Lecture 5: Labour Economics and Wage-Setting Theory

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Literature: Chapter 7 Cahuc-Carcillo-Zylberberg: 435-445

Topics

- **Weakly efficient bargaining**
- **Strongly efficient bargaining**
- **Wage dispersion**
- **Bargaining over working time**
- **Insiders and outsiders**

<u>Efficient contracts</u>

- **Bargaining over the wage only and letting employers determine employment (right to manage) is not efficient.**
- **An efficient solution can be found by bargaining over both the wage and employment.**

$$\underset{w,\,L}{\text{Max}} \quad \left[R(L) - wL\right]^{1-\gamma} \left[\nu(w) - \nu(\overline{w})\right]^{\gamma} L^{\gamma}$$

$$\text{s.t.} \quad 0 \le L \le N \quad \text{and} \quad w \ge \overline{w}$$

<u>Interior solution</u>

$$(1-\gamma)\frac{R'(L) - w}{R(L) - wL} + \frac{\gamma}{L} = 0 \qquad \text{(I)}$$

$$-(1-\gamma)\frac{L}{R(L) - wL} + \frac{\gamma\nu'(w)}{\nu(w) - \nu(\overline{w})} = 0 \qquad \text{(II)}$$

Eliminate γ between the two equations to get

$$w - R'(L) = \frac{\nu(w) - \nu(\overline{w})}{\nu'(w)} \qquad \text{(III)}$$

This is the equation of a <u>contract curve</u> (Pareto-efficient combinations of *w*, *L*) connecting tangency points of indifference and isoprofit curves.

The same equation would be obtained by maximising

$$L\left[\nu(w)-\nu(\overline{w})\right] \quad \text{s.t.} \quad \pi = \overline{\pi}$$

Differentiation of the contract curve equation gives:

$$\frac{dw}{dL} = \frac{R''(L)}{\nu''(w)\left[w-R'(L)\right]}$$

$\gamma = 0 \Rightarrow R'(L) = w$ according to (I)

$R'(L) = w \Rightarrow \nu(w) = \nu(\overline{w})$ and $w = \overline{w}$ according to (III)

Hence the contract curve starts on the labour demand schedule at $w = \overline{w}$

If $w > R'(L)$ **and workers are risk averse, i.e.**

$\nu'' < 0$, then $dw / dL > 0$ for $w > R'(L)$.

$\gamma = 0$ **gives the competitive level of employment** $L = L(\overline{w})$

With $\gamma > 0$**, the union uses its bargaining power to raise both the wage and employment over the competitive levels.**

If workers are risk-neutral, then $\nu'' = 0$ and $\dfrac{dw}{dL} \to \infty$**. Hence the contract curve is vertical. Employment is at the competitive level.**

Overemployment if workers are risk-averse – "weak efficiency" as

$R'(L) < \overline{w}$ due to employment being higher than L_c defined by $R'(L_c) = \overline{w}$

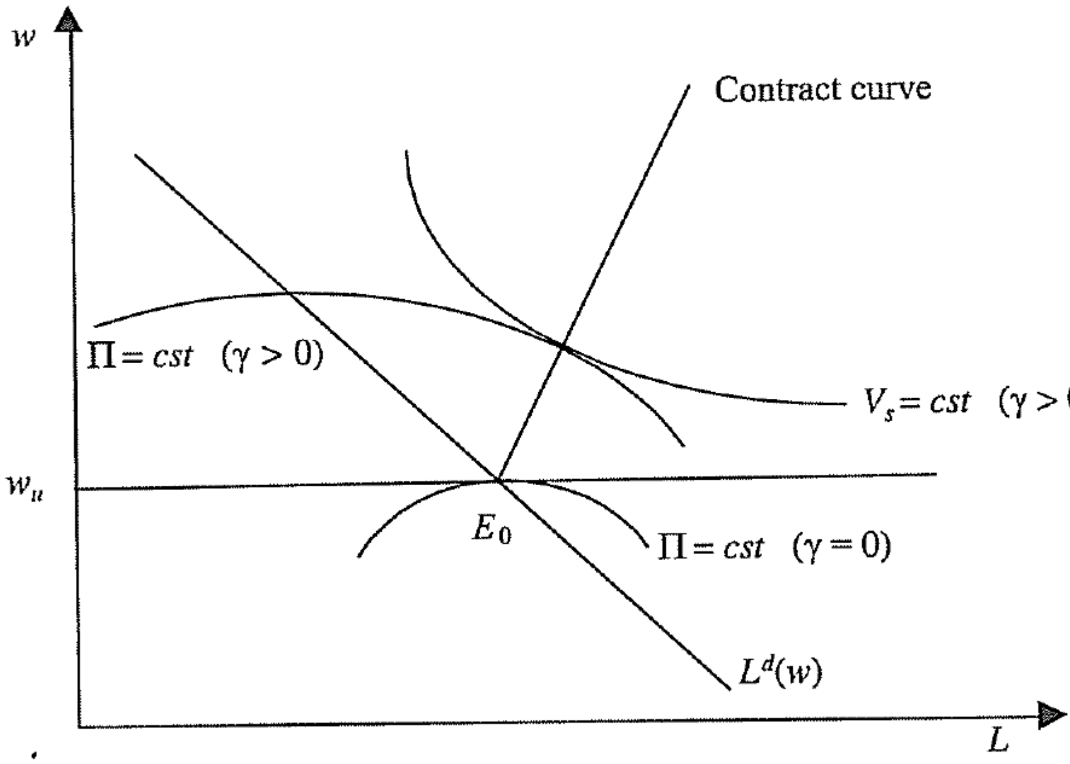


FIGURE 7.6
The model of bargaining over wages and employment.

