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The New Economy: Post Mortem or Second Wind?

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Introduction

After 1973, policymakers failed to appreciate the fact that the productivity growth trend had sharply declined. Along with the second oil price shock, the policy choices resulting from this failure contributed to the resurgence of inflation in the late 1970s. In the 1980s, policymakers convinced themselves that tax cuts would induce an acceleration of the productivity trend and based over optimistic budget predictions on their views. The result was chronic and damaging budget deficits. In the mid-90s, the Federal Reserve correctly perceived that trend productivity growth had accelerated and adopted a monetary policy that accommodated faster GDP growth. Budget planners over the same period consistently underestimated tax receipts and the improvement in the budget situation. Arguably, the conservative economic forecasts helped restrain the tax cutting and spending impulses of different elements of the Federal government and that this turned fiscal deficits into surpluses. Still, in a democratic system, forecast errors should not be a main determinant of policy choices.

The extent to which the faster productivity growth trend will persist going forward is a major issue facing policymakers today. Right now monetary policy is focused on reversing the economic downturn, but that could easily change if the economy bounces back. Productivity pessimists are raising concerns about the potential for rising inflation next year. On the budget side, projected surpluses over the next ten years seem to be disappearing in the face of increased spending, tax cuts and a weaker economy. Today, the fiscal outlook and the prospect of future deficits or surpluses depend heavily on the labor productivity trend over the next ten years.

This paper will explore the most recent evidence on the acceleration of the productivity trend after 1995, what caused it and whether it is likely to continue. I look at other signs of the new economy in the labor market and capital markets; and I consider implications for policy. First, however, is a review of the experience of the 1970s when productivity growth slowed down. This helps put the current debate in context and reminds us that explaining breaks in productivity trends is very hard to do.

How Well Does Growth Accounting Explain Shifting Productivity Trends?

Table 1 shows the growth accounting estimates made by the Bureau of Labor Statistics (BLS) covering the periods 1948-73 and 1973-95. Increases in capital services per hour worked accounted for a modest 28 percent of the growth in output per hour over the period 1948-73 in non farm business. This figure increased to 50 percent over the period 1973-95 but capital services per hour worked provides almost no explanation of the slowdown in labor productivity.

The slowdown in labor productivity growth that took place after 1973 is matched by an equal decline in the unexplained residual item of MFP growth.

As Table 1 also shows, there was a substantial shift in the composition of capital over time. IT capital accumulation became substantially more important and all other types of capital less important. This was the period when the big puzzle was to explain why IT was having so little effect on productivity growth. The failure to explain the post-73 slowdown extends beyond just the growth accounting framework. A large but inconclusive literature developed in the 1980s attempting to understand why productivity growth slowed after 1973.

Growth accounting failed to explain the post-73 acceleration; how does it do in explaining the pick-up in growth after 1995? Table 2 shows three estimates of the decomposition of the increase of productivity growth after 1995, focusing on the differences in growth rates pre- and post-1995. The first updates Steven Oliner and Daniel Sichel (2000)[1], the second updates the estimates reported in Baily and Lawrence (2001),[2] 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 last summer. Much of the revision came when the estimates of software investment were revised down. The first two columns differ for two main reasons. Oliner and Sichel base their non farm business productivity growth only the product side of the National Income accounts, while my preferred estimate averages the income and product figures from the accounts, which are both valid estimates of non farm output. This makes the acceleration of labor productivity larger, because estimated income grew more rapidly than estimated production. Second, the two columns estimate the contribution of the IT sector to MFP differently.[3] It is important to note that neither column uses an adjustment for business cycle effects. Jorgenson et al. apply their growth accounting to a broader definition of the economy, so the figures are not directly comparable. Their estimate of the contribution of computer MFP uses the same approach as that in Baily-Lawrence but they include software and communications equipment as well as computers.

