Foundations of Modern Macroeconomics
Third Edition

Chapter 7: A closer look at the labour market

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Outline

1. Some standard models
   - Two-sector labour market
   - Difference in unemployment over time and across countries
   - Assessment of standard models
2. Labour unions
   - Building blocks
   - Trade union models
   - Dual labour market
3. Efficiency wages

Aims of this chapter

- To discuss some of the most important stylized facts about the labour market
- To demonstrate what the "standard models" are able to explain
- To look for the direction(s) in which we should look for plausible explanations
- Note: Every serious student of the labour market(s) should consult the book by Layard, Nickell, and Jackman (1991), *Unemployment: Macroeconomic Performance and the Labour Market*

Some stylized facts

SF1 Unemployment fluctuates over time

SF2 Unemployment fluctuates more *between* business cycles than *within* business cycles. See **Figures 7.2(a)-7.2(b)** for long date series for the UK and the US. There is a lot of *persistence* in the data:

$$\hat{U}_t = \underset{(2.97)}{0.7305} + \underset{(20.88)}{0.8575}\, U_{t-1}, \qquad \text{(UK, 1856-2014)}$$

$$\hat{U}_t = \underset{(2.64)}{1.0157} + \underset{(18.30)}{0.8548}\, U_{t-1}, \qquad \text{(US, 1891-2014)}$$

SF3 The duration of unemployment spells differs between countries

Figure 7.1: Postwar unemployment

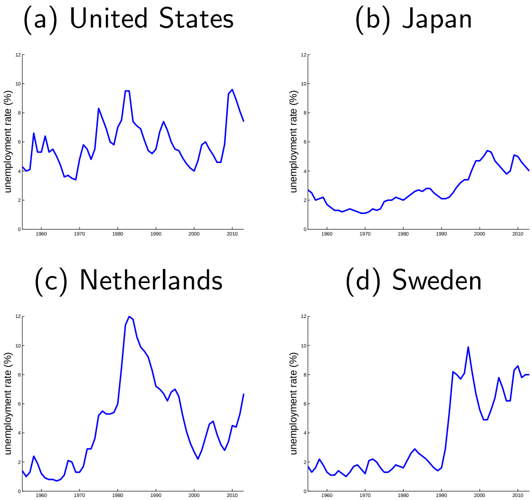


Figure 7.2(a): Unemployment in the United Kingdom, 1855-2014

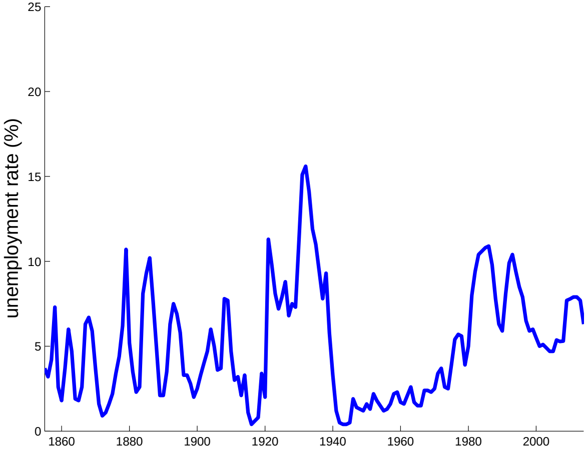
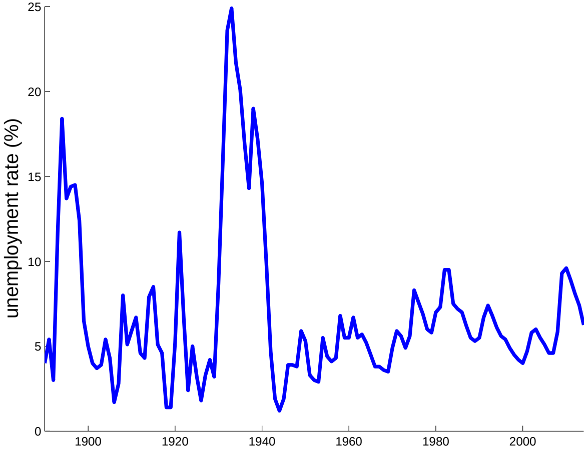


Figure 7.2(b): Unemployment in the United States, 1890-2014



Some stylized facts

SF4 In the **very** long run unemployment shows no trend. Take the time series representation for unemployment:

$$U_t = \alpha_0 + \alpha_1 U_{t-1} \quad \Rightarrow \quad \bar{U} = \frac{\alpha_0}{1-\alpha_1}$$

where $\bar{U}$ is the long-run unemployment rate [5.13% for the UK]. We can derive the transition speed as follows:

$$\begin{aligned} U_1 &= \alpha_0 + \alpha_1 U_0, \\ U_2 &= \alpha_0 + \alpha_1 U_1 = \alpha_0 + \alpha_1 \left[\alpha_0 + \alpha_1 U_0\right] \\ \vdots &\quad \vdots \\ U_t &= \alpha_0 \left[1 + \alpha_1 + \alpha_1^2 + \ldots + \alpha_1^{t-1}\right] + \alpha_1^t U_0 \end{aligned}$$

Some stylized facts

- We thus find:

$$U_t - \bar{U} = \left[U_0 - \bar{U}\right] \alpha_1^t$$

  where U_0 is the unemployment rate in some base year.
- *Experiment*: Suppose that the unemployment rate is currently U_0 and the long-run unemployment rate is $\bar{U}$. How many periods (t_H) does it take, for example, before **half** of the difference ($U_0 - \bar{U}$) is eliminated? We can use t_H (the "half life") as the indicator for the adjustment speed in the system:

$$\begin{aligned} \left[U_{t_H} - \bar{U}\right] \equiv \left[U_0 - \bar{U}\right] \alpha_1^{t_H} &= \tfrac{1}{2} \left[U_0 - \bar{U}\right] \ \Rightarrow \\ \alpha_1^{t_H} &= \tfrac{1}{2} \ \Rightarrow \\ t_H \ln \alpha_1 &= -\ln 2 \ \Rightarrow \ t_H = -\frac{\ln 2}{\ln \alpha_1} \end{aligned}$$

- For the UK the half life of the adjustment is 4.51 years.

Some stylized facts

SF5 Unemployment differs a lot between countries

SF6 Few unemployed have chosen themselves to become unemployed

SF7 Unemployment differs a lot between age groups, occupations, regions, races and sexes

- So we have quite a lot to explain!

Difference in unemployment of skill groups (1)

- Skilled and unskilled labour in the production function:

$$Y = G(N_U, N_S, \bar{K}) = G(N_U, N_S, 1) \equiv F(\underset{+}{N_U}, \underset{+}{N_S})$$

with $F_U \equiv \partial F/\partial N_U > 0$, $F_S \equiv \partial F/\partial N_S > 0$, $F_{UU} \equiv \partial^2 F/\partial N_U^2 < 0$, and $F_{SS} \equiv \partial^2 F/\partial N_S^2 < 0$

- Representative firm chooses two types of labour:

$$\max_{\{N_U, N_S\}} \Pi \equiv PF(N_U, N_S) - W_U N_U - W_S N_S$$

where the respective wage rates are W_U and W_S.

