

## 8. TRADE UNIONS AND UNEMPLOYMENT\*

- In this lecture we consider **another departure from the competitive labour market model**. We will **still think of the labour market as having many individual workers** supplying labour, and perhaps also **many buying firms**, but the **workers are now assumed to be organized in a trade union** that takes care of their interests through its **market power over the (real) wage rate**.
- The **labour markets are thus no longer atomistic**. In each sector of the economy the labour market has **on the supply side a big agent**, the trade union, and this **big agent sets the wage rate** in that market. The trade union will, however, be small in the total economy if there are many labour markets. **If the total labour supply coming from the individual union members exceeds the total labour demand of the firms at the wage rate chosen by the union, then there will be unemployment.**
- That is, **there will be individual workers who would like to work at the going wage rate but cannot find a job**. The presence of these unemployed workers should be **expected to**

**exert a downward pressure on the wage rate.** However, we will **assume that the union has sufficient control over the labour supply to enforce the wage rate it has chosen.** We thus assume that the **labour market is effectively monopolistic.**

■ In the real world **trade unions are most often faced with large agents on the other side** of the labour markets either in the form of **big firms or of employers' organizations** taking care of the interests of employers much the same way that trade unions take care of the workers' interests. However, instead of considering explicitly labour markets with bilateral monopoly, we will **simplify by assigning full market power to the supply side of labour** markets, turning these into monopolies. Our theory could be modified to take account of bilateral monopoly and that qualitatively, although not quantitatively, most of our conclusions would remain unaffected.

■ The lecture is thus concerned with the **economic consequences of labour markets being effectively monopolized** by unions. We begin by discussing **whether unions are important for wages** in practice. Reaching an answer mostly in the affirmative, we continue by presenting a simple **partial equilibrium model of a unionized labour** market. This will give

some **basic insights with respect to the incentive effects** implied by the presence of trade unions and into how a single unionized labour market functions. Then we extend the analysis to a **general equilibrium macro model of the entire economy with many unionized labour markets**. This will give additional insights that could not have been derived from partial equilibrium analysis. In particular, we will find that **unemployment is a necessary implication of labour markets that are monopolized by unions**.

- This lecture takes a rather “**dry**” **view of trade unions**: their only task will be to **set wages in the interests of their members**. In the real world **trade unions are involved in many other tasks**. For instance, they **assist individual members with legal aid, help in negotiations**, etc., when members have disputes or conflicts with their employers. This general presence of the trade union may help to **prevent individual members from being exploited or unfairly treated** by their employer.

- Furthermore, **trade unions take part in arranging general work conditions**. For instance, agreements between unions and firms (or employer's organizations) often regulate the conditions of **safety in the workplace**. Other agreements lay down the rules for the

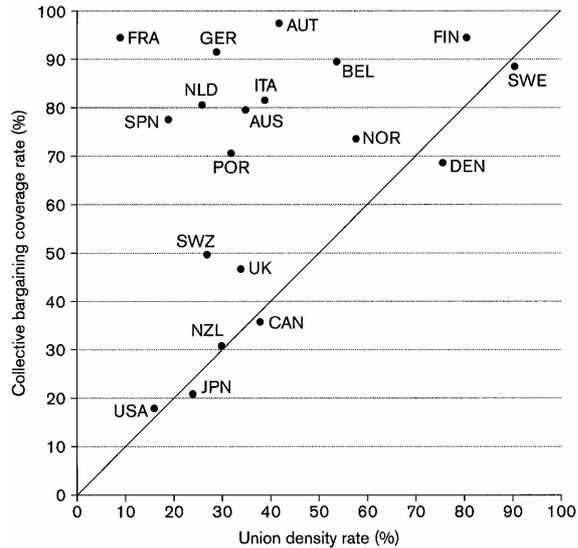
process of negotiation of wages and other issues and may, in particular, establish the existence of a particular **court for resolving conflicts** between employers and employees.

■ This may **help to avoid strikes** and to create a **general environment of security and predictability** concerning the complex relations between employers and employees, leading to **higher average productivity to the benefit of everybody**.

■ It may well be that **these other tasks of trade unions are more important than the task of wage negotiation** and that, historically, the general improvements that trade unions have helped to bring about are more associated with their influence on work conditions and rules in general than with their ability to influence wages. As economists **we focus**, nevertheless, **on this latter aspect**.

**Are unions important?**

- There is no doubt that in a formal sense **trade unions play an important role in many countries**. Figure 8.1 reports two different measures of trade union influence in selected countries.



**Figure 8.1: Union density and coverage rates, 1994**

Source: Employment Outlook 1997 (OECD).

- The “**union density rate**” is roughly the **percentage of all people in the labour force who are union members**, while the “**coverage rate**” is roughly the **percentage of employed people whose work conditions, among them the wage rate, are influenced by trade unions**.
  
- In the **Scandinavian countries both membership and coverage are high**. In several other countries the density rate is not so high, but the coverage rate is nevertheless high. **France is an extreme** such case where, according to the OECD figures, **only 9 per cent of people in the labour force are in unions**, but **unions negotiate the wages for 95 per cent** of all employees. For all countries in the upper part of the figure trade unions are, at least formally, widespread and important. This covers most European countries. In some non-European countries like the **US and Japan both membership and coverage are substantially lower**.
  
- Is **trade unionism increasing or decreasing over time?** In particular, is there some indication that **more and more people prefer not to be members of trade unions**, thereby gradually making unions unimportant? Table 8.1 shows how union density rates have

evolved over time in a number of countries. In some of them **membership has indeed gone down**, but **in other countries density rates have increased**, and there is **no clear tendency** that the decreases are larger or more widespread than the increases. Against this background we may conclude that **in most European countries trade unions appear to be a permanent feature**, both when it comes to density and coverage.

