Okun's Law Revisited: Should We Worry about Low Unemployment?

by David Altig, Terry Fitzgerald, and Peter Rupert

The Commerce Department yesterday raised its estimate of first-quarter growth to a 5.8 percent annual rate—the highest in more than a decade ...Coming at a time of low unemployment, the unusually rapid growth sparked concerns that it could cause an increase in inflation.

—John M. Berry,
Washington Post Online, May 31, 1997

The quotation above expresses a common, if not dominant, view of the genesis of inflationary pressure in an economy. The story goes something like this: High GDP growth eventually places excessive strain on a nation's resources. This strain can become particularly acute in labor markets, where it is manifested as low unemployment. The labor market tightness associated with this low unemployment ultimately leads to higher prices.

The connection between unemployment and GDP growth is often formally summarized by the statistical relationship known as "Okun's law." As developed by the late economist Arthur Okun in 1962, the "law" related decreases in the unemployment rate to increases in output growth. Over time, the exact quantitative form of this relationship has changed somewhat (a point we will return to below). However, the negative correlation between changes in the unemployment rate and changes in GDP growth is viewed as one of the most consistent relationships in macroeconomics.

The widely accepted connection of Okun's law to inflation can be better understood by noting that the unemployment/output relationship was more precisely considered by Okun as relating percentage deviations of output from its *potential* level to deviations of the unem-

ployment rate from its "natural" level. Potential output was—and is—understood to answer the question, in Professor Okun's words, "How much output can the economy produce under conditions of full employment?"[1] Because "full employment" is defined as the state in which labor markets are neither tight nor slack, inflationary pressures are presumed to arise when output growth pushes beyond its normal levels, which in turn is related to declines in the unemployment rate below its normal levels.

A key aspect of this perspective is the implicit, but critical, role of the potential-output and full-employment concepts in determining whether a particular growth rate or unemployment rate is inherently "inflationary."[2] The meanings and implications of these concepts are the subject of considerable debate among economists. We are ourselves skeptical that there exists a definitive notion of labor market tightness associated with above-trend (or above-potential) real GDP growth that is reliably related to price pressures. Nonetheless, since the conventional wisdom holds that "appropriate" monetary policy should consider this relationship, we will address it on its own terms.

This *Economic Commentary* reviews the connection between labor resource utilization and the growth/unemployment correlation summarized by Okun's law. In general, we emphasize the same caveats offered in Okun's original presentation of the statistical relationship that came to bear his name. The essence of our argument is that recognizing the instability in the relationship between GDP growth and changes in the unemployment rate can help us understand how we have found ourselves in the

Economists have long viewed the negative connection between unemployment and output growth—known as "Okun's law"—as one of the most consistent relationships in macroeconomics. When the economy is strong, unemployment falls, and this labor market tightness eventually leads to inflationary pressures. But how reliable is Okun's law, particularly over short time horizons? The answer has important implications for the proper conduct of monetary policy.

happy circumstance of an economy operating with low (and falling) unemployment, robust growth, and stable inflation.

■ Okun's Law Updated

In his original research, Okun found that a 1-percentage-point decline in the unemployment rate was, on average, associated with additional output growth of about 3 percentage points. Okun's law is now widely accepted as stating that a 1-percentage-point decrease in the unemployment rate is associated with additional output growth of about 2 *percent.* Figure 1, which plots annual changes in real GDP against annual changes in the unemployment rate, illustrates the basis for the current version of Okun's law.[3] The line drawn through the scatter of points indicates that the percentage change in output is roughly 3.2 minus two times the change in the unemployment rate.[4]

This relationship says that every percentage point of output growth in excess of 3.2 percent per year is associated with a drop in the unemployment rate of half a percentage point. For example, output growth of 4.2 percent would coincide with a 0.5-percentage-point decline in the jobless rate.[5]

The 3.2 percent value in this discussion has a natural interpretation as "potential GDP growth" in the Okun's law formulation. Seen in this light, the numbers reported above may seem startling. It has been a while since most Americans believed that the long-run growth rate of the economy is as high as 3.2 percent. In fact, as shown in figure 2, the Okun equation predicts output growth very well over most of the 1970s, but less well from about the mid-1980s on (or in the 1960s, for that matter).