Difference in unemployment of skill groups (2)

- The usual marginal productivity conditions are obtained:

$$F_U(N_U, N_S) = \frac{W_U}{P} \equiv w_U$$
$$F_S(N_U, N_S) = \frac{W_S}{P} \equiv w_S$$

- With our usual trick we find the demands for the two types of labour:

$$\begin{bmatrix} dN_S \\ dN_U \end{bmatrix} = \frac{1}{F_{SS}F_{UU} - F_{SU}^2} \begin{bmatrix} F_{UU} & -F_{SU} \\ -F_{SU} & F_{SS} \end{bmatrix} \begin{bmatrix} dw_S \\ dw_U \end{bmatrix}$$

Difference in unemployment of skill groups (3)

- We find:

$$N_S^D = N_S^D(\underset{-}{w_S}, \underset{?}{w_U})$$
$$N_U^D = N_U^D(\underset{?}{w_S}, \underset{-}{w_U})$$

  If $F_{SU} < 0$ then the cross effects are positive [skilled and unskilled labour *gross substitutes*]

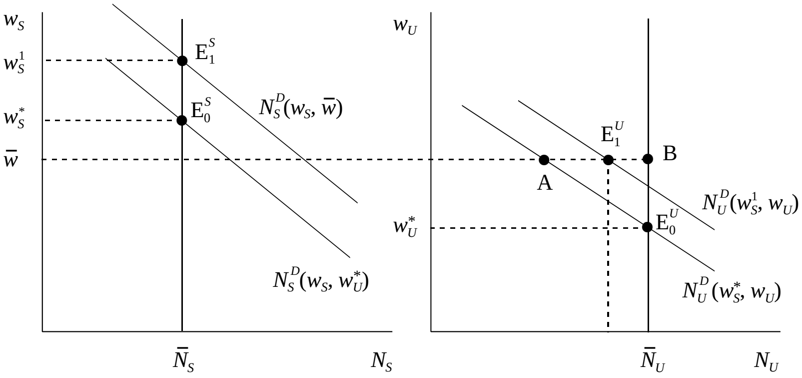
- Supply curves of the two types of labour are both assumed to be inelastic:

$$N_S^S = \bar{N}_S$$
$$N_U^S = \bar{N}_U$$

Difference in unemployment of skill groups (4)

- See **Figure 7.3** for a graphical representation. Punchlines:
  - With flexible wages, both types are fully employed [equilibrium skill premium, $(w_S/w_U)^*$]
  - With a binding, skill-independent, minimum wage $\bar{w}$ the unskilled will experience unemployment. How to cure it?
    - Abolish minimum wage [incomes distribution problems]
    - Subsidize unskilled work [“Melkert jobs”]
    - Let government hire unskilled workers [“dead end jobs”]
    - Train unskilled workers to become skilled [investment in human capital may pay for itself]
- So this standard model has sensible predictions

Figure 7.3: The markets for skilled and unskilled labour



Taxes and the labour market (1)

- Can taxes have an influence of unemployment ?
- Single type of labour (as in Chapter 1)
- Short-run (capital constant)
- Representative firm chooses employment (and thus output):

$$\Pi \equiv PF(N, \bar{K}) - W(1 + \theta_E)N$$

where θ_E is the *payroll tax* [a tax on the use of labour levied on employers, e.g. employer's contribution to social security]

Taxes and the labour market (2)

- The first-order condition, $F_N(N^D, \bar{K}) = w(1+\theta_E)$ can be loglinearized:
$$\tilde{N}^D = -\varepsilon_D \left[\tilde{w} + \tilde{\theta}_E\right]$$
$w \equiv W/P$ is the gross real wage, $\varepsilon_D \equiv -F_N/(NF_{NN})$ is the absolute value of the labour demand elasticity, $\tilde{N}^D \equiv dN^D / N^D$, $\tilde{\theta}_E \equiv d\theta_E/(1+\theta_E)$, and $\tilde{w} \equiv dw/w$
- The representative household chooses consumption and leisure just as in Chapter 1 but faces some extra taxes. The utility function and budget equation are:
$$U = U(C, 1-N^S)$$
$$P(1+\theta_C)C = WN^S - T(WN^S) \equiv (1-\theta_A)WN^S$$
where $T(WN^S)$ is the *tax function* and $\theta_A \equiv T(WN^S) / (WN^S)$ is the average tax rate

Taxes and the labour market (3)

- The tax system is *progressive*, i.e. the average tax rises with income and the marginal tax rate is denoted by:

$$\theta_M \equiv \frac{dT(WN^S)}{d\,(WN^S)} = T'$$

  Note: θ_M is either constant (if $T'' = 0$) or increasing (if $T'' > 0$)

- The household takes the tax progressivity into account when deciding on consumption and labour supply. The Lagrangian is:

$$\mathcal{L} \equiv U(C, 1 - N^S) + \lambda\left[(1 - \theta_A)WN^S - P(1 + \theta_C)C\right]$$

Taxes and the labour market (4)

- The first-order conditions:

$$\frac{\partial \mathcal{L}}{\partial C} = U_C - \lambda P(1+\theta_C) = 0$$

$$\frac{\partial \mathcal{L}}{\partial N^S} = -U_{1-N} + \lambda W \left[(1-\theta_A) - N^S \frac{d\theta_A}{dN^S} \right] = 0$$

- Simplifying the first-order conditions we obtain:

$$\lambda = \frac{U_C}{P(1+\theta_C)} = \frac{U_{1-N}}{W(1-\theta_M)} \quad \Rightarrow$$

$$\frac{U_{1-N}}{U_C} = w \frac{1-\theta_M}{1+\theta_C} \qquad \text{(S1)}$$

- The marginal rate of substitution between consumption and leisure is affected the **marginal** tax rate θ_M on labour income !
- The tax on consumption affects the MRS just as if it was a tax on labour income

Taxes and the labour market (5)

- Equation (S1) and the household budget constraint, $P(1+\theta_C)C = (1-\theta_A)WN^S$, together determine C and N^S
- In loglinearized form we get for labour supply:

$$\begin{aligned}\tilde{N}^S &= (1-N^S)\left[(\sigma_{CM}-1)\tilde{w} - \sigma_{CM}(\tilde{\theta}_M + \tilde{\theta}_C) + \tilde{\theta}_A + \tilde{\theta}_C\right] \\ &= \bar{\varepsilon}_{SW}\left[\tilde{w} - \tilde{\theta}_M - \tilde{\theta}_C\right] + \varepsilon_{SI}\left[\tilde{\theta}_A + \tilde{\theta}_C - \tilde{w}\right] \\ &= \varepsilon_{SW}\left[\tilde{w} - \tilde{\theta}_C\right] - \bar{\varepsilon}_{SW}\tilde{\theta}_M + \varepsilon_{SI}\tilde{\theta}_A\end{aligned}$$

where $\tilde{N}^S \equiv dN^S/N^S$, $\tilde{\theta}_C \equiv d\theta_C/(1+\theta_C)$, $\tilde{\theta}_M \equiv d\theta_M$ $/(1-\theta_M)$, and $\tilde{\theta}_A \equiv d\theta_A/(1-\theta_A)$

