

Summer School
Key to Exercise 3
Wages, Prices and Unemployment

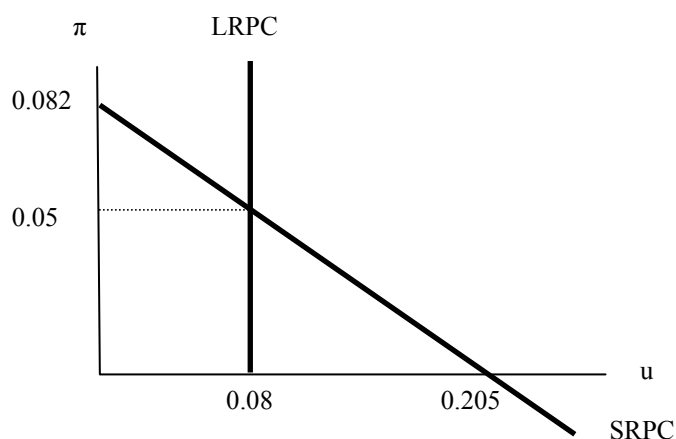
1. An economy has the following Phillips curve:

$$\pi = \pi^e + \varepsilon(u - u^*)$$

where u^* is the natural rate of unemployment, π is the inflation rate at time t and π^e is the expected inflation rate at t .

- (i) Describe briefly what sign you expect on parameter ε . Explain the economic significance of the sign.
- (ii) Assume $\varepsilon = -0.4$, $u^* = 0.08$, and $\pi^e = 0.05$ for all t . Graph the short run and long run Phillips curves (PC).
- (iii) Now assume that $\varepsilon = -0.4$, $u^* = 0.08$ and $\pi^e = \pi_{t-1}$, so that inflation in the current period t depends on unemployment and the inflation of the last period, $t-1$. What is the Non-Accelerating Inflation Rate of Unemployment (NAIRU)? Explain the intuition behind the NAIRU.
- (iv) If the government of the economy wants to reduce inflation by 4%, how much does the Phillips curve suggest unemployment will change?

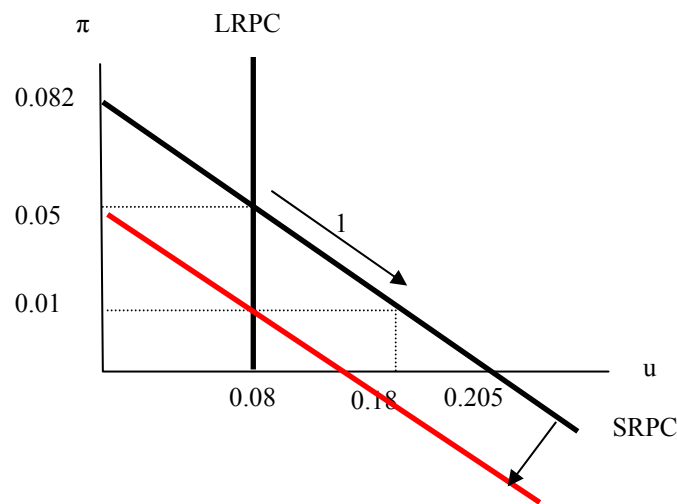
- (i) We expect ε to be negative, that is, $\varepsilon < 0$.
- (ii) Illustration of short-run Phillips Curve (SRPC) and long-run Phillips Curve (LRPC) are as follows: First, the equation for SRPC is $\pi - 0.05 = -0.4(u - 0.08)$. When $\pi = 0 \Rightarrow u = 0.205$ and $u = 0 \Rightarrow \pi = 0.082$. These values give horizontal and vertical intersection points, respectively. Obviously, $\pi = 0.05$ when $u = 0.08$. In the long-run, PC will become $u = 0.08$ by definition. Hence, the illustration is:



- (iii) When we use $\pi - 0.05 = -0.4(u - 0.08)$, we see that NAIRU has to be $u = 0.08$, that is, $u = 0.08$ implies $\pi = \pi^e = 0.05$.
- (iv) Suppose that money stock is decreased such that inflation is reduced by 4%. We may use SRPC to find out the unemployment that this policy will lead to. By substituting respective fall in (actual) inflation in the SRPC, we find out that

$\pi_{t+1} = 0.01 \Rightarrow \pi_{t+1} - \pi^e = 0.01 - 0.05 = -0.04$. Hence,
 $-0.04 = -0.4(u - 0.08) \Rightarrow u = 0.18$. If inflation is to be reduced by 4%, unemployment must rise to 18%. Quite a bit, isn't it?

