13-1 Productivity, Output, and Unemployment in the Short Run

A production function with technological progress can be written as:

$$Y = F(K, AN)$$

Leaving aside matters concerning capital, then:

$$Y = AN$$

Output is produced using only labor, *N*, and each worker produces *A* units of output. Increases in *A* represent technological progress.

13-1 Productivity, Output, and Unemployment in the Short Run

$$Y = F(K, AN)$$

Then, employment is equal to output divided by productivity.

$$N = Y/A$$

The concern is that, given output, an increase in productivity decreases the level of employment. This chapter explores this issue, in particular, the short- and medium-run responses of output, employment, and unemployment.

13-1 Productivity, Output, and Unemployment in the Short Run

Technological Progress, Aggregate Supply, and Aggregate Demand

Recall the basic structure of the aggregate supply and aggregate demand model:

- Output is determined by the intersection of the aggregate supply curve and the aggregate demand curve.
- The *aggregate supply* relation gives the price level for a given level of output.
- The *aggregate demand* relation gives output for a given price level.

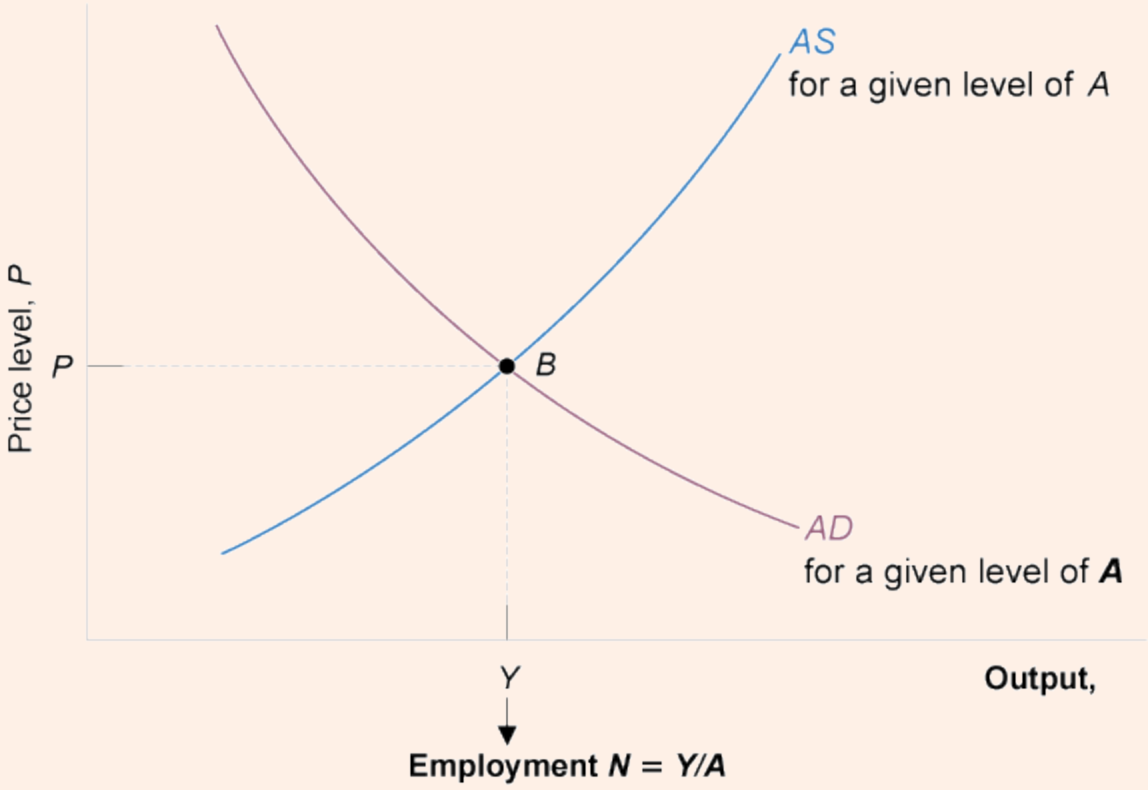
13-1 Productivity, Output, and Unemployment in the Short Run

Technological Progress, Aggregate Supply, and Aggregate Demand

Figure 13 - 1

Aggregate Supply and Aggregate Demand for a Given Level of Productivity

The aggregate supply curve is upward sloping: An increase in output leads to an increase in the price level. The aggregate demand curve is downward sloping: An increase in the price level leads to a decrease in output.



