

# LECTURE 5: THE LABOR MARKET\*

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Our analytical framework is built around equilibria in three markets: goods, financial, and labor. This lecture considers the labor market in isolation and introduces how unemployment rate (and wage rate) is determined in the medium run, a time frame over which it is reasonable to assume that price expectations are correct. In the medium run, the unemployment rate tends to return to the so-called natural rate in the medium run, determined by equilibrium in the labor market when the expected price level equals the actual price level. (Assigned reading: sections 6-1 and 6-2 of required textbook)

## 1 WAGE DETERMINATION

Wages are set in many ways. For example, in Japan and most European countries, wages are set by **collective bargaining**, i.e. bargaining between firms and unions. In the U.S., however, most wages are set either by employers or by bargaining between the employer and individual employees. Although institutional differences influence wage determination, there are two sets of common facts:

- Workers are typically paid a wage that exceeds their **reservation wage**, i.e. the wage that would make them indifferent between working or being unemployed.
- Wages typically depend on labor-market conditions. The lower the unemployment rate, the higher the wages.

There are two broad explanations for the above facts:

- Bargaining. The **bargaining power** of a worker depends on two factors: first, how costly it would be for the firm to replace the worker; second, how hard it would be for the worker to find another job. The more costly it is for the firm to replace him, and the easier it is for him to find another job, the more bargaining power he has.
- Efficiency wages. The **efficiency wage theory** argues that firms are willing to pay more than the reservation wage in order to make their workers productive or efficient. Paying a wage above the reservation wage also makes it more attractive for workers to stay and thus decreases turnover.

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These are notes that I used by myself to lecture from and for educational purposes only. The material presented here is largely based upon the undergraduate textbook by Blanchard and Johnson (2012), *Macroeconomics*, 6th Edition, Prentice Hall. Please do NOT circulate.

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*Wages, prices, and unemployment* We capture the determinants of aggregate nominal wage by the following equation

$$W = P^e F(u, z)_{(-,+)} \quad (1.1)$$

which depends on three factors:

- The expected price level  $P^e$ . Both workers and firms care about real wages rather than nominal wages, and wages depend on the expected price level  $P^e$  rather than the actual price level  $P$  because wages are set in nominal terms, and when they are set, the relevant price level is unknown.
- The unemployment rate  $u$ . An increase in unemployment rate leads to a decrease in the nominal wage.
- The other factors  $z$ . This is a catchall variable that stands for all the factors that affect wages given  $P^e$  and  $u$ . For example,  $z$  can represent the **unemployment insurance**, which is the payment of unemployment benefits to workers who lose their jobs, or the **employment protection**, which is the cost for firms to lay off workers.

## 2 PRICE DETERMINATION

We define the **production function**—the relation between the inputs used in production and the quantity of output produced—as follows

$$Y = AN \quad (2.1)$$

where  $Y$  is output,  $N$  is employment, and  $A = Y/N$  is labor productivity, i.e. output per worker, which is assumed to be a constant.<sup>1</sup> We can choose the unit of output so that one worker produces one unit of output. Then  $A = 1$  and the production function becomes

$$Y = N \quad (2.2)$$

which implies that the marginal cost of production—the cost of producing one more unit of output—is equal to the cost of employing one more worker at wage  $W$ . Since many goods market are not perfectly competitive, firms usually charge a price higher than their marginal

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<sup>1</sup>This assumption implies constant returns to labor. In reality, because there is technological progress, labor productivity steadily increases over time. Also, firms use other factors of productions, e.g. capital. We defer the discussion of these complications to a subsequent lecture on output determination in the long run.

cost. Thus, we assume that firms set their price according to

$$P = (1 + m)W \quad (2.3)$$

where  $m$  is the **markup** of the price over the cost. If goods markets were perfectly competitive, then  $m = 0$ . In general, firms have market power and hence  $m > 0$ .