Strongly efficient contracts

- **Efficiency gain for union if utility of employed and unemployed are equated**
- **Incentive to bargain with firm over unemployment benefit paid by the firm**

Union objective

$$L\nu(w) \; + \; (N - L)\nu(b \; + \; \overline{w})$$

Firm profit

$$\pi = R(L) - wL - (N - L)b$$

$$\underset{w,\,b}{\text{Max}} \quad L\nu(w) \; + \; (N - L)\nu(b + \overline{w})$$

$$\text{s.t.} \quad \pi = \pi_0$$

$$\underset{w,\,b}{\text{Max}} \quad L\nu(w) \; + \; (N - L)\nu(b + \overline{w}) \; + \; \lambda\left[R(L) - wL - (N - L)b - \pi_0\right]$$

FOC

$$L\nu'(w) - \lambda L \; = \; 0$$

$$(N - L)\nu'(b \; + \; \overline{w}) - \lambda(N - L) \; = \; 0$$

$$\nu'(w) \; = \; \lambda$$

$$\nu'(b \; + \; \overline{w}) \; = \; \lambda$$

Hence:

$$\nu'(w) = \nu'(b + \overline{w})$$

$$w = b + \overline{w}$$

- **Pareto efficiency requires a wage for the employed that is equal to the income as unemployed.**
- **The firm pays a benefit *b* to all unemployed.**
- **It pays a wage $\overline{w} + b$ to the employed.**
- **Employment does not matter to the union, since members are insured against unemployment.**

<u>The bargaining problem</u>

$$\underset{b}{\text{Max}} \quad \left[R(L^*) - \overline{w}L^* - bN\right]^{1-\gamma} \left[\nu(\overline{w} + b) - \nu(\overline{w})\right]^{\gamma}$$

FOC:

$$\frac{\nu(\overline{w} + b) - \nu(\overline{w})}{\nu'(\overline{w} + b)} = \frac{\gamma}{1-\gamma} \frac{\left[R(L^*) - \overline{w}L^* - bN\right]}{N}$$

with $\quad w = \overline{w} + b$

$$R'(L^*) = \overline{w}$$

- **Employment equals the competitive level**
- **Union members appropriate a share of the firm's profit without this having negative effects on employment**

Diagrammatical illustration

Indifference curves:

$$v_s = \nu(w)$$

$$\nu_1 dw = 0$$

$$\frac{\nu_1 dw}{dL} = 0$$

$$\frac{dw}{dL} = 0$$

The indifference curves are horizontal lines.

Isoprofit curve

$$\pi = R(L) - \overline{w}L - bN = R(L) - \overline{w}L - N(w - \overline{w})$$

$$d\pi = 0 = R'(L)dL - \overline{w}dL - Ndw$$

$$\frac{dw}{dL} = \frac{R'(L) - \overline{w}}{N}$$

- **Tangency points between isoprofit curves and indifference curves give a vertical contract curve (at the competitive level of employment)**
- **Bargaining over wages, employment and unemployment benefits from firms is strongly efficient.**