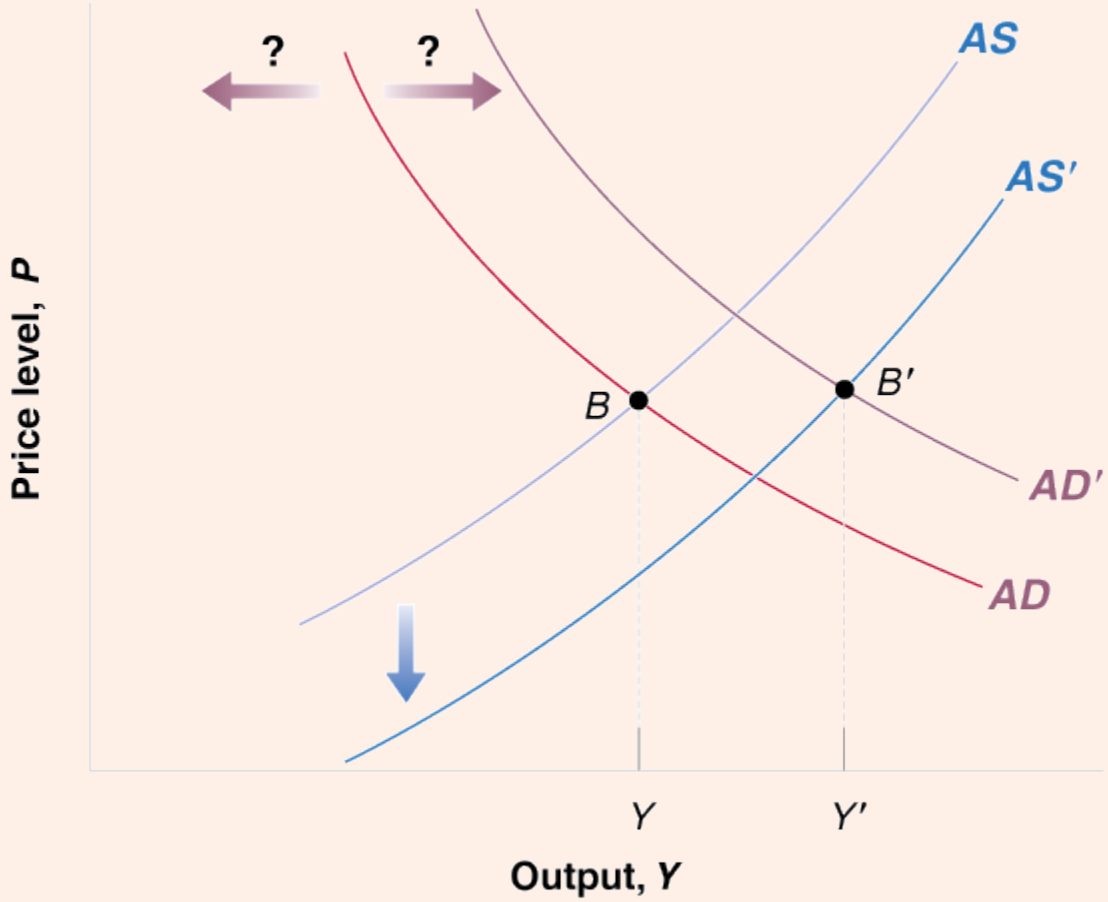
13-1 Productivity, Output, and Unemployment in the Short Run

Technological Progress, Aggregate Supply, and Aggregate Demand

Figure 13 - 2

The Effects of an Increase in Productivity on Output in the Short Run

An increase in productivity shifts the aggregate supply curve down. It has an ambiguous effect on the aggregate demand curve, which may shift either to the left or to the right. In this figure, we assume that it shifts to the right.



13-1 Productivity, Output, and Unemployment in the Short Run

Technological Progress, Aggregate Supply, and Aggregate Demand

The effects of higher productivity on aggregate demand depend on the source of the productivity increase:

- Technological breakthroughs will bring prospects of higher profits and a boom in investment. The demand for goods rises—aggregate demand shifts to the right.

- The more efficient use of existing technologies may require little or no new investment. Worries about job security will trigger more saving—the aggregate demand curve shifts to the left.