IMPORTANT REMARK: THE ABOVEMENTIONED TRADEOFF IS NOT PERMANENT. THE HIGH UNEMPLOYMENT CANNOT BE SUSTAINED. IN TIME, NOMINAL WAGES WILL FALL. HENCE, REAL WAGES, w/p WILL FALL. LABOR WILL BECOME CHEAPER. FIRMS START TO HIRE MORE. AND SRPC WILL SHIFT DOWN. THE ILLUSTRATION IS BELOW.



NOTE THAT THE QUESTION DOES NOT ASK THE FINAL EQUILIBRIA. WE EXPLORED IT FOR MATTER OF COMPLETENESS.

2. Suppose the Phillips curve is

$$\pi - \pi^e = -0.5(u - 0.06)$$

- (i) What is the natural rate of unemployment?
- (ii) Graph the short-run and the long-run relationship between inflation and unemployment.
- (iii) How much cyclical unemployment is necessary to reduce inflation by 5 percentage points immediately?

THIS QUESTION IS IDENTICAL TO THE PREVIOUS ONE. YOU MUST BE ABLE TO SOLVE IT.

3. Suppose that the Phillips curve is approximated by the following equation:

$$\pi - \pi^e = -1.1(u - u^*)$$

Assume that the natural rate of unemployment u^* is 5%, $\pi_0 = 0.05$ and that $\pi^e = \pi_{t-1}$. Actual unemployment is

Year	0	1	2	3	4
Actual unemployment (u)	5%	7%	6%	5%	5%

What is inflation in year 3? Year 4?

IT IS SUFFICIENT TO APPLY THE PC RULE: $\pi - \pi^e = -1.1(u - u^*) \rightarrow$

$$\pi_1 - \pi_0 = -1.1(u_1 - u^*) \rightarrow \pi_1 - 0.05 = -1.1(0.07 - 0.05) \rightarrow \pi_1 = 0.028$$

$$\pi_2 - \pi_1 = -1.1(u_2 - u^*) \rightarrow \pi_2 - 0.028 = -1.1(0.06 - 0.05) \rightarrow \pi_2 = 0.017$$

$$\pi_3 - \pi_2 = -1.1(u_3 - u^*) \rightarrow \pi_3 - 0.017 = -1.1(0.05 - 0.05) \rightarrow \pi_3 = 0.017$$

$$\pi_4 - \pi_3 = -1.1(u_4 - u^*) \rightarrow \pi_4 - 0.017 = -1.1(0.06 - 0.05) \rightarrow \pi_4 = 0.017$$

π^e FELL TO A LOWER PLATEAU.

4. Suppose that the Phillips relation stated above still holds. Assume again that the natural rate of unemployment u^* is 5% and the actual unemployment data is

Year	0	1	2	3	4
Actual unemployment (u)	5%	2%	3%	5%	5%

What is inflation in year 3?

THIS QUESTION IS IDENTICAL TO THE PREVIOUS ONE. YOU MUST BE ABLE TO SOLVE IT.

5. Given the following table, calculate u^* , the national natural rate of unemployment:

Group	u^* for the group	fraction
Teenagers	10%	20%
20-40	6%	40%
40-60	4%	30%
>60	7%	10%

$u^* = (0.1)(0.20) + (0.06)(0.40) + (0.04)(0.30) + (0.07)(0.10) = 0.063$ **WE FIND THE NATIONAL LEVEL NATURAL RATE OF UNEMPLOYMENT.**

6. Suppose that a fraction λ of the population follows wage indexation (i.e., those workers adjust immediately and precisely to the actual inflation rate). The remaining fraction has perfectly adaptive expectations. Write down the respective average (weighted) inflation of the population and the Phillips equation.

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

$$\pi - \pi^e = -\varepsilon(u - u^*) \rightarrow$$

$$\pi_t - \lambda\pi_t - (1 - \lambda)\pi_{t-1} = -\varepsilon(u - u^*) \rightarrow$$

$$\pi_t - \pi_{t-1} = -\frac{\varepsilon}{(1 - \lambda)}(u - u^*)$$