Notes on wage-setting

1. Wage-setting, price-setting and equilibrium employment

1.1. Introduction. We look at the micro-foundations of wage and price setting and how they lead to an equilibrium level of employment in the economy. We have already seen that when we have a wage-setting and a price-setting curve, the equilibrium employment rate is determined when the real wage implied by the wage-setting curve is equal to that implied by the price-setting curve. We shall see more precisely how this mechanism works.

1.1.1. Wage setting: the monopoly union model. The aim of wage-setters is to set the real wage, given the level of unemployment (or aggregate demand) in the economy. In this chapter we focus on a standard microeconomic model of how this is done: the monopoly union model, which we compare with the competitive labour market model.

A key assumption is that wage-setting is a highly disaggregated activity: there are many different wage-setters in the economy. Specifically we assume the economy is divided up into many sectors, each sector producing a single good. For convenience, each good is assumed to be produced by labour alone — each good is thus a final good and not an input into the production of other goods. We therefore assume that no capital is used in the production of goods. As an additional simplifying assumption, we assume that labour productivity, $\lambda$, is constant.

Of course, wage-setters cannot literally set the real wage. The real wage is a measure of the purchasing power of wage-earners and is therefore equal to the money wage divided by the consumer price level. Wage-setters can only set the money wage in their company or in their sector of the economy: the consumer price level is the economy-wide consumer price level, and over this, the individual wage-setter has virtually no control. Thus wage-setters set the money wage relative to their expectation of the consumer price level. They therefore set an expected real wage in relation to the unemployment or employment level.

We assume that in each sector of the economy there is a monopoly union that can unilaterally set the wage in the particular sector and that workers cannot move between sectors. Here the union’s concern is to strike a balance between (i) too high a wage, which will push up the relative price of the good produced by the sector and hence decrease sectoral demand and therefore the employment of members; and (ii) too low a wage, which fails to use the union’s monopoly power. Of course in practice unions bargain with employers or with employer associations. However, the monopoly union model is simpler and captures most of the insights of more complex bargaining models.

1.1.2. Price setting: monopoly and Bertrand pricing. There is strong empirical evidence that prices are set on the basis of some mark-up on unit costs of production and in particular on unit labour costs, i.e. the money wage divided by labour productivity. We refer to two standard microeconomic models of how profit maximizing firms set their prices on such a basis. The two standard models are the monopoly producer model and Bertrand competition. As with wage-setting, the basic assumption is that price-setting is a highly disaggregated activity: just as there are many different wage-setters in the economy, so we assume many different price setters. In the monopoly case, the monopolist controls the production of a single (differentiated) product so there is one producer per sector. The other model of price setting is that of Bertrand competition in which two or more companies in each sector compete with each other via price competition. If all companies face constant returns to scale and are identical, this produces the very simple result that the price is set equal to marginal cost. In terms of models where firms set prices, Bertrand competition is at the opposite end of the spectrum from monopoly: competition between the firms is intense with the result that supernormal profits are reduced to zero.

2. Intuition and some simple geometry

2.1. Worker and union indifference curves. We follow standard practice by assuming that the union in each sector sets the wage to maximize the expected utility of its members. Remember that “sector” could refer to an industry (e.g. unions could be organized as they are in Germany
by industrial sector (with an engineering industry union, a banking and insurance industry union etc.) or an individual firm (e.g. the union in Volkswagen negotiates separately with the company). All members of the union, i.e. all workers, are assumed to be identical. Union members have two concerns as far as employment is concerned that are reflected in the utility function: their real earnings from employment, because this enables them to buy consumer goods and to save; and the amount of leisure that they have. Let us look at this geometrically first of all. We adopt here the following utility function: they assume that each union member is employed the same number of hours $e_i$ hours in sector $i$, so that each worker is “unemployed” a given number of hours each period:

$$U_i = w_i e_i - \alpha e_i^\beta / \beta$$  \hspace{1cm} (2.1)

where $U_i$ is the utility of a worker in the sector $i$, $w_i$ is real earnings per worker in sector $i$, $e_i$ is proportion of hours worked and $\alpha$ and $\beta$ reflect the importance of the disutility of work. This produces indifference curves as shown in Fig.1.