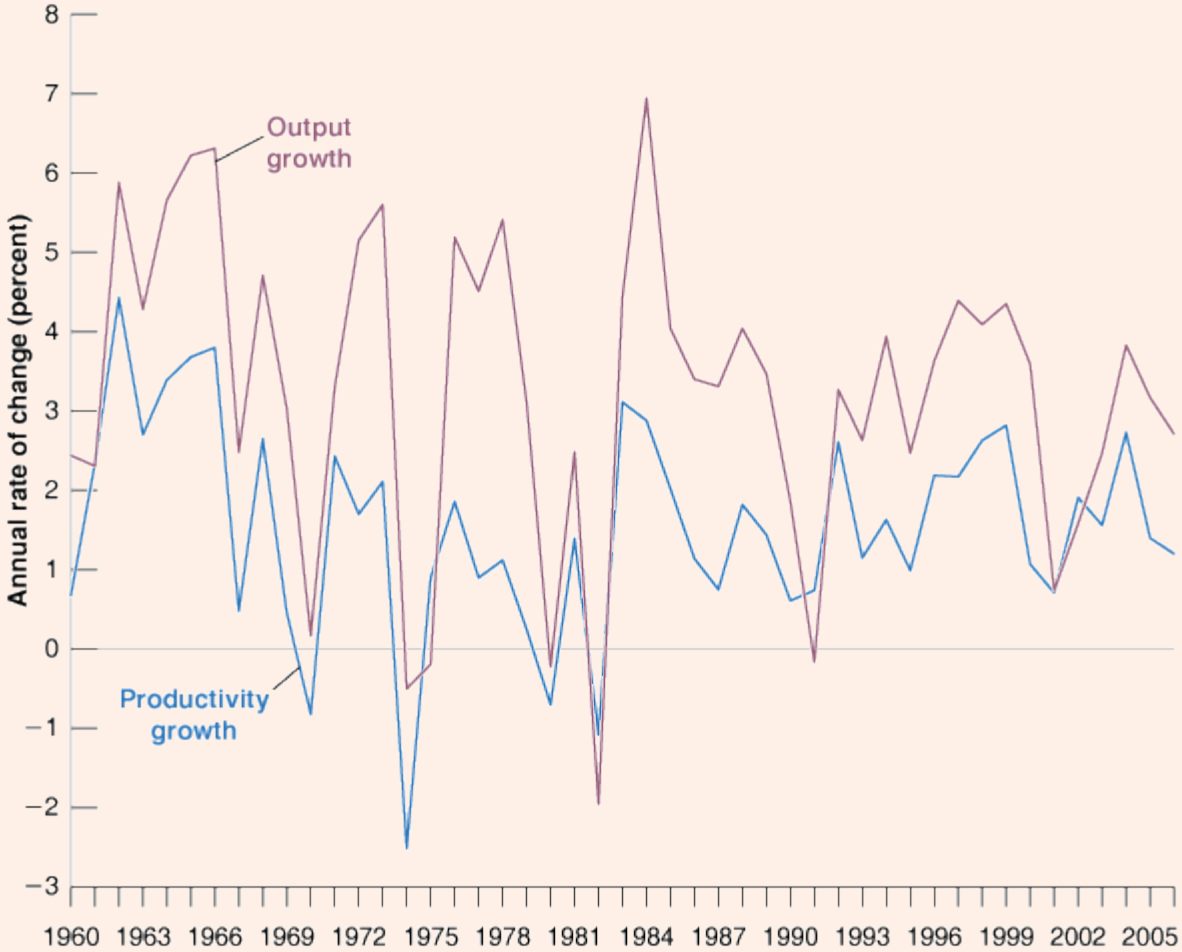
13-1 Productivity, Output, and Unemployment in the Short Run

The Empirical Evidence

Figure 13 - 3

Labor Productivity and Output Growth in the United States since 1960

There is a strong positive relation between output growth and productivity growth. But the causality runs from output growth to productivity growth, not the other way around.



13-1 Productivity, Output, and Unemployment in the Short Run

The Empirical Evidence

Research on the effects of exogenous movements in productivity growth on output shows that:

- Sometimes increases in productivity lead to increases in output sufficient to maintain or even increase employment in the short run.
- Sometimes they do not, and unemployment increases in the short run.

13-2 Productivity and the Natural Rate of Unemployment

Technological unemployment—a concept associated with the *technocracy movement* during the Great Depression—is the argument that unemployment comes from the introduction of machinery.

In its crudest form, the argument that technological progress must lead to unemployment is obviously false.

A more sophisticated version of the argument cannot, however, be dismissed so easily.

Perhaps periods of *fast technological progress* are associated with a *higher natural rate* of unemployment, and periods of *slower progress* are associated with a *lower natural rate* of unemployment.

13-2 Productivity and the Natural Rate of Unemployment

Recall from Chapter 6 that the natural rate of unemployment is determined by two relations, the price-setting relation and the wage-setting relation.

Our first step must be to think about how changes in productivity affect each of these two relations.

