The New Economy: Post Mortem or Second Wind?

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The US economic now seems poised for economic recovery, but questions remain about the strength and nature of that recovery. The glory days of GDP growth over five percent a year are gone. Data revisions scaled back the view of how strong growth had been in the late 1990s, and by mid-2000 a growth slowdown had started that turned into recession in 2001. Many economists, including myself, had hailed the arrival of a new economy in the late 1990s, driven by faster productivity growth and lower inflation and unemployment. But with the high-tech sector in a slump, the new economy seemed more fragile and less substantial.

This paper examines the latest evidence about the trend rate of labor productivity growth in the non-farm business sector of the US economy. This is the key economic variable that will determine the rate of potential GDP growth, how fast living standards increase, and will influence the economy's ability to operate with low inflation and unemployment. Although recognizing the substantial uncertainty around predictions of productivity, I will argue that strong productivity growth is likely to resume with economic recovery. The productivity trend remains much faster than the sluggish growth of the 1970s and 1980s, although trend growth may not achieve quite the rate of the late 1990s. The new economy will get a second wind.

The pace of productivity growth has tremendous implications for macroeconomic policy, and the history of the last three decades is filled with misjudgments of productivity growth. The slowdown of productivity growth in the early 1970 was not recognized quickly and this error contributed to policy choices that worsened the inflation problem of that decade. In the 1980s, policymakers argued that tax cuts would induce faster productivity growth and developed overoptimistic budget predictions based on this view. In the mid-1990s, the Federal Reserve correctly perceived that trend productivity growth had increased and adopted a monetary policy that accommodated faster GDP growth. However, budget planners over this period consistently underestimated tax receipts and the improvement in the budget situation. Going forward, the fiscal outlook and the prospect of future budget deficits or surpluses depend heavily on the labor productivity trend over the next ten years.

Can Growth Accounting Track the Shifting Productivity Trends?

The precise timing of shifts in the trend rate of productivity growth is not known, but I will follow the standard productivity literature by using growth accounting to evaluate the sources of growth prior to 1973; from 1973 to 1995; and from 1995 to 2000.[1] Growth accounting uses the framework of a neoclassical production function to estimate the contributions to nonfarm business output per hour coming from increases in capital per hour worked, labor quality and multifactor productivity (MFP), with the last being estimated as a residual. Table 1 gives the growth accounting estimates made by the Bureau of Labor Statistics (BLS) covering the periods 1948-73 and 1973-95. And it shows the contributions of capital services and labor quality changed little or not at all between the two time periods. The slowdown in labor productivity growth that took place after 1973 is matched by an equal decline in the unexplained residual item of multifactor productivity growth.

But although the overall contribution of capital services to growth in output per hour barely changed, the composition of these capital services shifted substantially. As table 1 shows, information technology capital accumulation became more important and all other types of capital less important. In this period economists were puzzled as to why productivity growth was so slow despite widespread use of information technology. Neither this growth framework nor the broader literature on productivity has yet produced a satisfactory accounting of the 1970s growth slowdown.

Can growth accounting capture the pick-up in productivity growth after 1995? Table 2 shows three estimates of the decomposition of the increase of productivity growth after 1995. For each estimate, the table takes the growth accounting decomposition of the level and sources of growth for 1995-2000 and then subtracts the level and sources of growth for 1973-95. The first column updates the results of Steven Oliner and Daniel Sichel (2000)[2], the second column updates the estimates reported in the *Economic Report of the President* (Council of Economic Advisers 2001),[3] and the third is from Dale Jorgenson, Mun Ho and Kevin Stiroh (2001). The results differ from those previously available largely because there was a major downward revision of the GDP and hence productivity data made in summer 2001. (Much of the revision came when the estimates of software investment were revised down.)

According to the results in the first and third columns, the speed-up in labor productivity growth after 1995 is largely accounted for by an information technology story. The rapid accumulation of information technology capital provided a large boost to labor productivity, more than offsetting the slowing of the contribution of "other capital." There was also a boost from faster multifactor productivity within the information technology sector. Of course, this still means that a change in output per hour is assigned to a multifactor productivity residual effect, but this case is much less mysterious than the traditional multifactor productivity residual. It is well known that the computer and semiconductor industries increased the rate of introduction of new generations of chips as a result of an increased pace of technological advance and intense competitive pressure.

Both studies also find a remaining step-up in "other multifactor productivity," but neither study makes any adjustment for the business cycle. Productivity is pro-cyclical, so the economic boom of the late 1990s may have pushed up productivity growth. If the mystery component of "other multifactor productivity" can be accounted for by the business cycle, as Robert Gordon has suggested,[4] then the whole acceleration in productivity growth after 1995 is explained--or at least can be easily described. Gordon argues that, after adjusting for cyclical effects, faster labor productivity growth was solely the result of faster multifactor productivity in the information technology sector. This added directly to productivity growth and the resulting decline in the price of information technology capital induced rapid capital accumulation that added to labor productivity in the rest of the economy.