**Table 8.1: Evolution of union density rates over time**

	1960-64	1965-72	1973-79	1980-87 (%)	1988-95	1996-98	Change from 1960-64 to 1996-98 percentage points
Sweden	64	66	76	83	84	87	23
Finland	35	47	66	69	76	80	45
Denmark	60	61	71	79	76	76	16
Norway	52	51	52	55	56	55	3
Ireland	47	51	56	56	51	43	-4
Italy	25	32	48	45	40	37	12
Canada	27	29	35	37	36	36	9
UK	44	47	55	53	42	35	-9
Germany (W)	34	32	35	34	31	27	-7
Netherlands	41	38	37	30	24	24	-17
Japan	33	33	30	27	24	22	-11
New Zealand	36	35	38	37	35	21	-15
US	27	26	25	20	16	14	-13
France	20	21	21	16	10	10	-10

Source: Stephen Nickell, 'Labour Market Institutions and Unemployment in OECD Countries', DICE Report, *Journal of Institutional Comparisons*, 1, 2003, pp. 13-26.

- Although unions are widespread and formally important in many countries, it is open for discussion **how much influence they really have on wages**. The question is to what extent unions really influence wages and **to what extent they have to give in to market pressures and set wages where the market would have set them anyway**.
- The Swedish survey among human resource managers mentioned in the previous lecture (Jonas **Agell** and Helge **Benmarker**, "Endogenous Wage Rigidity", CESIFO Working Paper No. 1081, Category 4: Labour Markets, 2003) also posed the following question to the 1200 managers involved: "**How common is it that your employees (or their union representatives) require wage rises because of high profits**, or high ability to pay, in your firm/organization?" In the sectors of manufacturing and so-called skilled services, **43.5 per cent** and **48.2 per cent**, respectively, **answered that workers or union representatives do demand higher wages when they think the firm has the ability to pay**. This indicates that **managers in firms do experience wage bargaining pressures** from workers and unions.
- **Another way of measuring union influence on wage formation is to compare the wages of union members to the wages of non-union members, or to compare wage levels in**

**unionized and non-unionized sectors** of the economy, **controlling for other factors** likely to affect wages. **Studies** of this kind generally **find a positive influence on wages of union membership**, but a somewhat weak effect in some countries (in the **UK 10 per cent higher wages for union members** than for non-members), and a stronger effect in other countries (**20 per cent in the US**, for instance) (see David Blanchflower and Richard Freeman, “Unionism in the United States and Other Advanced OECD Countries”, *Industrial Relations*, 31,1992).

■ Overall we think it is **safe to assume that trade unions do influence wages**. This lecture will indeed make such an assumption and investigate its potential consequences.

### **A partial equilibrium model of a unionized labour market**

#### **The labour market**

■ We consider a labour market where each of  $N$  **identical workers supplies (inelastically) one unit of labour in each period**, and where the **demand for labour as a function of the**

**real wage**  $w$  is  $L^d(w)$ . For simplicity we assume that the **labour demand curve is iso-elastic**, so  $L^d(w) = zw^{-\varepsilon}$ , where  $\varepsilon > 1$ , and  $z > 0$  is a shift parameter. Without the assumption  $\varepsilon > 1$ , the trade union equilibrium studied below would not be well behaved, since **unions would in principle want to drive wages to infinitely high levels if  $\varepsilon < 1$** .

■ We think of the  $N$  **workers as naturally connected to the labour market considered**. For instance, we may consider the **market for carpenters' labour in a specific area**. In that case the  $N$  **workers are the active carpenters living in that area**. Should one of the  $N$  workers **not get a job in the “local” labour market**, he will be **left with a real income  $v \geq 0$**  which we take as an exogenous variable in the partial equilibrium model. Like in the efficiency wage model,  $v$  **reflects a mix of what can be earned in the economy in general via alternative work opportunities, unemployment benefits, home production, etc.**

■ All of the  $N$  **workers are organized in a trade union**. We assume that this **trade union controls the money wage rate  $W$**  in the labour market considered, and that **through this control the union also determines the real wage rate  $w \equiv W/P$** , because the **general price level is given from the point of view of the union, or because the union takes fully into**

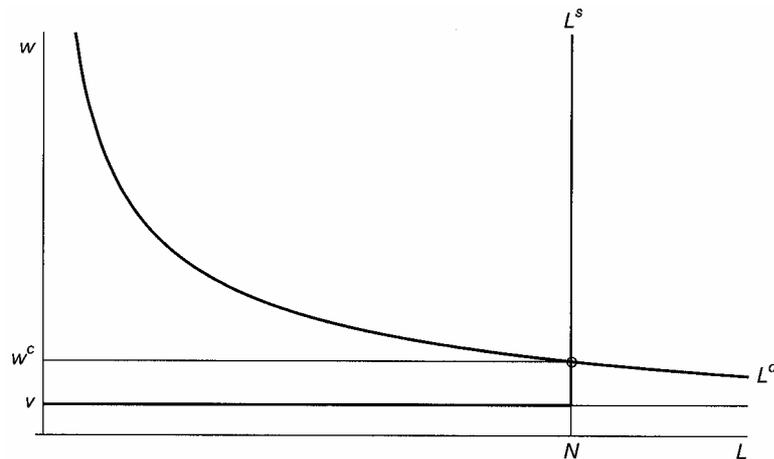
**account how the price level depends on  $W$  (the latter in the case of a large, economy-wide union).**

■ One can think of **labour demand as coming from a relatively large number of wage-taking firms** that decide on **how much labour to hire given a real wage rate  $w$** . Thus the **union does not interfere with the firms' employment decisions**, an assumption sometimes referred to as the firms having the “**right to manage**”.

■ Assume that employers in our “local” labour market are described by a **representative profit-maximizing firm** with a given real **revenue function  $\hat{z}R(L)$** , where  $R'(L) > 0$  and  $R''(L) < 0$ , just as in the previous lecture. The **parameter  $\hat{z}$**  can then be thought of as a **supply or a demand shock that takes values around 1**.

■ **Labour demand** will be **determined by a usual “marginal cost equal to marginal revenue” condition**,  $\hat{z}R'(L) = w$ . We will think of the **labour demand curve**,  $L^d(w) = zw^{-\varepsilon}$ , as **arising from such an optimization**.

- The ingredients of the labour market are illustrated in Figure 8.2.