In effect, the relationship between the jobless rate and a given amount of economic growth has shifted over time (and with it, the implied value of potential output). This can be clearly seen in figure 3, which shows the rates of output growth obtained from Okun's law models estimated for three distinct subsamples over the past three decades: 1961–70, 1971–80, and 1981–90. Although the predicted pattern of GDP growth is similar across all three variants, the projected levels are quite different, with the "fit" of the model improving when more recent data are used in the estimation.

Note that although Okun's law does generally capture the shape of the time series of output, there are several instances in which the direction of GDP growth is inconsistent with the model's predictions. In 1993, for instance, Okun's law would have had GDP growth increasing substantially, whereas it in fact fell relative to 1992. The reverse occurred in 1996: GDP growth was higher than in the prior year, despite the decline predicted by the Okun equation.

These short-run "mistakes" in the model occur for precisely the same reasons that the relationship between growth and unemployment does not remain constant over long periods. GDP growth depends in a fundamental way on the level and rate of change of labor resource utilization. This is the case in both the short and the long run, and such changes are only imperfectly captured by changes in the unemployment rate.

■ Labor Resource Utilization and GDP

Although Okun's law expresses a relationship between changes in the unemployment rate and output growth, it is more appropriate to think of it as a "rule of thumb," as it was intended, rather than as an immutable law derived from theory. To understand why the rule of thumb holds, it is necessary to understand the relationship between a nation's output and its inputs to production.

Basic economic theory tells us that output depends on both the amount of inputs used and the level of technology. In a very general categorization, the inputs to production are the labor services provided by a nation's citizens and the services provided by the current capital stock. It follows, then, that changes in output can result from changes in overall productivity, in the flow of capital services, and/or in the quantity of labor services. When observed over a relatively short horizon, such as a quarter or a year, shifts in the aggregate capital stock are likely to be limited because of the difficulty of quickly adjusting the size of this stock. Therefore, changes in output will largely reflect changes in productivity (output per hour) and in the level of labor services.[6]

The output of an economy does not depend directly on the unemployment rate. However, the labor services provided are related to the unemployment rate, and it is through this channel that unemployment is related to GDP growth. As shown in the box on page 3, a simple accounting exercise suggests that in the short run (holding capital services fixed), the percentage change in output can be written as the sum of the percentage change in productivity plus a constant times the percentage change in labor services. The percentage change in labor services, in turn, can be written as the sum of the percentage change in hours per worker, population growth, labor force participation, and other relevant factors (such as worker efficiency levels), minus the absolute change in the unemployment rate.

From this perspective, it may seem surprising that there is much association at all between changes in the unemployment rate and changes in output. After all, a change in the jobless rate is but one of several factors that contribute to a change in GDP. Also surprising is the fact that a 1-percentage-point decrease in unemployment would, on average, be connected with such a large

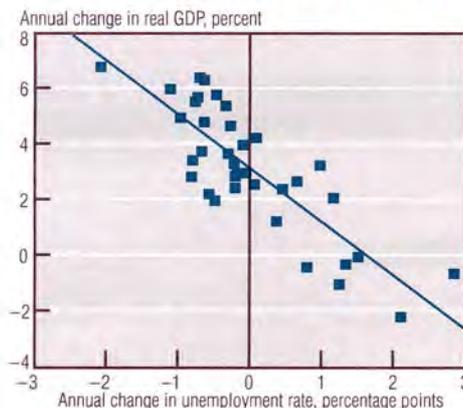**FIGURE 1   UNEMPLOYMENT AND OUTPUT GROWTH, 1960–1996**