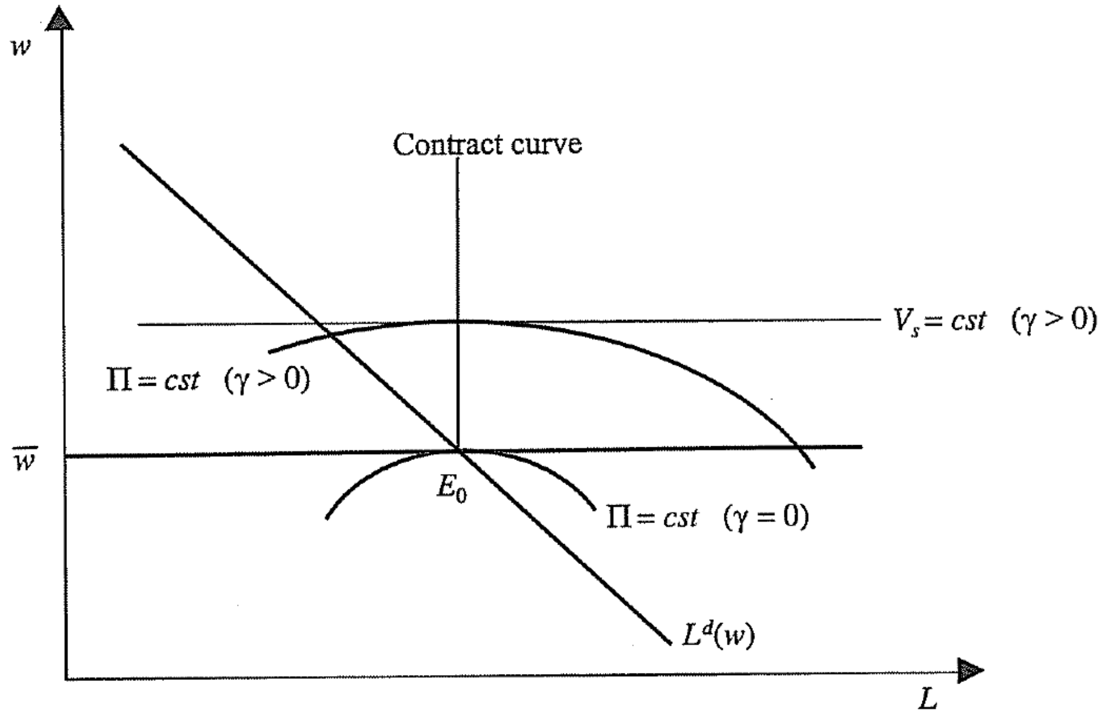


FIGURE 7.7
The strongly efficient bargaining model.

<u>Collective bargaining and wage dispersion</u>

- **Heterogeneous workers**
- **Collective bargaining reduces wage dispersion**

- **Two types of workers, indexed by *i* = 1, 2**
- **Revenue of the firm = $R(L_1, L_2)$**
- **Type -1 workers are more productive with a higher reservation wage** $\overline{w}_1 > \overline{w}_2$
- **N_i workers of type *i* in the firm's labour pool**
- **The union utility function**

$$\upsilon_s = \sum_{i=1}^{2} \{ L_i \upsilon(w_i) + (N_i - L_i) \upsilon(\overline{w}_i + b_i) \} \qquad L_i \leq N_i$$

- **Strongly efficient bargaining over employment, wages and unemployment benefits**
- **Optimal contract implies** $w_i = \overline{w}_i + b_i$

Bargaining problem

$$\underset{b_1, b_2, L_1, L_2}{\text{Max}} \left[R(L_1, L_2) - \sum_{i=1}^{2} (\overline{w}_i L_i + b_i N_i) \right]^{1-\gamma} \left[\sum_{i=1}^{2} N_i \left\{ \nu(\overline{w}_i + b_i) - \nu(\overline{w}_i) \right\} \right]^{\gamma}$$

$$\text{s.t.} \quad 0 \le L_i \le N_i \qquad i = 1, 2$$

FOCs

$$(11) \quad \frac{\partial R(L_1, L_2)}{\partial L_1} = \overline{w}_i$$

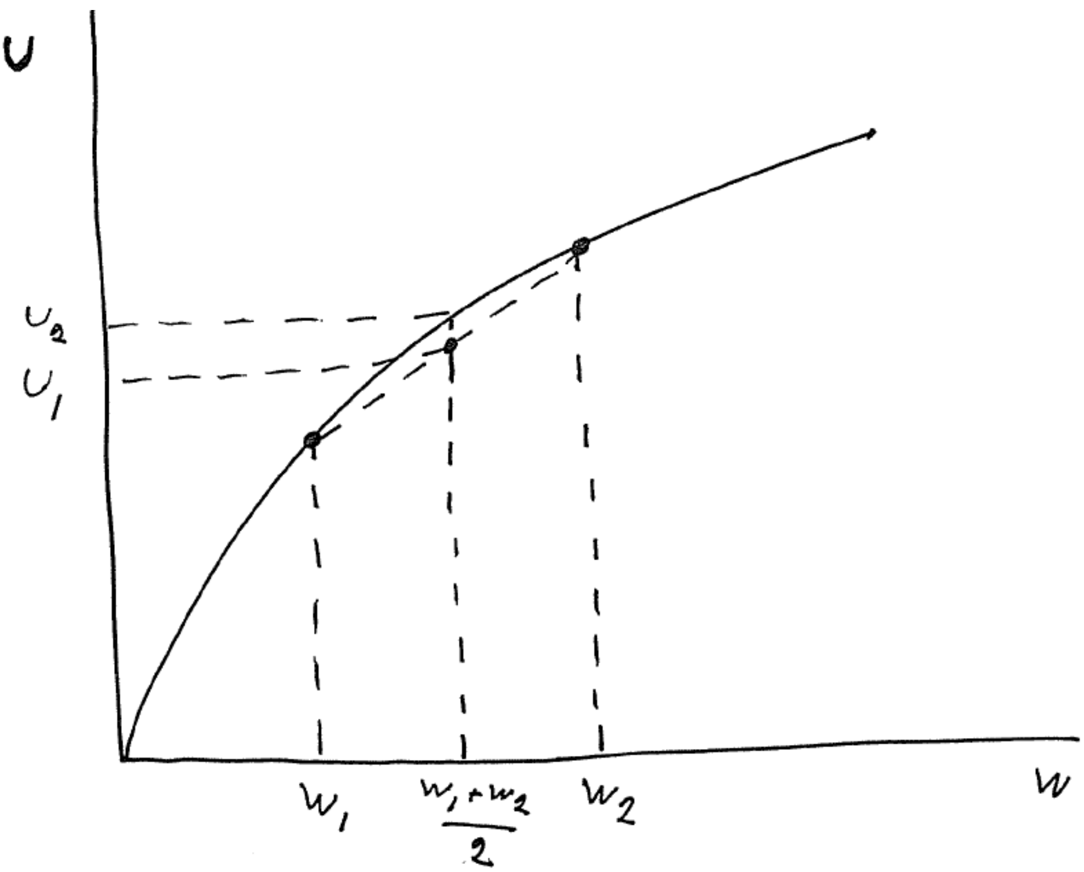
$$(12) \quad \nu'(\overline{w}_i + b_i) = \frac{1-\gamma}{\gamma} \frac{\left[\sum_{i=1}^{2} N_i \left[\nu(\overline{w}_i) + b_i) - \nu(\overline{w}_i) \right] \right]}{\left[R(L_1, L_2) - \sum_{i=1}^{2} (\overline{w}_i L_i + b_i N_i) \right]}$$