**Figure 8.2: Ingredients of the labour market considered**

■ The labour supply curve  $L^s$  is vertical, but it is only for real wages above  $v$  that a positive labour supply emerges, since no one would want to work in the specific labour market considered if they could earn more elsewhere in the economy. Thus  $L^s(w) = N$  for  $w > v$ , and  $L^s(w) = 0$  otherwise.

■ The labour demand curve may intersect the labour supply curve either at the labour supply curve's flat segment or at its vertical segment. We assume the latter, as illustrated in Figure 8.2, an assumption that can be stated as  $L^d(v) = zv^{-\varepsilon} > N$ , or  $v < (z/N)^{1/\varepsilon}$ . This means that if the labour market were characterized by competitive wage flexibility, the real wage rate,  $w^c$ , determined by the intersection of supply and demand would fulfil  $w^c > v$ . Algebraically,  $w^c$  would be given as the solution in  $w$  to  $L^d(w) = zw^{-\varepsilon} = N$ , or

$$w^c = \left( \frac{z}{N} \right)^{1/\varepsilon}, \text{ implying } L = L^C = N. \quad 8.1$$

- The condition  $w^c > v$ , or  $(z/N)^{1/\varepsilon} > v$ , is, of course, equivalent to our above condition for  $L^d(v) > N$ .
- Note that given this condition (ensuring  $w^c > v$ ), **if the labour market worked competitively, supply and demand shocks** (changes in  $z$ ) **would imply no fluctuations in employment** (which would always stay at  $N$ ), **whereas fluctuations in the real wage rate would be perfectly and positively correlated with  $z$  and hence with output** (since employment is constant).
- **With an elastic labour supply function, the shifts in the labour demand curve caused by shocks would give rise to fluctuations in both the real wage and in employment, but if the real wage elasticity of labour supply were small, the fluctuations in the real wage would be much larger than in employment.**
- **Empirically, the real wage elasticity of labour supply is small, and this is the situation approximated by the assumption of a completely inelastic labour supply.** The resulting **feature of the model, that fluctuations in the real wage are more closely correlated with**

**fluctuations in output than are the fluctuations in employment**, thus naturally arises from a competitive labour market, but **accords badly with the stylized facts of the business cycle**.

■ We assume that the labour market is not competitive, but monopolistic. One big agent, the trade union, decides on the real wage rate  $w$ . If the trade union sets a wage rate  $w$  larger than  $w^c$ , total employment will be given by labour demand, that is,  $L = L^d(w)$ , and there will be  $N - L^d(w)$  unemployed workers. This means that the rate of unemployment will be given as:

$$u(w) = \frac{N - L^d(w)}{N} \text{ if } w > w^c, \text{ and } u(w) = 0 \text{ otherwise.} \quad 8.2$$

■ But will the union actually want to set  $w > w^c$ ? To answer this crucial question, we must consider the objective of the trade union. What is the trade union trying to maximize?

### **The objective of the trade union**

■ We will assume that the **union's objective is derived from the members' utilities**. Since the members are identical, this will give rise to an unambiguous criterion for the union: it should simply try to **maximize the expected utility of its representative individual members**.

■ With identical union members, it is natural to assume that **in any period where the rate of unemployment is  $u$** , the individual **member's risk (probability) of becoming unemployed is also  $u$** . If the union sets the wage rate  $w$ , the **expected income of each and every union member** in that period will therefore be

$$\Omega(w) \equiv [1 - u(w)]w + u(w)v$$

■ This will also be each **union member's average income in the long run if the unemployment rate stays constant at  $u(w)$** . It is thus in the common interest of all the union

members that in each period the expected, or long-run average, income  $\Omega(w)$  is maximized. Hence the **union sets  $w$  in order to maximize  $\Omega(w)$ .**

■ **Such a  $w$  may involve unemployed members** (if  $L^d(w) < N$ ). In that case it will be in the individual **unemployed member's short-run interest to take a job at a wage lower than the  $w$**  chosen by the union, since this will increase the member's income in the short run where the alternative is unemployment.

■ However, it will be in the **individual member's long-run interest not to erode the market power of the union by such wage undercutting**, since the union sets the wage rate so as to maximize each and every member's long-run (average) income. It is an underlying **assumption here that members have realized this state of affairs** and therefore, through the union, have **made arrangements preventing undercutting**.

■ The **solution  $w^*$  to the problem of maximizing  $\Omega(w)$  is unique** (see below) and either  $w^* = w^c$  or  $w^* > w^c$ . In the latter case we say that the solution is interior. From the definition of  $u(w)$ , we have for  $w > w^c$ :

$$\Omega(w) = \frac{L^d(w)}{N}w + \frac{N - L^d(w)}{N}v = \frac{1}{N}(w - v)L^d(w) + v$$

■ Since the trade union takes  $N$  and  $v$  as given, an interior solution is simply a  $w^*$  that maximizes  $(w - v)L^d(w)$  with respect to  $w$ , where  $w^* > w^c$ . Note here that  $(w - v)L^d(w)/N$  has the interpretation that it is the **excess of the expected income that the union ensures for a worker over what the worker could get in the general economy**. Maximizing  $(w - v)L^d(w)$  is the **same as maximizing this surplus, or rent, from union membership**.

### Analysing the model

■ You may already have noticed yourself that setting  $w$  to maximize  $(w - v)L^d(w)$  is **equivalent to a traditional profit maximization problem of a monopolist firm**, if this firm has constant marginal cost  $v$  and is faced with a demand curve identical to  $L^d$ . It is also well known that **with an iso-elastic demand curve this problem has a unique solution where**

**price is a mark-up over unit cost**, and the **mark-up factor is given by the elasticity of the demand curve** as  $\varepsilon/(\varepsilon - 1)$ . Therefore, if the solution  $w^*$  to the union's maximization problem is interior it must be:

$$w^* = \frac{\varepsilon}{\varepsilon - 1}v, \text{ implying } L = L^* = z \left( \frac{\varepsilon}{\varepsilon - 1}v \right)^{-\varepsilon} \quad 8.3$$

(Just to confirm, set the derivative of  $(w - v)L^d(w)$  with respect to  $w$  equal to zero which gives (8.3) when solved for  $w$ .)

■ Conversely, if the  $w^*$  given this way fulfils  $w^* > w^c$ , then indeed the union's optimum is interior and the unique optimal wage rate is  $w^*$ .

