# Macroeconomics 1 (A European Perspective)

Week 4

Utrecht School of Economics
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# Recap

# Main readings

Blanchard, O., Amighini, A., Giavazzi, F. (2021). *Macroeconomics: A European Perspective*, 4th edition. Pearson: New York.

Zylberberg, A., Cahuc, P., Carcillo, S. (2014). *Labor Economics*, 2nd edition. The MIT Press.

Pages 1–4 of Lecture Notes of Whelan: Introducing the IS-MP-PC Model.

# Wage determination

- In a perfectly competitive (Walrasian) labour market model, we assume that there is a potentially infinite supply of employees having a *free* and *costless* choice of a large number of employers for whom they might work.

  $\hookrightarrow$ As a result, the **law of one wage** holds;

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- In actual labour markets, there is **equilibrium wage dispersion**.

  $\hookrightarrow$ There is some degree of imperfect competition;

  $\hookrightarrow$ Sources of imperfect competition: search/matching frictions, and institutions & collusion.

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  1. **Ex post wage-bargaining model** (two-sided):
     The matched worker(s) and firm bargain over wage and bargaining could take place collectively (union) or individually.
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     The wage is set unilaterally by the employer before the worker and the employer meet.
- Henceforth, it assumed that the economy has imperfect competition.

# Wage determination

- The aggregate nominal wage ($W$) depends on the expected price level ($P^e$), the unemployment rate ($u$), and other variables ($z$). Throughout, it is assumed that $P^e = P$.
- Algebraically, $W = P^e F(u, z)$.
- Workers do not care about how much money ($W$) they receive, but about how many goods ($W/P$) they can buy with that money.
- In the same manner, firms pay attention to the price of the goods they sell ($W/P$).

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- The marginal cost of production (from labour), which is the unit price (P), is equal to $W$.
- In the non-competitive market, firms set a mark-up of the price over the cost such that $P = (1 + m)W$.

# Price determination

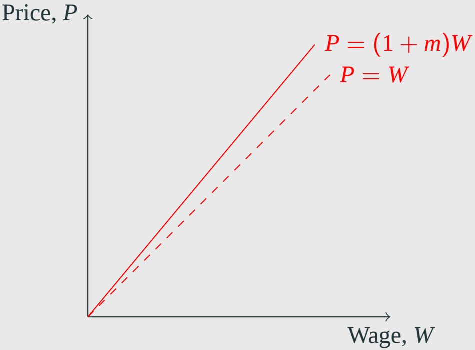


**Figure 1:** In an imperfectly competitive market, firms set the price equal to $(1 + m)W$—the solid line—in lieu of equal to $W$ alone—the dashed line.

# Setting the wage and price levels

- Dividing the wage determination equation, $W = PF(u, z)$, by $P$ gives

$$\frac{W}{P} = F(u, z). \tag{1}$$

  The higher the unemployment rate, the lower the real wage chosen by wage setters. In contrast, the higher the catch-all variables ($z$), the higher the real wage.

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- Let's call this the **wage-setting** (**WS**) relation!
- Dividing the price equation, $P = (1 + m)W$, by $P$ gives

$$1 = (1 + m)\frac{W}{P},$$

and after an appropriate manipulation, we get

$$\frac{W}{P} = \frac{1}{(1 + m)}. \tag{2}$$

The real wage is the reciprocal of 1 plus the mark-up.

- Let's call this the **price-setting** (**PS**) relation!

# Setting the wage and price levels: The equilibrium

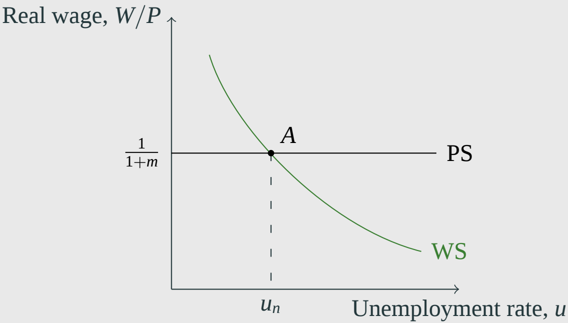


**Figure 2:** Equilibrium of real wage and unemployment rate occurs at point A. Any changes in external factors could shift either of the curves, particularly the WS relation.

# Natural unemployment, employment, and output

- In week 1, we have that $u = \frac{U}{L} = \frac{L-N}{L} = 1 - \frac{N}{L}$.
- This could give us the relation between natural level of employment ($N_n$) and unemployment ($u_n$) by rearranging the terms above such that

$$N_n = L(1 - u_n)$$

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- In the beginning, it assumed that $Y = AN$ and $A = 1$. Therefore, we have

$$Y_n = N_n = L(1 - u_n). \tag{3}$$

- Equating Eq. (1) to Eq. (2), and by solving for $u_n$ in Eq. (3), gives us

$$F(u, z) = \frac{1}{(1+m)} \tag{4}$$

$$F\left(1 - \frac{Y_n}{L}, z\right) = \frac{1}{(1+m)} \tag{5}$$

# Price and unemployment

- Our aim now is to derive the equation for the price level with a specific form for $F(u, z)$. Here, $F(u, z) = 1 - \alpha u + z$.
- Recall $W = P^e F(u, z)$! What is $P^e$? What is $F(u, z)$?