The estimates based on the approach from the 2001 *Economic Report* give a picture that is partly the same and partly different. In this analysis, the combined impact of increased information technology capital accumulation and increased multifactor productivity in the computer sector is also large. But this approach finds a larger overall acceleration of productivity growth and a smaller estimate of the direct impact of the information technology sector. As a result, about half of the overall acceleration in labor productivity comes from the residual term of increased multifactor productivity growth in the part of the economy that does not produce computers and semiconductors. These estimates suggest that the faster productivity growth after 1995 included a partial reversal of the unexplained collapse of multifactor productivity growth that took place after 1973.[5] This unexplained surge in "other multifactor productivity" after 1995 may be quite independent of advances in information technology.

These results raise a narrow question and a broader one. The narrow question is: Why do the three studies differ? The broader question is: Are there reasons to question whether the growth accounting approach is answering the right question about the rise in productivity?

On the narrow question, the three studies in table 2 differ for two basic reasons. One reason is that the studies use different bases for estimating the rise in output per hour. Oliner and Sichel base their nonfarm business productivity growth on only the product side of the national income accounts. The *Economic Report* averaged the income and product figures from the accounts, both valid estimators of output, an approach that makes the acceleration of labor productivity larger, because estimated income grew more rapidly than estimated production. Jorgenson, Ho, and Stiroh apply their growth accounting to a broader measure of output, including the farm sector, and estimated output and inputs associated with consumer durables and owner-occupied housing. The second reason for differences across the three studies is that they estimate the contribution of the information technology sector to multifactor productivity differently. Oliner and Sichel measure multifactor productivity in the computer and semiconductor industries and use this to estimate the contribution of the two industries to total multifactor productivity. In the *Economic Report* decomposition, productivity growth in the nonfarm business sector is calculated under the assumption that computer prices changed at the same rate as all other prices. This approach takes out the impact of the productivity growth in the computer sector and its supplying industries (notably semiconductors). Jorgenson, Ho, and Stiroh estimate the contribution of computer multifactor productivity in the same way as the *Economic Report*, but they include software and communications equipment as well as computers. These differences in methodology explain the differences in results, although it is puzzling why the Oliner and Sichel and *Economic Report* estimates are so far apart.

As to the broader question, there are four reasons for concern that the growth accounting approach might provide a misleading answer to thinking about the productivity resurgence of the late 1990s.

First, the methodology used by the Bureau of Labor Statistics for estimating the rise in investment in information technology has raised questions. The amount spent on investment in computers has risen some, but the quality and capability of these computers has risen dramatically. The BLS uses a hedonic method to take into account the rise in quality of computers, and the rise in computer investment is substantially due to this adjustment for quality. Some economists fear that the BLS price deflators for information technology are overdoing the effective rate of price decline. After all, current personal computers have greater functionality than those of five years ago, but the basic office tasks of word processing and spreadsheet analysis are not carried out all that differently. However, while various technical issues that have been raised about the Bureau of Labor Statistics methodology, it is not easy to overturn the basic conclusion that there was rapid growth of real information technology capital. Alternative price indexes typically show price declines just as fast as those the BLS estimates.

Second, the coincident timing of the surge in productivity and in investment in information technology is a key reason for thinking the latter caused the former, but correlation does not determine the direction of causality or even whether a causal relation exists. Instead of a surge in information technology causing the productivity surge, the reverse causality is also possible. With strong demand and strong productivity in the mid-1990s, profitability was high and the stock market was experiencing a massive boom, so there was plenty of corporate cash flow and cheap financing available for investment.

Great rewards were promised from information technology investment. Chief information officers had the upper hand in struggles with chief financial Officers. Maybe, to a degree, the broader economic boom of the late 1990s and groupthink approach to investment caused the explosion of information technology investment. The investment bubble burst in 2001 when companies realized they had already overinvested in information technology.

Third, a big part of the new economy story has involved intangible knowledge capital developed by companies. The stock market, despite its decline from the peaks reached in early 2000, still says the value of US corporations is much higher than the replacement cost of their physical assets (Hall 2001). If the economy has experienced a major shift to intangible capital accumulation, this change would throw off the growth accounting exercise. In current accounting, much of the investment in intangible capital like organizational skills, production skills, or specific worker training is treated as a current expense. If intangible capital were measured accurately, this amount would be categorized instead as reinvested earnings--which means that both earnings and investment would be higher. Moreover, to the extent that the creation and accumulation of intangible capital is being missed, the effective corporate capital stock is understated, which means that the sources of productivity are likely misstated as well. The growth accounting framework of physical capital and human capital, even when augmented with measures of research and development capital, fails to include the intangible capital that seems to matter a great deal to modern businesses.

To determine the importance of these issues with the growth accounting approach to productivity, we can look at industry data and case studies. If the growth accounting analysis is fundamentally correct, then the productivity acceleration should be showing up in the industries that invested more heavily in the information technology capital.

Industry Data and Case Studies: How Much More Do They Explain?