■ Drawing some **indifference curves of the union** in a diagram like Figure 8.3 gives a good illustration of the union's behaviour, and verifies some of our claims. **Combinations of wage and employment which ensure the same level of union utility** are  $(w, L)$  such that

$\frac{L}{N}w + \frac{N-L}{N}v = \frac{1}{N}[(w-v)L + Nv]$  is constant. These are, for a given  $N$ , **hyperbolas** of the form  $(w-v)L = \text{constant}$ , with the  $w$ -axis as **vertical asymptote** and  $w = v$  as **horizontal asymptote** (see Figure 8.3).

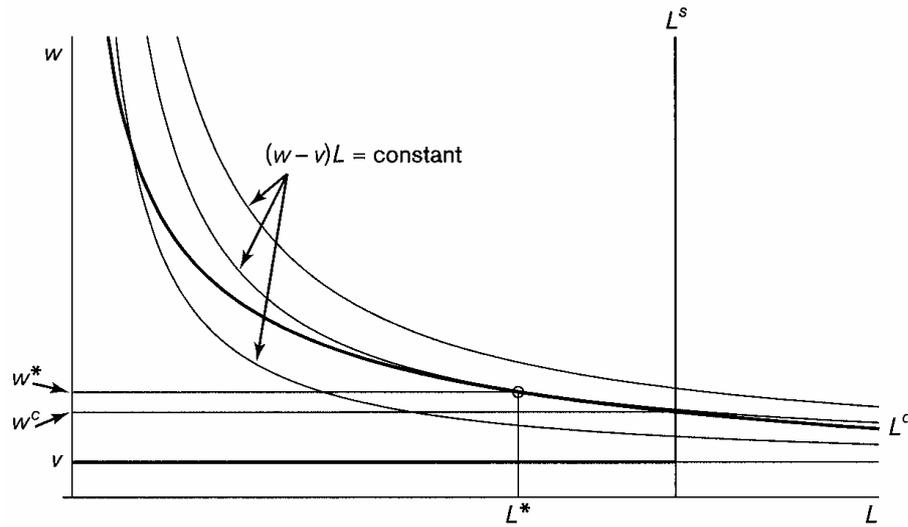


Figure 8.3: The union optimum

■ The union's optimum is where the **highest indifference curve intersects the area below the labour demand curve,  $L^d$ , and to the left of the maximal labour supply,  $N$** . This could either be **at the corner  $(w^c, N)$  or at an interior wage rate  $w^* > w^c$** . In the figure the latter is the case. **In all circumstances the optimum of the union is unique**, and if it is interior it is given by (8.3).

■ The union's **optimum may well be such that  $w^* > w^c$** , which implies **unemployment in equilibrium**:  $L^* = L^d(w^*) < L^s(w^*) = N$ . Using (8.1) and (8.3), the **condition for unemployment to emerge**,  $w^* > w^c$ , can equivalently be written:

$$\frac{\varepsilon}{\varepsilon - 1} v > \left( \frac{z}{N} \right)^{1/\varepsilon} \quad 8.4$$

■ This is indeed fulfilled for  $v$  or  $N$  large enough, or  $z$  small enough.

### **Discussion of the model's main implications**

- A first **conclusion from the partial equilibrium** model is that there **may well be unemployment in an equilibrium** where the wage rate is fully adjusted in the sense that the wage-setting agent, the union, does not want it to be any different. **Is there no pressure downwards** on the wage rate in such an equilibrium?
  
- There are surely **unemployed individuals who would like to work at even lower wages**. For these workers not to imply a downward pressure on the wage, it must be assumed, as mentioned earlier, that the **union has been given the power to hold back labour supply**, that is, **to order members not to take jobs at wage rates lower than the one set by the union**.
  
- **To delegate this power to the union is in the long-run interest of the members**, since this is what makes it **possible for them to appropriate the monopoly rent** in the labour market. However, the presence of jobless workers whose short-run interest it is to take jobs at lower wages may give rise to **difficulties holding the union together**.

- These **difficulties** are of exactly the same nature as those **facing any cartel**. For instance, exactly in so far as the **OPEC** organization of oil-producing countries manages to hold the **price per barrel of oil above the marginal cost** of producing one barrel, and in this sense is successful, individual **OPEC members will have an incentive to sell more oil at lower prices**.
  
- The **unemployment in an equilibrium** where  $w^* > w^c$  is **involuntary at the individual level**. One could say that it is “**collectively voluntary**”, since it arises only because all the **individual workers have decided to form a union that manages to hold the wage rate above  $w^c$  in the best long-run interest of the members**.
  
- A **second conclusion** is that **when the equilibrium involves unemployment**, that is, when (8.4) is fulfilled, the **real wage rate is insensitive to demand and supply shocks while employment, and therefore output, vary in the same direction as  $z$** .

- This can be seen directly from (8.3), where the **optimal wage rate,  $w^*$ , does not depend on  $z$**  (as long as  $v$  is not affected by  $z$ ), and **employment  $L$  is proportional to  $z$** . Since **employment co-varies closely with  $z$** , the rate of **unemployment,  $u^* = 1 - L^*/N$** , will fluctuate as well and be **negatively correlated with output and employment**.
- At the same time the fundamentals of the labour market may well be such that **if the market were competitive, demand and supply shocks would affect  $w$ , but not  $L$** . It was shown above that this requires that  $w^c$ , as determined by  $L^d(w) = N$ , is larger than  $v$ , or  $v < (z/N)^{1/\varepsilon}$ . So, if  $v < (z/N)^{1/\varepsilon} < (\varepsilon/(\varepsilon - 1))v$ , then for  $z$  fluctuating around 1, a **competitive labour market would imply fluctuations in  $w$  in the same direction as the fluctuations in output and no (or minor) fluctuations in employment, while a unionized labour market would imply no fluctuations in  $w$  and fluctuations in  $L$  in the same direction as those in output**.
- Thus, under a plausible assumption that **permanent changes in productivity ( $z$ ) are fully reflected in the normal income level  $v$** , while **short-run random fluctuations in  $z$  are not**, the trade **union model** may well, as (8.3) shows, have the property that **the first type of**