According to both Oliner and Sichel and Jorgenson et al, the speed-up in labor productivity growth after 1995 is largely 'explained' by the growth accounting framework, and

[1] The figures in Table 2 were kindly supplied by Dan Sichel.
[2] The figures shown use the approach developed by Steven N. Braun at the Council of Economic Advisers and reported in the 2001 *Economic Report of the President*. The results shown here do not necessarily reflect the views of the current CEA or the Administration.
[3] Oliner and Sichel measure MFP in the computer and semiconductor industries and use this to estimate the contribution of the two industries to total MFP. In the Baily and Lawrence decomposition, productivity growth in the non farm business sector is calculated under the assumption that computer prices changed at

the explanation is mostly an IT story. The rapid accumulation of IT capital provided a large boost to labor productivity (adding 0.59 percentage point in Oliner-Sichel), more than offsetting the slowing of the contribution of other capital. There was a small effect of labor quality (education and experience effects). And then a boost from faster MFP within the IT sector. Of course that is an MFP residual effect, but it is much less mysterious than the traditional MFP residual. It is well-known that the computer and semiconductor industries increased their pace of productivity advance after 1995 as a result of a faster rate of introduction of new generations of chips and intense competitive pressure. There is a small (0.23 percentage point in Oliner-Sichel) step-up in 'other MFP', but if some fraction of the productivity acceleration were cyclical, that mystery component could easily vanish, in which case the whole acceleration is explained or at least can be easily described.[4]

Following the data revisions of last summer, therefore, the latest Oliner and Sichel and Jorgenson et al. results are consistent with the view that the post-95 acceleration in the economy as a whole was driven by the IT sector. Faster MFP in the IT sector added directly to productivity growth and the resulting decline in the price of IT capital induced rapid capital accumulation that added to labor productivity in the rest of the economy. Robert Gordon also reaches very much the same conclusion.[5]

The estimates based on the approach from Baily and Lawrence, give a picture that is partly the same and partly different. The combined impact of increased IT capital accumulation and increased MFP in the computer sector is still large. But the larger overall productivity acceleration and the smaller estimate of the direct impact of the IT sector give the result that 45 percent of the overall labor productivity acceleration comes from the residual term of increased MFP growth in the non-computer part of the economy. These estimates suggest faster productivity growth after 1995 included a partial reversal of the unexplained collapse of MFP growth that took place after 1973. If these estimates are correct, there is a part of the post-95 acceleration that shows up in the MFP residual and is unexplained.[6] It may be quite independent of advances in IT.

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the same rate as all other prices. This takes out the impact of the productivity growth in the computer sector and its supplying industries (notably semiconductors).

[4] Neither Oliner and Sichel nor Jorgenson et al make a specific estimate of the impact of the cycle, but in their growth accounting estimates through 2001, the acceleration of MFP outside the tech sector has vanished (Oliner and Sichel (2002)).

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

[6] In Baily and Lawrence we 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 version of that model now estimates 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.

Questions about Growth Accounting. There is a concern among some economists that maybe the hedonic deflators for IT are overdoing the effective rate of price decline. Today's PCs 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.[7]

Second, microeconomic analyses of plants and firms find substantial adjustment costs to investment and lags between investment and productivity. The growth accounting approach assumes increases in capital intensity have an impact on productivity in the same year they occur. That is an important issue because the coincident timing of the productivity surge and the IT investment surge is a key reason for thinking the latter caused the former.

Third, the growth accounting framework formalizes what is essentially a one-observation correlation. Labor productivity accelerated at about the same time that IT investment surged. The assumption is made that the IT capital surge caused the productivity surge, but reverse causality is also possible. With strong demand and strong productivity, 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 IT investment. Everyone believed that this was the thing to do. Chief Information Officers had the upper hand in struggles with Chief Financial Officers. Great rewards were promised from all the IT investment. Maybe, to a degree, the boom of the late 90s caused the explosion of IT investment. The investment bubble burst in 2001 when companies realized they had already over-invested in IT. Real IT investment fell 11 percent between the fourth quarter of 2000 and the third quarter of 2001 (a 14 percent annual rate of decline). Further declines are expected through the first quarter of 2002.

Fourth, a big part of the new economy story has involved intangible capital. The stock market, despite its recent ups and downs, says that the value of US corporations is much higher than the replacement cost of their physical assets (Hall 2001). If there has been a major shift to intangible capital accumulation this would throw off the whole growth accounting exercise. Corporate earnings, output and productivity are all misstated, as indeed is the effective corporate capital stock, because the creation and accumulation of intangible capital is being missed. The way we approach growth accounting is very old-economy, with the emphasis all on physical capital.[8]

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[7] There are some technical issues that have been raised about the BLS methodology. But despite this, it has not been so easy to overturn the basic conclusion that there was rapid growth of real IT capital. The alternative price indexes show price declines that are just as fast as those in the BLS data (Pakes 2001).