Taxes and the labour market (6)

- Loglinearized labour supply:

$$\tilde{N}^S = \varepsilon_{SW}\left[\tilde{w} - \tilde{\theta}_C\right] - \varepsilon^c_{SW}\tilde{\theta}_M + \varepsilon_{SI}\tilde{\theta}_A \qquad \text{(S2)}$$

- We now have quantitative handles:
  - $\varepsilon^c_{SW} \equiv \sigma_{CM}(1 - N^S) \geq 0$ is the *compensated* wage elasticity [corresponds to the substitution effect and is always non-negative]
  - $-\varepsilon_{SI} \equiv -(1 - N^S) < 0$ is the *income* elasticity [corresponds to the income effect and is always negative]
  - $\varepsilon_{SW} \equiv \varepsilon^c_{SW} - \varepsilon_{SI} = (\sigma_{CM} - 1)(1 - N^S)$ is the *uncompensated* wage elasticity [the total effect of a change in the gross wage]. Total effect of a wage change is positive (zero, negative) if $\sigma_{CM} > 1$ $(= 1, < 1)$

Taxes and the labour market (7)

- Summary of our labour market model with tax effects:

$$\tilde{N}^S = \varepsilon_{SW}\left[\tilde{w} - \tilde{\theta}_C\right] - \varepsilon^c_{SW}\tilde{\theta}_M + \varepsilon_{SI}\tilde{\theta}_A \qquad \text{(S3)}$$

$$\tilde{N}^D = -\varepsilon_D\left[\tilde{w} + \tilde{\theta}_E\right] \qquad \text{(S3)}$$

we can complete [or "close"] the model in two ways:

(a) Equilibrium interpretation, $N = N^D = N^S$, or:

$$\tilde{N} = \tilde{N}^D = \tilde{N}^S \qquad \text{(S4)}$$

(b) Disequilibrium interpretation, $N = \min[N^D, N^S] = N^D$, say because the consumer wage $[w_C \equiv w(1-\theta_A)/(1+\theta_C)]$ is inflexible.

(a) Taxes and the labour market: flexible wages

- See **Figure 7.4** for the graphical illustration [**Table 7.1** contains the analytical results]
- More progressive tax system [$\tilde{\theta}_M > 0$ only]: shifts labour supply to the left [pure substitution effect], so that $w \uparrow$ and $N \downarrow$
- Higher average tax rate [$\tilde{\theta}_A > 0$ only]: shifts labour supply to the right [income effect], so that $w \downarrow$ and $N \uparrow$
- Higher payroll tax [$\tilde{\theta}_E > 0$ only]: shifts labour demand to the left, so that $w \downarrow$ and (provided $\varepsilon_{SW} > 0$) $N \downarrow$ [Try to draw opposite case also!]
- Higher consumption tax: [$\tilde{\theta}_C > 0$ only]: shifts labour supply to the left if $\varepsilon_{SW} > 0$, so that $w \downarrow$ and $N \downarrow$ [Try to draw opposite case also!]

Figure 7.4: The effects of taxation when wages are flexible

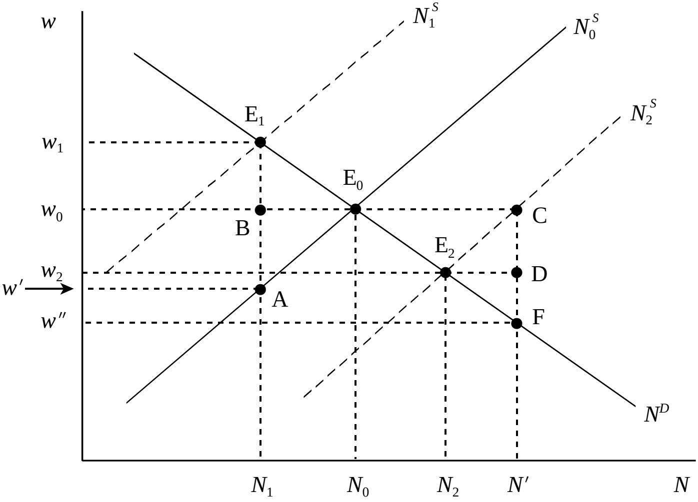


Table 7.6: Taxes and the competitive labour market

	(a) Flexible wage			*(b) Fixed consumer wage*		
	$\tilde{w}$	$\tilde{N}$	dU	$\tilde{w}$	$\tilde{N}$	dU
$\tilde{\theta}_M$	$\frac{\varepsilon_{SW}^c}{\varepsilon_{SW}+\varepsilon_D}$	$-\frac{\varepsilon_D\varepsilon_{SW}^c}{\varepsilon_{SW}+\varepsilon_D}$	0	0	0	$-\varepsilon_{SW}^c$
$\tilde{\theta}_A$	$-\frac{\varepsilon_{SI}}{\varepsilon_{SW}+\varepsilon_D}$	$\frac{\varepsilon_D\varepsilon_{SI}}{\varepsilon_{SW}+\varepsilon_D}$	0	1	$-\varepsilon_D$	$\varepsilon_{SW}^c+\varepsilon_D$
$\tilde{\theta}_M=\tilde{\theta}_A$	$\frac{\varepsilon_{SW}}{\varepsilon_{SW}+\varepsilon_D}$	$-\frac{\varepsilon_D\varepsilon_{SW}}{\varepsilon_{SW}+\varepsilon_D}$	0	1	$-\varepsilon_D$	ε_D
$\tilde{\theta}_E$	$-\frac{\varepsilon_D}{\varepsilon_{SW}+\varepsilon_D}$	$-\frac{\varepsilon_D\varepsilon_{SW}}{\varepsilon_{SW}+\varepsilon_D}$	0	0	$-\varepsilon_D$	ε_D
$\tilde{\theta}_C$	$\frac{\varepsilon_{SW}}{\varepsilon_{SW}+\varepsilon_D}$	$-\frac{\varepsilon_D\varepsilon_{SW}}{\varepsilon_{SW}+\varepsilon_D}$	0	1	$-\varepsilon_D$	ε_D
$\tilde{w}_C$	–	–	–	1	$-\varepsilon_D$	$\varepsilon_{SW}+\varepsilon_D$

Notes: (a) coefficients satisfy $\varepsilon_D>0$, $\varepsilon_{SW}^c>0$, $\varepsilon_{SI}>0$;
(b) for dominant substitution effect, $\varepsilon_{SW}\equiv\varepsilon_{SW}^c-\varepsilon_{SI}>0$;
(c) stability condition is $\varepsilon_{SW}+\varepsilon_D>0$.