**productivity shock affects the real wage proportionally while the second type does not affect the real wage, but affects employment proportionally to the shock.**

■ **These features are in good accordance with the stylized facts of growth and business cycles, respectively, so the trade union model (as well as the efficiency wage model) may contribute to bringing these two types of facts in accordance with each other.**

### **Trade unions in a macroeconomic framework**

■ **We will now consider a macroeconomic framework with many labour markets, where the demand curves for each type of labour as well as the general income level  $v$  will be endogenized. This will give rise to a full macroeconomic equilibrium determining the real wage, total employment and GDP.**

### **A macroeconomic framework**

■ The **framework** considered is very **close to the one studied in the previous lecture**. Just as in the macroeconomic efficiency wage model, we will assume that there are  **$n$  differentiated products** and that the demand curve for each product  $i = 1, \dots, n$  is:

$$D(P_i) = \left( \frac{P_i}{P} \right)^{-\sigma} \frac{Y}{n}, \sigma > 1 \quad 8.5$$

where  $P_i$  for  $i = 1, \dots, n$  are the **nominal prices** of the different products. This **demand curve** is in all respects as in the previous lecture: it can be viewed as **arising from a representative household's optimization of a CES utility function**,  $P = P(P_1, \dots, P_n)$  is the appropriate **price index**,  $Y$  is an indicator of **aggregate demand** that turns out to be the GDP of the economy, and  $\sigma$  is the **elasticity of demand with respect to  $P_i$  or  $P_i/P$**  (and equal to the elasticity of substitution between the different product varieties in the consumer's utility function).

■ **For each product there is a single firm** producing that type of output, so our framework is again one of **monopolistic competition** with one single firm representing the industry for each product. The **production function** of firm  $i$  is the **simplest possible**:

$$Y_i = L_i \quad 8.6$$

where  $L_i$  is labour input, and  $Y_i$  is output. **All industries use the same kind of labour**, but the **firm in sector  $i$  has to hire labour only from members of the trade union** that organizes all the workers presently connected to industry  $i$ . This framework is intended to represent an **economy with industry unions**.

■ In each industry's labour market a **single firm thus faces a single trade union**. This should define a **bilateral monopoly** and the **wage,  $W_i$ , in labour market  $i$**  should be determined in some form of **negotiation between the firm and the trade union**.

■ For simplicity we will, nevertheless, **assume that the trade union in each labour market has all the market power and sets the wage as a monopolist**. As a consequence of our

simplifying assumption of monopoly unions, **each firm takes the money wage rate,  $W_i$ , as set by the union of sector  $i$  as given.** The **firm decides unilaterally how much labour it will employ at that wage**, so in our trade union model the **firms have the right to manage.**

■ We will assume that in a given period a specific number,  $N_i$ , of workers are connected to production sector  $i$ . **Each worker supplies one unit of labour inelastically.** The workers of sector  $i$  are all gathered in the trade union that sets the money wage rate,  $W_i$ , in accordance with the members' interests. The **union takes  $N_i$  as given** as this number results from the number of workers seeking employment in sector  $i$ . Since there are many sectors, **each union also takes economy-wide variables such as  $P$ ,  $Y$  and  $n$  as given.**

■ It will be part of our story that **workers are not permanently tied to a sector**, but can **migrate to other sectors** in between periods. In a full macroeconomic equilibrium it will be **determined endogenously how many workers are connected to each sector.** The condition determining this allocation will be a **no-arbitrage condition** stating that the **expected income should be the same in all sectors since otherwise some workers would**

**migrate.** Because the sectors are symmetric, in the full macroeconomic equilibrium the number of workers in each sector will turn out to be the same.

### **Prices and wages in each industry**

■ Using the fact that  $Y_i = L_i$ , the **real profit of the firm** in sector  $i$  is  $\Pi_i = (P_i Y_i - W_i L_i)/P = Y_i(P_i/P - W_i/P)$ . Given the definitions of the real or relative prices,  $p_i \equiv P_i/P$  and  $w_i \equiv W_i/W$ , the profit of firm  $i$  can be written as  $\Pi_i = Y_i(p_i - w_i)$ . Inserting from (8.5) how **output  $Y_i$  must relate to the relative price  $p_i$** , we get:

$$\Pi_i = p_i^{-\sigma} \frac{Y}{n} (p_i - w_i) \quad 8.7$$

■ The firm in sector  $i$  takes the nominal wage rate,  $W_i$ , as well as the price level,  $P$ , as given, so it has no influence on  $w_i$ . It will set its price  $P_i$ , and hence, given  $P$ , its relative

price  $p_i$ , so as to maximize  $\Pi_i$ . Maximizing  $\Pi_i$  is the **same as maximizing the log of  $\Pi_i$**  since the logarithmic function is everywhere increasing:

$$\frac{\delta \ln \Pi_i}{\delta p_i} = -\frac{\sigma}{p_i} + \frac{1}{p_i - w_i} = 0$$

■ From this one easily derives:

$$p_i = m^p w_i, \text{ where } m^p \equiv \sigma/(\sigma - 1) \quad 8.8$$

■ As we know **from microeconomics**, the **optimal price  $p_i$  is a mark-up over the marginal cost  $w_i$** , and the **mark-up factor,  $m^p > 1$ , relates to the elasticity of demand** as shown. Given this price-setting behaviour, the **labour demand function** of firm  $i$  follows: if we insert the optimal value of  $p_i$  into the demand function (8.5), we get the **optimal output of firm  $i$** :  $Y_i = (m^p w_i)^{-\sigma} Y/n$ . From our simple production function this **output equals employment** in firm  $i$ , so the **labour demand function** in each sector  $i$  is:

$$L^d(w_i) = (m^p w_i)^{-\sigma} Y/n \quad 8.9$$

■ This demand curve is iso-elastic. Its **wage elasticity is the same as the price elasticity** in the demand for products. Note also that the **demand curve for labour is the same for all sectors**. Hence **each industry trade union is faced with the labour demand curve in (8.9)**.