The first term on the right hand side of equation (2.1) is real earnings per worker. The worker benefits from an increase in this component, since it is equal to the worker’s consumption of consumer goods plus any savings. The second term is negative and is the disutility due to the loss of leisure that results from having to work.

In the ‘real wage-employment’ diagram (see Fig.1) we can draw an indifference curve for any given level of union utility $U_i$. The first term on the right hand side of equation (2.1) is a rectangular hyperbola; the second, the leisure disutility term, is subtracted from the first and ensures that the utility curve first falls (when the rectangular hyperbola effect is dominant) and then rises as the leisure disutility effect starts to kick in. As shown in Fig.1, there are a series of indifference curves, each representing a different level of utility.

**2.2. Deriving the competitive labour supply curve.** Before looking at what the monopoly union does, we can use the indifference curves to see what individual workers would do in a competitive labour market in the absence of a union. In a competitive labour market, each worker has to choose how many hours of work to provide at any given real wage. If we take any given level of the real wage, say, $w_0$, this is a horizontal line in the diagram and $e_0^s$ is the amount of hours which gets the worker to the highest available indifference curve. This indifference curve sits on the $w_0$ line at point A. Raising the real wage to $w_1$ and repeating this exercise shows $e_1$ to be the optimal amount of hours to supply given a real wage of $w_1$ (point B). In this way we can construct a complete supply of labour curve by tracing a line through the lowest points of each indifference curve. This is shown as the $E^s$-curve in Fig.1.

![Figure 1. Deriving the competitive labour supply curve](image-url)
2.3. Deriving the WS-curve. In a competitive labour market, workers take the wage as given and supply the optimal amount of labour at that wage. By contrast, the monopoly union sets the wage; and the employer, taking the wage as given then decides how many worker hours to hire. The assumption that the employer chooses the amount of employment given the wage, is referred to as the “right to manage” assumption.

At this stage we need to introduce the labour demand curve for the sector (which could be as small as one firm) over which the union has monopoly wage-setting rights. The labour demand curve shows how much labour will be hired by the employer in sector \( i \) given (i) the wage the union has set and (ii) the level of aggregate demand in the economy as a whole. It thus provides a critical link between the microeconomics of labour markets and the macroeconomy of aggregate demand and the IS/LM model. In Fig.2, the labour demand curve, \( e^D(y_0^D) \), corresponding to a particular level of aggregate demand \( y_0^D \) is shown as downwards sloping. Given this level of aggregate demand, the labour demand curve shows how a lower level of wages in sector \( i \) will increase the demand for employment by the employer(s) in this sector. This provides a constraint on the union: the higher the wage set, the lower the amount of employment and vice versa.

![Figure 2. Deriving the WS-curve](image)

But why is the labour demand curve for sector \( i \) downwards sloping? Recall that we have assumed that labour productivity is constant (\( \lambda \)) so the downwards slope does not represent declining marginal productivity. The reason the labour demand curve for sector \( i \) slopes downwards is that an increase in the wage in sector \( i \) will lead to higher prices in that sector. For a given level of aggregate demand in the economy, if the prices of sector \( i \) output rise relative to the economy-wide average, demand for that sector’s output will fall. Because of the fall in demand for sector \( i \)’s output, the demand for labour in sector \( i \) will fall too.

By assuming there are many sectors in the economy, we are assuming that any one union cannot influence the level of aggregate demand. Each union has to choose a point on \( e^D(y_0^D) \). It will choose the point that puts it onto its highest possible indifference curve (point \( A \) in Fig.2). This point will be where an indifference curve is just tangential to the labour demand curve, in this case at \( w_0 \).