[8] Human capital and R&D capital have been included in growth accounting, so the statement is unfair. These terms have not played much role in explaining the shifting productivity trends.

To determine the importance of all these issues we have to go down a level to look at industry data and case studies. If the growth accounting is correct, then the productivity acceleration should be showing up in the industries that invested in all the IT capital.

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

The availability in 2000 of output by industry data prepared by the Bureau of Economic Analysis using new price deflators spawned a series of analyses of the productivity acceleration that changed the perspective on the slowdown (see for example, Stiroh (2001), Nordhaus (2001), Baily and Lawrence (2001), Gordon (2001b)). I will discuss the findings of these studies shortly, but before that it is worth looking at the latest industry numbers since updated and revised figures were released in November 2001. Table 3 shows labor productivity growth estimates from 1989-95 and 1995-2000. Each industry's output reflects the value added in that industry (gross product originating) and labor input is measured by the number of full-time equivalent employees.[9] These new figures confirm the important conclusion that emerged in the literature cited above, namely that the increase in labor productivity growth took place in service industries as well as in durable goods manufacturing. In particular there was a surge in productivity in wholesale and retail trade and in the finance sector.

One difference emerging from the latest data is that the increase of labor productivity in wholesale and retail trade, while still large, is not quite as large. By contrast, the large productivity acceleration in finance has become even bigger. A more detailed break down by industry than is shown in Table 3 reveals that much of this acceleration is driven by a small part of the industry, security and commodity brokers, where measures of productivity are questionable. But banks (depository institutions) now show a solid acceleration of labor productivity of 1.22 percent a year, whereas the previous data had indicated banks had experienced slower productivity growth after 1995. Within the goods-producing sector, the biggest change from last year's figures is that mining now shows a large slump in labor productivity. This may reflect the shift of resources into the industry, in response to high energy prices in 2000, without a response of output in the short term.

Stiroh argued that the productivity acceleration was broad-based covering a majority of industries and he has confirmed this finding in the latest data, reporting accelerations in labor productivity in two-thirds of the disaggregated industries (he used gross output rather than value

[9] 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.

added). Gordon provided valuable additional insight into the industry data by comparing the BEA data with the BLS industry series. He points to inconsistencies in the data, encouraging caution in interpretation of any industry patterns. He also argues the revival of productivity is broad-based—like Stiroh, he finds this in the gross output per hour figures.

Nordhaus used the value added data and pointed out that even though many industries show acceleration, only a small number of industries, notably wholesale and retail trade and computers and semiconductors account for a large fraction of the total increase—the contribution to the aggregate acceleration is concentrated in a few industries. Nordhaus also separates within-industry effects and mix effects, which can be important. For example, telecom contributed to the overall productivity acceleration even though it did not accelerate its own productivity growth. It expanded employment rapidly and has a high level of labor productivity.

What about the link to IT capital? Baily and Lawrence carried out a simple exercise that is repeated in the last two rows of Table 3. The industries were divided into those that were more IT-intensive and those that were less IT-intensive, measured by IT capital in 1995 relative to value added. The IT-intensive group had much faster productivity growth throughout and a larger productivity acceleration.

Stiroh has gone well beyond this simple calculation and estimated the impact of IT intensity. His strongest results come from defining IT intensity based on the share of IT capital services in total capital services in 1995. If that is high, he argues, it "identifies industries expending tangible investment on IT and reallocating assets toward high-tech assets." (page 10). He also argues that it is important to use a measure that is exogenous, not one that is defined over the same period as the productivity revival. Hence he uses the IT intensity in 1995. He finds that industries that are above the median in their IT intensity, by his measure, have much larger increases in labor productivity after 1995. His findings are pretty robust, remaining strong even after excluding outliers and making other tests. One place that gives weaker results is when IT intensity in 1995 is calculated as IT services per FTE. He notes that industries that had invested heavily in IT to reduce labor in the early 90s would have had difficulty making further labor productivity gains in the late 90s.

The McKinsey Global Institute (2001) recently completed an analysis of the acceleration in US productivity growth. They main part of this study consisted of case studies, which I will discuss later, but they also offer an alternative regression analysis with mixed results. Starting with value added data, they find that if each industry is considered as one observation, there is almost no correlation between the acceleration in labor productivity growth by industry after 1995 and the surge in IT capital per employee by industry. On the other hand, if each industry is

weighted by employment, there is a positive and significant correlation.[10] The study argued further that the concentration of the acceleration in a few industries is revealing because these industries account for much of the total acceleration, but a much smaller fraction of the total surge in IT capital accumulation. This again, they argue, undermines the IT/productivity link.