### 3 THE NATURAL RATE OF UNEMPLOYMENT

In what follows, we assume that  $P^e = P$  and look at the implications of wage and price determination for the equilibrium rate of unemployment in the medium run.

*The wage-setting relation.* We may rewrite (1.1) that characterizes wage determination as

$$\frac{W}{P} = F(u, z)_{(-,+)} \quad (3.1)$$

which is called the **wage-setting relation**. It implies a negative relation between the real wage,  $W/P$ , and the unemployment rate,  $u$ : the higher the unemployment rate, the weaker the workers' bargaining position, and hence the lower the real wage.

*The price-setting relation.* We may rewrite (2.3) that characterizes price determination as

$$\frac{W}{P} = \frac{1}{1 + m} \quad (3.2)$$

which is called the **price-setting relation**. It determines the real wage paid by firms: an increase in the markup,  $m$ , leads firms to increase their prices given the nominal wage they have to pay and hence a decrease in real wage.

*Equilibrium real wages and unemployment.* Equilibrium in the labor market requires that the real wage chosen in wage setting be equal to the real wage implied by price setting, i.e.

$$F(u_n, z) = \frac{1}{1 + m} \quad (3.3)$$

where the equilibrium unemployment rate,  $u_n$ , is called the **natural rate of unemployment**. See Figure 1 below. We may also consider how changes in  $z$  and  $m$  affect the equilibrium unemployment rate:

- At a given unemployment rate, higher unemployment benefits lead to a higher real wage. A higher unemployment rate is needed to bring the real wage back to what

firms are willing to pay. See Figure 2 below.

- By letting firms increase their market power, less stringent enforcement of antitrust legislation leads to a decrease in the real wage. Higher unemployment is required to make workers accept this lower real wage. See Figure 3 below.