Thus for any given level of aggregate demand the union will pick a particular wage, at the point where the labour demand curve is tangential to the highest possible indifference curve. A higher level of aggregate demand shifts the labour demand curve outwards. This is shown by \( e^D(y_1^D) \). Higher aggregate demand thus means that the employer will hire more labour at any given wage. As we have drawn the indifference curves, it can be seen that the union’s chosen point shifts from point \( A \) to \( B \): the increase from \( y_0^D \) to \( y_1^D \) has the effect of raising the wage the union chooses — from \( w_0 \) to \( w_1 \) — and of increasing employment — from \( e_0 \) to \( e_1 \). What is going on? Had the wage remained constant after the outward shift in the labour demand curve, employment would have increased. The union is concerned to maximise the utility of the average union member; and
s/he requires some compensation in terms of higher wages for the reduction in leisure implied by an increase in employment.

By adding other levels of aggregate demand, we have a set of labour demand curves. In conjunction with the union indifference curves, we can trace out how the union responds to shifts in the labour demand curve due to changes in aggregate demand: the union sets higher wages. This is one way of deriving the wage-setting curve from a microeconomic foundation. We label the set of tangencies between the labour demand and union indifference curves, the “wage-setting” or WS-curve.

2.3.1. Filling in gaps: deriving the sectoral labour demand curve from the sectoral demand for output. The sectoral labour demand curve is a key element in understanding the links between micro and macro. Indeed, the proper way to derive and understand the sectoral labour demand curve is by first deriving the sectoral demand curve for output. Assume all sectors are symmetric: this means that if sectoral prices were all equal then the demand for output would be equally divided between the sectors. Let the total number of sectors be \( N \). Since total demand for output is \( y^D \), the demand for the output of each individual sector when they are each charging the same price will be \( y^D/N \).

We now introduce the concept of the relative price of a sector’s output. Let \( p_i \) be the price of sector \( i \)’s output; and let \( P \) be the overall price level. For instance, we can think of \( P \) as the average of all the sectoral prices

\[
P = \sum_{i=1}^{N} \frac{P_i}{N}.
\]

Then \( P_i/P \) or \( p_i \) is the relative price of sector \( i \). If \( p_i > 1 \) the price of \( i \) sector goods is above average and vice versa.

Now we come back to the sectoral demand for output: if \( p_i = 1 \) we assume that the demand for the output of the \( i \)th sector, \( y_i^D = y^D/N \). If \( p_i > 1 \), that implies \( y_i^D < y^D/N \) and vice versa in the case where sector \( i \)’s price is below average. Hence, the demand for sector \( i \)’s output relative to average is a function of its relative price. Thus

\[
y_i^D = F(p_i) \cdot y^D/N,
\]

where \( F(1) = 1; F(p_i) > 1 \) when \( p_i < 1 \); and \( F(p_i) < 1 \) when \( p_i > 1 \). A simple form for \( F() \) is \( F(p_i) \equiv p_i^{-\eta} \). Thus we have:

\[
y_i^D = p_i^{-\eta} \cdot y^D/N
\]

This is the constant elasticity demand curve for output in sector \( i \). It implies a 1% increase in the relative price lowers sectoral output demanded by \( \eta \)%.

And it is easy to see that if \( p_i = 1, y_i^D = y^D/N \). If we now assume that all prices are equal so that each \( p_i = 1 \) — we can add up the demands for the output of each sector and see that total demand is equal to \( y^D \):

\[
\sum_{i=1}^{N} y_i^D = N \cdot y^D/N = y^D.
\]

2.3.2. Deriving the sectoral labour demand curve: relative prices and the sectoral real wage. To take the next step toward deriving the sectoral labour demand curve, we need to express the sectoral demand for output in terms of employment and then to show how it depends on the sectoral real wage. Let employment demanded in sector \( i \) be \( e_i^D \) and labour productivity be \( \lambda \). Then if the demand for sector \( i \) output is \( y_i^D \), \( e_i^D = y_i^D/\lambda \) or:

\[
e_i^D = y_i^D/\lambda = \lambda^{-1} \cdot p_i^{-\eta} \cdot y^D/N
\]