No statistical evidence can be definitive, but there is a pretty strong case for saying there is *some* connection between IT and the productivity acceleration. But how close that connection is and exactly how it works is not certain. Case study evidence can provide more information.

Case Study Evidence The main contribution of the McKinsey study was a series of eight industry case studies, looking in detail at what had happened to productivity in the 90s. Six industries that had contributed disproportionately to the productivity acceleration were included, wholesale and retail trade, computers and semiconductors, telecom and securities. And retail banking and hotels were included as two industries that had invested heavily in IT but had experienced no surge in productivity.[11]

Based on these case studies, the study 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, both because of its own large size and high productivity, but also because it put competitive pressure on other retailers. In the semiconductor industry, Intel came under competitive pressure from AMD and responded by shortening its product cycle. There was an accelerated decline in the price of microprocessors that was translated into an acceleration of measured productivity in this industry. Going in the opposite direction, the study found that hotels and retail banks were facing weaker competitive pressure and were able to earn large profits without pushing as hard to improve efficiency.

In general, the case studies make clear that productivity improvements come from a variety of sources. 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.

There are examples where IT investments yielded little payoff. Banks invested very heavily in powerful computers that were not really needed for the tasks that most of the bank employees were performing. However, there are also examples where IT did contribute substantially to productivity. Two of the industries were high-tech producers. The telecom industry is a direct application of IT. The Internet allowed much higher productivity in the

[10] The case for weighting the observations is that the variance in productivity measures may be larger for small industries.

[11] Note, however, that the latest BEA data now find increased growth in banking productivity after 1995.

securities industry, and IT is used heavily in the giant wholesale and retail sectors. Wal-Mart, for example, has relied heavily on IT as an enabler of its efficient supply chain. It operates the largest commercial database in the world.

The relation between IT and productivity revealed in the cases is a complex one, and often IT systems developed prior to 1995 were vital facilitators of productivity improvements after 1995. This suggests some of the impact of the surge in spending after 1995 may show up as faster growth in future years.

Conclusions from the Industry and Case Study Data. There are pitfalls in any industry-level analysis of productivity because the data are not collected in a way that really allows the researcher to allocate outputs and inputs by industry, particularly inputs. Deciding which industries are using IT capital intensely is problematic, for example. One example of the kind of problem posed is business services. This is a large industry that has grown a lot and is a large investor in IT. There is no serious measure of real output or productivity for this industry, so it is very hard to know the extent to which the industry or its IT may be contributing to the acceleration of productivity in other industries.

Another difficulty in drawing strong conclusions about the IT--productivity link from the industry data results from the fact that a main driver of the surge in IT capital was the accelerated price decline that encouraged everyone to invest more. Investing in IT became the thing to do. Ex post, some companies or industries used their IT capital well and others not so well. 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 IT capital accumulation.

Despite these difficulties the industry data and case studies are valuable. It does look as if the productivity acceleration, even though it is concentrated, spread outside just the IT producing sector. There are signs that IT using industries have done relatively well in productivity growth, but clearly other factors are important. It is hard to look at the industry data and the detailed case studies and conclude the productivity acceleration was *just* IT-driven.

Other Indicators of Structural Change: What do they Show?

There are three aspects of US macroeconomic performance in the 1990s that give an alternative reading on the economy in the late 90s.[12] They are related to productivity, but rely on different data.

Rising Real Wages and Low Unemployment 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. The corresponding acceleration of real consumption wages was 1.9 percent for compensation per hour and 1.3 percent for the employment cost index.[13] It appears that the strong economic performance and increased productivity growth of the late 90s translated into much faster real wage growth. This result is important because it shows that the economy in the late 90s did not just generate faster computers and communications equipment, it affected the ability of the economy to deliver consumer goods in return for hours of work. It changed the path of workers' real consumption wages, including hourly employees. Some part of this was likely the result of the very strong labor demand in the period, but not that much, 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 than 1995-2000, using any of the three measures of wages. So the pattern of solid real consumption wage performance has continued despite demand weakness in the economy.