■ As before, we will assume that the **union maximizes the expected income of each of its  $N_i$  members**. So the union chooses a  $w_i$  (or rather, it sets  $W_i$  so that, at the given  $P$ , it creates a  $W_i/P = w_i$ ) that maximizes:

$$\Omega(w_i) \equiv \frac{L^d(w_i)}{N_i} w_i + \frac{N - L^d(w_i)}{N_i} v_i = \frac{(w_i - v)L^d(w_i)}{N_i} + v_i \quad 8.10$$

■ Again,  $v$  is a worker's “**outside option**”, which should be thought of as the **average income a worker can expect to earn in the general economy if he is separated from**

**sector  $i$ .** Therefore  $v$  is the same from the point of view of all sectors. Note that  $\Omega(w_i)$ , as defined in (8.10), is only really the expected income of a worker if  $L^d(w_i) \leq N_i$ . However, in the macroeconomic equilibrium, the **endogeneity of  $v$  will ensure that there is unemployment in equilibrium**,  $L^d(w_i) < N_i$ , so the definition of  $\Omega$  above is appropriate.

■ Since the union takes  $N_i$  and  $v$  as given, maximizing  $\Omega(w_i)$  is the **same as maximizing the “union rent”**  $(w_i - v)L^d(w_i)$ . This is **independent of  $N_i$ , so an optimal wage for the union, and a wage in the members' interests, will be independent of how many members the union presently has**. We already know that there is a **unique solution** to maximizing  $(w_i - v)L^d(w_i)$ , given our iso-elastic labour demand function. The solution is:

$$w_i = m^w v, \text{ where } m^w \equiv \sigma/(\sigma - 1) \quad 8.11$$

■ The **optimal wage is a mark-up over the outside option  $v$** , where the **mark-up factor  $m^w \equiv \sigma/(\sigma - 1) > 1$  is given by the wage elasticity of labour demand** in the usual way.

- Note that the **price mark-up factor**,  $m^p$ , and the **wage mark-up factor**,  $m^w$ , are **identical because the elasticities of the product demand functions and the labour demand functions are the same**. It is **nevertheless useful to carry with us a logical distinction between the two**.
- This completes the description of equilibrium in each sector  $i$ . Everybody in the sector takes  $P$  as given. Given this  $P$ , the **union sets a wage rate**  $W_i$  that ensures  $w_i \equiv W_i/P = m^w v$ , and faced with this  $w_i$  the **firm sets a price**  $P_i$  that ensures  $p_i \equiv P_i/P = m^p w_i$ , which **implies a level of output and employment**,  $Y_i = L_i = (m^p w_i)^{-\sigma} Y/n$ .

### The wage curve, the price curve and the macroeconomic equilibrium

- It follows directly from (8.11) that the **real wage will be the same in all sectors**,  $w_i = w$ , and this common  $w$  will, of course, be the **general real wage level in the economy**. Recalling that each individual **union member faces a probability of unemployment equal to the general rate of unemployment**, the outside option  $v$  should be tied to the

**unemployment rate,  $u$ , the real unemployment benefit rate,  $b$ , and the general real wage,  $w$ , as:**

$$v = ub + (1 - u)w \quad 8.12$$

■ Writing  $w$  for  $w_i$  on the left-hand side of (8.11), and inserting on the right-hand side the expression in (8.12) for  $v$  gives:

$$w = \frac{\sigma}{\sigma - 1} [ub + (1 - u)w]$$

where it is now convenient to insert the expression  $\sigma/(\sigma - 1)$  for  $m^w$ . Solving for  $w$  gives:

$$w = \frac{\sigma u}{\sigma u - 1} b = \frac{1}{1 - 1/\sigma u} b \quad 8.13$$

or expressed in terms of the rate of employment,  $e = 1 - u$ :

$$w = \frac{\sigma(1-e)}{\sigma(1-e)-1} b = \frac{1}{1-1/(\sigma(1-e))} b \quad 8.14$$

■ At the aggregate level, the real wage is thus a mark-up over the rate of unemployment benefit, and (assuming  $u > 1/\sigma$ ) the mark-up factor is larger than 1, implying  $w > b$ . Furthermore, the mark-up, and hence  $w$ , is larger the lower  $u$  is, or the larger  $e$  is.

■ The relationship in (8.13) or (8.14) is the “wage curve” as derived from a macro model with trade unions. In the  $e$ - $w$  diagram in Figure 8.4 below, the wage curve is the increasing function labelled WS. This time the basic incentive effect behind the wage curve is that a higher rate of employment, from the point of view of each sector, means a better outside option, and hence each sector's union must set a higher wage to defend the union rent.