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$$W = P^e(1 - \alpha u + z). \tag{6}$$

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- Then we substitute $W$ in $P$-equation with Eq. (6) to yield

$$\underbrace{P}_{\text{Price level}} = \underbrace{P^e}_{\text{expected price level}} (1+m) \underbrace{(1 - \alpha u + z)}_{\text{unemployment rate}}. \tag{7}$$

## Inflation and unemployment

- After some steps of derivation (please see the appendix), Eq. (7) becomes

$$\pi = \pi^e + (m + z) - \alpha u.$$

- Again! The sign is actually '$\approx$' instead of '$=$'.
- An increase in $\pi^e$ leads to an increase in actual inflation, $\pi$.
- Given $\pi^e$, an increase in the mark-up, or other factors that affect wage determination, causes an increase in $\pi$.
- Given $\pi^e$, a decrease in $u$ leads to an increase in $\pi$.
- Using time subscript, we have

$$\pi_t = \pi_t^e + (m + z) - \alpha u_t. \tag{8}$$

# The Phillips curve

- Firms expect inflation to be on average, say $\bar{\pi}$.
- Hence, Eq. (8) becomes $\pi_t = \bar{\pi} + (m+z) - \alpha u_t$;
  $\hookrightarrow$ The expected inflation is now treated exogenous,
  $\hookrightarrow$ This is what we call 'anchored expectation.'
- They could also de-anchor expectation by means of weighted values of $\bar{\pi}$ and past inflation, $\pi_{t-1}$ such that

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

  where $0 \leq \theta \leq 1$ is the decision weight.
- As such, we could rearrange the inflation equation to be as follows

$$\pi_t = \underbrace{(1-\theta)\bar{\pi} + \theta\pi_{t-1}}_{\pi^e} + (m+z) - \alpha u_t. \tag{9}$$

# The Phillips curve

- Setting $\theta = 1$, we obtain

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

- After rearranging algebraically, we end up with

$$\pi_t - \pi_{t-1} = (m + z) - \alpha u_t. \tag{10}$$

- Therefore, when $\theta = 1$ the unemployment rate affects not the *inflation rate*, but rather the *change in the inflation rate*.

# NAIRU

Please read this brief article about NAIRU by St. Louis Fed. This a good starting point to understand the long-run (natural) unemployment level. Another recommended source is NAIRU by RB Australia, which beautifully visualises the economic cycle and NAIRU. One thing though: I failed to access it on the UU Wifi connection, so please use your own provider to open it.

# Self-recap

Make sure you review and understand, but not limited to, the following terms/concepts

- The assumption of $\pi = \pi^e$. Why and how?
- Variations in the natural rate over time: Good reasons to believe that *m* and *z* vary over time. (Discuss with your study group! And try to relate the concept to the public transport strike or the ASML market power)
- "Wage indexation increases the effect of unemployment on inflation." How does it happen?
- Short-run-to-medium-run adjustment, deflation spiral/trap, dynamic effects of fiscal consolidation, the relation between the price oil and the mark-up of the price over the nominal wage.

# Problem Set

# Problem set

1. Start with the presentation of the WS-PS model as depicted in figure 7.6.
   (a) Explain the downward-sloping appearance of the WS curve.
   (b) Explain the horizontal appearance of the PS curve.
   (c) Give 2 examples of an upward shift of the WS curve.
   (d) Give 2 examples of an upward shift of the PS curve.
   (e) Following an upward shift of the WS curve: what will happen in the labour market?
   (f) Following an upward shift of the PS curve: what will happen in the labour market?
   (g) Imagine that unemployment levels will fall: what will happen in the labour market, according to the WS-PS model?

2. Q3, Page 181 Blanchard. The natural rate of unemployment.

   (a) The Phillips curve is $\pi_t = \pi_t^e + (m + z) - \alpha u_t$. Rewrite this relation as a relation between the deviation of the unemployment rate from the natural rate, inflation, and expected inflation.

   (b) In the previous chapter, we derived the natural rate of unemployment. What condition on the price level and the expected price level was imposed in that derivation? How does it relate to the condition imposed in part (a)?

   (c) How does the natural rate of unemployment vary with the mark-up?

   (d) How does the natural rate of unemployment vary with the catch-all term $z$?

   (e) Identify two important sources of variation in the natural rate of unemployment across countries and across time.

# Problem set

3. Q4, Page 181 Blanchard. The formation of expected inflation. The text proposes the following model of expected inflation:
   $\pi_t^e = (1-\theta)\bar{\pi} + \theta\pi_{t-1}$.
   (a) Describe the process of the formation of expected inflation when $\theta = 1$!
   (b) Describe the process of the formation of expected inflation when $\theta = 0$!
   (c) How do you form your own expectation of inflation – more like part (a), or more like part (b)?