(b) Taxes and the labour market: rigid consumer wage

- Suppose that workers have an aversion against reductions in their real consumer wage, i.e. $w_C \equiv w(1-\theta_A)/(1+\theta_C)$, is inflexible downward
- In loglinearized form we have:

$$\tilde{w}_C \equiv \tilde{w} - \tilde{\theta}_A - \tilde{\theta}_C \tag{S5}$$

- Substituting (S5) into the demand and supply functions yields:

$$\tilde{N}^D = -\varepsilon_D \left[\tilde{w}_C + \tilde{\theta}_A + \tilde{\theta}_E + \tilde{\theta}_C\right]$$

$$\tilde{N}^S = \varepsilon_{SW}\tilde{w}_C + \varepsilon_{SW}^c \left[\tilde{t}_A - \tilde{\theta}_M\right]$$

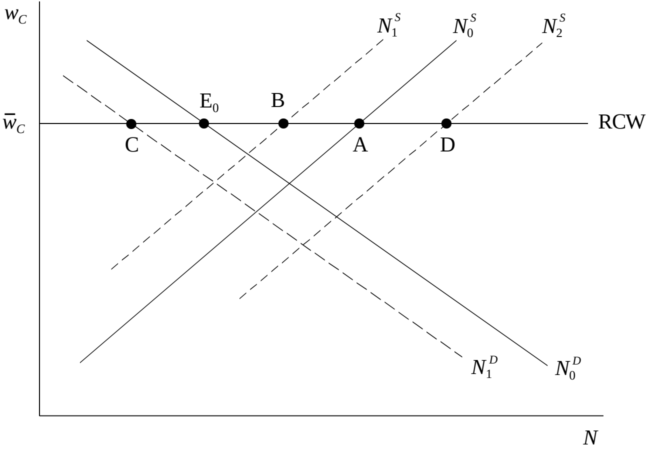
We have approximately that the change in the unemployment rate is:

$$dU = \tilde{N}^S - \tilde{N}^D$$

Taxes and the labour market: rigid consumer wage

- Note: $U \equiv \frac{N^S - N^D}{N^S} = 1 - \frac{N^D}{N^S} \approx \ln\left(\frac{N^S}{N^D}\right)$ so that $dU = \tilde{N}^S - \tilde{N}^D$.
- Workings of the disequilibrium model are illustrated in **Figure 7.5**. Taxes work differently now
- More progressive tax system [$\tilde{\theta}_M > 0$ only]: shifts labour supply to the left [pure substitution effect], so that w_C and N constant but unemployment down
- Higher average tax rate [$\tilde{\theta}_A > 0$ only]: shifts labour supply to the right [income effect] and shifts labour demand to the left. Hence, w_C constant but $N \downarrow$
- Higher payroll tax [$\tilde{\theta}_E > 0$ only]: shifts labour demand to the left; w_C constant but $N \downarrow$ (regardless of sign of ε_{SW})
- Higher consumption tax: [$\tilde{\theta}_C > 0$ only]: shifts labour demand to the left; w_C constant but $N \downarrow$ (regardless of sign of ε_{SW})

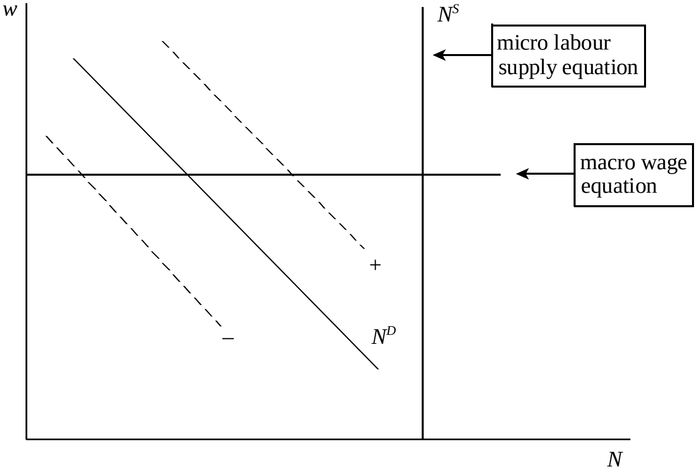
Figure 7.5: The effects of taxation with a fixed consumer wage



Conclusion based on 'standard models'

- Models with flexible wage(s) hard to bring in line with the real world (e.g. empirical studies suggest that $\sigma_{CM} \approx 1$ to that $\varepsilon_{SW} \approx 0$: almost vertical uncompensated labour supply curve)
- The facts suggest that the **macroeconomic wage** equation is almost horizontal (even though the **microeconomic labour supply** is almost vertical). See **Figure 7.6**
- Hence, we desperately need a theory of real wage rigidity [one of the Holy Grails of modern macroeconomics]

Figure 7.6: Labour demand and supply and the macroeconomic wage equation



Aims of this section

- To discuss the most important trade union models and their implications for the wage rate and unemployment
  - Monopoly union model
  - Right-to-manage model
  - Efficient bargaining model
- Unions in general equilibrium
- Wage rigidity and labour unions

Union

- Objective function of the union:

$$V(\underset{+}{w}, \underset{+}{N}) \equiv \frac{N}{N^{\max}} u^e(\underset{+}{w}) + \left[1 - \frac{N}{N^{\max}}\right] u^u(\underset{+}{b}), \quad w \geq b$$

  - $N^{\max}$ the (fixed) number of union members
  - N the number of employed members of the union ($N \leq N^{\max}$)
  - w is the real wage rate ($w \geq b$)
  - b is the pecuniary value of being unemployed (referred to as the unemployment benefit)
  - $u^e(.)$ and $u^e(.)$ are the *indirect* utility functions of, respectively, the employed and unemployed representative union member

Union indifference curve

- Graphical device: the union indifference curve: (w, N) combinations for which $V(w, N)$ is constant. See **Figure 7.8**
- The slope of an indifference curve of the union is determined in the usual way:

