Introduction to Macroeconomics

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Outline

These slides follow the original slides of Quijano/Quijano that accompany the Blanchard textbook.

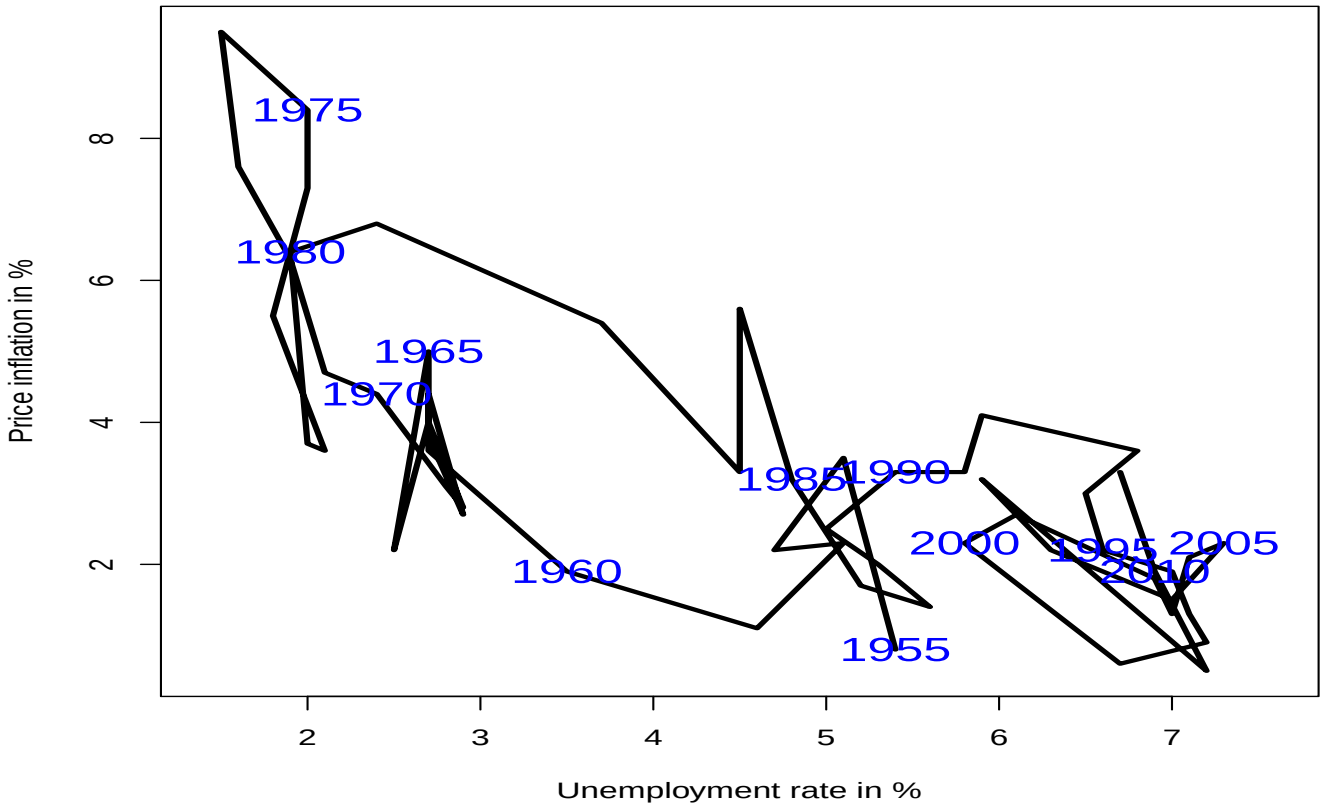
The main idea of this section

The basic workings of IS-LM and AS-AD are derived under the assumption of a stationary economy: output Y has a natural level, prices P tend to remain constant.

In the real world, output tends to grow over time: real economic growth g_Y; money tends to grow over time: monetary growth g_M; prices tend to grow over time: price inflation π.

In this regard, the economy considered in this section is more 'realistic' than the one used in deriving IS-LM and AS-AD.

Scatterplot of unemployment and inflation for Austria



Unemployment tends to be higher in times of low inflation. This negative relation is called the Phillips curve, after William Phillips (1958, U.K. data).

