Productivity, the Stock Market and Monetary Policy in the New Economy

ONE OF THE new economy's defining features is faster productivity growth. The new economy's most prominent (and, to many, most worrisome) feature is a booming stock market. Of the new economy's implications, those for monetary policy are among the most controversial.

In this article I discuss productivity growth—what it is, why it's important and evidence that it has recently been increasing. I also touch on the stock market and what it's saying about expectations for future growth in productivity. However, the bulk of the article is devoted to an analysis of the connection between productivity growth and monetary policy.

The main conclusion is that, for policymakers, whether productivity growth is high or low is less important than whether productivity growth is rising or falling. Rising productivity growth means good times for central bankers. It means the Federal Reserve can realistically hope to deliver low unemployment, rising wages and more rapid output growth, all without any acceleration in consumer prices. Once productivity growth stabilizes—even at a high level —policy choices become more difficult.

The good news is we're experiencing faster productivity growth and have reason to believe this faster growth will continue. Over time, even a small increase in productivity growth can lead to a huge improvement in living standards for Americans. Unfortunately, although productivity can keep rising forever, productivity growth cannot. Hence, we must be prepared for a shift to a less favorable policy environment. Looking ahead, the days of low unemployment without inflation are probably numbered,

even if the days of rapid output growth and high stock prices are not. The big challenge will be recognizing the shift in the policy environment when it occurs.

Productivity Growth

What It Is. When people talk about productivity, what they usually have in mind is labor productivity—output per hour or output per worker. Government statisticians distinguish among three underlying sources of labor productivity growth.

The first is increases in the amount of plant and equipment per worker. For example, I recently had an ink-jet printer installed in my office. It saves me from having to walk down the hall when I print something from my computer. It saves others on the floor from having to wait for my documents to print. So both my productivity and that of my colleagues have increased.

The second source of productivity growth is improvements in the quality of the workforce. One would expect a workforce with more schooling and more job experience to be more productive, on average.

The final source of productivity growth is improvements in technology and in the organization of the production process—in other words, better equipment and better management. The label economists apply to productivity gains from this third source is "multifactor productivity growth."

Why We Care. Productivity growth is important because it is the main determinant of changes in our standard of living. Chart 1 shows the growth rate of GDP per capita along with the growth rate of labor productivity. Note how

Chart 1
Productivity Growth Has a Big Impact on Living Standards

Percent per year
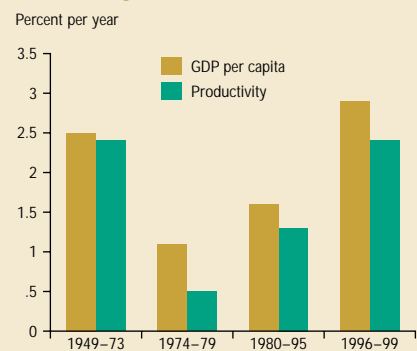
SOURCES: Department of Commerce; Department of Labor; author's calculations.

growth in GDP per capita tends to rise and fall in conjunction with growth in labor productivity.

The most striking feature of the chart is the big slowdown in both productivity and per capita GDP growth during the 1970s. Average annual per capita GDP growth fell from 2.5 percent in the 1950s and 1960s to 1.1 percent in the late 1970s as productivity growth slowed from 2.4 percent to 0.5 percent per year. We don't yet have a good understanding of what caused this deterioration.

Although we saw a partial reversal in the 1980s and early 1990s, it's only been since 1995 that labor productivity and per capita GDP growth have fully recovered. Driven by rapid productivity increases in the high-tech industries, overall productivity growth is back to where it was during its post–World War II golden age.

The timing of the increase in productivity growth is noteworthy. Ordinarily, productivity growth surges as we

emerge from a recession, only to taper off as the economic expansion matures. In contrast, the recent increase began after the economy had been growing for nearly five years. So, there's reason to believe the increase is not just a flash in the pan.

Irrationally Exuberant?