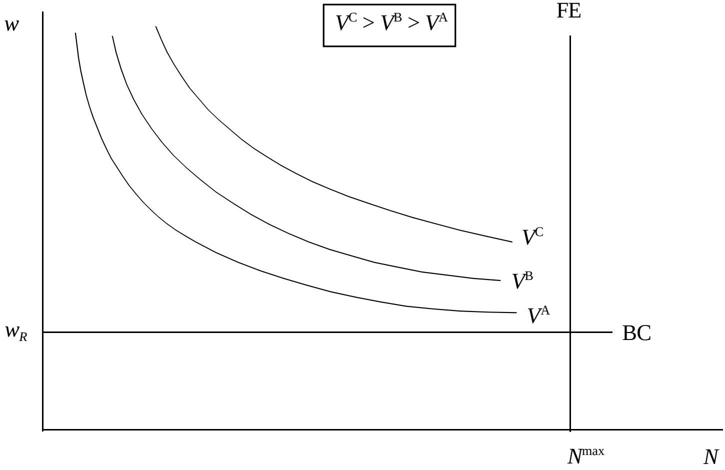
$$dV = V_w dw + V_N dN = 0 \qquad \Rightarrow$$

$$\left(\frac{N}{N^{\max}}\right) u_w^e dw + \frac{1}{N^{\max}} \left[u^e(w) - u^u(b)\right] dN = 0 \qquad \Rightarrow$$

$$\left(\frac{dw}{dN}\right)_{dV=0} = -\left(\frac{u^e(w) - u^u(b)}{N u_w^e}\right) < 0$$

  - The union's indifference curves are downward sloping
  - Union utility rises in North-Easterly direction (because $V_w > 0$ and $V_N > 0$), i.e. $V^C > V^B > V^A$ in Figure 7.8
  - Note the constraints $w \geq b$ and $N \leq N^{\max}$

Figure 7.8: Indifference curves of the union



Firm

- Objective function of the firm:

$$\pi(\underset{-}{w}, \underset{?}{N}) \equiv \underbrace{AF(N, \bar{K})}_{Y} - wN$$

  - π is short-run profit
  - A is index of general productivity
  - $\bar{K}$ capital stock (fixed in the short run)

- The (profit maximizing) demand for labour is such that $\pi_N \equiv \partial\pi/\partial N = 0$ or:

$$\pi_N = AF_N(N, \bar{K}) - w = 0 \quad \Leftrightarrow$$
$$N^D = N^D(\underset{-}{w}, \underset{+}{A}, \underset{+}{\bar{K}})$$

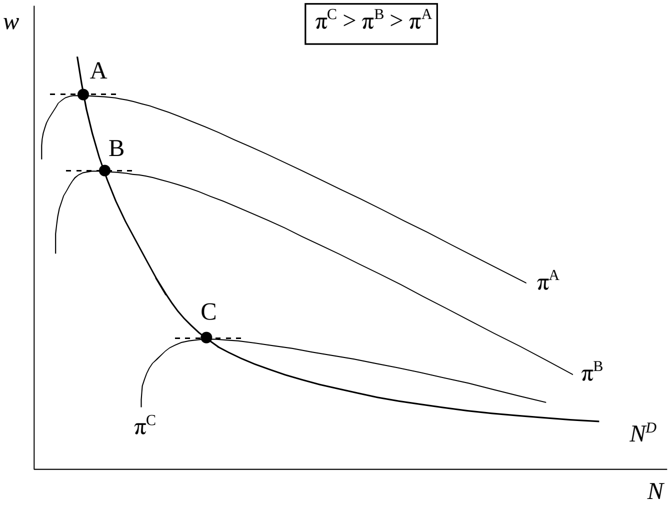
Iso-profit line

- Graphical device: the iso-profit line ($\approx$ indifference curve for the firm): (w, N) combinations for which $\pi(w, N)$ is constant. See **Figure 7.7**. The slope of an iso-profit curve can be determined in the usual fashion: $d\pi = \pi_w dw + \pi_N dN = 0 \;\Rightarrow$

$$\left(\frac{dw}{dN}\right)_{d\pi=0} = -\frac{\pi_N}{\pi_w}$$

  - We know that $\pi_w = -N < 0$ so π_N determines the slope of an iso-profit line
  - But $\pi_N \equiv AF_N - w$, and $F_{NN} < 0$, so π_N is positive for a low employment level, becomes zero (at the profit maximizing point), and then turns negative as employment increases further
  - Top of the iso-profit line is on the labour demand function
  - As we move downward along labour demand profit increases

Figure 7.7: The iso-profit locus and labour demand



Three major trade union models

(A) Monopoly union model [Dunlop (1944)]: union exploits monopoly power in its labour market

(B) Right-to-manage model [Leontief (1946)]: union and firm bargain over the wage. The firm sets the employment level

(C) Efficient bargaining model [McDonald and Solow (1981)]: union and firm bargain over wage *and* employment simultaneously

(A) Monopoly union model (1)

- The union picks the wage to maximize union utility subject to the labour demand curve:

$$\max_{\{w\}} V(w,N) \text{ subject to } \underbrace{\pi_N(w,A,N,\bar{K})=0}_{(a)}$$

(a) The firm determines employment and thus the constraint means that the solution lies on the demand for labour curve

- Substituting the constraint yields:

$$\max_{\{w\}} V\left(w, N^D(w,A,\bar{K})\right)$$

(A) Monopoly union model (2)

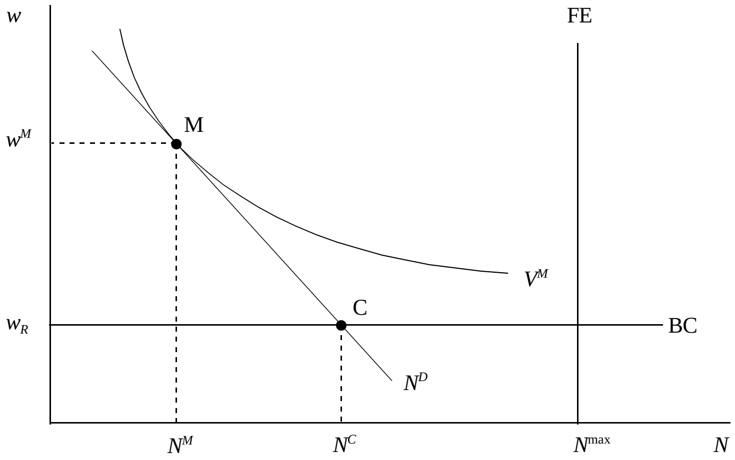
- The first-order condition:

$$\frac{dV}{dw} = 0: \quad V_w + V_N L_w^D = 0 \quad \Rightarrow$$
$$\underbrace{-\frac{V_w}{V_N}}_{(a)} = \underbrace{N_w^D}_{(b)}$$

  (a) Slope of the union indifference curve
  (b) Slope of the labour demand curve

- In **Figure 7.9** the solution is in point M. The competitive market solution (attained in the absence of unions) would be C. Hence, there is too little employment (and too much unemployment) with a monopoly union.

