revenue of any web-based retailer.

The macroeconomic implications of faster productivity growth

Theory teaches us that the step-up in the growth rate of productivity will have important and pervasive implications for the performance of the economy. The main reason policymakers and economists are interested in the growth rate of productivity is that it is the crucial determinant of the rate of change in the general standard of living. If productivity increases 1 ½ percent per year on average, the standard of living will double about every 46 years – or about every two generations. On the other hand, if trend productivity growth steps up to 3 percent per year, the standard of living will double roughly every 23 years – or about every generation. That is certainly a difference worth studying and understanding, and at this stage our understanding is woefully incomplete.

A second important reason for being interested in the growth rate of productivity is that in the near term it affects both the supply of and demand for goods and services. On the supply side, the effect is fairly clear and immediate: An increase in trend productivity growth implies a more rapid pace of growth of the economy's productive capacity. In short, the economy can produce more, overall, without running up against production bottlenecks. Of course, this effect tends to cumulate over time, with progressively larger increases in supply coming as time goes by. Separately, businesses may respond to the increase in trend productivity growth by stepping up the pace of their investment in plant and equipment, further boosting the growth in the supply potential of the economy.

How does the increase in trend productivity growth play out on the demand side of the economy? One immediate effect is the step-up in capital expenditures that I just noted, as businesses perceive and react to new profit opportunities. In addition, stock market investors will react to the pickup in productivity growth by looking ahead, recognizing the improved prospects for future earnings, and bidding up equity prices today. The run-up in equity prices implies a reduction in the cost of capital for businesses, which could support a further increase in investment demand, especially on the part of firms that rely on this market for at least part of their funding.

The increase in stock market wealth will also operate through the household sector. As you know, economists often speak of the "wealth effect." Econometric modeling indicates that consumers eventually tend to raise the level of their spending by approximately 3 to 5 cents for every incremental dollar of wealth. Given changes in stock market wealth as large as the ones we have seen recently, this wealth effect can have a noticeable effect on consumption and macroeconomic performance. To take the most prominent example, the wealth effect is the most important reason why the personal saving rate in the United States has fallen from roughly 8 percent in 1990 to -1 percent in the first quarter of this year. And to put a rough number on the impact on aggregate activity more recently, simulations by the Board staff using our econometric model of the economy suggest that wealth generated in the equity markets over the past four years added about 1 percentage point to the growth rate of real GDP.

Overall, the stock market, working through the spending decisions of both households and businesses, will act to bring forward the demand effects of the improved outlook for supply, potentially even pushing demand up ahead of the increase in supply.

It is important to emphasize that higher productivity growth translates into higher real income growth for employees. This added income is seen most clearly in the higher wages paid to that growing number of workers whose cash compensation is tied to company performance, either directly or through stock options. But real incomes should increase even for workers whose compensation is not

directly linked to company performance, as profitable business opportunities bolster the demand for scarce labor.

Conclusion

Obviously the history of the productivity surprise in the United States is a long and complex one. Indeed, it is premature to write the entire story. But, the role of the Federal Reserve in this saga will continue unchanged. We have been given the responsibility to provide the monetary conditions that will promote the maximum sustainable growth in output. We will continue to perform that duty.