Bureau of Economic Analysis data available prior to 2000 had suggested little or no acceleration of labor productivity in service industries, including those that were major purchasers of IT capital. This had suggested that IT capital was being used inefficiently, or in ways that did not increase measured productivity. That picture changed in 2000 when BEA made available new data on output by industry, incorporating new price deflators for many service industries. These data showed, an acceleration of labor productivity after 1995 in the service (non-goods producing) sector. Table 3 shows estimates of labor productivity growth by industry from 1989-95 and 1995-2000, based on the most recent BEA data from November 2001. Each industry's output reflects its value added and labor input is measured by the number of full-time equivalent employees.[6] The 2001 data differ from the 2000 data in ways that are important for some industries, but the broad picture remains the same. Table 3 confirms the increase in labor productivity growth occurred in a range of industries, including service industries as well as durable goods manufacturing.

The resurgence of productivity was especially strong in a few industries.[7] For example, there was a surge in productivity in wholesale and retail trade and in the finance sector. A more detailed breakdown by industry than is shown in table 3 reveals that much of the productivity acceleration in finance is driven by a small part of the industry--security and commodity brokers--where measures of productivity are questionable. But depository institutions (banks) now show a solid acceleration of labor productivity of 1.22 percent a year, in contrast to earlier estimates. Within durable goods manufacturing, a more detailed breakdown shows that a large portion of the gain was due to computers and semiconductors.

Nordhaus (2001) showed that in looking at the sources of productivity gains, both within-industry effects and mix effects can be important. For example, the telecommunications industry contributed to the overall productivity acceleration even though it did not accelerate its own productivity growth. It did so because the telecommunications industry already has an above-average level of labor productivity, so when the industry expanded its share of aggregate employment, it pulled up the average level of labor productivity.

What about the link from information technology capital to productivity? Table 3 reports, in the last two rows, the results of a simple exercise. The industries were divided into those that were more information technology-intensive and those that were less so, measured by information technology capital in 1995 relative to value added. The information technology-intensive group had much faster productivity growth throughout and a larger productivity acceleration.

Stiroh (2001) has gone well beyond this calculation. He uses gross output per FTE as his labor productivity measure (table 3 reports value added per FTE) and his strongest results come from defining the intensity of information technology based on the share of information technology capital services in total capital services for each industry in 1995. If that proportion is high, he argues (p. 10), it "identifies industries expending tangible investment on information technology and reallocating assets toward high-tech assets." He finds that industries that are above the median in their information technology intensity, by his measure, have much larger increases in labor productivity after 1995. His findings are robust to the exclusion outliers and certain other tests, however, one place that gives weaker results is when information technology intensity in 1995 is calculated as information technology services per full-time equivalent employee.

The McKinsey Global Institute (2001) recently completed an analysis of the acceleration in U.S. productivity growth. The main part of this study consisted of case studies, which I will discuss later, but it also offered an alternative regression analysis. Using value added as the measure of industry output, McKinsey finds that if each industry is considered as one observation, there is almost no correlation between the acceleration in labor productivity growth after 1995 and the surge in information technology capital per employee across industries. On the other hand, if each industry is weighted by employment, there is a positive and significant correlation.[8] The study argued further the industries that account for a relatively large share of the acceleration in productivity account for a much smaller fraction of the surge in accumulation of information technology capital. McKinsey argues that this finding undermines the information technology/productivity link.

No statistical evidence can be definitive, and the results discussed here are quite mixed. But there is a rather strong case for saying an important connection exists between information technology and the productivity acceleration. How close that connection is and exactly how it works is not certain. Case study evidence may provide more information.

The main contribution of the McKinsey Global Institute (2001) study was a series of eight industry case studies, looking in detail at what had happened to productivity in the 1990s. Six industries that had contributed disproportionately to the productivity acceleration were included, wholesale and retail trade, computers and semiconductors, telecommunications and securities. Retail banking and hotels were included as two industries that had invested heavily in information technology but had experienced no surge in productivity (McKinsey constructed its own banking productivity measure. As noted, the latest BEA data now find increased growth in banking productivity after 1995).

Based on these case studies, the report concluded that competitive pressure was the main driver of the productivity acceleration, by forcing improvements in business operations. In the retail trade case, they found that Wal-Mart played a pivotal role, because its large size and high productivity put competitive pressure on other retailers. In the semiconductor industry, Intel came under competitive pressure from AMD and the result was an accelerated decline in the price of microprocessors that translated into productivity acceleration in this industry. Conversely, the study found that hotels and retail banks were facing weaker competitive pressure and were able to earn profits without pushing as hard to improve efficiency.

The case studies also make clear that productivity improvements come from a variety of sources, not just from information technology. Improvements in retail productivity came about through organizational improvements, the advantages of large-scale "big box" stores, and by a shift to higher value goods associated with the growth in the number of high-income consumers.

The relation between information technology and productivity revealed in the case studies is complex. In some cases, investments in information technology yielded little payoff. Banks invested very heavily in powerful computers that were not really needed for the tasks that most bank employees were performing. In other cases, information technology contributed substantially to productivity in some cases. The telecommunications industry is a direct application of information technology. The Internet allowed much higher productivity in the securities industry, and information technology is used heavily in the giant wholesale and retail sectors. Wal-Mart, for example, has relied on information technology to operate its efficient supply chain. Indeed, Wal-Mart operates the largest commercial database in the world. In still other cases, information technology systems developed prior to 1995 were vital facilitators of productivity improvements after 1995. This finding suggests some of the impact of the surge in spending after 1995 may show up as faster growth in future years.