Based on the experience of the 70s and 80s, estimates of the non-accelerating rate of unemployment (NAIRU) for the US were 6 to 6_ percent a year. Certainly the experience of the 80s expansion seemed to confirm this, where wage and price inflation started to worsen as the unemployment rate fell below 6 percent. By contrast, unemployment fell below 6 percent in September of 1994 and moved to around the 4 percent mark. There was no sign of accelerating inflation until 2000, in fact core inflation fell over much of the 90s. Several writers have linked the improvement in the inflation/unemployment tradeoff to the change in the path of real wages.[14] Nominal wage changes do not increase immediately when productivity growth improves, and so unit costs fall relative to trend and inflation is held down.

In summary: the experience of the labor market provides confirmation of a structural change in the US economy in the 90s that is somewhat independent of specific productivity numbers. The hedonic price indexes for computers have changed the measured rate of

[12] For a more extended discussion of these issues see Baily (2001).
[13] 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 workers living standards, but the fluctuations in the prices of these items are largely unrelated to the performance of the nonfarm business sector. Using the core CPI shows smaller, although still strong, increases in real wage growth. See Baily (2001) Table 5. The employment cost index starts only in 1980.
[14] Blinder (2001), Ball and Moffitt (2001) and Council of Economic Advisers (2001).

productivity growth, but they have relatively little impact on consumer prices and cannot be the main reason why unemployment stayed so low for so long.

Market Value of Corporations According to Robert Hall (2001), the ratio of the market value of corporations to the replacement cost of their capital (Tobin's Q) nearly tripled in the 1990s. In part, this increase in market value came about because stocks were valued by different criteria at the beginning and end of the decade. In particular, the risk premium may have declined. Moreover, stock prices reached unsustainable levels in 1999 (the end point of Hall's 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 the fundamentals.

The surprising thing about the increase in market value, 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 attacks, stock price indexes remain very high. Even if Tobin's Q were to fall sharply from its level at the end of 1999, it would still be well above unity, its value at the beginning of the 90s. This means that markets 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-90s before clear signs of improved productivity had emerged, Wall Street analysts started to increased their expected profit growth figures and market valuations, which had been rising strongly since the mid-80s, started to rise even faster. History may look back at the current period as one where the market turned out to be dramatically over-valued. 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 Figure 1 shows the rapid increase in the net inflow of foreign capital into the United States, heavily concentrated in direct foreign investment and securities.[15]

As a consequence of the foreign appetite for these US investment opportunities, the portfolio of assets held by foreigners has shifted into equities and direct ownership of US companies. These two classes of investment constituted roughly 50 percent of all assets held by foreigners in 1999, up from around 30 percent in 1990.

The desire of foreign companies to buy into the United States does not mean they are just buying high-tech or IT 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 there was also a large increase in investment spread throughout a range of different industries, including traditional manufacturing industries and heavy IT users such as insurance and financial services.[16] 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 dramatically and then move into recession, triggered in part by the terrorist attacks, 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 weakness in Japan is a separate issue, but the continued strength of the dollar against the Euro and other currencies remains something of a surprise. It appears the rest of the world believed in the increased profitability of capital in the US and continues to believe that the prospects for asset returns are stronger in the US 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.[17]

Causes and Future Prospects

Based on the data given above and the studies described, the weight of the evidence points clearly to the conclusion that there was a structural break in the performance of the US economy in the 1990s. Despite revisions, the aggregate productivity data still show a break in the productivity trend. The case study evidence supports the view that the pace of innovation picked up in a range of different industries. The changes in the labor market, the rise in the market valuation of corporate capital, and the inflow of capital to the US, all support the conclusion that structural change took place. This combination of economic outcomes suggests productivity growth and the return on capital both increased in the 90s.

A caveat is in order. 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 is like a large oil tanker, it does not change direction quickly and much economic activity today is similar to what it was in the early 1990s. Most employment and

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[15] The "other private assets" category includes bank loans.
[16] See the table at http://www.bea.doc.gov/bea/di/fdi-ind.htm
[17] Jaume Ventura (2001) disagrees with this interpretation. He argues that US residents experienced a very large increase in wealth in the 90s and responded by increasing their consumption and borrowing from the rest of the world. However the fact that US residents could attract funds as easily as they did suggests a perception by foreigners that returns had increased in the US.

output remain in traditional industries and we 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. While I use the term new economy, because it captures the idea of a shift in the economy in the 90s, I recognize that it probably overstates the extent of change.