Figure 7.9: Wage setting by the monopoly union



(A) Monopoly union model (3)

- We can rewrite the first-order condition:

$$V_w + V_N N_w^D = \frac{N}{N^{\max}} u_w^e + \frac{1}{N^{\max}} \left[u^e(w) - u^u(b) \right] N_w^D = 0$$

$$= \frac{N}{wN^{\max}} \left[wu_w^e + \left[u^e(w) - u^u(b) \right] \frac{wN_w^D}{N} \right] = 0 \Rightarrow$$

$$\frac{u^e(w) - u^u(b)}{wu_w^e} = \frac{1}{\varepsilon_D} \qquad \text{(S6)}$$

where $\varepsilon_D \equiv -\frac{w}{N^D} \frac{\partial N^D}{\partial w}$ is the labour demand elasticity

- If ε_D is constant then productivity shocks [changes in A] have no effect on the optimal real wage. Rationale for horizontal real wage curve (provided the union is not fully employed)

(A) Monopoly union model (4)

- If (indirect) utility is logarithmic, $u^e(x) = u^u(x) \equiv \ln x$ then (S6) reduces to:

$$w = e^{1/\varepsilon_D}\, b$$

  The wage is a markup over the unemployment benefit! [recall that $e^{1/\varepsilon_D} > 1$]
  - The higher is ε_D, the lower is the markup [less monopoly power of the union]
  - Lowering b lowers the wage and raises employment
- A fully employed union (for which $N = N^{\max}$) is interested only in raising the real wage: $V(w, N) = u^e(w)$ in that case. Positive productivity shocks translate into higher real wages.

(B) Right-to-manage model (1)

- Firm and union bargain over the wage
- Firm picks the employment level ("buyer's sovereignty")
- Generalized Nash bargaining
- Formally, the wage bargain maximizes:

$$\max_{\{w\}} \Omega \equiv \beta \ln \left(V(w, N) - V^{\min} \right) + (1 - \beta) \ln \left(\pi(w, N) - \pi^{\min} \right)$$

$$\text{subject to } \pi_N(w, A, N, \bar{K}) = 0,$$

  - β relative bargaining strength of the union
  - $1 - \beta$ relative bargaining strength of the firm
  - $V^{\min}$ fall-back position of the union, e.g. $V^{\min} = u^u(b)$
  - $\pi^{\min}$ fall-back position of the firm (minimum profit to cover capital cost)
  - Constraint $\pi_N = 0$ because the firm will pick employment on labour demand

(B) Right-to-manage model (2)

- By substituting labour demand we get:

$$\max_{\{w\}} \Omega \equiv \beta \ln \left(V(w, N^D(w, A, \bar{K})) - V^{\min} \right) + (1-\beta) \ln \left(\pi(w, N^D(w, A, \bar{K})) - \pi^{\min} \right)$$

- First-order condition:

$$\frac{d\Omega}{dw} = \beta \overbrace{\frac{V_w + V_N N_w^D}{V - V^{\min}}}^{(a)} + (1-\beta) \overbrace{\frac{\pi_w + \pi_N N_w^D}{\pi - \pi^{\min}}}^{(b)} = 0 \qquad \text{(S7)}$$

(a) This term can be simplified to:

$$V_w + V_N N_w^D = \frac{N}{w N^{\max}} \left[w u_w^e - \varepsilon_D [u^e(w) - u^u(b)] \right]$$

(B) Right-to-manage model (3)

- Continued.
  (b) This term can be simplified to:

$$\pi_w + \pi_N L_w^D = \pi_w = -N,$$

- By substituting these terms into (S7) we get:

$$\frac{\beta}{V - V^{\min}}[V_w + V_N N_w^D] = -\frac{1-\beta}{\pi - \pi^{\min}}\pi_w \;\Rightarrow$$

$$\frac{N}{wN^{\max}}\left[wu_w^e - \varepsilon_D[u^e(w) - u^u(b)]\right] = \frac{(1-\beta)(V - V^{\min})}{\beta(\pi - \pi^{\min})}N \;\Rightarrow$$

$$wu_w^e - \varepsilon_D\left[u^e(w) - u^u(b)\right] = \frac{(1-\beta)wN}{\beta(Y - wN - \pi^{\min})}\left[u^e(w) - u^u(b)\right]$$

(B) Right-to-manage model (4)

- We get:

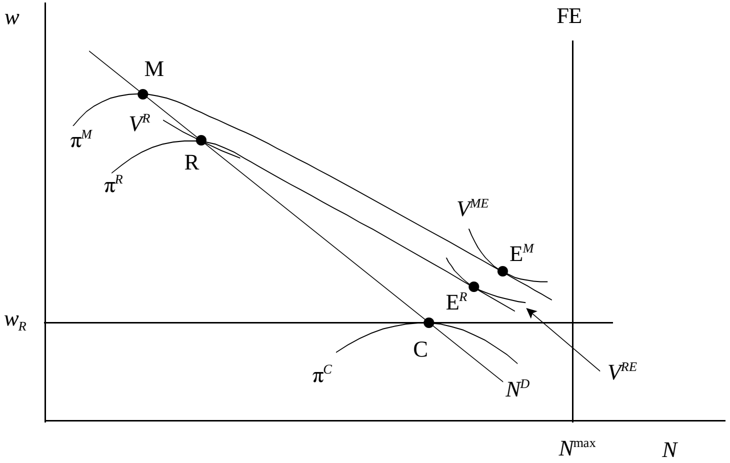
$$\frac{u^e(w) - u^u(b)}{w u^e_w} = \frac{1}{\varepsilon_D + \phi}, \quad \phi \equiv \frac{(1-\beta)\omega_N}{\beta(1-\omega_N-\omega_\pi)} \geq 0$$

  - Normal case ($0 < \beta < 1$): the RTM union sets a lower wage than a monopoly union [because the markup is smaller for the RTM union, i.e. $\frac{1}{\varepsilon_D+\phi} < \frac{1}{\varepsilon_D}$]
  - Corner case 1 ($\beta = 1$): if the union holds all the bargaining power then $\phi = 0$ and the RTM solution is the monopoly union solution
  - Corner case 2 ($\beta = 0$): if the firm holds all the bargaining power then $\phi \to \infty$ and the wage is set at the competitive level ($w = b$)

(B) Right-to-manage model (5)

- In **Figure 7.10** the RTM solution can lie anywhere between point M and C
- A disturbing property of the RTM solution is that it leads to an *inefficient* outcome: through point R there is an iso-profit line π^R along which union utility can be increased
- Point E^R is the efficient point

Figure 7.10: Wage setting in the right-to-manage model



(C) Efficient bargaining model (1)

- Now the firm and the union bargain over the wage *and* the employment level to maximize:

$$\max_{\{w,N\}} \Omega \equiv \beta \ln \left(V(w,N) - V^{\min}\right) + (1-\beta) \ln \left(\pi(w,N) - \pi^{\min}\right)$$

- First-order conditions:

$$\frac{\partial \Omega}{\partial w} = \frac{\beta}{V - V^{\min}} V_w + \frac{1-\beta}{\pi - \pi^{\min}} \pi_w = 0$$
$$\frac{\partial \Omega}{\partial N} = \frac{\beta}{V - V^{\min}} V_N + \frac{1-\beta}{\pi - \pi^{\min}} \pi_N = 0$$

(C) Efficient bargaining model (2)