- **Equation (11): Productive efficiency, i.e. the marginal productivity of each type of worker equals the reservation wage. This implies the competitive level of employment.**
- **Equation (12): RHS is independent of *i*. Hence the same wage for the two types of labour.**
- **Wage equality follows from the assumption of a utilitarian union and identical preferences.**

$$\frac{N_1}{N_1+N_2}\nu(w_1) + \frac{N_2}{N_1+N_2}\nu(w_2) \le \nu\left[\frac{N_1}{N_1+N_2}w_1 + \frac{N_2}{N_1+N_2}w_2\right]$$

Because of concavity the union is better off with a wage

$\frac{N_1}{N_1+N_2}w_1 + \frac{N_2}{N_1+N_2}w_2$ **for everyone than with separate wages w_1 and w_2.**



$U_2 > U_1$

<u>Two-stage bargaining over employment (Manning 1987)</u>

Stage 1: Bargaining over the wage

Stage 2: Bargaining over employment

Different bargaining strengths in the two negotiations

<u>Bargaining over employment (given the wage)</u>

$$\underset{L}{\text{Max}} \quad \left[R(L) - wL\right]^{1-\gamma_L} \left[\nu(w) - \nu(\overline{w})\right]^{\gamma_L} L^{\gamma_L} \qquad \text{s.t. } 0 \leq L \leq N$$

The solution gives $L = L(\gamma_L, \overline{w}, w)$

<u>Bargaining over the wage</u> (takes the outcome of second-stage bargaining over employment into account)

$$\underset{w}{\text{Max}} \quad \left[R(L) - wL\right]^{1-\gamma} \left[\nu(w) - \nu(\overline{w})\right]^{\gamma} L^{\gamma}$$

$$\text{s.t. } L = \hat{L}(\gamma_L, \overline{w}, w) \quad \text{and} \quad w \geq \overline{w}$$

<u>Different cases</u>

- $\gamma_L = 0$ and $\gamma > 0$ **gives the right-to-manage model**
- $\gamma_L = \gamma$ **gives (weakly) efficient bargain model**
- **Otherwise solution on neither labour-demand schedule nor contract curve**

<u>Considerations</u>

- **Efficient bargaining is complex**
- **Wage bargaining precedes employment bargaining**
- **Wage bargaining is often at more centralised level**
- **Strongly efficient bargaining is improbable because of moral hazard problems: unemployed being fully insured will not search effectively for jobs**
  - **argument for partial insurance**
  - **individual firm (sector) offering full insurance would be swamped by labour inflow**
- **One does not find many examples of contracts with unemployment benefits paid by firms**
- **Unclear empirical results on right-to-manage model and (weakly efficient) bargaining**

Bargaining over hours

- **Real-world bargaining appears often to be about both wages and working time**

Ω = wage income
***T* = time allocation**
***H* = hours worked**

$\Omega = wH$
Utility function of a worker is $\upsilon(\Omega, H)$
***e* (*H*) = productivity of a worker**
***L* = number of workers**

Revenue of the firm

$$R\left[e(H)L\right] = \left[e(H)L\right]^{\alpha} / \alpha \qquad \alpha \in \left[0, 1\right]$$

$\eta_H^e = He'(H) / e(H) > 0$ **is the elasticity of worker productivity w.r.t. hours.**

$e(H)/(H) =$ **the productivity per hour. It increases with the number of hours if** $\eta_H^e > 1$.

- **Bargaining about the hourly wage and hours only**

Union utility

$$V_s = \ell\left[\nu(\Omega, T-H)\right] + (1-\ell)\nu(\overline{w}, T) \qquad \ell = \text{Min}\,(1, L/N)$$

Firm profit

$$\pi \;=\; \frac{1}{\alpha}\left[e(H)L\right]^{a} - \Omega L \qquad (24)$$

Right-to-manage assumption

Firm determines employment from profit maximisation. *w* and *H* or equivalently Ω and *H* are taken as given.

