

Federal Reserve Bank of Cleveland

# Productivity Gains During Business Cycles: What's Normal?

by Mark E. Schweitzer

*The growth of labor productivity surged to an average annual rate of 3.1 percent for the second and third quarters of 1997, after averaging less than 1 percent a year over the previous decade. Such an increase this late in an expansion is unusual and has led some commentators to expect that the burst of productivity will persist, but the CBO feels that is unlikely.*

Congressional Budget Office<sup>1</sup>

*[T]he fact that no slowdown [in productivity growth] is now apparent is evidence . . . that the economy is behaving as if it remains in a mid-expansion phase, rather than an end-of-expansion phase.*

Economic Report of the President<sup>2</sup>

Productivity links the labor force to the economy's real output, a key position that makes productivity growth one of the most eagerly forecast and analyzed economic statistics. A prime example is the current business cycle, in which the pattern of productivity gains has struck many observers as extraordinary.<sup>3</sup>

Economists generally acknowledge that labor productivity growth is procyclical, which means that it is higher, on average, when the economy is expanding and lower when the economy is contracting. This *Economic Commentary* reviews the leading explanations for this pattern, to see what economic theory implies for productivity growth. Then it uses two different approaches to compare the time pattern of productivity gains over the business cycle. One approach describes the pattern in terms of the number of quarters of economic

growth since the business cycle's trough. The other approach uses our knowledge about the ends of past recoveries to describe the typical pattern of productivity gains as a cycle ages.

## ■ Why Should Productivity Be Procyclical?

The procyclical nature of productivity growth is typically expressed as a positive correlation between productivity growth and output growth. In other words, productivity growth tends to be above average when real GDP growth is above average.<sup>4</sup> Theory provides at least three explanations for this business cycle "fact": procyclical technology shocks, increasing returns to scale, and labor hoarding.<sup>5</sup> To this list I would add the depletion of workforce skills, which can be linked to labor hoarding.

**Procyclical Technology Shocks.** Real business cycle models of the economy assume that patterns generally occur because labor and capital become—for some mysterious reason—more or less productive. In this story, "technology shocks" simply arrive, like manna from heaven. They can introduce procyclical productivity growth because periods with productivity-enhancing shocks also tend to have higher rates of economic growth. The shocks can't be observed, but they're measured after the fact as what remains after accounting for increases in labor and capital.<sup>6</sup> In the current period, even this measurement is unclear, making for a time pattern of productivity that is uncertain but likely to be correlated with output growth.

**Economic analysts yearn for a means of predicting labor productivity growth. Can they get some help from business cycle patterns?**

**Increasing Returns to Scale.** As a firm's output increases, the unit cost of production falls. Instead of changing over the business cycle, firms' production technologies might just be responding to higher returns to scale. Clearly, using equipment and workers that were previously idle will yield better returns if these resources had to be paid regardless of whether they were producing goods. This would raise measured productivity without any change in production techniques as the firm increases output in response to rising demand. Because the limits of firms' production technologies are not known, however, the actual pattern over the business cycle is uncertain.

**Labor Hoarding.** This explanation relies on the idea that firms hold similar numbers of workers whether demand is high or low, possibly from a wish to keep the job-specific skills that the firm might lose by laying off workers. While this model suggests that productivity would rise rapidly as the workforce returned to full production early in the business cycle, it is unclear what the pattern would be after that point.

**Workforce Skills Depletion.** Individually, the workers available to firms may be more or less productive. At the beginning of an expansion, high unemployment rates let firms choose the best workers, who may become more difficult to hire away from other firms as the expansion continues. In this case, the pattern of productivity growth would depend on occupation-specific skill levels and might vary according to which occupations hiring was concentrated in.

We need not choose one of these explanations in preference to the rest because they are not mutually contradictory. In fact, these simple models don't tell us much about the pattern of productivity growth we would expect to see over a business cycle.

### ■ Quarterly Time Patterns, 1949–97

Other difficulties in interpreting productivity growth patterns become clear when we look at U.S. data. Figure 1 shows productivity growth in the eight business cycle expansions since the Bureau of Labor Statistics started measuring nonfarm business productivity in 1947.<sup>7</sup> It also shows the current expansion. The figure has too many lines to let us interpret individual patterns, but the quarterly variation in productivity is

plainly large enough to permit all sorts of time patterns. At almost any number of quarters after the business cycle trough, there have been declines as well as substantial growth.

On careful inspection, however, regularities in the data show a procyclical tendency. In particular, some of the very highest productivity growth rates—and never any declines—have occurred in the second and third quarters following the trough. Even beyond that point, the slope is slightly negative. Two major problems make it hard to interpret the raw data. First, quarterly productivity growth is highly variable: The standard deviation of productivity growth in completed recoveries is over 4 percent, so that growth within any given quarter could be negative or well over 6 percent. Second, the length of business cycles also varies considerably, from five to 36 quarters since the 1950s.