Any industry-level analysis of productivity has its pitfalls. Industry data can be difficult to interpret. For example, consider the business services industry. This large and growing industry is a large investor in information technology. But the business service industry has no serious measure of real output or productivity, so it is very hard to know the extent to which the industry or its information technology may be contributing to the acceleration of productivity in other industries.

Another difficulty in drawing strong conclusions about the link from information technology to productivity from the industry data results from the fact that a main driver of the surge in information technology capital was the accelerated price decline that encouraged all businesses to invest more. However, some industries were subject to unrelated productivity shocks and some to swings in measured productivity resulting from vagaries in the measurement process. Without controls for these "other factors" it is hard to separate out the impact of greater or lesser amounts of information technology capital accumulation.

Despite these difficulties, the industry data and case studies are valuable. The productivity acceleration, even though it is concentrated in a few industries, does seem to have spread outside the narrow sector of producing information technology. There are signs that industries using information technology have done relatively well in productivity growth, but clearly other factors are also important. It is hard to look at the industry data and the detailed case studies and conclude the productivity acceleration was only driven by information technology.

Other Indicators of Structural Change: What Do They Show?

A number of macroeconomic indicators are related to productivity, although they do not rely on productivity data directly. In this section, I will discuss three aspects of US macroeconomic performance in the 1990s that give perspective on the likelihood that the economy experienced a structural change in productivity growth in the mid-1990s: wages and employment; stock market values, and the inflow of foreign capital.

Rising Real Wages and Low Unemployment

The strong economic performance and increased productivity growth of the late 1990s changed the path of workers' real wages. Average hourly earnings, adjusted for consumer prices, declined by 0.5 percent a year from 1978-95 and then increased at 2.0 percent a year from 1995-2000, a difference of 2.5 percent a year. Other measures of payments to workers confirm this general finding. The corresponding acceleration of real consumption wages was 1.9 percent for compensation per hour and 1.3 percent for the employment cost index.[9]

Some part of this rise in wages was likely the result of the very strong labor demand in the period, but probably not a large part, because average real wages are not strongly pro-cyclical. Moreover, real wages grew even faster from the third quarter of 2000 to the third quarter of 2001 from than 1995-2000, using any of the three measures of wages. So the pattern of solid real consumption wage performance has continued even when demand weakened.

Based on the experience of the 1970s and 1980s, estimates of the non-accelerating rate of unemployment (NAIRU) for the United States were 6 to 6.5 percent a year. The experience of the 1980s expansion seemed to confirm such estimates, since wage and price inflation started to worsen as the unemployment rate fell below about 6 percent. However, unemployment fell below 6 percent in September of 1994 and moved to around 4 percent. There was no sign of accelerating inflation until 2000. One possible explanation of the reduced NAIRU is that there has been a structural shift in the labor market and one sign of this is that the Beveridge curve has shifted in (there has been a decrease in the unemployment rate associated with any given level of vacancies). An important part of the explanation, however, is to link the improvement in the inflation/unemployment tradeoff to the change in the path of real wages (for example, Ball and Moffitt, 2001). Nominal wage changes do not increase immediately when productivity growth improves, and so unit costs of production fall relative to trend and inflation is held down (this effect is likely to be largely temporary).

The experience of the labor market suggests a structural change in the US economy in the mid-1990s using statistics that are somewhat independent of specific productivity numbers. The hedonic price indexes for computers have changed the measured rate of productivity growth, by making output of computers larger than it otherwise would have been, but these prices have very little impact on consumer prices and thus cannot explain why real wages have increased or why unemployment stayed so low for so long.

Market Value of Corporations

The ratio of the market value (stocks and bonds) of corporations to the replacement cost of their capital was roughly unity in 1990; that is, stock prices could be viewed as determined by the tangible capital held by corporations. However, this ratio of market value to the replacement value of tangible capital nearly tripled from 1990 to 1999 (Hall 2001). One interpretation of this increase is that stocks were valued by different criteria at the beginning and end of the 1990s. The risk premium perceived for stocks may have declined. Moreover, stock prices had reached unsustainable levels in 1999 (the end point of Hall's 2001 calculation), and have fallen since then. Technology stocks certainly went through a bubble, and the overall stock market may also have experienced an increase that was not driven by fundamentals.

The surprising thing about the stock market, however, is not that it has weakened from its extreme highs, but how robust it has been. Despite the economic downturn and the uncertainty induced by the September 11, 2001, attacks, stock price indexes remain very high. In contrast to 1990, stock markets apparently have a persistent belief that corporations now hold valuable intangible capital assets.

Wall Street pays some attention to productivity data, but not a lot. Market valuations are based on expectations about profits. Back in the mid-1990s before clear signs of improved productivity had emerged in macroeconomic data, Wall Street analysts started to increased their expected profit growth figures. Stock market valuations, which had been rising strongly since the mid-1980s, started to rise even faster. History may look back at the current period as one where the market turned out to be dramatically overvalued. But for the present, Wall Street seems convinced that there is still strong profit growth potential in the corporate sector. It retains the belief that the economy has experienced a structural change.