Equation (2.6) says that higher aggregate demand increases the demand for employment, (and that a rise in labour productivity reduces it at given relative prices). It also says that the higher the relative price level of a sector the lower the demand for labour in the sector. To derive the sectoral labour demand curve, we need to know how the demand for labour is related to the real wage. Hence, the
next step is to work out the relationship between the relative price of a sector and the real wage. This requires a model of price-setting. We begin with the simplest such model — Bertrand competition.

2.4. Price-setting under Bertrand competition. How is the price in the sector set in relation to the costs of production and particularly wages? For simplicity, we assume there are two producers in each sector (the argument easily extends to more). There are no fixed costs of production; labour is the only factor of production and labour productivity $\lambda$ is constant and identical for both producers. Thus the marginal cost of each producer is constant and equal to the wage bill $(W_i \times e_i)$ per unit of output (i.e. divided by $y_i$): $W_i/\lambda$. Bertrand competition assumes that each producer sets a price and they both set their prices at the same moment in time so that neither can respond to the other. In any sector both producers produce the same product: thus if producer A sets a lower price than producer B (assuming the goods are genuinely identical) A will get the whole market demand. We shall see that the only “Nash equilibrium” is where both producers in sector $i$ set the same price, namely $P_i = W_i/\lambda$, i.e. price is set equal to marginal cost. Suppose this was not the case and A sets a price above $W_i/\lambda$, say $(W_i/\lambda) + k$; it would then pay B to set a price marginally below $(W_i/\lambda) + k$; but that could not be a Nash equilibrium, since it would then pay A to set a still slightly lower price in order to take the entire market. But nor would either producer set a price below $W_i/\lambda$ since that would mean a price below marginal cost and would result in a loss. Hence both set $P_i = W_i/\lambda$. Of course this argument is highly simplistic but our aim is to provide a simple model of price-setting, which is at the same time rational given the assumptions made.

Hence for the moment we assume that in each sector $P_i = W_i/\lambda$. The relative price is $P_i/P$ where $P$ is the economy-wide price level, that is, the consumer price level. This implies

$$P_i/P = p_i = \frac{W_i}{\lambda} = \frac{u_i}{\lambda}$$

In other words the relative price in a sector is simply the real wage divided by the level of labour productivity. Note that the real wage is defined here as $u_i = W_i/P$, the real consumption wage. The term real wage is used to refer to the real wage in terms of consumer prices. Whenever we want to refer to the real wage in terms of producer prices, the so-called real producer wage, we state this explicitly. Thus we have

$$e_i^D = \lambda^{-1}p_i^{-\eta}y_i^D/N$$

which implies with $p_i = u_i/\lambda$

$$e_i^D = \lambda^{-1}\frac{u_i^{-\eta}}{\lambda^{-\eta}}y_i^D/N = \lambda^{\eta-1}.u_i^{-\eta}.y_i^D/N \quad (2.9)$$

Thus in each sector the monopoly union faces a downwards sloping demand curve for labour: a lower real wage in the sector implies a higher level of sectoral employment. The mechanism is simple: a lower real wage in sector $i$ — given a particular assumption about pricing behaviour — implies a lower relative price for $i$. Hence demand for $i$ increases relative to other goods and employers in the $i$th sector demand more labour to meet the extra demand.

Given this constraint, the monopoly union chooses a real wage for each level of aggregate demand (hence for each labour demand curve). The real wage chosen maximizes the union’s utility for that labour demand curve. In each case this will be where the demand curve is tangential to the highest union indifference curve (see Fig.2). This traces out the wage-setting curve, the real wage rising as aggregate demand increases.