Set $\partial\pi / \partial L \;=\; 0$ **and solve for *L*:**

$$L(\Omega, H) \;=\; \left[e(H)\right]^{\alpha/(1-\alpha)} \Omega^{1/(\alpha-1)} \qquad (25)$$

If $L(\Omega,\ H) \;<\; N$, **we can plug (25) into profit equation (24).**

$$\pi(\Omega, H) \;=\; \left(\frac{1\text{-}\alpha}{\alpha}\right)\left[\frac{e(H)}{\Omega}\right]^{\alpha/(1-\alpha)}$$

Nash bargaining solution

If no agreement:
Employee gets $\nu(\overline{w}, T)$

Firm gets zero profit

$$\underset{\Omega,\, H}{\text{Max}} \quad \left[\frac{L(\Omega, H)}{N}\right]^{\gamma} \left[\nu(\Omega,\ T-H) - \nu(\overline{w},\ T)\right]^{\gamma} \left[\pi(\Omega, H)\right]$$

s.t. $\quad L(\Omega, H) \;\le\; N \quad$ and $\quad H \;\le\; \overline{H}$

$\overline{H}$ **is <u>legal constraint</u> on hours (maximum hours allowed by legislation).**

<u>Interior solution</u>

Take logs and differentiate w.r.t. Ω and *H*.

<u>FOCs</u>

$$\frac{\gamma\nu_1(\Omega,\ T-H)}{\nu(\Omega,\ T-H)-\nu(\overline{w},\ T)} = \frac{\alpha(1-\gamma)\ +\ \gamma}{(1-\alpha)\Omega} \tag{26}$$

$$\frac{\gamma\nu_2(\Omega,\ T-H)}{\nu(\Omega,\ T-H)-\nu(\overline{w},\ T)} = \frac{\alpha}{(1-\alpha)}\ \frac{e'(H)}{e(H)} \tag{27}$$

Divide (26) by (27):

$$\frac{\nu_1(\Omega,\ T-H)}{\nu_2(\Omega,\ T-H)} = \frac{\left[\alpha(1-\gamma)\ +\ \gamma\right]}{(1-\alpha)\Omega} \cdot \frac{(1\text{-}\alpha)}{\alpha} \cdot \frac{e(H)}{e'(H)} =$$

$$= \frac{\left[\alpha(1-\gamma)+\gamma\right]}{\alpha} \cdot \frac{e(H)}{e'(H)\cdot H} \cdot \frac{H}{\Omega} = \frac{H}{\Omega}\frac{\left[\alpha(1-\gamma)+\gamma\right]}{\alpha\eta_H^e} \tag{28}$$

$$\eta_H^e = He'(H)/e(H)$$

Equation (28) defines the MRS between income and leisure as a function of the wage $w = \Omega/H$ and the elasticity of employee productivity w.r.t. H, η_h^e.

Assume Cobb-Douglas utility function:

$$\nu(\Omega,\ T-H) = (\Omega)^{\mu}(T-H)^{1-\mu} \qquad \mu \in (0, 1)$$

Then:

$$\nu_1 = \mu\Omega^{\mu-1}(T-H)^{1-\mu}$$

$$\nu_2 = (1\text{-}\mu)(T-H)^{-\mu}\Omega^{\mu}$$

$$\frac{\nu_1}{\nu_2} = \frac{\mu}{1\text{-}\mu}\Omega^{-1}(T-H) = \frac{\mu}{1\text{-}\mu}\frac{(T-H)}{\Omega}$$

Assume that *e*(*H*) = *H*, then

$$e'(H) = 1 \text{ and } \eta_H^e = e'(H)\cdot H / e(H) = 1.$$

(28) then simplifies to:

$$\frac{\mu}{1-\mu}\frac{(T-H)}{\Omega} = \frac{H}{\Omega}\left[\frac{\alpha(1-\gamma) + \gamma}{\alpha}\right]$$

$$H^* = \frac{\mu\alpha}{(1\text{-}\mu)\left[\gamma + \alpha(1-\gamma)\right] + \mu\alpha} T \qquad (29A)$$

<u>Optimal number of hours</u>

- **is increasing in μ (the importance of income relative to leisure)**
- **is decreasing in union bargaining power γ**
  - **unions want low working time to get leisure and more workers employed**
  - **explanation of work sharing: reduction in hours to boost employment**

<u>Legal maximum of hours</u> $\overline{H} < H^*$

Negotiated wage is then given by (26) with $H = \overline{H}$

With Cobb-Douglas preferences one obtains:

$$\Omega^{\mu}(T-\overline{H})^{1-\mu} = \frac{\gamma(1-\alpha) + \alpha}{\gamma(1-\mu)(1-\alpha) + \alpha}\, \nu(\overline{w}, T) \qquad \text{(A)}$$