Capital Inflow and the Dollar

The very large US current account deficits in recent years have been financed by extremely large net foreign purchases of US assets (as reported by the Federal Reserve). As a result of the increased foreign demand for US investment opportunities, the portfolio of assets held by foreigners has shifted into equities and direct ownership of US companies. The desire of foreign companies to buy into the US economy does not mean they are just buying high-tech or information technology companies. The new economy in the United States is apparently making traditional industries attractive, too. The breakdown of direct foreign investment by industry shows increased investment in high-tech sectors such as electronic components, computer services and telecom. But a large increase in investment also spread throughout a range of different industries, including traditional manufacturing industries and heavy information technology users such as insurance and financial services.[10] Equity investment may have been more heavily skewed to the tech sector, but I do not have a breakdown of that capital inflow.

When the US economy started to slow and then move into recession, one might have expected the value of the US dollar to fall as the appetite for US assets declined. Instead, the US dollar has remained very high against both the euro and the yen. The macroeconomic weakness in Japan makes the continued weakness of the yen somewhat understandable, but the continued strength of the dollar against the euro and other currencies remains a surprise. It appears the rest of the world continues to believe that the prospects for asset returns are stronger in the United States than in the other main industrial countries. The inflow of capital and the strength of the dollar can be seen as another piece of evidence supporting the view of a structural change in the US economy.

An Explanation for the Improvement in Productivity Growth?

Is there some compromise or consensus explanation of the improvement in productivity growth? It seems clear that information technology is one major reason for the productivity acceleration. But for a number of reasons already laid out in the discussion so far, I believe that information technology was not the sole reason for the productivity shift after 1995.

First, I prefer the growth accounting framework used in the 2001 *Economic Report*, which makes use of both income and product data and indicates a significant increase in multifactor productivity growth after 1995 outside the information technology hardware sector. Second, the growth accounting framework itself may overstate the causal link from information technology capital to growth, if there is reverse causality. Third, the case studies provide evidence that innovative business practices, in some cases unrelated to information technology, contributed to faster productivity. Fourth, the magnitude of the acceleration in real *consumption* wages is too great to be accounted for by faster productivity growth in consumer goods and services industries driven only by the accumulation of information technology capital (see Baily 2001). Finally, the failure of the growth accounting framework to explain the productivity slowdown in the 1970s leaves some residual skepticism about its ability to fully capture the speed up.

Whether the improved economic performance of the 1990s was wholly driven by information technology or only partly so, the question remains as to why the pace of innovation accelerated in the

1990s. What was it about economic conditions in the 1990s that fostered stronger economic performance?

From a historical perspective, the rapid productivity growth of the 1950s and 1960s was apparently generated by a pool of innovations and investments available to be exploited after World War II. After the easier ways to raise performance had already been found, a productivity lull occurred. During the 1970s and 1980s, there was an ongoing push of economic change and innovation, the information technology revolution was in the making and old capital was being destroyed, but the benefits were not yet showing up, at least in measured productivity. In the 1990s, a new flow of productivity-enhancing innovations came on stream and the economic environment was favorable, so that there has been a return to faster productivity growth.

This quick sketch of broad patterns is far from conclusive. However, one can see some of the reasons why the environment in the US economy in the 1990s was favorable for rapid innovation and diffusion of innovation, both information technology-related and otherwise. Innovation in information technology is driven by the demand for improved technologies in the industries that use such technology. The 1990s economy experienced heightened competition in an increasingly deregulated economy with strong international competition. In particular, US service industries, which often compete on a global scale, sought out new technologies to improve their productivity. If the new economy were the result of a random surge in innovation, then all countries should have had similar changes together. After all, the new technologies are available globally. In practice, the US economy has been well ahead of most of the industrial countries and a reason for this is that the United States has highly competitive markets in the industries that are using information technology.

High competitive intensity in a market raises productivity growth for three reasons. First, it will increase static efficiency and drive out X-inefficiency, and this will raise productivity growth for some period of time. Second, research on individual firms and establishments reveals that productivity growth over extended periods is driven by the expansion of high productivity enterprises and the contraction or closure of low productivity enterprises, a process that is sustained by competition. Third, competition encourages the adoption of innovation as companies are forced to change in order to survive.

Another reason the 1990s were a particularly favorable time is because rapid advances in computing power, software and communications capabilities formed a set of powerful complementary innovations. When complementary innovations occur, the effects can be much greater than the sum of the impacts of each innovation separately.

The policy environment contributed to a nourishing environment for growth and innovation. Policies to deregulate industries and to maintain domestic competition and increase international competition have been stressed. Funds have been provided to support basic research and education. The mix of monetary and fiscal policy has kept interest rates low and encouraged investment.

Future Prospects

On the basis that information technology is an important reason for faster productivity growth in the 1990s but not the only reason: How much of the post-1995 growth surge will continue? The basic drivers of the productivity acceleration--rapid improvements in information technology, strong competition and the impact of globalization--are in place for a continuation of growth. Looking ahead, the Internet is likely to add to productivity, although it was not a major factor in the mid-1990s growth. Litan and Rivlin (2001) estimate that the Internet will add about between 0.25 and 0.5 percentage point per year to future growth. The "other" indicators of a new economy--the robust stock market and the strong dollar--are still signaling that markets expect continued high returns to capital, which will contribute to growth.