One way to solve the first problem is to focus on more than one quarter at a time in order to average out part of the substantial variation in each. Figure 2 uses the statistical technique of regression to smooth out some of the variation shown in figure 1 and to distinguish a clearer cyclical productivity pattern.<sup>8</sup> The typical business cycle is based on the eight cycles completed since 1947. The current business cycle, smoothed using the same technique, clearly had a slow start followed by two spurts of productivity growth. Both estimates, though certainly not identical, are susceptible to statistical variation because of data limitations. The error band shown in figure 2 indicates the range of typical (95 percent confidence) patterns consistent with the eight business cycles used in the regression. About 95 percent of the time, our estimate of a smooth productivity growth rate would fall within the band. In our short history of business cycles, only the beginning of the current expansion is statistically distinctive.<sup>9</sup>

### ■ Age Patterns of Business Cycles

The wide variation in the length of business cycles, as well as the common descriptions attached to them (*early, mid, late*), suggest judging productivity growth not by the number of quarters from the start, but by how far into the expansion phase the economy has gone. For an expansion that will last only two years, the seventh quarter is late; in the current cycle, it is not

even the midpoint. Furthermore, if recoveries with strong productivity growth tend to last longer, then, as the sample of recoveries is thinned by recessions, productivity growth estimates will tend to rise with the number of quarters since the last trough.

Figure 3 shows estimates of the productivity growth pattern relative to the fraction of the expansion that has been completed.<sup>10</sup> This way of accounting for time fits the data better, because early phases of the expansion show stronger productivity growth that eventually heads toward zero.<sup>11</sup> It is also evident from this perspective that the decline in productivity growth occurs more evenly over the expansion. Again, the variability of the data must be considered. While the typical pattern tends to flatten out after the first half of the expansion, the data are consistent with a smoothed productivity growth trend that could dip nearly to zero and then return to over 4 percent.

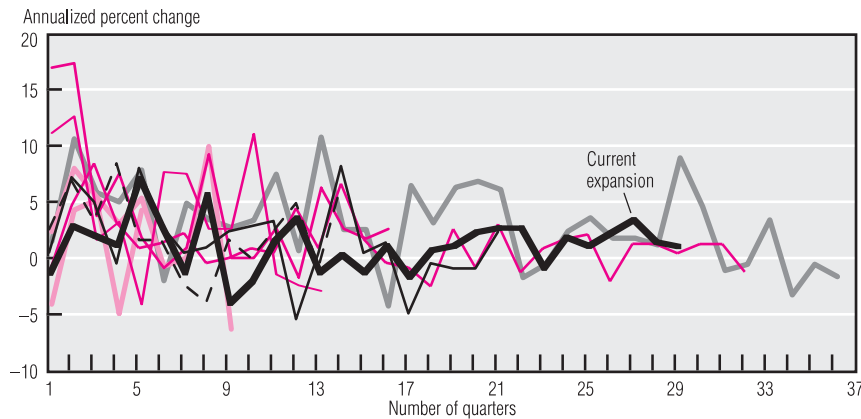
It is hard to place the current expansion in this context because we can't know how far through the cycle we are until it ends. Figure 3 shows one possibility—that the current expansion will last as long as that of the 1980s (32 quarters). This would put us about 80 percent through the expansion (which is essentially the CBO's view). However, the patterns of previous recessions yield little to support strongly either the CBO's or the Administration's assertions about timing. Shifting the current expansion to the left relative to history (halfway through the expansion would be the Administration's estimate) still leaves the current high-trend productivity growth only slightly above the historical norm.

### ■ Conclusion

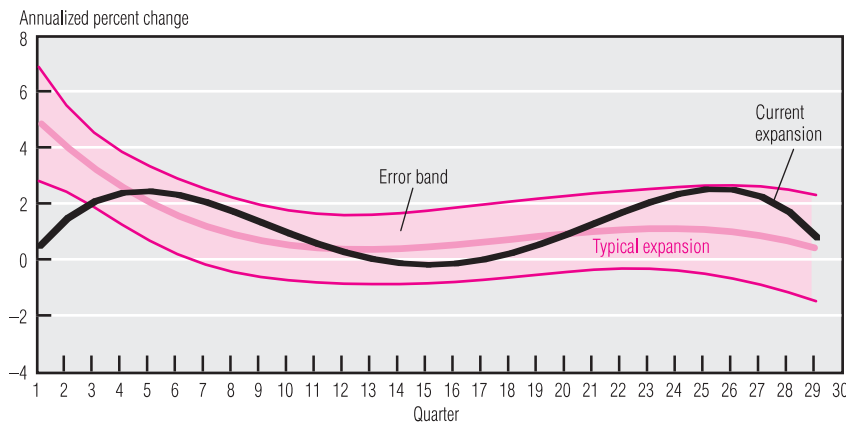
Compared to previous expansions, the present one is interesting but hardly pathbreaking. The variation inherent in measured labor productivity makes the current pattern essentially consistent with the previous eight. Interestingly, the slow start of productivity growth in this expansion stands out more than the relatively high growth rates of the last few quarters.