With that terminology disclaimer out of the way, the question is whether there is some compromise or consensus explanation of the productivity improvement that emerges. Certainly advances in IT are changing the way business is done. And as we have seen, the aggregate growth accounting evidence and some analyses of the industry data make a case that a major part of the productivity acceleration was the result of these advances. But for the following reasons, I judge that IT was not the sole reason for the productivity shift after 1995.

First, I prefer the growth accounting framework used in Baily-Lawrence. This framework indicates there was a significant increase in MFP growth after 1995 outside the IT hardware sector. Second, the growth accounting framework itself may overstate the causal link from IT capital to growth if there is reverse causality. Third, the large increase in real wage growth, together with the extraordinary growth in the market valuation of corporations does not seem consistent with a model where there is faster MFP growth only in the IT hardware sector that affects other sectors only through IT capital accumulation. Fourth, the case studies provided evidence that innovative business practices, that in some cases were unrelated to IT, contributed heavily to faster productivity. Fifth, the regressions from the industry data and the case studies indicate that IT capital in place prior to 1995 facilitated productivity growth after 1995. This puts into question the immediate and direct linkage from rapid IT capital accumulation to rapid productivity growth that is built into the growth accounting exercise. And finally, the failure of the growth accounting framework to explain the slowdown in the 70s leaves some residual skepticism about its ability to fully capture the speed up.

Whether the improved economic performance of the 90s was wholly IT driven or only partly IT driven, there remains the question of why did the pace of innovation speed up in the 90s. What was it about the economic conditions in the 90s that fostered stronger economic performance? One simple way to describe the shifts in the productivity trend is that there was a pool of innovations and investments to be exploited after World War II, and these generated the fast trend of productivity over the period. There was then a lull as the easy ways to raise performance had already been found. During the 1970s and 1980s there was a lot of change taking place and old capital was being destroyed. There was an ongoing push of economic change and innovation, and the IT revolution was in the making, but the benefits were not yet showing

up, at least in measured productivity. Some time in the 1990s a new flow of productivity-enhancing innovations came on stream, the economic environment was favorable, and there has been a return to something closer to the postwar trend of faster growth.

While there is no proof here, one can see some of the reasons why the environment in the US economy in the 1990s was favorable both for rapid innovation and rapid diffusion of innovation, both IT related and otherwise. There has been heightened competition in an increasingly deregulated economy facing strong international competition. IT innovation is driven by the demand for improved technologies in the using industries. The United States has competitive service industries, often on a global scale, and this encourages them to seek out new technologies to improve their own productivity. If the new economy were entirely the result of a random surge in the flow of innovation, then all countries should have had similar changes together. The new technologies are available globally. In practice the United States has been well ahead of most of the industrial countries and a reason for this is that the United States has competitive markets in the industries that are using IT.

When innovations occur in one area, they can bring benefits. But when complementary innovations occur together the effects can be greatly increased. The 90s were a particularly favorable time because a combination of rapid advances in computing power, software and communications capabilities formed such a set of complementary innovations. Large amounts of data can be processed and presented in a way non-technical personnel can use and then transmitted to remote locations within the same firm or to other firms.

The policy environment contributed to the creation of the right 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. And the mix of monetary and fiscal policy has lowered interest rates and encouraged investment.

Future Prospects If you believe the productivity revival was structural, but it came from the surge in productivity growth within the computer sector, plus some cyclical component, there is a case for a rather pessimistic view of future productivity growth. First, the huge rate of decline in computer prices of the late 90s may not continue indefinitely and, second, there may be diminishing returns to investment in IT capital. The collapse of investment in the past year seems consistent with this view, and has caused a large adjustment in some commercial forecasters' predictions of productivity growth. Macroeconomic Advisers, for example, predicts labor productivity growth to be fairly strong in the second half of 2002, with a cyclical bounce, but to average only 1.6 percent for the four quarters of 2003, because of the collapse of IT investment.

Using 'conservative' assumptions, Oliner and Sichel (2002) argue that the productivity growth trend could fall slightly below 2 percent.