RHS of (A) is a constant. Hence:

$$\Omega^{\mu}(T-\overline{H})^{1-\mu} = \textbf{constant}$$

$$\mu \ell n \Omega + (1-\mu)\ell n(T-\overline{H}) = \textbf{constant}$$

Differentiate w.r.t. *dℓnH*

$$\mu \cdot \frac{d\ell n\Omega}{d\ell n\overline{H}} + (1-\mu)\frac{d\ell n(T-\overline{H})}{d\ell n\overline{H}} = 0$$

$$\mu \cdot \frac{d\ell n\Omega}{d\ell n\overline{H}} + (1-\mu)\frac{d\ell n(T-\overline{H})}{d\overline{H}} \cdot \frac{d\overline{H}}{d\ell n\overline{H}} = 0$$

$$\mu \cdot \frac{d\ell n\Omega}{d\ell n\overline{H}} + (1-\mu) \cdot \frac{(-1)}{T-\overline{H}} \cdot \overline{H} = 0$$

$$\frac{d\ell n\Omega}{d\ell n\overline{H}} = \eta_h^{\Omega} = \frac{\overline{H}(1-\mu)}{(T-\overline{H})\cdot\mu}$$

- **The elasticity of wage income w.r.t. hours, η_h^{Ω}, is positive.**
- **Hence wage income falls if hours fall.**
- **It falls more if hours are long to begin with.**

$$L(\Omega,\ H) \;=\; \left[e(H)\right]^{\alpha/(1-\alpha)}\,\Omega^{1/(\alpha-1)} \qquad (25)$$

Assume again $e(H) \;=\; H$

$$L(\Omega,\ H) \;=\; H^{\alpha/(1-\alpha)}\Omega^{1/\alpha-1} \qquad (B)$$

- **We want to know what happens to employment *L* if binding legal maximum $\overline{H}$ is reduced.**
  - **direct effect from change in $\overline{H}$**
  - **indirect effect from induced change in wage income Ω.**

Take logs of (B):

$$\ell nL \;=\; \frac{\alpha}{1-\alpha}\,\ell n\overline{H} \;+\; \frac{1}{\alpha-1}\,\ell n\Omega$$

Differentiate w.r.t. $d\,\ell n\overline{H}$

$$\frac{d\,\ell nL}{d\,\ell nH} \;=\; \frac{\alpha}{1-\alpha} \;+\; \frac{1}{\alpha-1}\;\frac{d\,\ell n\Omega}{d\,\ell n\overline{H}}$$

We use:

$$\frac{d\,\ell n\Omega}{d\,\ell n\overline{H}} \;=\; \frac{\overline{H}(1-\mu)}{(T-\overline{H})\cdot\mu}$$

$$\frac{d\ell n L}{d\ell n \overline{H}} = \frac{\alpha}{1-\alpha} + \frac{1}{\alpha - 1} \cdot \frac{\overline{H}(1-\mu)}{(T-\overline{H})\cdot\mu}$$

$$\frac{d\ell n L}{d\ell n \overline{H}} < 0 \quad \text{if} \quad \frac{\alpha}{1-\alpha} + \frac{1}{\alpha - 1} \cdot \frac{\overline{H}(1-\mu)}{(T-\overline{H})\cdot\mu} < 0$$

This is equivalent to $\overline{H} > \hat{H}$

$$\hat{H} = \frac{\mu\alpha}{(1-\mu) + \mu\alpha} T$$

<u>Interpretation</u>

- **A reduction in working time raises employment only if** $\overline{H} > \hat{H}$**.**
- **From (29A) we have that** $\hat{H}$ **is optimal hours for unions.**

$$H^{*} = \frac{\mu\alpha}{(1-\mu)\left[\gamma + \alpha(1-\gamma)\right] + \mu\alpha} T \qquad (29A)$$

$\gamma = 1 \Rightarrow$

$$H^{*} = \frac{\mu\alpha}{(1-\mu) + \mu\alpha} T$$

- **A reduction in $\overline{H}$ increases employment only down to the point where H reaches the trade union optimum.**
- **Further reductions lower employment.**