The case for using productivity growth to date an expansion—or for using the age of an expansion to predict productivity—is weak, despite a statistically significant pattern of productivity increases (higher in the early quarters of the expansion, then increasingly stable until the very

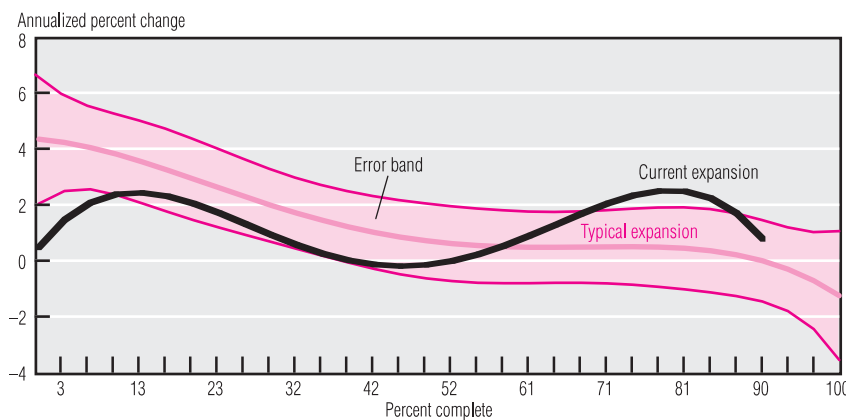
**FIGURE 1 PRODUCTIVITY GROWTH BY NUMBER OF QUARTERS INTO EXPANSION**



**FIGURE 2 PATTERN OF PRODUCTIVITY GROWTH BY QUARTER**



**FIGURE 3 PATTERN OF PRODUCTIVITY GROWTH BY AGE OF EXPANSION**



**SOURCES:** U.S. Department of Labor, Bureau of Labor Statistics; National Bureau of Economic Research, Inc.; and author's calculations.

end). How can this be? First, there are very few recoveries for which we have data on productivity growth. Second, the length of recoveries is highly uncertain. And third, the data on productivity growth are highly variable from quarter to quarter. The approach taken here—looking at the patterns in a smooth underlying component—favors finding an interpretation of patterns in the data. If the quarterly figures were used on their own, the inference would be much less certain. A reasonable error band on the productivity data in the current quarter, based on the length of the expansion phase, is broad, ranging from less than –6 percent to more than 8 percent. So, although productivity is one number we would fervently wish to forecast with confidence, its pattern over the business cycle is not very informative.

**Footnotes**

1. Congress of the United States, Congressional Budget Office, *The Economic and Budget Outlook: Fiscal Years 1999–2008*. Washington, D.C.: U.S. Government Printing Office, 1998; or <http://www.cbo.org>.

2. *Economic Report of the President*, February 1998. Washington, D.C.: U.S. Government Printing Office, 1998, p. 81.

3. The “New Economy” adherents, who argue that a permanent change in U.S. business cycle patterns has already occurred, focus attention on the productivity numbers and their failings. For a careful analysis of this interpretation, see John B. Carlson and Mark E. Schweitzer, “Productivity Measures and the ‘New Economy,’” Federal Reserve Bank of Cleveland, *Economic Commentary*, June 1998.

4. Finn E. Kydland and Edward C. Prescott, “Business Cycles: Real Facts and a Monetary Myth,” Federal Reserve Bank of Minneapolis, *Quarterly Review*, vol. 14, no. 2 (Spring 1990), measure the contemporaneous correlation as 0.51, where 1.0 would indicate perfectly proportional comovements and zero would indicate no comovement. These figures are for detrended data and use household hours and GNP for constructing a productivity measure, instead of using the published series, in order to match the series typically used in real business cycle models. For long-run patterns, the difference between their results and published statistics should be small.

5. The list is that of Ben S. Bernanke and Martin L. Parkinson, “Procyclical Labor Productivity and Competing Theories of the Business Cycle: Some Evidence from Interwar U.S. Manufacturing Industries,” *Journal of Political Economy*, vol. 99, no. 3 (June 1991), pp. 439–59.

6. Economists call this the Solow residual.

7. NBER dating from trough to peak is used throughout. The earliest productivity data are not used because the data for the expansion of October 1945–November 1948 would be incomplete.

8. To combine information from surrounding quarters flexibly, we regressed productivity growth on a four-term quadratic expansion for the number of quarters since the trough. This approach measures a smooth but flexible underlying trend in productivity. The regression is further augmented to adjust for a permanent slowdown in productivity growth after 1973, which has been the focus of considerable research. Using a dummy variable, this regression estimates a slowdown in productivity growth of 2 percent after 1974. An alternative approach, using business-cycle fixed effects, yielded very similar estimates of the time patterns of productivity growth.

9. More detailed statistical tests of difference could very well accept the hypothesis that these early low-productivity growth points are consistent with the existing pattern, once the error in the current period estimates is included and heteroskedasticity is allowed for. I did not undertake these because the conclusion of this *Economic Commentary* is qualitative.

10. Figure 3 employs the same statistical technique used to smooth out some of the quarterly variation in figure 2. Again, the regression includes a four-term quadratic expansion of the time variable (in this case, the fraction of the business cycle completed) and an adjustment for the slowdown in productivity.

11. The  $R^2$  for the fraction regression is 0.195, compared to 0.184 for the regression on the number of quarters.

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