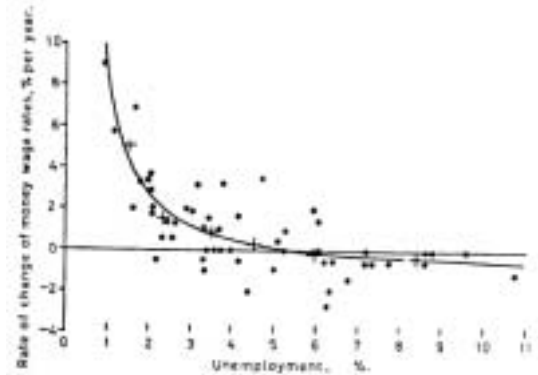


### Phillips Curve

For data for the United Kingdom, the engineer Phillips [1] found a stable statistical tradeoff between inflation and unemployment (figure 1).

1

Figure 1: Inflation and Unemployment 1861-1913



2

### Interpretation

Economists were excited, because the relation was quite stable for such a long period, 1861-1957.

The interpretation was straightforward: unemployment was a proxy for aggregate demand for labor and goods in the economy. Lower unemployment signified higher aggregate demand, so wages rose.

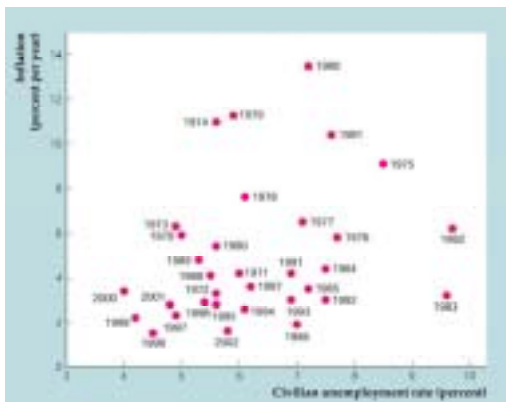
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### Breakdown

Although the relationship held somewhat during the 1960's for the United States, it disappeared for later data (figure 2).

4

Figure 2: Inflation and Unemployment in the United States



5

### Inflation-Augmented Phillips Curve

This failure led to the concept of an inflation-augmented Phillips curve:

$$\pi = \pi^e - h(u - u_N), h > 0. \tag{1}$$

Here  $\pi$  is inflation and  $\pi^e$  is expected inflation.

Here  $u$  is unemployment, and  $h$  is a fixed positive coefficient.

The number  $u_N$  is the “natural rate of unemployment,” explained below.

6

### Price-Setting Equation

Whereas one interprets the traditional Phillips curve as a response of price to demand and supply, in contrast one interprets the inflation-augmented Phillips curve as a price-setting equation. Firms and workers strive to set real (relative) prices and wages in line with unemployment and expected inflation.

Unemployment reduces inflation, as smaller aggregate demand reduces profit margins and wage demands. Expected inflation is neutral, in that one per cent more expected inflation causes prices and wages to be set one per cent higher.

7

### Expected Inflation

If expectations are rational, on average the expectation of inflation should be correct, so on average  $\pi = \pi^e$ .

By (1), therefore on average  $u = u_N$ . Consequently  $u_N$  deserves the name “natural rate of unemployment,” since it prevails on average. Its value depends on the economic structure, factors such as the efficiency of job placement and the size and availability of unemployment benefits.

8

### Short-Run Phillips Curve

Given expected inflation  $\pi^e$  and the natural rate of unemployment  $u_N$ , there exists a tradeoff between inflation and unemployment, as found by Phillips. This relationship is the short-run Phillips curve.

For an economy in recession, unemployment is higher than the natural rate; and inflation is less than expected.

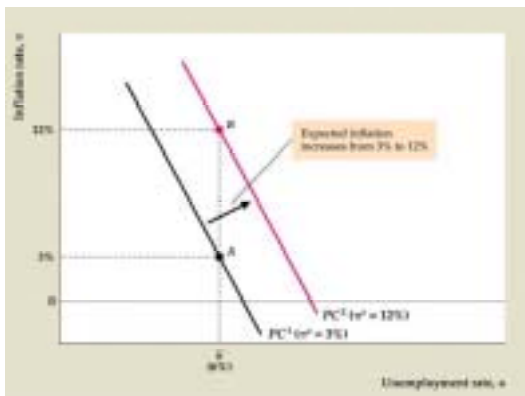
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### Shifting Phillips Curve

However as time passes both  $\pi^e$  and  $u_N$  may change, and the Phillips curve shifts (figures 3 and 4). Such shifts account for the lack of pattern in figure 2.

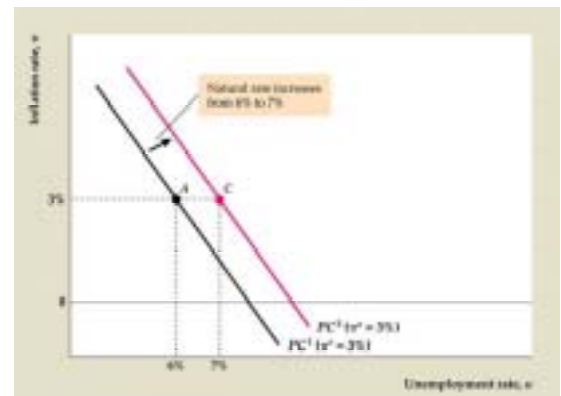
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Figure 3: Changing Expected Inflation



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Figure 4: Changing Natural Rate of Unemployment



12

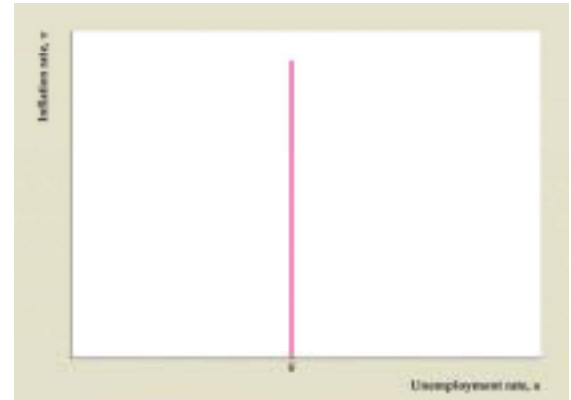
### Long-Run Phillips Curve

On average, in the long run unemployment must average out to the natural rate. Inflation can be high or low.

In figure 5, the “long-run Phillips curve” is therefore a vertical line at the natural rate of unemployment.

13

Figure 5: Long-Run Phillips Curve



14

### References

- [1] A. W. Phillips. The relation between unemployment and the rate of change in the money wage rates in the United Kingdom 1861-1957. *Economica*, 25(100):283–299, November 1958. HB1E5.

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