The AS curve and the Phillips curve

The Phillips curve can be derived from a specific form of the AS curve. Consider the aggregate-supply relation

$$P = P^e(1 + \mu)F(u, z).$$

This relation can be rewritten to establish a relation between inflation, expected inflation, and the unemployment rate. To do so, explicitly assume the functional form

$$F(u, z) = 1 - \alpha u + z$$

for some $\alpha > 0$. Insert it into the aggregate-supply relation

$$P = P^e(1 + \mu)(1 - \alpha u + z).$$

A relation in the price level becomes one in inflation

Let prices and their expectations be dated, indexed by t for 'time':

$$P_t = P_t^e(1+\mu)(1-\alpha u_t + z).$$

Unemployment is also dated, everything else is assumed time-constant. Note that

$$\frac{P_t}{P_{t-1}} = 1+\pi_t, \quad \frac{P_t^e}{P_{t-1}} = 1+\pi_t^e,$$

by definition. Division of the above equation by P_{t-1} yields:

$$1+\pi_t = (1+\pi_t^e)(1+\mu)(1-\alpha u_t + z).$$

From this, we obtain

$$\pi_t \approx \pi_t^e + \mu + z - \alpha u_t,$$

by ignoring all 'small' product terms. This (with $=$ instead of $\approx$) is the Phillips curve used in this section.

Interpretation of the Phillips curve

According to this equation:

$$\pi_t = \pi_t^e + \mu + z - \alpha u_t,$$

- An increase in the expected inflation π_t^e leads to an increase in inflation π_t;
- Given expected inflation π_t^e, an increase in the markup μ or an increase in the factors that affect wage determination z lead to an increase in inflation π_t;
- Given expected inflation π_t^e, an increase in the unemployment rate u_t leads to a decrease in inflation π_t.

The early incarnation of the Phillips curve

Assume prices are expected to be constant, and inflation is expected to be 0. If we set $\pi_t^e = 0$, then:

$$\pi_t = \mu + z - \alpha u_t.$$

This is the negative relation between unemployment and inflation that Phillips found for the United Kingdom, and Solow and Samuelson found for the United States (or the **original Phillips curve**).

A comparable Phillips curve emerges if $\pi_t^e = \bar{\pi}$, i.e. a constant rate of inflation is expected:

$$\pi_t = \bar{\pi} + \mu + z - \alpha u_t.$$

Learning about inflation: adaptive expectations

Now suppose workers and also firms expect last year's inflation to persist:

$$\pi_t^e = \pi_{t-1}.$$

Then, the Phillips curve changes to

$$\pi_t = \pi_{t-1} + \mu + z - \alpha u_t.$$

This destroys the original Phillips curve, and instead we have

$$\pi_t - \pi_{t-1} = \mu + z - \alpha u_t,$$

a relation between the changes (first differences) in inflation and the unemployment rate. One may also write $\Delta\pi_t = \pi_t - \pi_{t-1}$.

The wage-price spiral

Remember the effects in the AS model:

$$u_t \downarrow \Rightarrow W_t \uparrow \Rightarrow P_t \uparrow \Rightarrow \frac{P_t - P_{t-1}}{P_{t-1}} \uparrow \Rightarrow \pi_t \uparrow$$

- Low unemployment leads to a higher nominal wage;
- In response to the higher nominal wage, firms increase their prices and the price level increases;
- In response, workers ask for a higher wage;
- Higher nominal wage leads firms to further increase prices. As a result, the price level increases further;
- This further increases wages asked for by workers.