2.5. Equilibrium. In the basic macro model, the economy is in stable-inflation equilibrium when the real wage implied by the wage-setting curve is equal to the real wage implied by the price-setting curve. Let us see how that works out in this multi-sectoral context. We begin with the wage-setting curve: we have just seen that the monopoly union’s choice of real wage in each sector $i$ is a rising function of the level of aggregate demand: as the level of aggregate demand rises, the sectoral labour demand curve shifts to the right. The tangency with the union indifference curve
is at a higher real wage and a higher level of employment. (This is shown in the upward-sloping WS-curve in Fig.2) Hence we can write:

\[ w_i = B(e_i) \]  

(2.10)

This can be thought of as the sectoral wage-setting curve.

The sectoral price-setting curve is derived directly from the price-setting behaviour described above:

\[ \frac{p_i}{P} \equiv p_i = \frac{W_i}{P} \cdot \frac{1}{\lambda} = \frac{w_i}{\lambda} \]  

(2.11)

Thus in each sector we have two equations: equation (2.10) the wage-setting equation \( w_i = B(e_i) \) and the price-setting equation \( p_i = w_i/\lambda \). As shown in Fig.3, the wage-setting equation is upward-sloping and the price-setting equation is horizontal.

![Figure 3: The WS-curve and the PS-curve](image)

In equilibrium the relative price will be equal to 1:

\[ \text{Equilibrium : } p_i = 1 \text{ for all } i = 1, \ldots, N \]  

(2.12)

and the wage, price and employment level in each sector will be identical. We can therefore drop the subscripts. Hence,

\[ w^{PS} = \lambda \]  

(PS-curve)

and from equation (2.10)

\[ w^{WS} = B(e) \]  

(WS-curve)

In equilibrium, there will be a unique common employment level in each sector, \( e^e \), defined by \( \lambda = B(e) \).

2.5.1. Deriving an explicit expression for equilibrium employment. In order to find an explicit expression for equilibrium employment, we first need to derive the wage-setting curve explicitly. The union maximizes \( U_i = w_i e_i - \alpha e_i^\beta/\beta \) subject to the labour demand curve \( e_i^D = w_i^{-\eta} \cdot \lambda^{\eta-1} \cdot A \), where for convenience in the maximization process, we define \( A \equiv y^D/N \). The maximization can be performed directly by substituting \( w_i^{-\eta} \cdot \lambda^{\eta-1} \cdot A \) for \( e_i \) in the utility function. Alternatively we can follow the geometry above and set the slope of the indifference curve equal to the slope of the labour demand curve.

Using this second method, the slope of the indifference curve is first derived. An indifference curve is just the utility function for some fixed value of utility, say \( U_i = \bar{U}_i \). Totally differentiating the indifference curve we get (dropping subscripts and, for convenience, setting \( \beta = 2 \)):

\[ w \cdot de + e \cdot dw = \alpha e \cdot de \]  

(2.13)
so that the slope of the indifference curve is given by
\[
\frac{dw}{de} = \frac{\alpha e - w}{e} \tag{2.14}
\]

Totally differentiating the labour demand curve
\[
de = -\eta \frac{w^{-\eta}A}{w} dw \Rightarrow w.de = -\eta w.dw \tag{2.15}
\]
to give a slope of
\[
\frac{dw}{de} = -\frac{w}{\eta e} \tag{2.16}
\]
Equating these two slopes gives
\[
-\frac{w}{\eta e} = \frac{\alpha e - w}{e} \Rightarrow -w = \alpha \eta e - \eta w \tag{2.17}
\]
Thus, finally, we get the wage-setting curve:
\[
w^{WS} = \frac{\alpha \eta}{\eta - 1}.e \tag{2.18}
\]
The price-setting curve implies
\[
w^{PS} = \lambda \tag{2.19}
\]
In equilibrium, the equilibrium level of employment is
\[
e^e = \frac{\lambda}{\alpha} : \frac{\eta - 1}{\eta} \tag{2.20}
\]
This says that the greater the elasticity \(\eta\) of the demand curve for the product, the higher will be \(e^e\); (compare \(\eta = 3\) with \(\eta = 2\)). And the greater is \(\alpha\) — reflecting the weight attached to the disutility of work — the lower is \(e^e\).