The most recent productivity data also suggest a strong productivity growth trend. Despite a weak economy, labor productivity over the six quarters from mid-2000 to the end of 2001 grew at about 1.8 percent at an annual rate. Non-farm output declined in the second, third and fourth quarters of 2001--and yet labor productivity growth was not only positive in all three quarters, it grew at an annual rate of 2.2 percent. This pattern of negative hours and output in non-farm business, and positive productivity over two or three quarters, has never occurred before over the post-World War II period. It may be that employers adjusted labor input more quickly in this recession than in prior episodes, making it hard to read the underlying productivity trend. Moreover, recent data are often revised. However, with those caveats understood, such strong labor productivity growth during a down part of the business cycle, is quite consistent with a continuation of the pace of productivity growth rate observed 1995-2000.

Pushing in a more conservative direction is the possibility that some portion (as much as 0.5 percent a year) of the rapid productivity growth 1995-2000 was the result of temporary or cyclical factors, perhaps tied to the boom in financial markets or the impact on retailing of the surge of consumer spending. This leads me to give 2.2 to 2.7 as the likely range of values for the current labor productivity trend.[11]

If in fact the productivity revival came mostly from the surge in productivity growth within the computer sector, plus some cyclical component, then there is a case for a more pessimistic view of future productivity growth. The huge rate of improvement in computer technology prices of the late 1990s (that is, the effective fall in the price of computing power) may not continue indefinitely. Moreover, investment in information technology capital may face diminishing returns. The collapse of investment in 2001 year seems consistent with this view, and has caused a large adjustment in some commercial forecasters' predictions of productivity growth. The private forecasting firm Macroeconomic

Advisers (2002), for example, predicted labor productivity growth to be fairly strong in the second half of 2002, with a cyclical bounce, but to be only 1.6 percent for 2003 (the average of the four predicted quarterly increases), because of the collapse of information technology investment. Using what they call "conservative" assumptions, Oliner and Sichel (2002) argue that the productivity growth trend could fall slightly below 2 percent.

However, even if one believes that most of the productivity growth in the mid-1990s was driven by information technology, one need not reach a pessimistic conclusion. Information technology prices, so far, are still falling rapidly. For example, a *New York Times* story recently argued that the rate of increase in chip speed is actually increasing (Markoff 2002). Even if the declines in the price of computing power were to moderate, the share of information technology capital in total capital has been rising rapidly. When a fast-growing component of investment like information technology makes up a larger share of overall capital investment, as Daniel Sichel has pointed out, the effect is to push up the overall rate of real capital accumulation.

On these grounds, several of those who view the productivity revival of the mid-1990s as being driven by information technology are rather optimistic about the future prospects for labor productivity. For example, Jorgenson, Ho, and Stiroh (2001) anticipate a productivity growth rate of 2.24 percent a year, not much slower than in the late 1990s. (Their estimated range for the trend is 1.33 percent to 2.98 percent.) Oliner and Sichel (2002) project as much 2¾ percent as the future productivity trend under more optimistic assumptions. Macroeconomic Advisers is also more optimistic beyond 2003, when it predicts a resumption of hearty investment spending and a productivity trend of well over 2 percent.

The McKinsey Global Institute (2001), which argued that information technology played only a secondary role, made a forecast of future labor productivity growth based upon industry case studies. It estimated labor productivity growth at 2 percent a year going forward, with a range of 1.6 to 2.5 percent.

A Second Wind

Despite different perceptions of the drivers of productivity, the literature I have reviewed above generally concludes that the productivity trend for the near-term is likely to be in the range of 2-2¾ percent per year. Productivity growth at that level will increase wages and living standards. When combined with the increase in hours worked, it will allow potential GDP growth to expand at a rate of 3.0 to 3.7 percent a year. Growth of GDP in this range is slower than the rate of over 4 percent achieved 1997-2000, but is still very strong.

Should the improvement in economic performance be described as having created a new economy? There are reasons to be skeptical about the term "new economy." After all, the economy, like a large oil tanker, does not change direction or transform itself quickly. Much employment and output today is similar to what it was in the early 1990s. We also learned in 2001 that the business cycle is still alive. In fact, the current recession, which involves large swings in inventory and equipment investment, looks rather like the old-style recessions of the period after World War II. Despite these concerns, I use the term new economy, because it captures the idea of an important shift in the US economy that took place in the 1990s. And with productivity growth expected to remain strong, the new economy can be described as getting a second wind.

The continuation of solid productivity growth in the next few years, occurring in industries that produce consumer goods and services as well as those making investment goods, implies real wages should continue to grow more rapidly going forward than they did during the post-1973 period. However, there is no guarantee that the unemployment will stay as low as it did in the later 1990s. I would expect some persistent benefit in lower unemployment coming from faster productivity growth, largely because unemployment was generally lower in the 1950s and 1960s when real wage growth was rapid than in the 1970s and 1980s when growth in real wages was weak. But given the wide disagreements in the profession over the nature or even existence of tradeoffs between inflation and unemployment, there is no definitive evidence to prove this view.

Getting a second wind does not mean a return to the economic euphoria of the late 1990s.