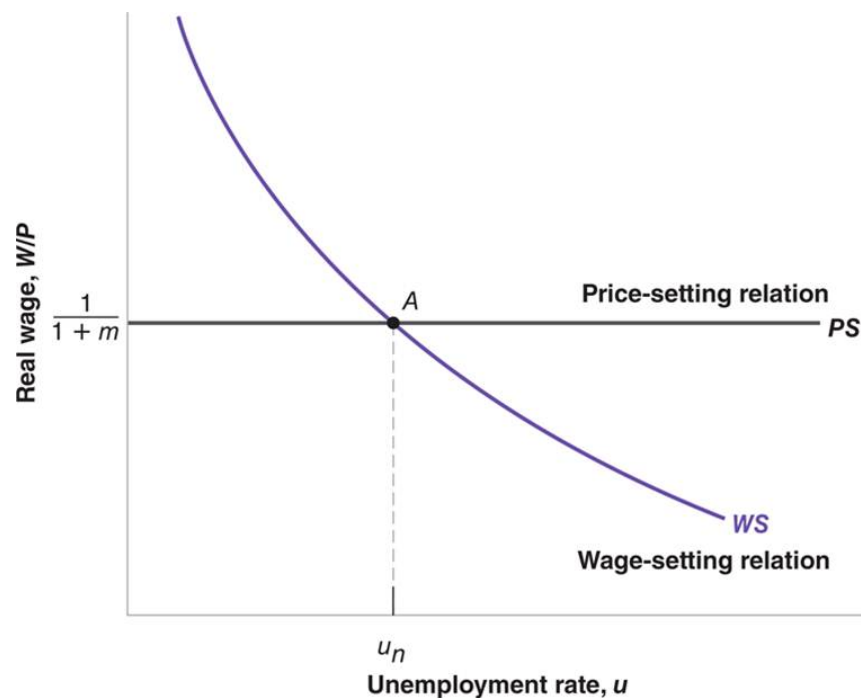


Figure 1. Wages, prices, and the natural rate of unemployment

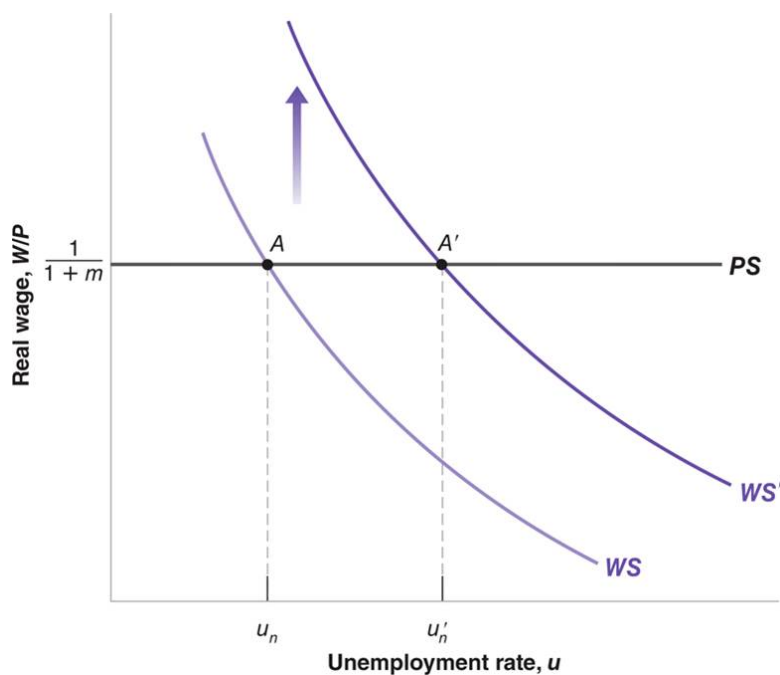


Figure 2. Unemployment benefits and the natural rate of unemployment

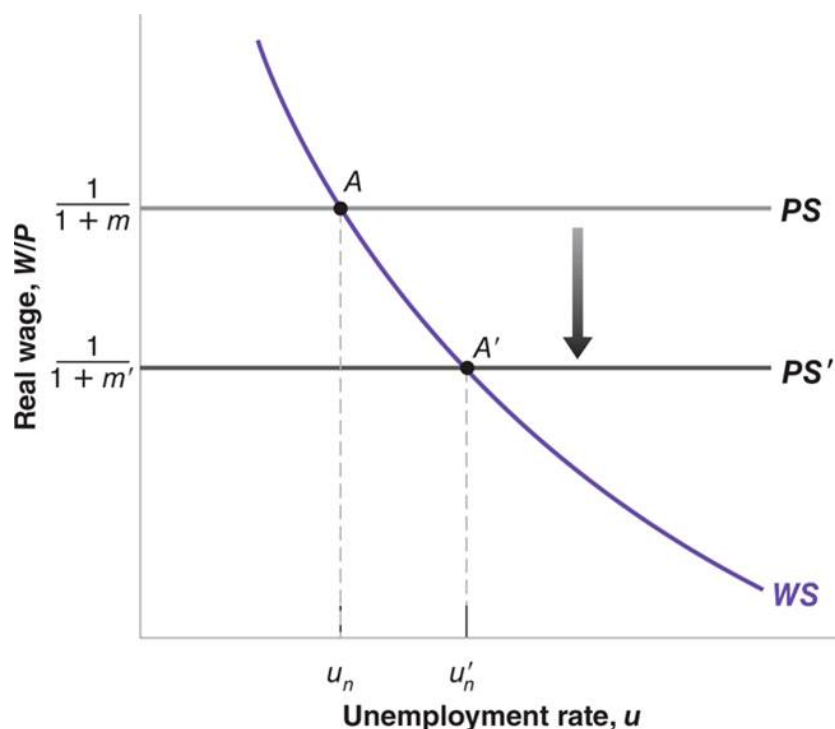


Figure 3. Markups and the natural rate of unemployment

*From unemployment to employment.* The **natural level of employment** is the level of employment that prevails when unemployment is equal to its natural rate. Since the employment rate is given by  $(1 - u)$ , the level of employment can be written as

$$N = L(1 - u) \quad (3.4)$$

and the natural level of employment  $N_n$  is therefore given by

$$N_n = L(1 - u_n) \quad (3.5)$$

For example, the U.S. labor force in 2010 is 153.8 million. If  $u_n = 5\%$ , then the natural level of U.S. employment is 146.11 million.