3. Equilibrium employment, elasticity of demand and Calmfors-Driffill

We can interpret the effect of variations in the elasticity of demand on equilibrium employment in a straightforward way. If the elasticity of demand for sector \(i\)'s output is very high, then this implies that the sectors are defined very narrowly so that there are many close substitutes for the good produced by sector \(i\). Hence the labour demand constraint that unions in sector \(i\) face will be very flat. This implies that a small increase in the real wage in that sector would be expected to lead to a large fall in output and employment as customers switched to alternative suppliers. If the labour demand curve for sector \(i\) is very flat, then the union chooses a lower real wage (given the level of aggregate demand) than it would in the case of a more favourable real wage-employment trade-off. A low elasticity of demand will present the union with a more favourable trade-off: with limited substitutability between sectors, a higher real wage would be expected to have a more limited impact on employment. Hence the union would set a higher real wage.

The relationship between the elasticity of demand and equilibrium employment forms the basis of a widely cited piece of economic analysis: the so-called Calmfors-Driffill model. Calmfors and Driffill used this relationship to provide an explanation for why there might be an inverse U-shaped relationship between the employment rate and the way in which wage-setting takes place in the economy. We can derive their central result from Fig.4.

Suppose that wages are set by a monopoly union. We consider three different levels at which such a monopoly union could operate: at one extreme is the case in which there is a monopoly union in each firm — this is the “decentralized” case. At the other extreme, there is a monopoly union that sets the wage for the entire economy — this is the “centralized” case. The third case is the “intermediate” one in which there is a monopoly union in each industry in the economy. How do these three cases match up with our analysis of wage-setting? They can best be captured by redefining the “sector” in each case. Each firm is a sector in the case of decentralized wage-setting;
each industry is a sector in the intermediate case; and for centralized wage-setting, there is a single sector in the economy.

Since we are assuming Bertrand competition in the product market, the real wage is equal to \( \lambda \) in equilibrium: the economy-wide price-setting curve is the same in each case. But the wage-setting curve differs. The \( WS \) curves for the decentralized and intermediate cases are derived as shown in Fig.4 from the tangencies of the common union indifference curves and the labour demand curves reflecting the relevant elasticity of demand. The \( WS \) curve for the decentralized case is below that for the intermediate case. A higher elasticity of demand moderates union behaviour. The logic of the centralized case is different: in this case the economy-wide monopoly union can solve the model and knows that the real wage will be equal to \( \lambda \). It therefore chooses the highest possible employment rate: this will be shown by the labour supply curve. Hence the Calmfors-Driffl result follows: both decentralized and centralized wage-setting produce lower unemployment than does wage-setting at an intermediate (e.g. industry) level.

4. Monopoly union and monopoly price-setting

In this section, we maintain the assumption that wages are set by a monopoly union. But instead of Bertrand competition between firms, which results in the price set equal to marginal cost, we introduce monopoly pricing by firms. It is easy to foresee what will happen — the elasticity of demand will not only affect the wage set by the union but will also affect the price set by the firm. If the elasticity of demand is low, the monopoly union will perceive a favourable trade-off between the real wage and employment. The monopoly union will therefore set a ‘high’ wage. In this setting, a monopoly firm that faces a low elasticity of demand for its product will choose the profit-maximizing price and this implies a ‘high’ mark-up of price over marginal cost. If we take the case of a low elasticity of demand: when we switch from Bertrand to monopoly pricing, the price-setting curve shifts down (to reflect the higher mark-up). Hence the equilibrium employment rate falls.