Productivity and the Stock Market. The period of rising productivity growth since 1995 has been marked by sharp increases in price/earnings and price/dividend ratios, suggesting a connection between productivity growth and the stock market. A connection certainly has intuitive appeal. For a given rate of labor force growth, the more rapid productivity growth is, the greater the potential growth rates of output, earnings and dividends. With faster expected growth in earnings and dividends, people are willing to pay more for a stock at any given level of *current* earnings or *current* dividends.[1] That's why an Amazon.com can have a market capitalization some 14 times that of Barnes & Noble, despite never having earned a profit.[2]

Of course, interest rates, inflation and investors' risk perceptions also affect stock valuations. However, if all these other factors are held constant, high stock market valuations ought to signal that investors expect rapid productivity growth.

Chart 2
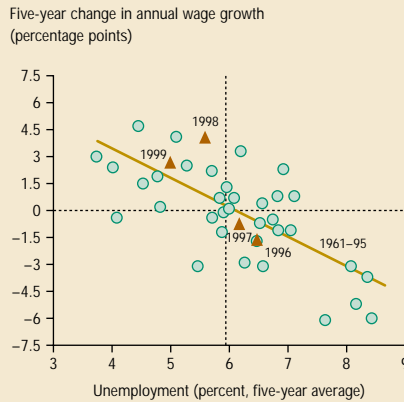### Stock Valuations Predict Strong Productivity Growth

Percent per year
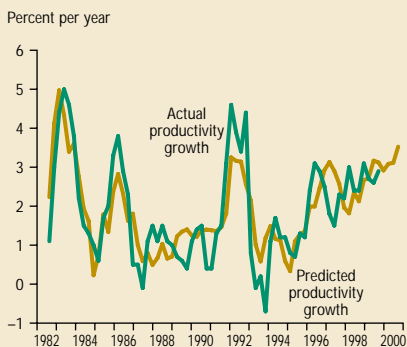
SOURCES: Department of Labor; Federal Reserve Bank of Philadelphia; Standard & Poor's Corp.; Moody's Investors Service; author's calculations.

Chart 3
Wage Growth Accelerates When Labor Market Is Tight

Five-year change in annual wage growth (percentage points)

SOURCES: Department of Labor; author's calculations.

Chart 2 shows what happens when price/earnings and price/dividend ratios are used to predict productivity growth in the nonfarm business sector, after controlling for interest rates, inflation expectations and employment trends.[3] The chart illustrates that although investors have been overly optimistic or overly pessimistic at times, in general they have done a good job of anticipating productivity swings. In particular, recent high and rising stock market valuations have been justified, so far, by high and rising productivity growth.

As of third quarter 1999, investors were anticipating an additional 60-basis-point rise in productivity growth—to 3.5 percent—during the coming year. Hence, current market valuations assume not just that productivity growth will remain rapid but that it will continue to increase in the year ahead.

Productivity Growth and Monetary Policy

That productivity growth is high and may well remain so is extraordinarily good news; it's the story that belongs on the front page with the banner headline. But for monetary policymakers, some more obscure details of the story are important too.

Is Inflation Dead? Since fourth quarter 1995, inflation has remained contained even as output has accelerated and unemployment has fallen to a 30-year low. This performance has led some commentators to proclaim that inflation is dead. Is it true that in the new economy, with faster productivity growth, the Fed need no longer worry about inflation? The answer lies in the linkages between wages, prices, productivity and unemployment.

Chart 3 traces the relationship between changes in wage growth and the level of unemployment over the 35 years from 1961 through 1995. Note that wage growth tends to rise over time when the unemployment rate is low and to fall over time when the unemployment rate is high. The critical unemployment rate is just under 6 percent. Recent experience has been generally consistent with this historical relationship. (See the points marked with triangles.) As Alan Greenspan has noted, at low unemployment rates, "upward pressures on wage costs are inevitable, short of a repeal of the law of supply and demand."[4]

We've just seen that money wage growth rises or falls depending on the amount of slack in the labor market. Chart 4 shows that *real*, or inflation-adjusted, wage growth tracks growth in labor productivity. Faster productivity growth means faster real wage growth. In particular, the higher rates of productivity growth since 1995 have been accompanied by a marked acceleration of real wages. The linkage isn't perfect, but it's quite good. The linkage also makes sense: firms ought to be willing to pay workers more, in real terms, the more productive they are.

Chart 4
Real Wages Rise Along with Labor Productivity

Percent per year

SOURCES: Department of Labor; author's calculations.