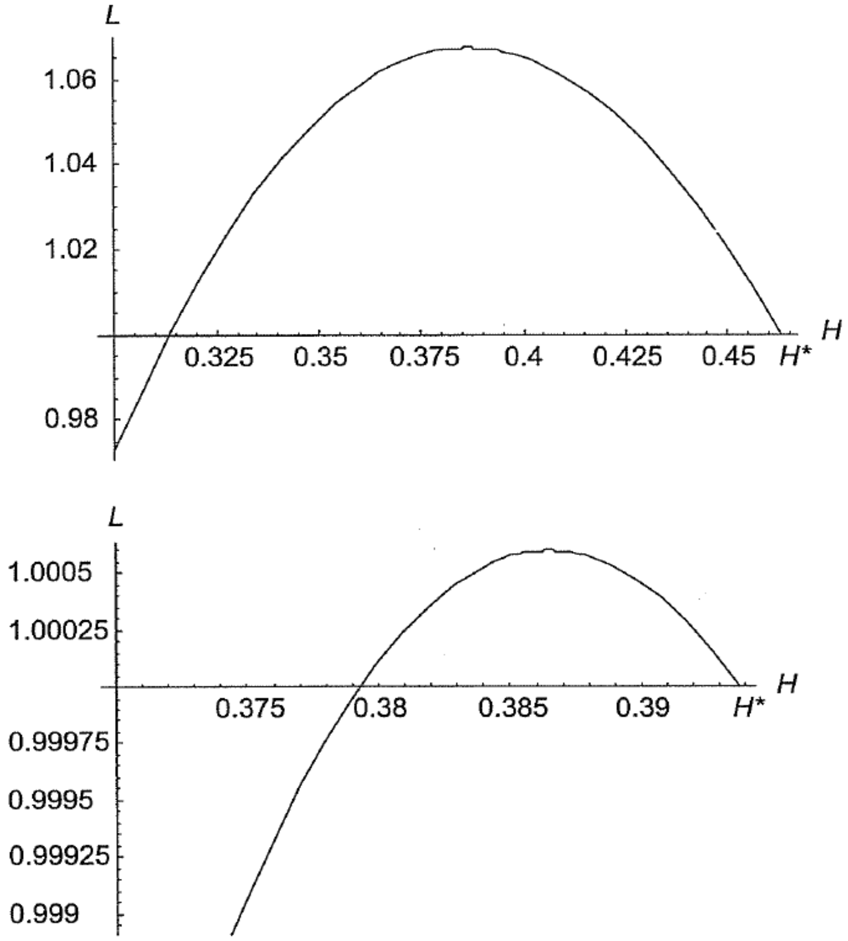


FIGURE 7.9
The impact of a reduction in the number of hours worked. The graph on the top corresponds to a value $\gamma = 0.1$ of bargaining power and the one on the bottom to $\gamma = 0.9$. The number of hours worked is given on the horizontal axis and stops at the negotiated number, H^*, which has a value of 0.463 (on the top) and 0.394 (on the bottom), knowing that the time allocation $T = 1$. The ratio between actual employment and its value for H^* is given on the vertical axis.

Insiders and outsiders

- **Unions negotiate on behalf of insiders (the already employed those with a strong affiliation to the labour market)**
- **Unions do not negotiate on behalf of outsiders (the unemployed in general or the long-term unemployed)**

An insider-outsider model

- **L_O insiders**
- **The firm decides on how many insiders $L_I \leq L_O$ it wants to retain.**
- **It also decides on how many outsiders L_E it wants to hire.**
- **Revenue function $R(L_I + L_E)$**
- **The firm's profit: $\pi = R(L_I + L_E) - w(L_I + L_E)$**
- **Employment of insiders, L_I, and of outsiders, L_E, is found by maximising profits s. t. $L_I \leq L_O$ and $L_E \geq 0$.**
- **Define w_O by $R'(L_O) = w_O$.**
- **Define $\tilde{L}$ as the employment level such that $R'(\tilde{L}) = w$, where w is the current wage.**

Labour demand

$L_I = \tilde{L}$ and $L_E = 0$ if $w \geq w_O$

$L_I = L_O$ and $L_E = \tilde{L} - L_O$ if $w \leq w_O$

If $w > w_O$ we have $L_I = \tilde{L} < L_O$, so some insiders are fired.

Wage bargaining

V_I **= expected utility of an insider**

$$V_I = \ell \nu(w) + (1-\ell)\nu(\overline{w}) \qquad \ell = \text{Min}\,(1, \tilde{L}/L_O)$$

$\overline{w}$ **= the reservation wage**

$$\underset{w}{\text{Max}} \quad \left[\pi(w)\right]^{1-\gamma} \left\{\ell\left[\nu(w) - \nu(\overline{w})\right]\right\}^{\gamma}$$

$$\text{with} \quad \pi(w) = R(\tilde{L}) - w\tilde{L}$$

- **Let w_1 be the solution when $\ell = \tilde{L}/L_O$ (interior solution with some unemployed insiders).**
- **The solution is the same as in the standard right-to-manage model but with $L_O = N$.**

$$\frac{\nu(w_1) - \nu(\overline{w})}{w\nu'(w_1)} = \frac{\gamma}{\gamma\eta_w^L + (1-\gamma)\eta_w^\pi} \qquad (10)$$

Solution with $\ell = 1$

- **Set $\eta_w^L = 0$ in (10); employment of insiders cannot increase**

$$\frac{\nu(w_2) - \nu(\overline{w})}{w_2\nu'(w_2)} = \frac{\gamma}{(1-\gamma)\eta_w^\pi}$$

Different solutions

$B_1 =$ Nash bargaining product when $\tilde{L} > L_0$,
i.e. some employed outsiders

$B_2 =$ Nash bargaining product when $\tilde{L} < L_0$,
i.e. some unemployed insiders

We have:

$$\frac{\partial B_1}{\partial w} > \frac{\partial B_2}{\partial w}$$

Larger gain from wage increase if only outsiders lose their jobs than if also insiders do.