Policy Implications

Public policy to encourage productivity growth is multidimensional and often indirect, in the sense that is it often better aimed at creating economic conditions and incentives that encourage agents in the economy to increase productivity, rather than having government seek to increase productivity in any direct way.

The high level of competitive intensity in the US economy has been important in stimulating innovation in both the high-tech sector and in the "old economy" traditional industries. Policy should sustain this competitive pressure by maintaining open international markets and avoiding protectionist measures. Maintaining competitive intensity also means pursuing an antitrust policy that allows industry change to take place, including consolidations where necessary, but that resists anticompetitive actions by dominant players that could discourage innovation. Antitrust policy is not just about improving static efficiency, it is also about maintaining the competitive environment for innovation and productivity growth.

Regulatory policy is also important for productivity growth. The deregulation movement of the 1970s and 1980s, for example, surely contributed to the flowering of innovation in the 1990s. However, good regulatory policy is not just a matter of getting rid of regulations. It should set the rules of the game for competitors in a way that enhances efficiency and innovation. Since the expansion of more productive firms and industries and the decline or shut down of less productive firms is important to productivity growth, regulations should help this process of change by avoiding favoritism to established companies, or to new ones. A level playing field is important.

The continual development of skills is important, as well, especially as the increased deployment of information technology has changed the skill requirements of many jobs. The returns to education and skill have risen dramatically in the past 20 years, which has contributed to a widening of the wage and income distribution. Much of the skill acquisition necessary comes in training on the job, but workers who are better prepared before they enter or re-enter the workforce are more likely to be trained on the job and are more able to take advantage of training. Moreover, since innovation and productivity growth often involve the loss of jobs in some firms and industries as others expand, workers should have the opportunity to acquire new skills and become re-employed. Demographic trends projected by Jorgenson, Ho, and Stiroh (2001) indicate that labor quality may grow more slowly in the future than it has over the period 1959-2000, as average educational attainment increases more slowly. This will provide a small drag on future productivity unless there are offsetting efforts to increase worker skills. It is hard to create effective programs to enhance skills for adult workers, because government programs are not good at providing these skills directly. Instead, education and training programs should try to prepare workers for a life of acquiring new skills, by giving them the expectation and the skills needed to learn how to learn.

Good macroeconomic policy contributed to the favorable economic environment of the 1990s. Monetary policy encouraged growth in the mid-1990s; it tightened up at the end of the decade as growth started running too fast; and it acted strongly to mitigate the recession that began in 2001. But monetary policy may face new challenges going forward, either if the recovery is not sustained or if the return to economic growth is too strong. In the 1990s, an exaggerated view developed of what monetary policy can accomplish, which in turn may engender disappointment in the next few years.

Fiscal policy in the 1990s contributed to growth by moving toward budget surpluses, which helped to interest rates low and to stimulate private investment. Going forward, it will be necessary to rely more heavily on domestic saving as a source of investment funds than was the case in the 1990s. The US economy needs to be rebalanced with a higher domestic saving rate, lower growth of imports, and a smaller current account deficit. Maintaining budget surpluses can contribute to this rebalancing and sustain the environment for growth. I noted earlier that budget planners consistently underestimated the improvement in the fiscal situation in the 1990s, but that lesson now seems to have been learned too well. The danger today, especially when the economy gets its second wind, is that budget planners will consistently overestimate tax revenues and underestimate spending, thereby leading to smaller budget surpluses (or even budget deficits) than the political process had chosen.

Conclusion

When running or playing a sport like tennis it is easy to start too strong and then become winded and exhausted. After setting a better pace, the body fortunately seems to get a second wind. The exhaustion recedes and breathing becomes easier, although one does not have quite the same energy as was available in the beginning. That analogy seems appropriate for the US economy in recent years. The enthusiasm for information technology and for the shares of high technology companies went too far. Growth became unsustainably rapid and a corresponding slowdown inevitable. But the excessive optimism of the 1990s should not give way to excessive pessimism now. Many of the drivers of faster productivity growth in the 1990s, both those linked to information technology and those unrelated to it, remain in place.

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1. Statistical tests show a decline in the trend rate of labor productivity growth in the early 70s (in non-farm business although not in manufacturing) and an increase (in both sectors) in the early 90s. However, there is uncertainty around the exact timing of the trend shifts, see Roberts (2000) and Hansen (2001).

2. The figures in table 2 were supplied by Dan Sichel.

3. The figures were provided by Steven N. Braun at the Council of Economic Advisers.

4. Based on a panel presentation made at the Federal Reserve Bank of New York, November 2, 2001.

5. In the 2001 *Economic Report*, it was suggested the business cycle was not a cause of faster productivity growth because the level of productivity was already about 2 percent above trend by 1995. The latest estimates from the same cyclical adjustment model, developed by Steven N. Braun, now indicate that actual productivity growth 1995-2000 was slightly slower than the structural trend, because of the sharp drop in the rate of growth in the economy during 2000.

6. This measure of labor input is deficient in not catching self-employed. An alternative measure, persons engaged in employment, has the problem that it counts as one person a worker who only worked part of a year in a given industry.

7. Using gross output per FTE rather than the value added per FTE shown in table 3 reinforces the conclusion that the productivity recovery was broad-based across industries and implies less concentration in a few industries.