Chart 5
Chart 5
Predicted Effects of Rising Productivity Growth

Percent per year

SOURCES: Department of Labor; author's calculations.

Why has inflation not increased despite tight labor markets? The key to the mystery is rising productivity growth. As shown in Chart 4, real wage growth—the difference between money wage growth and inflation—is closely tied to growth in labor productivity:

$$\text{Wage Growth} - \text{Price Growth} = \text{Productivity Growth}$$

Turning this relationship around, price growth is linked to growth in unit labor costs—the difference between wage growth and productivity growth:

$$\underset{\text{(inflation)}}{\text{Price Growth}} = \underset{\text{(growth in unit labor costs)}}{\text{Wage Growth} - \text{Productivity Growth}}$$

Hence, if productivity growth is rising quickly enough, inflation can remain steady or decline even if tight labor markets are driving wage growth higher. In other words, rising productivity growth can offset, or more than offset, the inflationary effects of tight labor markets. That's exactly what has happened over the past four years. Faster growth in output and wages, a falling unemployment rate and low inflation have spelled good times for Joe Sixpack and good times for central bankers—all courtesy of the high-tech productivity revolution.

However, if it is rising productivity growth that has kept tight labor markets from putting upward pressure on inflation, policymakers have reason to be wary. Productivity growth, even if it remains high forever, cannot keep rising forever. Once productivity growth stabilizes, the buffer between tight labor

markets and inflation will disappear. Inflation isn't dead, merely sleeping—awaiting the day when productivity growth begins to level off.

Tough Policy Choices Ahead. It is useful to run through some examples that illustrate how the policy environment will change when productivity growth stops rising. In each case, I assume the economy enjoys a five-year period during which productivity growth rises from 1.2 percent per year to 3.5 percent per year. This path mimics the actual behavior of productivity growth in the United States since 1995. Thus, the 1.2 percent figure matches the rate of nonfarm productivity growth in the U.S. economy in 1995 (and the trend rate of the early 1990s), while the 3.5 percent figure matches the rate stock market investors expect during 2000.[5]

Of course, real-world productivity growth may rise above 3.5 percent. But it can't keep rising forever, and my illustrations all assume that 3.5 percent is the limit. In each year from 2000 on, the average worker produces and earns 3.5 percent more than the previous year—up from a 1.2 percent annual increase in 1995. There's no question that society in general is much better off because of this transition to a higher rate of productivity growth. People feel wealthier than they did before—and justifiably so.

While productivity growth is rising, life is rosy for Fed policymakers as well. They can simultaneously deliver low unemployment and steady inflation, as illustrated in Chart 5. The unemploy-

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Chart 6
Where Do We Go from Here? One Extreme: Hold Unemployment Down

Percent per year

SOURCES: Department of Labor; author's calculations.

Chart 7
Where Do We Go from Here? The Opposite Extreme: Hold Inflation Down

Percent per year

SOURCES: Department of Labor; author's calculations.

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ment path plotted in the chart reproduces the actual path seen in the United States since 1995. Given assumed changes in unemployment and productivity, predicted paths for output growth, wage growth and inflation are generated using the historical relationships displayed in Charts 3 and 4.[6] Note that wage growth is predicted to more than double over five years. Inflation remains low. Output growth rises from 2.7 percent in 1995 to 5 percent in 1999. On the whole, the predicted patterns of output growth, wage growth and inflation pretty well approximate what we've observed in the U.S. economy over this period.

The exercise shown in Chart 5 makes the Fed's job look a lot simpler than it was. Productivity-growth and inflation trends don't become obvious until well after the fact. As a result, many economists, fearing that falling unemployment and rapid output growth would lead to higher inflation, wanted a tighter monetary policy during the late 1990s. At the other extreme were analysts concerned that, without a looser policy, we might actually see runaway *de*flation. Fortunately, those in the middle—"new-paradigm optimists"—won the day.

Policymaking in the years ahead—as productivity growth stabilizes—is going to be even more difficult. I look at two extreme policy choices. The first assumes the Fed tries to hold the unemployment rate at its current level (4.1 percent). Results, shown in Chart 6, are as follows. First, because the unem-

ployment rate remains low, labor markets stay tight and wage inflation rises indefinitely. Second, because rising productivity growth no longer acts as a buffer between wages and prices, price inflation changes direction and begins to follow wage inflation upward. Finally, because the unemployment rate is no longer falling, output growth slows a little.