Second-order conditions for a maximum

$$\frac{\partial^2 B_1}{\partial w^2} = \frac{\partial(\partial B_1 / \partial w)}{\partial w} < 0$$

$$\frac{\partial^2 B_2}{\partial w^2} = \frac{\partial(\partial B_2 / \partial w)}{\partial w} < 0$$

(1) Interior solution with $w \leq w_0$ and $\tilde{L} \geq L_0$

$$\frac{\partial B_1}{\partial w} = 0 \qquad \frac{\partial B_2}{\partial w} < 0$$

(2) Corner solution with $w = w_0$ and $\tilde{L} = L_0$

$$\frac{\partial B_1}{\partial w} > 0 \qquad \frac{\partial B_2}{\partial w} < 0$$

(3) Interior solution with $w \geq w_0$ and $\tilde{L} \leq L_0$

$$\frac{\partial B_1}{\partial w} > 0 \qquad \frac{\partial B_2}{\partial w} = 0$$

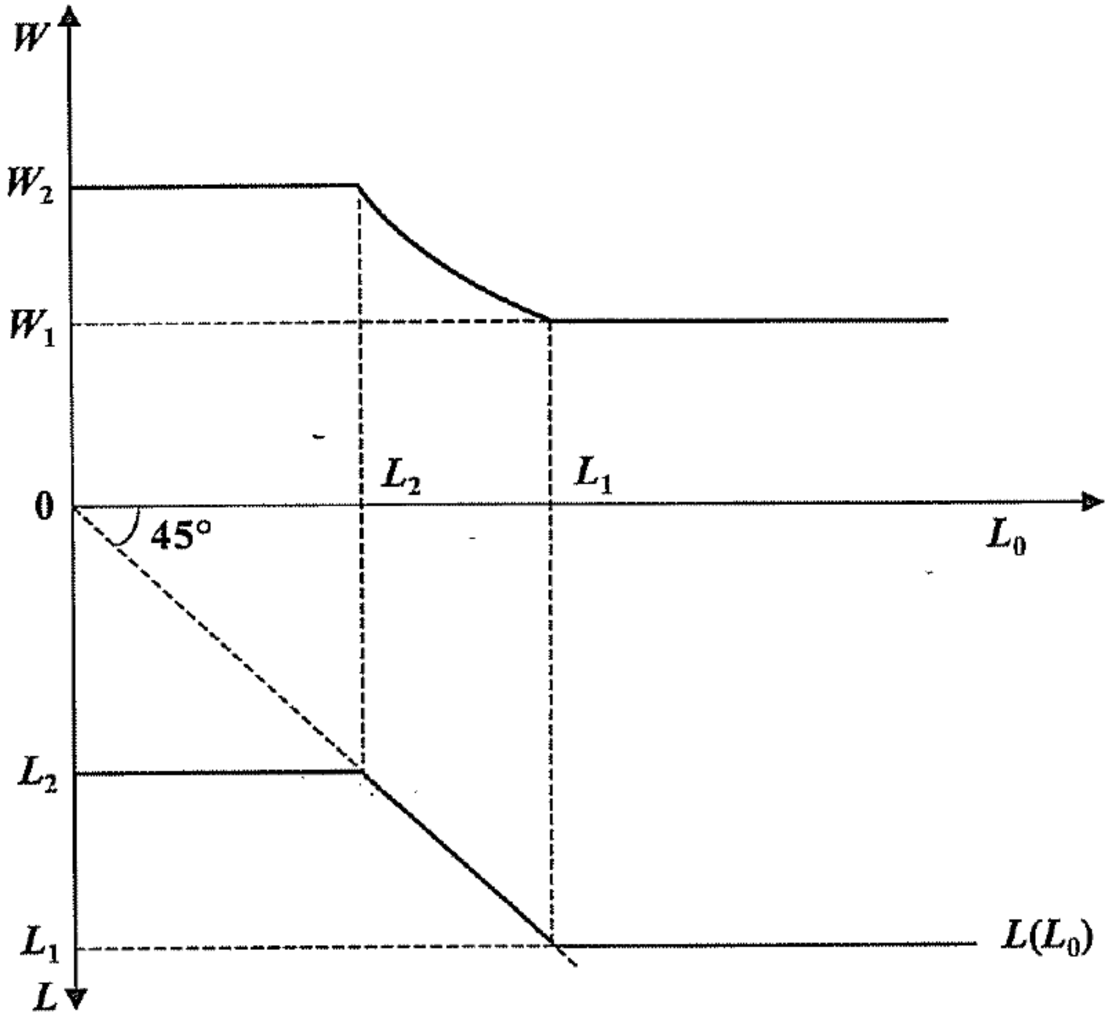


Figure 7.8
Wage and employment in the insiders/outsiders model.

Conclusions

- **A fall in the number of insiders results in an unchanged wage or in an increase in the wage**
- **Explanation of the persistence of unemployment**
- **No incentive to reduce the wage as the union does not care about the unemployed**
- **Empirical research has had problems finding that a reduction in lagged employment has a positive effect on the wage.**