Annual change in real GDP, percent

Annual change in unemployment rate, percentage points

FIGURE 2   OUTPUT GROWTH AND OKUN'S LAW

Annual change in real GDP, percent

Actual

Predicted

FIGURE 3   OKUN'S LAW PREDICTIONS

Annual change in real GDP, percent
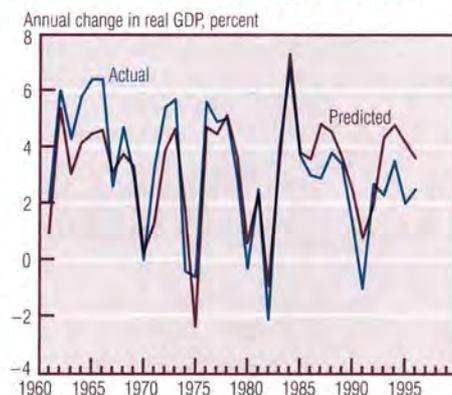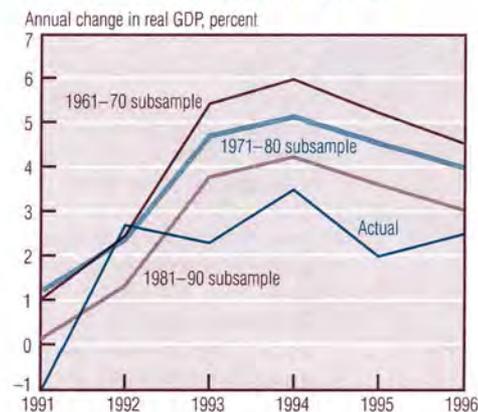
1961–70 subsample

1971–80 subsample

Actual

1981–90 subsample

NOTE: Subsamples in figure 3 are estimates.
SOURCES: U.S. Department of Commerce, Bureau of Economic Analysis; U.S. Department of Labor, Bureau of Labor Statistics; and authors' calculations.

OUTPUT, LABOR SERVICES, AND THE UNEMPLOYMENT RATE

$$\text{Percentage change in output} \cong \text{Percentage change in productivity} + A * \text{Percentage change in labor services}$$

$$\text{Percentage change in labor services} \cong \text{Percentage change in hours per worker} + \text{Percentage change in population} + \text{Percentage change in labor force participation} + \text{Percentage change in other factors} - \text{Absolute change in the unemployment rate}$$

NOTE: Given typical assumptions about the technology that describes the macroeconomy, the parameter A in the first expression can be interpreted as the share of total national income earned by labor. This, of course, would imply that $0 < A < 1$.

(2-percentage-point) increase in output growth. The simple accounting intuition above suggests that a 1-percentage-point drop in the unemployment rate would translate into roughly a 1-percentage-point rise in employment, which itself translates into an increase in GDP growth of something less than 1 percentage point.

The reason that the association between the unemployment rate and output is relatively strong is that changes in the unemployment rate are related to changes in the other factors that affect output growth. For example, using average annual data, a rising unemployment rate is strongly associated with decreases in both hours per worker and labor force participation. Since each of these factors contributes to falling output, it is clear how small upticks in the unemployment rate could be associated with larger declines in GDP.

■ When and Why the Okun's Law Relationship Changes
The preceding discussion sheds light on why and when the association between the unemployment rate and output may change or fail to hold altogether. As noted, a stable and relatively predictable relationship between these two measures requires that the relationship between unemployment and the full set of factors determining labor resource utilization itself be relatively predictable and constant over time.

The association between changes in the unemployment rate and output growth can become less reliable for a variety of reasons, including breaks in the historical magnitude (or even the direction) of the correlation between the unemployment rate and the population growth rate, labor

force participation rates, or average hours per worker. However, the predominant factor that has tended to undermine specific representations of Okun's law (in both the short and the long run) has been changes in productivity.

Productivity changes are only slightly correlated with changes in the unemployment rate, and the variability of these changes is large—roughly two-thirds of the variability of output. Since 1960, annual changes in productivity, measured as total output per hour, have varied from as low as −1.6 percent in 1974 to as high as 4.5 percent in 1962.