*From employment to output.* The **natural level of output** is the level of production when employment is equal to its natural rate. Given the production function  $Y = N$ , the natural level of output  $Y_n$  can be written as

$$Y_n = N_n = L(1 - u_n) \quad (3.6)$$

In the above numerical example,  $Y_n = 146.11$  million units of output. Combining with (3.3),

we can obtain

$$F\left(\underbrace{1 - \frac{Y_n}{L}}_{u_n}, z\right) = \frac{1}{1+m} \quad (3.7)$$

which will prove to be very useful in the next lecture.

Caution: the fact that factors determining output movements in the short run, e.g. monetary and fiscal policy, do not enter (3.6) does not invalidate our earlier conclusions about output determination. This is because the price level can be different from what was expected and there is no reason for  $u = u_n$  and  $Y = Y_n$  in the short run. But price expectations are unlikely to be systematically wrong. As a result, both unemployment rate and output tend to return to their natural counterparts.

#### 4 APPENDIX: LABOR SUPPLY AND LABOR DEMAND

We can also measure employment  $N$  on the horizontal axis and represent the wage- and price-setting relations in a way similar to the representation of labor-market equilibrium in terms of labor supply and demand. See Figure 4 below.

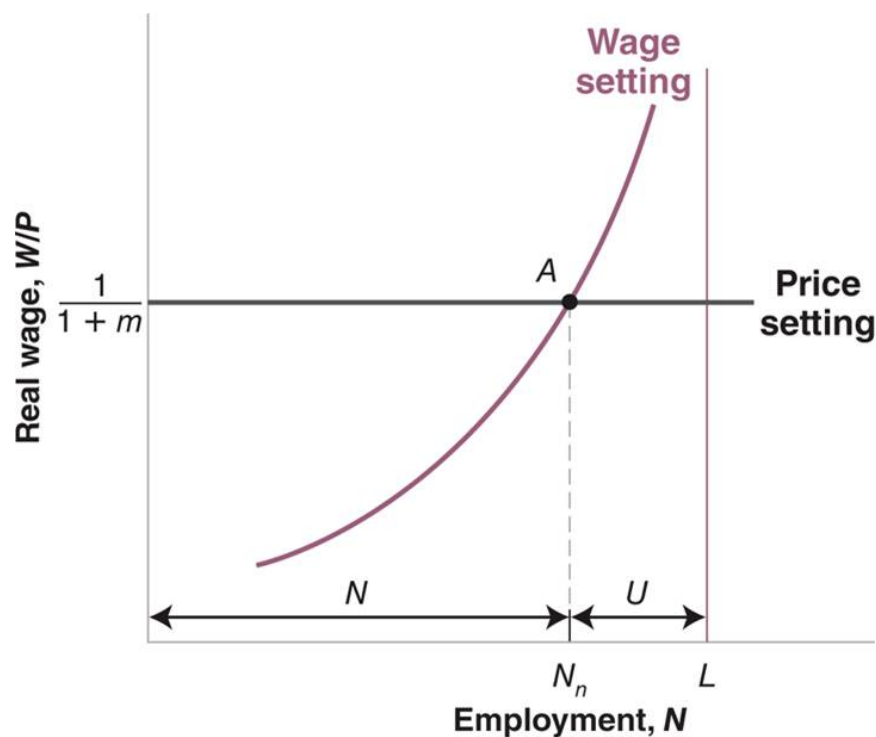


Figure 4. Wage and price setting and the natural level of employment