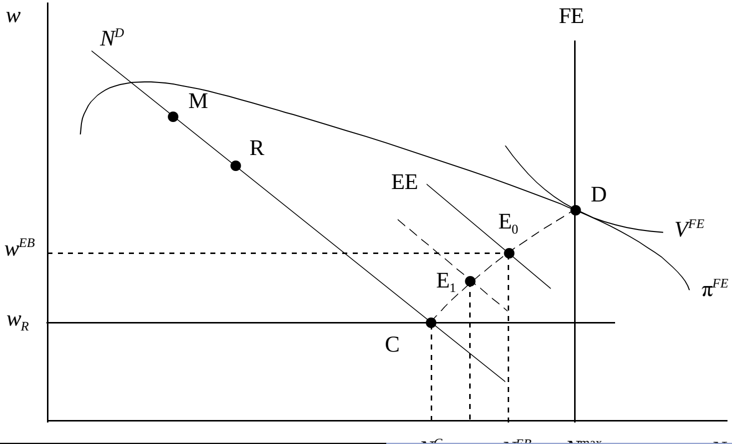
- Combining these conditions yields the *contract curve:*

$$-\frac{1-\beta}{\pi-\pi^{\min}} = \frac{\beta}{V-V^{\min}}\frac{V_w}{\pi_w} = \frac{\beta}{V-V^{\min}}\frac{V_N}{\pi_N}$$

$$\frac{V_N}{V_w} = \frac{\pi_N}{\pi_w} \qquad \text{(S8)}$$

  - Contract curve is all points of tangency between indifference curves of the firm and the union
  - All points on the contract curve are efficient
  - Except in point C all points on the contract curve are off the labour demand curve
  - See **Figure 7.11** for an illustration

Figure 7.11 Wages and employment under efficient bargaining



(C) Efficient bargaining model (3)

- To close the model we postulate a so-called *equity locus* or "fair share" rule
- After repeated interactions in the past the firm and the union have decided on a target share (ω_N^f) of the output that accrues to the union:

$$wL = \omega_N^f Y, \qquad 0 < \omega_N^f < 1$$

- It follows that the firm gets:

$$\pi(w, N) = \underbrace{AF(N, \bar{K})}_{Y} - wN = (1 - \omega_N^f) AF(N, \bar{K})$$

(C) Efficient bargaining model (4)

- The slope of the equity locus, $wN = \omega_N^f AF(N, \bar{K})$, is:

$$\left(\frac{dw}{dN}\right)_{EE} = \frac{\omega_N^f AF_N - w}{N} < 0$$

  (Note: The solution lies to the right of the labour demand so $\pi_N \equiv AF_N - w < 0$. hence, a fortiori, $w > \omega_N^f AF_N$ (since $0 < \omega_N^f < 1$).)

- The equity locus shifts to the right if the union's share of the pie is increased:

$$\left(\frac{\partial N}{\partial \omega_N^f}\right)_{EE} = \frac{Y}{w - \omega_N^f AF_N} > 0$$

- In Figure 7.11 the equity locus is represented by the EE line. The initial equilibrium is at point E_0

(C) Efficient bargaining model (5)

- Crucial features of the solution:
  - employment is higher than under the competitive solution! Profits are turned into jobs under efficient bargaining
  - Wage moderation [e.g. the Wassenaar Agreement] as modelled by $\omega_N^f \downarrow$ may actually be bad for employment! A lower ω_N^f shifts the EE locus to the left so that the new equilibrium is at E_1. Effective bargaining power of the firm is increased and the equilibrium moves closer to the competitive solution C
- Key problem with the efficient bargaining union is its spectacular lack of empirical support. The standard case appears to be the RTM model in the real world

Unions in a two-sector setting

- Dual labour market idea: labour is homogeneous but there are two sectors in the economy:
  - *Primary sector*: unionized (monopoly union). Here is where the good jobs are found
  - *Secondary sector*: competitive. Here is where the poor jobs are found
- If there is no unemployment benefit ($b = 0$): full employment and wage disparity, $w_1^M \gg w_2^C$ as the union keeps secondary sector workers out of the primary sector – see In **Figure 7.12**
- If there are unemployment benefits ($b > 0$): there will also be unemployment now in the secondary sector – In **Figure 7.13**

Figure 7.12: Unions and wage dispersion in a two-sector model

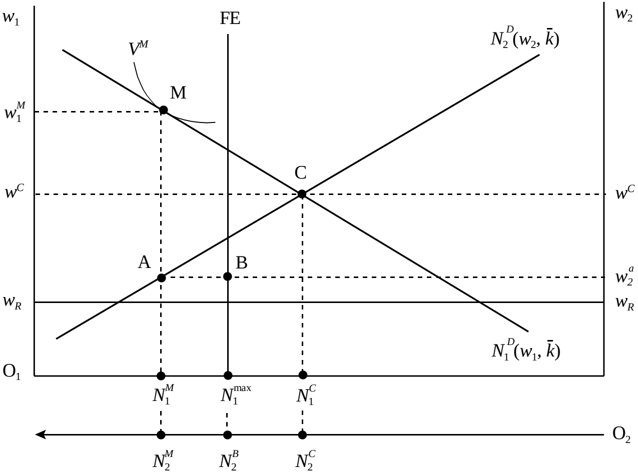
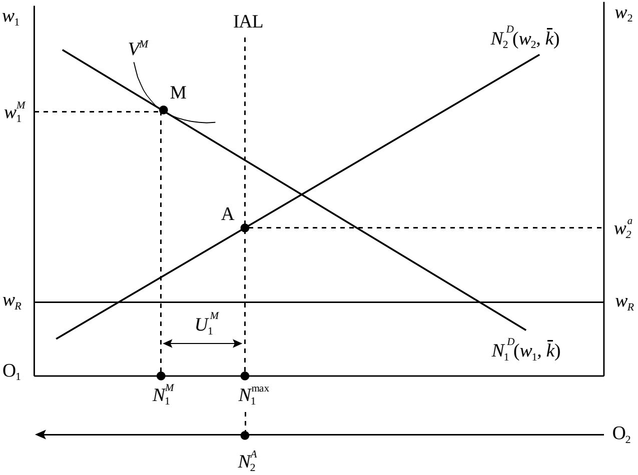


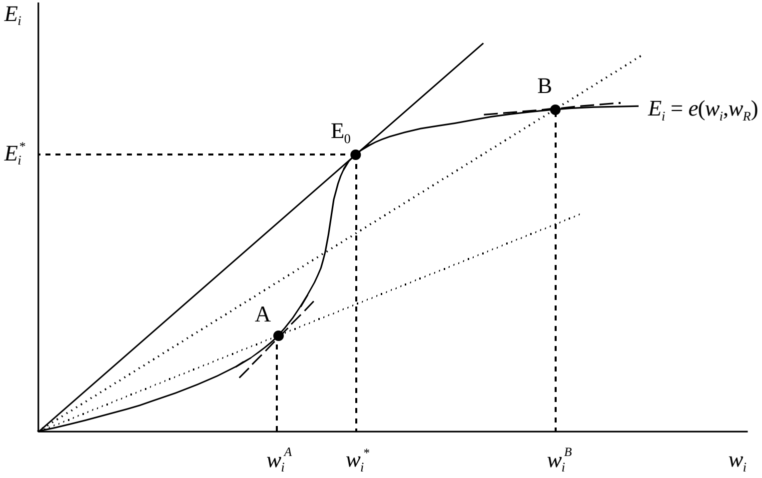
Figure 7.13: Unions and unemployment in a two-sector model