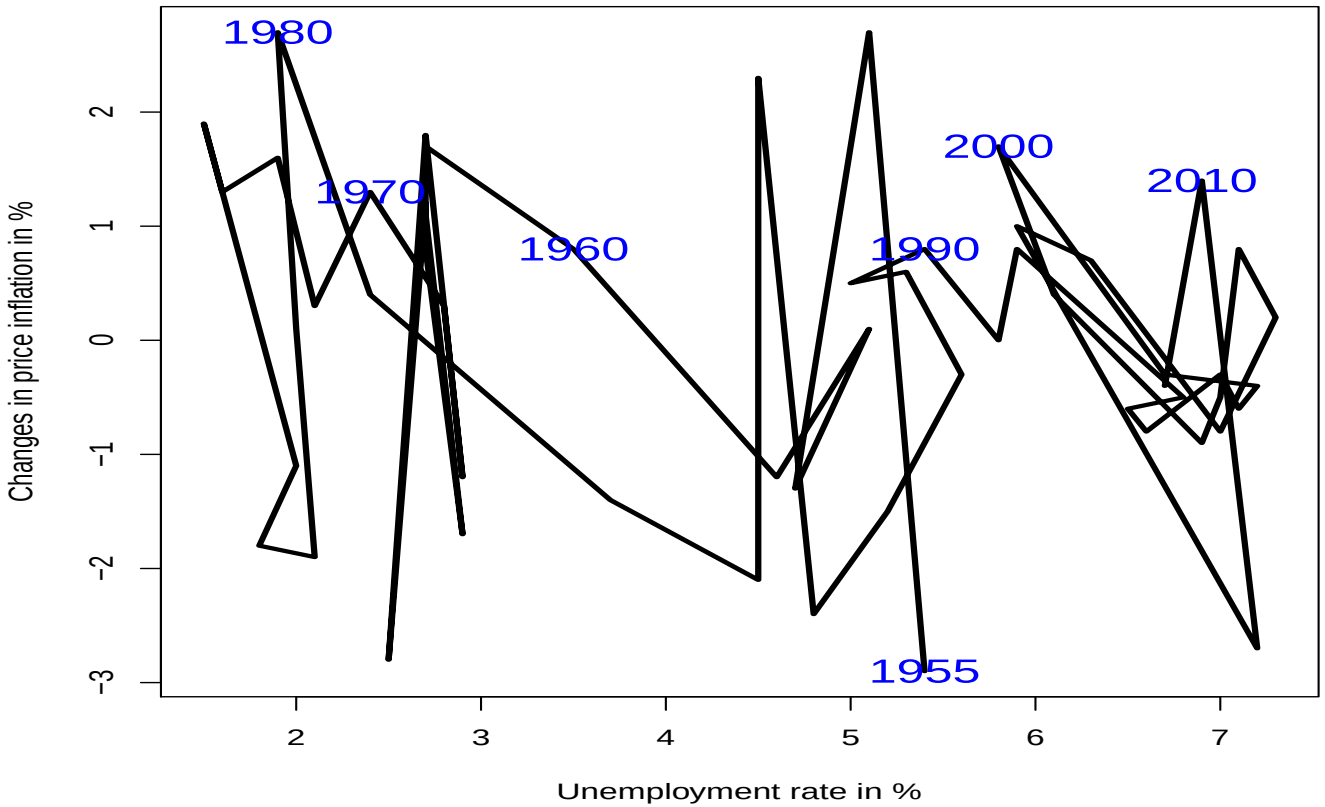
And so the race between prices and wages results in steady wage and price inflation.

The vanishing Phillips curve of the 1970s

The negative relation between unemployment and inflation held throughout the 1960s, but it vanished after that, for two reasons:

- An increase in the price of oil, but more importantly,
- Change in the way wage setters formed expectations due to a change in the behavior of the rate of inflation:
  - The inflation rate became consistently positive, and
  - Inflation became more persistent.

Scatterplot of u_t and $\Delta\pi_t$ for Austria



There is no recognizable relation. The curve may fit for the United States in the 1970s, though not for Austria.

An encompassing model

Suppose expectations are formed as a weighted average ($0 < \theta < 1$) of observed inflation and a constant or target rate:

$$\pi_t^e = \theta \pi_{t-1} + (1 - \theta)\bar{\pi}.$$

This yields

$$\pi_t = \theta \pi_{t-1} + (1 - \theta)\bar{\pi} + \mu + z - \alpha u_t.$$

For $\theta = 0$, this is the original Phillips curve. When θ is positive, the inflation rate depends on both the unemployment rate and last year's inflation rate. For $\theta = 1$, we obtain the curve in differences

$$\pi_t - \pi_{t-1} = \mu + z - \alpha u_t.$$

A formal explanation of the vanishing Phillips curve

The value of θ steadily increased in the 1970s, from zero to one.