A policy that implies ever-increasing inflation is ultimately unsustainable, so holding the unemployment rate down permanently is not really an option. The point of Chart 6 is that the longer you try to keep the unemployment rate down, once productivity growth has leveled off, the higher the inflation rate you're ultimately going to be saddled with.

At the opposite extreme from a policy that tries to hold down the unemployment rate is a policy that holds down the inflation rate. Chart 7 shows the consequences that pursuing a hardline anti-inflation stance would have for the labor market and output growth. Because prices respond with a lag to changes in productivity growth, holding inflation down does not require that the unemployment rate return immediately to its long-run average level. Nevertheless, the increase is fairly rapid. Rising unemployment and steady productivity growth are sufficient to halt the acceleration of money wages, but rising unemployment also means a period of sluggish output growth—a "growth recession."[7]

In summary, the days of low unemployment accompanied by low inflation will be over once productivity growth begins to level off. If we try to hold the unemployment rate at an artificially low level after this date, we can expect wage pressures to begin spilling over to prices. If we try to hold inflation down, we can expect to experience a period of slow output growth and rising unemployment.

Know When to Hold Them, Know When to Fold Them. How will policymakers know when it's time to shift gears? The conventional wisdom is that low unemployment, rising wage growth, rapid output growth and high stock valuations are all symptoms of an overheated economy. When we see several of these symptoms at once—as we do

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The Dynamics of Wage and Price Adjustment

The wage growth and inflation paths plotted in Charts 5, 6 and 7 are derived from the following wage and price adjustment equations, which were fitted to data for the nonfarm business sector:

$$w(t) = .193p(t-1) + .210p(t-2) + .117p(t-3) - .039p(t-4) +$$
$$\quad\ (.136) \qquad\quad (.144) \qquad\quad (.142) \qquad\quad (.111)$$

$$.558w(t-1) + .140w(t-2) - .649w(t-3) + .470w(t-4) +$$
$$(.130) \qquad\quad (.130) \qquad\quad (.136) \qquad\quad (.135)$$

$$.256q(t-1) + .127q(t-2) + .155q(t-3) - .057q(t-4) -$$
$$(.092) \qquad\quad (.097) \qquad\quad (.096) \qquad\quad (.088)$$

$$.600[u(t-1) - 5.991]$$
$$(.104) \qquad\quad (.234)$$

Adjusted R^2 = .806   Standard error = 1.100

$$p(t) = .565p(t-1) + .241p(t-2) + .401p(t-3) + .274p(t-4) +$$
$$\quad\ (.192) \qquad\quad (.211) \qquad\quad (.197) \qquad\quad (.151)$$

$$.103w(t-1) + .053w(t-2) - .472w(t-3) - .164w(t-4) -$$
$$(.196) \qquad\quad (.182) \qquad\quad (.186) \qquad\quad (.190)$$

$$.441q(t) + .191q(t-1) + .242q(t-2) + .341q(t-3) + .148q(t-4) -$$
$$(.078) \qquad (.143) \qquad\quad (.149) \qquad\quad (.140) \qquad\quad (.126)$$

$$.470[u(t-1) - 5.991] - 30.802[P(t-1) + Q(t-1) - W(t-1) - 4.595]$$
$$(.147) \qquad\qquad\quad (.234) \quad (10.913) \qquad\qquad\qquad\qquad\qquad (.004)$$

Adjusted R^2 = .773   Standard error = 1.312

Here w, p and q are fourth-quarter-over-fourth-quarter wage, price and productivity growth, respectively. The variables W, P and Q are the log levels of the wage rate, the price level and output per hour. Finally, u is the fourth-quarter unemployment rate. The numbers in parentheses are standard errors. In estimating the equations, several restrictions were imposed. (These restrictions are needed to preserve a stable long-run relationship between the price level and unit labor costs.) In each equation, the coefficients of the lagged price-growth and wage-growth terms were required to sum to 1. In the wage equation, the coefficients of the lagged wage-growth and productivity-growth terms also were required to sum to 1. And in the price equation, the coefficients of the lagged wage-growth terms were required to have the same sum as the coefficients of current and lagged productivity-growth terms. The sample period runs from 1960 through 1998.