8. Since the error variance may well be larger for small industries than large industries, there is a case for a weighted regression. Weighting by employment is questionable, however, since this is the denominator of the labor productivity variable.

9. In all three cases, consumer prices are measured by the chain price index for personal consumption expenditure, excluding food and energy. Food and energy do of course affect the living standards of workers, but the fluctuations in the prices of these items are largely unrelated to the performance of the nonfarm business sector. Using the core Consumer Price Index shows smaller, although still strong, increases in real wage growth. See Baily (2001, table 5). The employment cost index starts only in 1980.

10. For data on foreign direct investment, see the table at http://www.bea.doc.gov/bea/di/fdi-ind.htm.

11. One negative for productivity growth over the next year or so is the impact of the terrorist attacks of September 11, 2001. Although the aftermath of these attacks could reduce economic growth for a period, it should not affect the longer run trend. The attacks of September 11 will have some lasting effects on the level of productivity in the US economy and hence a short-term effect on productivity growth. One quick way to estimate the impact is as follows: If private business were to hire 200,000 additional security personnel, about a 50 percent increase over the current amount, and the all-in cost

per person were $100,000, then this would add to $20 billion or about 0.2 percent of GDP. If there were also extra travel time, higher inventories, and so one, the result could be a reduction of productivity growth by about 0.2 to 0.3 percentage point for a couple of years. The forecasting firm, Macroeconomic Advisers, has suggested the productivity effect of the attacks would be smaller. Their macro model estimates the productivity effect at just 0.01 to 0.02 percentage point per year, although the effect was more persistent in their view. The strong performance of productivity in the fourth quarter of 2001, when the disruption might have been expected to be quite large, suggests September 11 will not have a big effect on productivity.

Table 1
Growth Accounting and the Post-73 Productivity Slowdown
nonfarm business, percent per year

Period	**1948-73**	**1973-95**	**Difference**
Output per hour	2.9	1.4	-1.5
Contributions from[a]			
Capital	0.8	0.7	-0.1
IT Capital	0.1	0.4	0.3
Other Capital	0.7	0.3	-0.4
Labor quality	0.2	0.2	0.0
Multifactor Prod.	1.9	0.4	-1.5
MFP from R&D	0.2	0.2	0.0

Source: Bureau of Labor Statistics USDL 01-125 May 3, 2001.
Note: [a] Contributions do not add exactly to the total because of rounding and because growth rates compound multiplicatively.

Table 2
Accounting for the Post-95 Productivity Speed-Up
percent per year

Difference in growth (1995-2000 minus 1973-95)

	Oliner-Sichel[a]	***Economic Report***[b]	**J-H-S**[c]
Output per hour	1.15	1.39	0.92
Contributions from:[d]			
Capital Services	0.34	0.44	0.52
IT Capital	0.59	0.59	0.44
Other Capital	-0.25	-0.15	0.08
Labor quality	0.04	0.04	-0.11
Multifactor Prod.	0.77	0.91	0.51
Computer sector MFP	0.47	0.18	0.27
Other MFP	0.30	0.72	0.24

Notes: [a] Updated figures provided by Daniel Sichel, see Oliner and Sichel (2000). Nonfarm business.

[b] Updated by the author using data provided by Steven N. Braun. Nonfarm business.

[c] Dale Jorgenson, Mun Hoh and Kevin Stiroh (2001). Business sector plus consumer durables and owner-occupied housing.

[d] Contributions do not add exactly to the total because growth rates are compounded multiplicatively.

Table 3 Labor Productivity Growth by Industry

GDP originating per full-time equivalent employee, average annual
Percent changes, selected periods.

	1989-95	1995-2000	Difference
Private Industries[a]	0.88	1.97	1.09
Agriculture	0.34	2.75	2.41
Mining	4.56	-1.78	-6.34
Construction	-0.10	-0.66	-0.56
Manufacturing	3.18	4.45	1.27
Durables	4.34	6.77	2.43
Non-Durables	1.65	1.43	-0.23
Transportation	2.48	1.52	-0.96
Trucking and Warehousing	2.09	0.99	-1.10
Transportation by Air	4.52	2.19	-2.33
Other Transportation	1.51	1.51	0.00
Communication	5.07	2.19	-2.88
Electric / Gas / Sanitary	2.51	2.25	-0.26
Wholesale Trade	2.84	5.90	3.06
Retail Trade	0.68	4.74	4.05
FIRE	1.70	3.51	1.81
Finance	3.18	9.53	6.34
Insurance	-0.28	0.42	0.70
Real Estate	1.38	2.80	1.42
Services	-1.12	0.08	1.21
Personal Services	-1.47	0.66	2.13
Business Services	-0.16	1.12	1.28
Health Services	-2.31	-0.23	2.09
Other Services	-0.72	-0.24	0.47
IT Intensive Half	2.43	4.15	1.72
Non-IT Intensive Half	-0.10	1.05	1.15

Source: Based on data from Bureau of Economic Analysis, released November 2001.
Note a: Covers different periods, includes agriculture and non-business sectors and so is not directly comparable to the non-farm business sector results reported earlier.