The basis for pessimism in the IT-only scenario can be questioned, however. First, IT prices could well continue to fall rapidly since the technological drivers of improved performance and the intense competition are still at work.[18] And even if the price declines do moderate, there is an offset, a "share effect."[19] The share of IT capital in total capital has been rising rapidly, with the effect of pushing up the rate of real capital accumulation. The growth rate of the total capital stock is a weighted average of the growth rates of the components. The faster-growing components (IT equipment) are a growing share of the total. Jorgenson et al. (2001) are actually rather optimistic about the future prospects for labor productivity, even though they view the revival as being IT driven. Jorgenson et al. anticipate a growth rate of 2.24 percent a year, not much slower than in the late 90s, based on the assumption of continued rapid decline of processor and computer prices. There is a wide error band around their central figure, ranging from a pessimistic estimate of 1.33 percent and an optimistic estimate of 2.98. Macroeconomic Advisers is also more optimistic beyond 2003, when they predict a resumption of investment spending picks and a productivity trend of well over 2 percent. And Oliner and Sichel (2002) project as much 2_ percent as the future productivity trend under more optimistic assumptions.

The McKinsey Global Institute, which argues that IT is only a secondary factor in the productivity surge made a forecast of future labor productivity growth based upon the case studies. They looked at each industry under study and asked to what extent would the drivers of productivity in the 90s continue into the future and were there innovations in process that would increase productivity. They estimated growth at 2.0 percent a year going forward with a range of 1.6 to 2.5 percent.

As I have noted, my view of the determinants of recent productivity puts less weight on IT than Jorgenson et al. or Oliner and Sichel, but somewhat more weight than that ascribed by the cases studies. On this basis, how much of the post-95 growth surge will continue? The basic drivers of the acceleration, rapid improvements in IT, strong competition and the impact of globalization are in place for a continuation of growth. One cannot necessarily tell how new technologies will be used, but going forward the Internet is likely to add to productivity, whereas it was not a major factor in the 90s growth. Robert Litan and Alice Rivlin (2001) estimate that the Internet will add about a quarter of a percentage point to future growth. And although they do

[18] For example, John Markoff reports in the June 30th *New York Times* (2001) on an advance made at Intel "demonstrating that the semiconductor industry will be able to continue shrinking its basic building blocks at a torrid pace at least until the end of this decade."
[19] Daniel Sichel has pointed this out.

not allow one to put a specific number on productivity, 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.

Despite a weak economy, labor productivity over the six quarters since mid 2000 grew at about 1.5 percent at an annual rate. Non farm output declined in the second, third and fourth quarters of 2001 and yet there was positive labor productivity growth in all three quarters. This has never occurred before over the postwar period. With the caveat that recent data are often revised, this suggests that the trend of labor productivity is well above 1.5 percent.

I take as a starting point the figure that labor productivity grew at about 2.7 percent a year 1995-2000, based on an averaging of income and product estimates. At one time, it was thought that the productivity trend was continuously accelerating, but once the output data were revised, that view became hard to sustain. To the contrary, it seems much more likely that some part of the growth over this period was either temporary or cyclical. There was a boom in financial markets that drove revenues through the roof in the financial services sector and pushed measured productivity growth unsustainably high. There was a spending boom that pushed productivity in the trade sector way up. Some part of that productivity increase does not seem sustainable. Therefore, 2.5 percent is a reasonable upper bound on the trend. The fact that technology and competition remain strong, plus the evidence of recent productivity data, suggest 2.0 percent growth is a reasonable lower bound to the current labor productivity trend.[20]

A Second Wind but at a Lesser Strength Despite different perceptions of the drivers of productivity, it seems that the literature I have reviewed above all concludes that the productivity trend is likely to be in the range of 2 to 2_ percent a year. That is a strong performance that will increase wages and living standards and allow potential GDP growth in the range 2.8 to 3.3 percent a year. It is certainly enough to say the new economy will get a second wind. That does not mean we will go back to the 90s. This rate of GDP growth is far slower than the rate of over 4 percent achieved 1997-2000. Moreover, other elements of the new economy may look weaker.

[20] One negative for productivity growth over the next year or so is the impact of September 11. As others have noted, this could reduce underlying growth for a period, but 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 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 inventory etc, 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. They expect around 100,000 extra employees at a cost of $54,000 per person, giving a total cost of only $5.4 billion. Running this through their macro model, they estimate the productivity effect as 0.01 to 0.02 percentage point per year, although the effect was more persistent in their view.