As long as inflation was low and not very persistent, it was reasonable for workers and firms to ignore past inflation and to assume that the price level this year would be roughly the same as the price level last year (maybe, plus a basic typical inflation $\bar{\pi}$, such as today's 2%).

But, as inflation became more persistent, workers and firms started changing the ways they formed expectations.

When $\theta = 1$, the unemployment rate affects not the *inflation rate* but the *change in the inflation rate*.

Names

The original Phillips curve is:

$$\pi_t = (\bar{\pi}+)\mu + z - \alpha u_t.$$

The modified Phillips curve, or the **expectations-augmented Phillips curve**, or the **accelerationist Phillips curve**, is:

$$\pi_t - \pi_{t-1} = \mu + z - \alpha u_t.$$

The accelerationist version may not be relevant today, in the era of targeted inflation rates of around 2%. It still often serves as a building block within dynamic macro models.

Back to the natural rate of unemployment

FRIEDMAN and PHELPS questioned the (apparent) trade-off between unemployment and inflation in the original Phillips curve. They argued that the unemployment rate could not be sustained below a certain level, a level they called the *natural rate of unemployment*.

Here, the natural rate of unemployment is the unemployment rate such that the actual inflation rate is equal to the expected inflation rate. For the original Phillips curve, this means:

$$0 = \mu + z - \alpha u_n \Rightarrow u_n = \frac{\mu + z}{\alpha}.$$

u_n is then the unemployment rate that implies no (or only basic) inflation.

Natural unemployment and the accelerationist Phillips curve

For the accelerationist Phillips curve with $\pi_t^e = \pi_{t-1}$ and $u_n = \frac{\mu+z}{\alpha}$,

$$\pi_t - \pi_{t-1} = \mu + z - \alpha u_t = -\alpha(u_t - u_n),$$

$u_t = u_n$ will not lead to no inflation, but rather to constant inflation at the level π_{t-1}. For u_n, any given inflation in $t-1$ will persist.

This gives us another way of thinking about the *natural rate of unemployment*. The *non-accelerating-inflation rate of unemployment* (or **NAIRU**) is the rate of unemployment required to keep the inflation rate constant.

Remarks on the natural unemployment rate

Consider the accelerationist Phillips curve

$$\pi_t - \pi_{t-1} = \mu + z - \alpha u_t = -\alpha(u_t - u_n).$$

When the unemployment rate exceeds the natural rate of unemployment, the inflation rate decreases. When the unemployment rate is below the natural rate of unemployment, the inflation rate increases.

Consider $u_n = \frac{\mu+z}{\alpha}$. The factors that affect the natural rate of unemployment (μ, α, z) differ across countries. There is no reason to expect all countries to have the same natural rate of unemployment.

High inflation and the Phillips curve

The relation between unemployment and inflation is likely to change with the level and the persistence of inflation. When inflation is high, it is also more variable.

The form of wage agreements also changes with the level of inflation. **Wage indexation**, a rule that automatically increases wages in line with inflation, becomes more prevalent when inflation is high.

A Phillips curve with wage indexation

Let λ denote the proportion of labor contracts that is indexed, and $1 - \lambda$ the proportion that is not indexed.
Then, $\pi_t - \pi_t^e = -\alpha(u_t - u_n)$ becomes:

$$\pi_t = \{\lambda\pi_t + (1 - \lambda)\pi_t^e\} - \alpha(u_t - u_n).$$

The proportion of contracts that is indexed responds to π_t, while the proportion that is not responds to π_t^e.

Cases for wage indexation λ

When $\lambda = 0$ and $\pi_t^e = \pi_{t-1}$, all wages are set on the basis of expected inflation (equal to last year's inflation), then:

$$\Delta\pi_t = -\alpha(u_t - u_n).$$

When $0 < \lambda < 1$,

$$\Delta\pi_t = -\frac{\alpha}{1-\lambda}(u_t - u_n).$$

According to this equation, the higher the proportion of wage contracts that is indexed—the higher λ—the larger the effect of the unemployment rate on the change in inflation.

When λ is close to 1, small changes in unemployment can lead to very large changes in inflation.