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today—it's a clear signal that we need tighter monetary policy.

The conventional wisdom is at best a half-truth. The fact is, low unemployment and accelerating wages are perfectly consistent with a steady or even declining inflation rate if productivity growth is rising. Similarly, unusually rapid output growth and historically high stock market valuations may simply signal that trend productivity growth is higher now than in the past. If low unemployment, rapid wage and output growth, and high stock valuations are accompanied by high and rising productivity growth, they are to be celebrated, not feared.

The implication is that the conventional inflation indicators are of little use unless you know what's happening to productivity growth. Unfortunately,

available measures of productivity growth bounce around a lot from quarter to quarter and are subject to major revisions. So, timely recognition of productivity trends is difficult.

It follows that the best place to look for emerging inflation pressures is probably in the inflation statistics themselves. That doesn't necessarily mean waiting for consumer price inflation to start rising. Changes in commodity prices may give advance warning that retail price increases are in the pipeline.

Conclusions

The good news is that productivity growth has sped up, implying more

Productivity

rapid gains in living standards for the average American and higher real wages for workers.

Investors are counting on continued solid growth in productivity. Indeed, they are betting that productivity growth will increase further in the year ahead. In the past, investors have done fairly well at anticipating fluctuations in productivity growth.

The bad news, from the perspective of the Federal Reserve, is that even if productivity growth remains rapid, policymaking is likely to become more difficult. The tension between our desire for low unemployment and our desire to maintain low inflation will increase in the years ahead.

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Notes

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1. For a brief, informal discussion of this point, see Paul Krugman, "Dow 36,000: A Self-Defeating Prophecy," *Fortune*, December 6, 1999, pp. 70–71. For an in-depth analysis, see Richard W. Kopcke, "Are Stocks Overvalued?" Federal Reserve Bank of Boston *New England Economic Review*, September/October 1997, pp. 21–40.

2. As of January 14, 2000, Amazon.com's market capitalization was $21.9 billion, as compared with $1.52 billion for Barnes & Noble. (Source: http://biz.yahoo.com)

3. The estimated forecasting equation is

$$q(t) = 3.500 + .714R(t-4) - 1.427p^e(t-4) - .962I(t-4) -$$
$$(.710) \quad (.167) \qquad (.556) \qquad (.357)$$

$$.297e(t-4) + .484\epsilon(t-4) - 1.229\delta(t-4)$$
$$(.064) \qquad (.198) \qquad (.487)$$

$$\text{Adjusted } R^2 = .601 \quad \text{Standard error} = .813$$

where q is the four-quarter growth rate of productivity in the nonfarm business sector, R is the interest rate on A-rated corporate bonds, p^e is the 10-year inflation expectation from the Federal Reserve Bank of Philadelphia's survey of professional forecasters, I is the four-quarter growth rate of the labor force, e is the four-quarter growth rate of nonfarm employment, and ϵ and δ are the earnings/price and dividends/price ratios for Standard & Poor's 500. The equation is estimated over a sample period that runs from fourth quarter 1982 through third quarter 1999, with due allowance for a moving average error term. Standard errors appear in parentheses.

4. Humphrey–Hawkins testimony before the House Committee on Banking and Financial Services, July 22, 1999.

5. More generally, the productivity growth rates I use in my examples equal the actual rates recorded in the nonfarm business sector for 1995–98. I assume 3.3 percent productivity growth in 1999 and 3.5 percent productivity growth every year thereafter.

6. To generate the wage and price paths displayed in Chart 5, the historical relationships shown in Charts 3 and 4 are generalized to allow for more sophisticated dynamic interactions. (See the box entitled "The Dynamics of Wage and Price Adjustment.") The output growth path is derived from the assumed paths of productivity and unemployment using Okun's Law. See Arthur M. Okun, "Potential GNP: Its Measurement and Significance," in *The Political Economy of Prosperity*, 1970 (Washington, D.C.: Brookings Institution), pp. 132–45.

7. Chart 7 should be treated with caution. It predicts fairly sharp swings in output growth but takes the path of productivity growth as given. In reality, swings in output growth typically induce endogenous swings in productivity growth in the same direction.

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