Consider the situation in 1993, when the unemployment rate fell 0.6 percent, compared to an increase of 0.6 percent in the previous year. Contrary to what Okun's law would suggest, output growth was lower in 1993 than in 1992. Why? Using the accounting method described above, we find that the difference is due to a relatively large, 2.7 percent increase in productivity that occurred in 1992, versus a slight decline of 0.4 percent in 1993.

Changes in productivity are difficult to predict, even in richer models of the interaction between unemployment and output. Furthermore, it is widely accepted that the trend growth of productivity has tended to shift over time. As the trend path of productivity changes, so must the conventional measures of potential GDP embedded in the standard Okun's law model. Considering this, and the variability of productivity changes generally, it is no surprise that productivity changes are not reliably captured by the simple rule-of-thumb relationship represented by Okun's law.

■ Okun's Law and Monetary Policy
Our discussion can be summarized by the simple observation that the relationship between the unemployment rate and GDP growth changes through time or, in Okun's language, that potential GDP growth is not constant over time. Although this is widely understood to be true over extended periods—decade to decade, say—it is equally true over the much shorter horizons that characterize the business cycle. If these changes are substantial, Okun's rule of thumb can send very misleading signals about the rate of economic growth associated with any given change in the unemployment rate.

From the standpoint of conventional wisdom, the implications of this observation should be clear. Even accepting the proposition that higher output growth begets lower unemployment rates, which in turn beget inflationary pressure, this chain of effects is useful for monetary policy only to the extent that these crucial relationships are stable and predictable. On this score, both theory and evidence provide ample ammunition for the skeptic.

Perhaps the recent downticks in the unemployment rate do indeed signal strains on labor resource utilization that threaten the promotion of price stability, as suggested by the opening quotation. On the other hand, we could be witnessing a fundamental shift in the level of potential GDP, as traditionally defined, and a transition to a new version of Okun's law associated with permanently higher GDP growth. The uncertainty about which of these alternatives is true raises serious questions about the usefulness of Okun's-law-type relationships when conducting monetary policy in real time.

■ Footnotes

1. See Arthur M. Okun, "Potential GNP: Its Measurement and Significance,"American Statistical Association, *Proceedings of the Business and Economics Section,* 1962, pp. 98–103. Gross National Product (GNP) was the typical gauge of total output at the time Okun was writing. It measures the total output of U.S. citizens, independent of the country in which production occurs. Gross Domestic Product (GDP), the measure we use today, represents total output produced in the United States, independent of what country's citizens own the resources used in production.

2. There is a sense in which the terminology used here is misleading and unfortunate. It is widely accepted that in the long run, inflation is a purely monetary phenomenon. In other words, inflation that persists when output is at its potential and unemployment is at its natural rate is solely attributable to monetary growth in excess of demand. Seen in this context, the trend inflation rate is wholly unconnected to the level of resource utilization in labor markets. Nonetheless, for purposes of this discussion, we will proceed using the conventional, though imprecise, language.

3. In his original work (footnote 1), Okun offered changes in GDP growth and the unemployment rate as empirical proxies for deviations from potential, or "natural," levels.

4. The actual estimated linear regression equation is 3.17 for the intercept and –1.93 for the slope.

5. This follows from a simple algebraic rearrangement of the Okun's law equation: Letting u be the unemployment rate and g be the growth rate of GDP, the equation can be expressed as

$$g = 3.2 - 2\Delta u$$
$$\Rightarrow g - 3.2 = 2\Delta u$$
$$\Rightarrow \Delta u = \frac{g - 3.2}{2}.$$

For $g = 4.2$, this implies $\Delta u = 1/2$.

6. This ignores the important possibility that capital services can adjust in the short run via fluctuations in capital's utilization rate. As a measurement issue, failure to control for variable capital utilization would lead us to ascribe too large a fraction of total output to factor productivity.

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The views stated herein are those of the authors and not necessarily those of the Federal Reserve Bank of Cleveland or of the Board of Governors of the Federal Reserve System.