The theory of efficiency wages

- Basic idea: worker productivity depends positively on the wage that he/she receives
- Possible reasons for this effect are:
  - Link between productivity and nutrition
  - Labour turnover and training costs
  - High wage to attract the best workers
  - High wage to limit shirking
  - Fair wage hypothesis
- The effort exerted by a worker may be S-shaped as in **Figure 7.14**

Figure 7.14: Efficiency wages



A simple model of efficiency wages (1)

- Effort function:

$$E_i \equiv e(\underset{+}{w_i}, \underset{-}{w_R}), \quad e_w > 0, \; e_{w_R} < 0$$

where E_i is the effort of a worker in firm i, w_i is the wage paid by firm i to its workers, and w_R is the *reservation wage* [the wage that can be obtained elsewhere in the economy]

- Profit of firm i is defined as:

$$\Pi_i \equiv P_i A F(\underbrace{E_i N_i}_{L_i}, \bar{k}) - W_i N_i \qquad \text{(S9)}$$

where P_i is the price of firm i, A is a general productivity index, and L_i represents the effective labour units employed in firm i [dimension: bodies $\times$ effort per body]

A simple model of efficiency wages (2)

- Firm chooses N_i and w_i [the latter to control effort]. First-order conditions:

$$\frac{\partial \Pi_i}{\partial N_i} = P_i A E_i F_N(E_i N_i, \bar{k}) - w_i = 0 \tag{S10}$$

$$\frac{\partial \Pi_i}{\partial w_i} = P_i A N_i F_N(E_i N_i, \bar{k}) e_w(w_i, w_R) - N_i = 0$$

  By combining these conditions we get the Solow condition:

$$\frac{w_i e_w(w_i, w_R)}{e(w_i, w_R)} = 1 \tag{S11}$$

  Hence, the firm picks the wage w_i for which the elasticity of the effort function equals unity. In terms of Figure 7.14, points A and B are no good but point E_0 is just right
- Once w_i and thus–via the effort function–E_i are known, equation (S10) determines the number of workers, N_i

A simple model of efficiency wages (3)

- Major result already: The firm chooses (w_i, E_i, N_i) but there is no reason to believe that all firms taken together will demand enough labour to employ all workers. The wage does not clear the market but instead is a motivating device. Unemployment will probably exist!
- We close the model with an expression for the *reservation wage*:

$$w_R = (1-U)\bar{w} + Ub = \bar{w}\left[1 - U + \beta U\right] \tag{S12}$$

where U is the unemployment rate, $\bar{w}$ is the average wage paid in the economy, and $\beta \equiv b/\bar{w}$ is the unemployment benefit expressed as a proportion of the average wage paid in the economy (the so-called replacement rate)

A simple model of efficiency wages (4)

- Finally, we adopt a specific effort function to keep things simple:

$$E_i = (w_i - w_R)^{\varepsilon}, \quad 0 < \varepsilon < 1 \qquad \text{(S13)}$$

where ε measures the strength of the productivity-enhancing effects of high wages, which we call the *leap-frogging effect*

- For this effort function we can apply the Solow condition:

$$\frac{w_i}{E_i}\frac{\partial E_i}{\partial w_i} = 1 \quad \Rightarrow$$

$$\left(\frac{w_i - w_R}{w_i}\right) = \varepsilon \quad \Leftrightarrow$$

$$w_i = \frac{w_R}{1-\varepsilon} \qquad \text{(S14)}$$

Hence, the firm pays a markup $\frac{1}{1-\varepsilon}$ times the reservation wage!

A simple model of efficiency wages (5)

- But all firms are assumed to be the same so that they all set the same wage so that $w_i = \bar{w}$. This implies:

$$w_i = \bar{w} = \frac{w_R}{1-\varepsilon} = \frac{\bar{w}(1-U+\beta U)}{1-\varepsilon} \quad \Rightarrow$$
$$U^* = \frac{\varepsilon}{1-\beta}$$

- Hence, there is indeed a positive *equilibrium unemployment* as we thought there would be
- U^* is higher the higher is ε and the higher is β

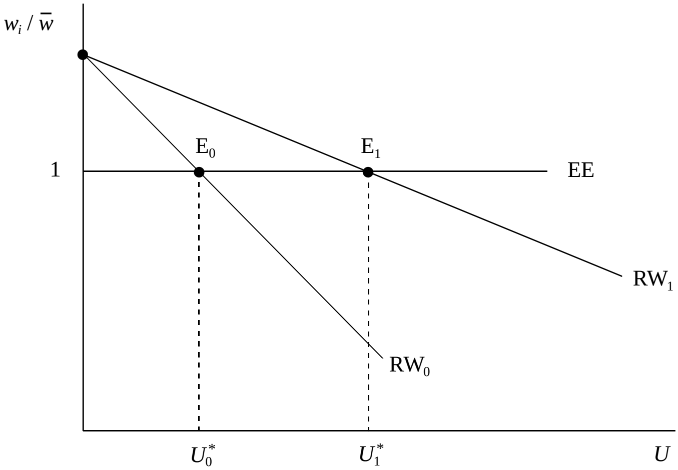
A simple model of efficiency wages (6)

- The intuition can be understood with **Figure S1**

$$\frac{w_i}{\bar{w}} = \frac{1-(1-\beta)U}{1-\varepsilon} \qquad \text{(RW curve)}$$
$$\frac{w_i}{\bar{w}} = 1 \qquad \text{(EE curve)}$$

- The RW curve slopes down because, as U is high there is a strong threat of unemployment. This means there is less reason to pay high wages
- An increase in β or ε rotates the RW curve counter-clockwise and raises equilibrium unemployment

Figure S1: The relative wage and unemployment



Test your understanding

****** Self Test ******

Study the effects of taxation on unemployment and wages for the efficiency wage model. One interesting result is that increasing the progressivity of the tax system leads to a reduction of the equilibrium unemployment rate! There is less scope for leap frogging by firms. Wages fall and employment rises.

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Punchlines

- We have stated some stylized facts about the labour market.
- Standard models can explain a lot.
- There is a tension between micro- and macroeconomic evidence regarding the labour supply elasticity.
- The efficiency wage theory has some very attractive features in removing this tension.
- Taxes affect the labour market no matter what theory you use [the direction of the effects depends on the details].