13-2 Productivity and the Natural Rate of Unemployment

Price Setting and Wage Setting Revisited

Consider price setting first:

- From $Y=AN$, each worker produces A units of output.
- If the nominal wage is equal to W, the nominal cost of producing one unit of output is therefore equal to $(1/A)\ W = W/A$.
- If firms set their price equal to $1+\mu$ times cost, the price level is given by:

$$\text{Price setting} \quad P = (1+\mu)\frac{W}{A}$$

13-2 Productivity and the Natural Rate of Unemployment

Price Setting and Wage Setting Revisited

An extension of our earlier wage-setting equation that accounts for increases in productivity equals:

$$\text{Wage setting} \quad W = A^e P^e F(u, z)$$

Wages now depend on the expected level of productivity.

- Workers care about real wages, not nominal wages, so wages depend on the (expected) price level, P^e.
- Wages now also depend on the expected level of productivity, A^e.

13-2 Productivity and the Natural Rate of Unemployment

The Natural Rate of Unemployment

$$\frac{W}{P} = \frac{A}{1+\mu}$$

The real wage paid by firms, *W/P*, increases one for one with productivity, *A*. Higher productivity leads to a lower price set by firms given the nominal wage; therefore, the real wage rate rises.

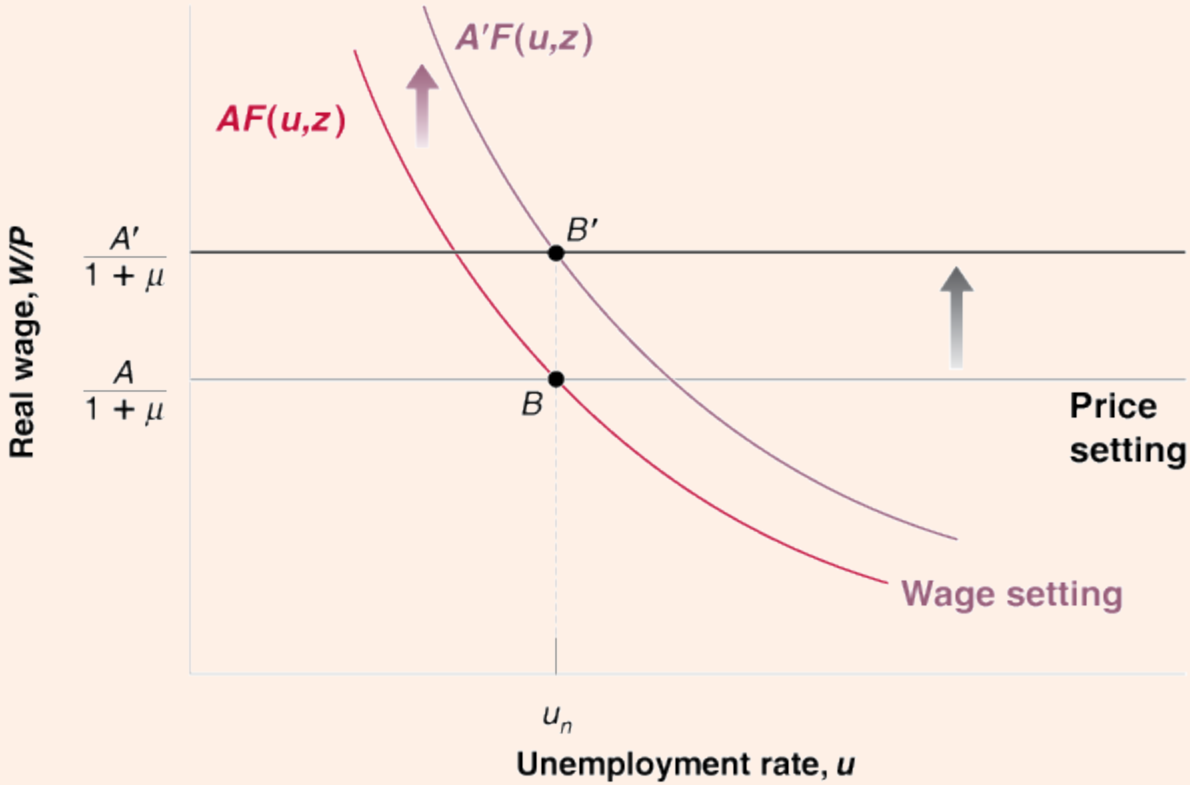
13-2 Productivity and the Natural Rate of Unemployment

The Natural Rate of Unemployment

Figure 13 - 4

The Effects of an Increase in Productivity on the Natural Rate of Unemployment

An increase in productivity shifts both the wage and the price-setting curves by the same proportion and thus has no effect on the natural rate.



13-2 Productivity and the Natural Rate of Unemployment

The Natural Rate of Unemployment

Under the condition that expectations are correct, then Pe=P and Ae=A, the wage-setting equation es:

$$\frac{W}{P} = AF(u,z)$$

The real wage rate depends on both the level of productivity and the unemployment rate.