4.1. Monopoly price-setting. The monopoly price-setter in the \( i \)th sector maximizes profits (in real terms)

\[
\pi_i = p_i y_i - w_i e_i \tag{4.1}
\]

subject to the demand constraint

\[
y_i = p_i^{-\eta} A, \tag{4.2}
\]

where \( A = y^D / N \) and the production function

\[
e_i = y_i / \lambda \tag{4.3}
\]
and subject to whatever value of \( w_i \) the monopoly union imposes on the monopoly price-setter. This means the monopolist maximizes

\[
p_i^{1-\eta}A - w_i.e_i = p_i^{1-\eta}A - w_i.y_i/\lambda = p_i^{1-\eta}A - (w_i/\lambda).p_i^{-\eta}.A
\]

Differentiating w.r.t \( w_i \) and setting the result equal to zero produces

\[
(1 - \eta).p_i^{-\eta}.A + \eta \frac{(w_i/\lambda).p_i^{-\eta}.A}{p_i} = 0
\]

If we now divide through by \( p_i^{-\eta}.A \) and rearrange, this produces the profit maximising price formula of

\[
p_i = \frac{\eta}{\eta - 1}.(w_i/\lambda)
\]

Since \( p_i = P_i/P \) and \( w_i = W_i/P \), we can see that this is the simple markup formula used to derive the \( PS \)-curve (e.g. in Carlin and Soskice Chapter 2). Firms set prices as a constant mark-up on marginal costs. We can now see where this formula comes from.

**Monopoly wage-setting:** As before the monopoly wage-setter maximizes the utility of the representative union member, \( w_i.e_i - \alpha e_i^2/2 \). The union still faces the constraint of the labour demand curve, but with a difference. Before if the marginal cost was \( w_i/\lambda \) this was also the price under Bertrand price-setting. But now the price is a markup over marginal costs of \( \frac{\eta}{\eta - 1}.(w_i/\lambda) \). This means that at any given wage the price will be higher and hence the demand for labour lower than before. The union needs to take this into account. Thus in moving from \( y_i = p_i^{-\eta}.A \) the union knows that

- as before, \( y_i = e_i/\lambda \); but in addition
- \( p_i = \frac{\eta}{\eta - 1}.(w_i/\lambda) \).

When both substitutions are made in the sectoral product demand curve we get the labour demand curve

\[
e_i = w_i^{-\eta}.\lambda^{\eta - 1}.\left(\frac{\eta}{\eta - 1}\right)^{-\eta}A
\]

**4.1.1. The sectoral wage-setting curve under monopoly pricing.** We now derive the wage-setting curve explicitly. The union maximizes \( U_i = w_i.e_i - \alpha e_i^2/\beta \) subject to the labour demand curve which we have just derived (4.7). The maximisation can be performed directly by substituting \( w_i^{-\eta}.\lambda^{\eta - 1}.\left(\frac{\eta}{\eta - 1}\right)^{-\eta}A \) for \( e_i \) in the utility function. Alternatively we can do as we did with Bertrand competition and set the slope of the indifference curve equal to the slope of the labour demand curve. This quickly shows us that (with the particular assumptions we have made) the move from Bertrand pricing to monopoly pricing makes no difference to the wage-setting curve. First, the slope of the indifference curve is not affected by the switch in pricing behaviour: the slope reflects simply the union’s preferences between the real wage and employment. The slope of the indifference curve is given by

\[
\frac{dw}{de} = \frac{\alpha e - w}{e}
\]

Totally differentiating the new labour demand curve

\[
de = -\eta \frac{w_i^{-\eta}}{w_i}.\lambda^{\eta - 1}.\left(\frac{\eta}{\eta - 1}\right)^{-\eta}A.dw \Rightarrow w.de = -\eta e.dw
\]

gives the same slope as before

\[
\frac{dw}{de} = -\frac{w}{\eta e}
\]
This is because the switch of pricing regimes has merely multiplied the right hand side of the labour demand curve by a constant. Thus, equating these two slopes gives us the same wage-setting curve (restoring subscripts) as before

\[ w_i = \frac{\alpha \eta}{\eta - 1} e_i \]  