Even though the new economy is likely to continue with faster productivity, this does not imply that stocks or the dollar will remain as strong. Future corporate earnings could justify the current level of the stock market or stimulate further growth, but they may very well not do so. Even a substantial fall in the market would still leave Tobin's Q well above unity, consistent with a sizeable valuation of intangible capital, and that is the main expectation based on the new economy. For the dollar: At some time in the future the dollar is very likely to decline even if the returns to capital in the US remain high. The dynamics of servicing a rising foreign debt suggest this, plus new economy opportunities may develop more strongly in other countries, changing the relative attractiveness of investing in the US.

The continuation of solid productivity growth, 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 NAIRU will stay as low as it seemed to be in the 90s. In many specifications of the Phillips curve, an increase in the trend rate of growth of real wages induces only a temporary shift in the inflation/unemployment tradeoff.[21] I would expect some persistent benefit in lower unemployment coming from faster productivity growth, largely because the NAIRU was much lower in the 50s and 60s when real wage growth was rapid than in the 70s and 80s when real wages were weak. But given the wide disagreements in the profession of the nature or even existence of a Phillips curve, there is no definitive evidence to prove this view.

In summary: Even though I conclude that the 'new economy' will get a second wind, this does not mean a return to the economic euphoria of the late 1990s.

Policy Implications

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, or the traditional industries. Policy must act to sustain this by maintaining open international markets and avoiding protectionist measures. Maintaining competitive intensity also means pursuing an anti-trust policy that allows industry change to take place, including consolidations, but that resists anti-competitive actions by dominant players that could discourage innovation and encourage inefficiency. Anti-trust policy is not just about improving static efficiency, it is also about maintaining the competitive environment for innovation and productivity growth.

[21] See Baily (2001) for a more extended discussion of this issue and additional references.

Regulatory policy is just as important for productivity growth. The deregulation movement of the 70s and 80s surely contributed to the flowering of innovation in the 90s. Good regulatory policy is not just a matter of getting rid of regulations, however, it should set the rules of the game for competitors in a way that enhances efficiency and innovation. One example is regulatory policy towards the use of wireless spectrum, an area of potential future technology growth. The current allocation of wireless spectrum is very inefficient, and a more economically rational allocation of wireless spectrum would enhance the development of this important area of the new economy.[22]

There is not the space here to deal with the issue of skills, but I want to acknowledge their importance. The returns to education and skill have risen dramatically in the past twenty years, contributing to a widening of the wage and income distribution. The increased deployment of IT has also changed the skill requirements of jobs. So it seems evident that education and training have become more important. In practice it is hard to create effective programs to enhance skills. 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. Since innovation and productivity growth often involve the loss of jobs in some firms and industries as others expand, it is essential that workers have the opportunity to acquire new skills and become re-employed.

Good macroeconomic policy contributed to the favorable economic environment of the 90s. Monetary policy encouraged growth in the mid 90s, tightened up at the end of the decade as growth started running too fast. And it acted strongly to mitigate the impact of the downturn and recession of 2001. It may face new challenges going forward, either if the recovery fails to materialize or if the turnaround is too strong. As I noted earlier, the combination of low unemployment and low inflation achieved in the 90s may not be as easily reached over the next five years. In the 90s there was an exaggerated view of what monetary policy can accomplish that may engender disappointment in the future.

Fiscal policy in the 90s contributed to growth by keeping interest rates low and stimulating 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 90s. The US economy needs to be rebalanced with a higher saving rate in the US, lower growth of imports, and a smaller current account deficit. Maintaining budget surpluses can contribute positively 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 90s, but that lesson now seems to

[22] See Martin Baily, Robert Willig, Peter Orszag and Jonathan Orszag, (2001).

have been learned too well. The danger today, even if the new economy gets a second wind, is that budget planners will overestimate tax revenues and underestimate spending, thereby eroding or eliminating the budget surpluses.

Conclusion

When running or playing a racquet sport 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 lessens and breathing becomes easier, although one does not have quite the same energy as was available in the beginning. That seems an appropriate analogy for the economy in recent years. The enthusiasm for IT and for the shares of high-tech companies went too far. Growth became unsustainably rapid and a slowdown inevitable. But the excessive optimism of the 90s should not give way to excessive pessimism now. Many of the drivers of growth in the 90s, those linked to IT and those unrelated to it, remain in place.

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