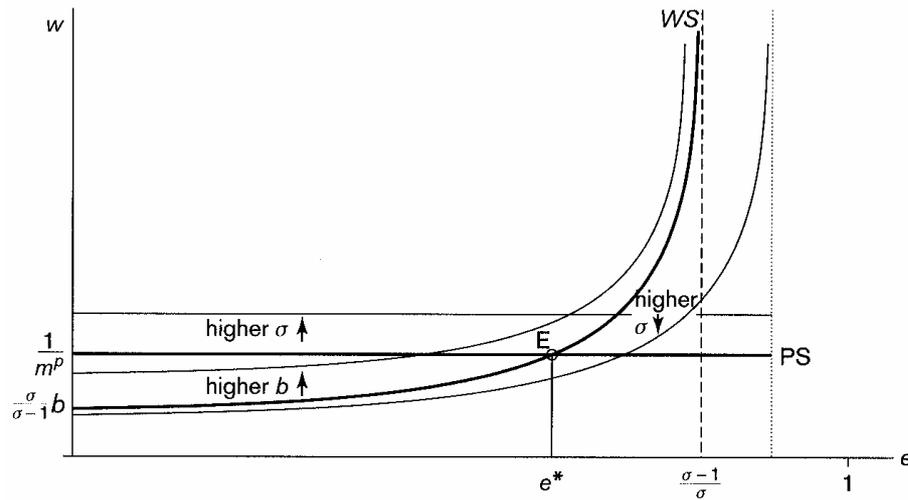


Figure 8.4: The macroeconomic equilibrium

- An increase in the benefit rate  $b$  pushes the wage curve upwards, since, just like an increase in  $e$ , it improves the outside option. An increase in the elasticity of labour demand shifts the wage curve downwards. The more elastic labour demand is, the more costly, in terms of lost employment, it is for the union to push wages further up above  $v$ . So they will do this to a smaller extent, the larger  $\sigma$  is.
- The expressions for the wage curve in (8.13) and (8.14) are, of course, only really meaningful if the mark-up factors involved are positive. This requires that  $u > 1/\sigma$ , or  $e < (\sigma - 1)/\sigma$ . We therefore view the wage curve, as drawn in Figure 8.4 for instance, as a function from employment rates  $e$  between 0 and  $(\sigma - 1)/\sigma$  to the associated wage rates, or, alternatively, as a function from unemployment rates  $u$  between  $1/\sigma$  and one to the real wage.
- Unemployment rates above  $1/\sigma$  will, of course, be quite large for elasticities  $\sigma$  close to 1. For the rates of unemployment coming out of the present model to be realistic, we must think of  $\sigma$  as relatively large, e.g.  $\sigma$  has to be 20 to give a minimal rate of unemployment of 5 per cent. However, this is a consequence of the formulation given here where all market power lies with the unions.

- One can **explore a model where both employees and employers have influence on the wage rate and negotiate it** between them. One consequence will be that the **wage curve may start at a more reasonable minimum rate of unemployment**.
- We found above that each **sector's output price** must fulfil  $p_i = m^p w_i$ . Since  $w_i = w$  in all sectors, there will be **one common real output price across sectors**,  $p_i = m^p w$  for all  $i$ . Hence  $P_i/P$  is the same for all  $i$ , implying that  $P_i$  has to be the same, and then since  $P$  is a price index,  $P_i = P$  for all  $i$ . Thus  $P_i/P \equiv p_i = 1$  for all  $i$ . It then follows that  $m^p w = 1$ , or  $w = 1/m^p$ .
- The line  $w = 1/m^p$ , illustrated as PS in Figure 8.4, is the **price curve** in this model. We prefer not to insert how  $m^p$  depends on  $\sigma$  in order to **preserve our logical distinction between market power in product markets and market power in labour markets**. Nevertheless, an increase in  $\sigma$ , meaning stronger competition on the product markets, will of course give a lower value of  $m^p = \sigma / (\sigma - 1)$ , and therefore a higher position of the price curve, as illustrated in Figure 8.4.

■ The **full macroeconomic equilibrium** is at the **point E** in Figure 8.4 where the **wage curve intersects the price curve**. The associated rate of employment,  $e^*$ , or unemployment,  $u^*$ , can be found analytically by inserting  $w = 1/m^p$  into the wage curve (8.14), or (8.13), giving:

$$e^* = \frac{\sigma(1 - m^p b) - 1}{\sigma(1 - m^p b)} \quad \text{and} \quad u^* = \frac{1}{\sigma(1 - m^p b)} \quad 8.15$$

■ We assume that the parameters of our model are such that  $(m^p)^2 b < 1$ . This ensures a **meaningful macroeconomic equilibrium** where the rates of employment and unemployment are both between 0 and 1.

■ The **real wage of the macroeconomic equilibrium** is  $w^* = 1/m^p$ . It is **seemingly a striking result that  $w^*$  is given from the price-setting behaviour of the firms alone** and is not at all

influenced by the wage-setting behaviour of the unions, as reflected by the horizontal price-setting curve, PS, in Figure 8.4.

■ We should note that this is an **artifact of our simplifying assumption of a constant marginal productivity of labour**. Had we assumed **diminishing returns to labour**, the **price curve** in Figure 8.4 **would have been decreasing**, meaning that both the wage and the price curve would be needed for determining the equilibrium wage rate. Our model, as we have set it up here, can be said to show in a strong form the general insight that **even though an economic agent may be large and influential in one part of the economy, the agent will, nevertheless, be constrained by the market forces of the entire economy**.

■ The only element of the macroeconomic equilibrium we have not described is the **allocation of workers across industries**. What we have found above is that for any such allocation, the real wage rate in each industry will be  $w^* = 1/m^p$ , and hence the outside option as seen from any industry will be  $v^* = u^*b + (1 - u^*)/m^p$ . Given our assumption  $m^pb < 1$ , we have  $v^* < w^*$ , since  $m^pv^* = u^*m^pb + (1 - u^*) < 1$ , implying  $v^* < 1/m^p = w^*$ .

■ This means that the **income elements,  $w^*$  and  $v^*$** , that enter the expected income of a worker currently connected to industry  $i$  are the **same in all sectors**. Only the **probabilities,  $L^d(w^*)/N_i$  and  $1 - L^d(w^*)/N_i$ , by which  $w^*$  and  $v^*$  are achieved can differ between sectors**. However, for the expected income to be the same in all industries, these probabilities, and hence  $N_i$ , must be the same in all industries. So, if the total number of workers is  $\bar{L}$ , there will be  $N = \bar{L}/n$  workers in each industry union, and the **GDP of the economy** will be  $Y = e^* \bar{L}$ . This is the  $Y$  that entered into the demand curves (8.5).

■ Note that the **macroeconomic equilibrium** we have arrived at is **worse with respect to welfare than an equilibrium with perfect competition in the labour markets**, since **under perfect competition all workers would be employed** and the **GDP** would be  $\bar{L}$ , which is **larger than the GDP with unions,  $e^* \bar{L}$** , since  $e^* < 1$ .

■ This gives **another important general equilibrium insight**. Taking as given what happens in the remaining economy, the **trade union in each industry does something good for its members by ensuring that they get a higher expected income than they would**

**otherwise have had.** These members would therefore be worse off if the trade union of that particular sector alone were dissolved.