(4.11)

The equilibrium employment rate is however lower because of the monopoly price-setting equation:

\[ p_i = \frac{\eta}{\eta - 1} \left( \frac{w_i}{\lambda} \right), \]  

(4.12)

where \( p_i \) is the relative price in sector \( i \). In equilibrium relative prices are equal to 1; and hence the real wage will be the same in each sector:

\[ 1 = \frac{\eta}{\eta - 1} \left( \frac{w}{\lambda} \right) \]  

(4.13)

\[ \Rightarrow w^{PS} = \lambda \frac{\eta - 1}{\eta}. \]  

(4.14)

In other words the price-setting real wage is equal to labour productivity deflated by the profit markup. The wage-setting real wage curve is

\[ w^{WS} = \frac{\alpha \eta}{\eta - 1} e \]  

(4.15)

so that equilibrium employment is

\[ w^{WS} = w^{PS} \]  

(4.16)

\[ \Rightarrow e^e = \frac{\lambda}{\alpha} \left( \frac{\eta - 1}{\eta} \right)^2 \]  

(4.17)

Equilibrium employment is therefore equal to labour productivity, \( \lambda \), divided by \( \alpha \), a measure of the disutility of work. Both variables have sensible signs: a rise in labour productivity increases equilibrium employment by enabling a higher price-setting real wage; and a rise in the disutility of work depresses the equilibrium employment rate, given the price-setting real wage. The term \( \left( \frac{\eta - 1}{\eta} \right)^2 \) is of key importance: it says that two monopolists have been responsible for reducing equilibrium employment, each by the factor \( \frac{\eta - 1}{\eta} \). First, the monopoly union; then the monopoly producer.

Compare this result with equilibrium employment in the monopoly-union/Bertrand-competition combination. Here there is only one monopolist — the monopoly union — and we see that \( e^e \) in the monopoly-union/Bertrand-competition case is equal to \( \frac{\lambda}{\alpha} \left( \frac{\eta - 1}{\eta} \right) \). From this analysis, it is clear that the Calmfors-Driffill argument will continue to hold in the case of monopoly unions and monopoly price-setters. Indeed, the poor employment outcome for the intermediate wage-setting case is reinforced if there is monopoly price-setting since a higher mark-up reduces equilibrium employment further.

5. Summary: comparison with the competitive benchmark

It is instructive to compare both cases (i.e. ‘monopoly union with Bertrand pricing’ and ‘monopoly union with monopoly pricing’) with the competitive benchmark. The labour supply curve has already been derived geometrically. It is straightforward to derive it mathematically. Workers take the wage as given in each sector, and choose how much labour to supply. As before their utility function is \( U_i = w_i e_i - \alpha e_i^2/2 \). The individual worker chooses \( e_i \) to maximize \( U_i \), holding \( w_i \) constant (instead of — as the union does — taking the labour demand curve as its constraint). This means

\[ \frac{dU_i}{de_i} = w_i - \alpha e_i = 0 \Rightarrow w_i = \alpha e_i \]  

(5.1)
With perfect competition in product markets price is equal to marginal cost so that \( p_i = w_i / \lambda \). In equilibrium \( p_i = 1 \), so \( w_i = w = \lambda \). And therefore

\[
\epsilon^e = \frac{\lambda}{\alpha}
\]  

(5.2)

This is a useful benchmark. It tells us that one monopolist — the monopoly union — deflates equilibrium employment by \( \frac{\eta - 1}{\eta} \). And two monopolists — the monopoly union together with the monopoly price-setter — deflate equilibrium employment by \( \left( \frac{\eta - 1}{\eta} \right)^2 \).