# Problem set

4. The Phillips curve.
   (a) Present the Phillips curve: How can you derive the Phillips curve from the WS/PS model?
   (b) Explain the (positive or negative) output gap.
   (c) In which situation will the 'wage-price spiral' occur?
   (d) In which situation will this not occur or stop?
   (e) Explain the meaning of the NAIRU (inflation-stabilizing rate).
   (f) How does the introduction of expected inflation change the position of the Phillips curve?
   (g) What is the effect of supply shocks on the Phillips curve?

# Problem set

5. The IS-LM-PC model. Start with the IS-LM-PC model as in Figure 9.1, assuming that the full model is in equilibrium, i.e. $Y = Y_n$ and $U = U_n$.
   (a) Explain the relation between the IS-LM-PC model and the WS-PS model.
   (b) Imagine that a positive demand shock occurs: What happens in the short run? What happens in the medium run? What happens meanwhile in the WS-PS model?
   (c) Imagine that a negative demand shock occurs: what happens in the short run? What happens in the medium run? What happens meanwhile in the WS-PS model?
   (d) Imagine that minimum wages increase: what happens in the short run? What happens in the medium run? What happens meanwhile in the WS-PS model?
   (e) Imagine that, due to relaxed competition law, the level of competition in society would fall: what happens in the short run? What happens in the medium run? What happens meanwhile in the WS-PS model?
   (f) Imagine that energy prices increase: What happens in the short run? What happens in the medium run? What happens meanwhile in the WS-PS model?

6. Q5, Page 181 Blanchard. Mutations of the Phillips curve. Suppose that the Phillips curve is given by:

$$\pi = \pi_t^e + 0.1 - 2u_t$$

and expected inflation is given by:

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

and suppose that $\theta$ is initially equal to 0, and that $\bar{\pi}$ is given 2% and does not change. It could be zero or any positive value. Suppose that the rate of unemployment is initially equal to the natural rate. In year t, the authorities decide to bring the unemployment rate down to 3% and hold it there forever.

(a) Determine the rate of inflation in periods $t + 1, t + 2, t + 3, t + 4, t + 5$. How does $\bar{\pi}$ compare to $\pi$?

(b) Do you believe the answer given in part a? Why or why not? (Hint: think about how people are more likely to form expectations of inflation.)

Now suppose that in year $t+6$, $\theta$ increases from 0 to 1. Suppose that the government is still determined to keep $u$ at 3% forever.

(c) Why might $\theta$ increase in this way?

(d) What will the inflation rate be in years $t+6$, $t+7$, and $t+8$?

(e) What happens to inflation when $\theta = 1$ and unemployment is kept below the natural rate of unemployment?

(f) What happens to inflation when $\theta = 1$ and unemployment is kept at the natural rate of unemployment?

7. Q6, Page 182 Blanchard. The macroeconomic effects of the indexation of wages. Suppose that the Phillips curve is given by:

$$\pi_t - \pi_t^e = 0.1 - 2u_t,$$

where

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

Suppose that inflation in year $t-1$ is zero. In year $t$, the central bank decides to keep the unemployment rate at 4% forever.

   (a) Compute the rate of inflation for years t, t + 1, t + 2 and t + 3. Now suppose

   that half the workers have indexed labour contracts.

   (b) What is the new equation for the Phillips curve?

   (c) Based on your answer to part (b), recompute your answer to part (a).

   (d) What is the effect of wage indexation on the relation between $\pi$ and $u$?

# Problem set

8. Q7, Page 182 Blanchard. Exploring the natural rate of unemployment.
   (a) The equation of the Phillips curve from 1970 to 1995 is:

   $$\pi_t - \pi_{t-1} = 7.4\% - 1.2u_t.$$

   Calculate and define the natural rate of unemployment using this curve.

   (b) The equation of the Phillips curve from 1996 to 2018 is

   $$\pi_t = 2.8\% - 0.16u_t.$$

   Here the natural rate of unemployment cannot immediately be calculated from this Phillips curve. Explain why.

   (c) Graph the Phillips relation $\pi_t = 2.8\% - 0.16u_t$ with inflation on the vertical axis and unemployment on the horizontal axis. Calculate and interpret the intercept on the vertical axis. Why might this be an undesirable economic outcome? Calculate and interpret the intercept on the horizontal axis. Why might this be an undesirable economic outcome? What is the unemployment rate if inflation is 2%?

# Problem set

(d) What is the natural rate of unemployment using the relation $\pi_t = 2.8\% - 0.16u_t$ under the assumption that the value of $\bar{\pi} = 2.0\%$. Explain the logic of the calculation.

(e) How has the natural rate of unemployment changed between 1970–95 and 1996–2018?

(f) What are the possible explanations for the change in the natural rate of unemployment between the 1980s and the 2000s?

Questions?