■ **But when all unions in the economy have optimized on behalf of their members, the members are worse off than they would have been in a situation without trade unions at all.** In our model this takes the **drastic form that the equilibrium real wage rate is unaffected by the unions** (the real wage is  $1/m^p$ , as follows from the price-setting behaviour of the firms with or without unions) and **all that the unions really achieve collectively is to create some unemployment.** We should note again, however, that **with a decreasing price curve** in Figure 8.4, the **presence of trade unions would imply both unemployment and higher real wages.**

### **Main implications and structural policy**

■ As can be seen directly from (8.15), or from Figure 8.4, **according to the macroeconomic trade union model there is necessarily unemployment in equilibrium** (given our assumption,  $(m^p)^2 b < 1$ , that is required for a meaningful model). **When unemployment is**

very low, the outside option  $v = ub + (1 - u)w$  will be very close to the general wage level  $w$ . The unions only obtain rents for their members if they can attain a wage above  $v$ , so each union will seek to raise the wage in their sector above the general wage level, but of course not everybody can be above average. As all unions try to raise wages, the general wage level will be pushed up. Only when this has created some unemployment will all unions be able to ensure some rent for their members, since one can have  $w > v = ub + (1 - u)w$  only when  $u > 0$ .

■ The **comparative static results** also follow easily, either from (8.15) or from shifting the wage and price curves appropriately as shown in Figure 8.4. By either method one sees that according to the macroeconomic trade union model **more generous unemployment benefits mean higher structural unemployment**, a result that is naturally associated with **structural labour market policy (reforms of the benefit system)**.

■ At the same time, with our horizontal price curve the real wage rate is unaffected by  $b$ . When  $b$  increases, the outside option  $v$  increases, given  $u$  and  $w$ . Hence each union will set a higher real wage as reflected by the upward shift of the wage curve. However, **in**

**equilibrium the real wage is completely nailed down by the price-setting behaviour of the firms**, so to keep each union satisfied with this (constant) real wage, the **value of the outside option must fall back to its old level**. This **situation is brought about by an increase in unemployment**. With a decreasing price curve, an increase in  $b$  would give both higher unemployment and higher real wages.

■ For our next results it may be convenient to replace the  $\sigma$  that appears in the equation for  $u^*$  in (8.15) with the equivalent expression,  $m^w/(m^w - 1)$ , written in terms of the mark-up  $m^w = \sigma/(\sigma - 1)$ :

$$u^* = \frac{1}{\frac{m^w}{m^w - 1}(1 - m^p b)}$$

- We can then see that according to the macroeconomic trade union model **more market power in the labour markets** (a higher  $m^w$ , which must arise from a lower wage elasticity  $\sigma$  of labour demand) **implies higher structural unemployment**.
- **What kind of policy** does this result suggest if policy makers want to **bring down structural unemployment**? Perhaps a policy to **make the union structure in the economy more decentralized** would work to **increase the elasticity of labour demand**, and thus **decrease market power and mark-ups for each trade union**.
- The reason is that **the more “local” unions are, the easier it will be for firms to substitute away from the specific type of labour organized by a union if this particular union tries to increase the wage rate of its members**. This may be part of an explanation why the **union structure in many countries has become more decentralized in recent years**.
- We can also see that according to the macroeconomic trade union model **more market power in the product markets** (a higher  $m^p$ , arising from a lower price elasticity  $\alpha$  of

product demand) **implies higher structural unemployment and lower real wages**. As in the previous lecture we arrive at the conclusion that structural unemployment is not only a matter of the structure of labour markets. **Structural features of the product markets such as the degree of competition may also be important for the level of structural unemployment**. Of course, this points to the **relevance of competition policy** as part of a policy package **to fight structural unemployment**.

### Summary

- In most European countries trade unions are widespread and large and even in countries where only a small fraction of workers are organized in unions, the agreements that trade unions enter into are often extended to cover a large part of the labour market. Furthermore, empirical investigations show that union members have higher wages than (otherwise comparable) non-union members. Unions thus seem to be important for wage determination.
- Unions are involved in regulating many equally important working conditions, but this chapter concentrated on economic models where trade unions only have a role as wage

setters. The models focused on monopoly unions with a market power so strong that they can dictate the wage rate to employers. In most respects, a model where employers are also assumed to have some market power generates the same qualitative results as the monopoly union model.

- Under plausible assumptions, a union seeking to defend the interests of its members will want to maximize the expected, or long-run average, income of its representative members. This is equivalent to maximization of the total union “rent”, defined as the excess of the union wage over the income members could obtain elsewhere in the economy times the number of employed union members enjoying this excess.
- In a partial equilibrium labour market model where firms have given revenue curves leading to downward-sloping labour demand curves, the wage rate set by the union to maximize the union rent could well be so high that labour demand falls short of the labour supplied by union members. The resulting unemployment is involuntary at the individual level, but voluntary from the collective long-run perspective of all union members, since the wage rate set by the union maximizes the long-run average income of the representative

member. Those who are currently unemployed may have an interest in undercutting the wage set by the union in the short run, but if such undercutting leads to a breakdown of the union, the members are better off abstaining from undercutting. Trade unions thus face a “cartel problem” like any other cartel. We assumed throughout the lecture that the union could impose sufficient discipline among its members to avoid breakdown due to the cartel problem.

- If the labour market equilibrium in the partial equilibrium model with trade unions implies unemployment, shocks to the firms' revenue curves will have no impact on the real wage, but will be fully absorbed by fluctuations in employment and output, as long as the outside option (the income that union members can obtain elsewhere in the economy) is unaffected by the shocks. The trade union model may thus help to explain the business cycle fact that employment is much more closely correlated with output than real wages are.

- The theory of monopoly union behaviour may be incorporated in a macro model with many production sectors and monopolistic competition and with a trade union in each sector. In such a general equilibrium model firms' revenues arise from consumer demand, and the

outside option viewed from each production sector is a weighted average of the unemployment benefit and the general wage level, where the weights are given by the rate of unemployment. In a symmetric equilibrium the wage set by each union equals the general wage level, and the real (relative) output price of each sector is 1. Moreover, the equilibrium necessarily involves unemployment. The individual trade union can only create some rent for its members if there is a positive unemployment rate since, in the absence of unemployment, the wage set by each union equals the outside option.

- In the general equilibrium macro model with trade unions the level of structural unemployment will increase if the market power of trade unions in the labour markets increases, if the market power of firms in the product markets goes up, or if the level of unemployment benefits is raised. These results are of obvious importance for labour market and competition policies.